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THE

ELECTRICAL WORLD

A REVIEW OF CURRENT PROGRESS IN ELECTRICITY
AND ITS PRACTICAL APPLICATIONS

VOLUME L

JULY 6 to DECEMBER 28, 1907

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*Indicates illustrated article

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NEW YORK, SATURDAY, JULY 6, 1907.

CONTENTS.

A. I. E. E. STANDARDIZATION RULES

The revised standardization rules, adopted at the Niagara Falls convention of the American Institute of Electrical Engineers, mark a distinct advance since the last report of the standardization committee was published in 1902. In the matter of increase of material, there has been a great advance. The earlier edition of five years ago contained about 100 numbered sections. The new edition contains about 360 numbered sections. The growth of electrical engineering has been so rapid that the original plan of the rules has had to be overturned and reconstructed. The first edition was reported to the Institute in 1899. Subjects which at that time were dealt with sufficiently in an appendix have since come to receive a full textual treatment. Thus, incandescent lamps have been dealt with in the new rules to the extent of 17 sections.

The candle-power unit is defined in the new rules as 100/88 of the hefner unit, and is recommended to be obtained from the National Bureau of Standards at Washington. The hefner amyl-acetate flame is, therefore, the acknowledged fundamental or primary standard of luminous intensity in the United States, but it is recommended that properly standardized incandescent lamps should be used as secondary standards, leaving the use of the primary standard entirely to the standard laboratories. By this means, international agreement is provided for on the basis of the hefner, while national unity of standards is also provided for, on the basis of a single source of reduction from the primary flame to the secondary standard incandescent lamp. The efficiency of an incandescent lamp is properly defined as the ratio of the mean spherical candle-power of the lamp to the watts consumed at terminals. Thus, an ordinary 16-cp lamp, consuming, say, 50 watts, would perhaps have a mean spherical candle-power of 12, and its efficiency would thus be 12/50; or 0.24 mean spherical candle-power per watt. The reason for adherence to the term "candle-power" throughout this division of the rules, instead of "candles," is probably that the term "candle" suggests the old parliamentary candle, which used to be the legal standard of Great Britain, and which was defined as a spermaceti candle six to the pound with a diameter of ⅞ in. and burning at the rate of 120 grains per hour. Fortunately, we have gotten rid of that incubus of incongruity. The hefner flame standard is indeed far from the goal of desire, and we earnestly hope for a better standard to succeed it; but even conservative England has been unable to keep her standard candle alight amid the gloom of its specifications. She has since adopted the Vernon-Harcourt pentane flame standard and now considers her candle as a decimal fraction of this. The mean spherical candle-power of a lamp is properly defined as the only correct candle-power basis of comparison between different lamps. It is hardly reasonable to expect the commercial rating of incandescent lamps to be changed to a mean spherical basis

but in all comparative tests between lamps of any kind, the only correct criterion of comparison must be the total light emitted by each lamp, or what comes to the same thing, the mean spherical candle-power of each. It is true that for particular illuminating effects, the luminous intensity in a particular direction may render one lamp preferable to another. For example, suspended over a reading table, a lamp with a large end-on candle-power may be preferred to a lamp of the same total light emission, or mean spherical candle-power, but with less end-on and more horizontal candle-power. Nevertheless, it may be considered as a general rule that by means of suitable reflectors or refractors and desired zonal distribution of light can be obtained with but little loss, if a given total flux of light is emitted by the lamp.

The standard temperature elevations of machinery under continuous rated load have not materially changed since the last edition of the rules. The standard temperature elevation of windings remains at 50 deg. C. for the general run of machinery. On the other hand, however, a number of new clauses have been introduced relating to details of temperature tests. For example, a correction for low barometric pressures, such as are found at high altitudes, is introduced for the first time. A number of new definitions have been incorporated, which ought to be useful to the electrical business generally, such as "load-factor," "saturation-factor" and "reactive-factor." In the direction of high voltages and high-voltage testing, much new matter has been added. The highest transmission voltage classified is 88 kilovolts. The testing voltage of high-tension machinery has been placed at double the rated voltage, a marked increase in severity, but a very welcome increase in security. Altogether, the Institute is to be congratulated on the completion of this edition, which has evidently taken a large amount of work in committee. The present edition may be expected to serve usefully for several years without revision.

The Burton Bill and Niagara Falls.

The Burton bill has now become law, and the effect of its provisions have already been made apparent. The Niagara Falls present a magnificently grand spectacle, although the effect is greatly marred by unæsthetic structures and unsightly advertisements in the foreground. It also represents a total estimated available amount of power, at times of minimum flow, of some 2,300,000 horse-power, which if developed, would be worth, say, $20 per horse-power per annum, in saving over the same amount produced by coal. On these rough figures, the falls are worth $46,000,000 annually in realizable power, or capitalized at 5 per cent, not far from a billion dollars, after all of the water shall have been deflected into wheel-pits, a work of decades or of generations. A few per cent of this power are already utilized. The vast remainder, it is intended by the framers of the bill to withhold from what is called spoliation. It is, of course, entirely within the rights and powers of the peoples on the North American continent to keep Niagara Falls substantially intact for another thousand years, their estimated remaining natural lifetime. If, however, the peoples so decide, they should clearly understand the cost of their decision. They virtually throw away nearly a million dollars a week on the ornament. It is a question whether so white an elephant, and so extravagant an ornament, are worth keeping. This is a question [illegible] men, whichever way they decide it, and we need not fear but that it will in the long run be intelligently answered. Meanwhile, the Burton bill, by preventing the United States from receiving more than a certain limited amount of power from Canada artificially stimulates industrial enterprise and material development on the Canadian side of the river by forcing the Canadian market, while artificially retarding enterprise and development on the American side. From a large and humanitarian standpoint, this is a small matter, because the English speaking races receive the benefit and stimulus, either north of the river, or south of it, whether they call themselves Canadians or Americans; but from a purely national standpoint a bigger gift to Canada at the expense of the United States could hardly be devised.

Progress of the New Incandescent Lamps.

We are glad to know that there seems to be a prospect that the tungsten lamp will soon be in commercial use on this side of the water. The announcement of a series street incandescent of this type is a most hopeful sign. The ordinary carbon lamp for this service has never been greatly loved by the central station man. It has not been highly efficient and its candle-power is fugitive and uncertain. If the tungsten lamp stands up well under street conditions it will prove a most valuable addition to the available material of street lighting. The filament of a series incandescent is necessarily rather stout and the tenuity of section which has been urged as an objection to the tungsten and other metallic filament lamps for ordinary incandescent circuits is obviated in applying the metallic filament to series work. It is not necessary in such work to push the filament to the highest efficiency, since it has to compete only with rather inefficient illuminants. So far as general use on incandescent circuits is concerned, the tungsten lamps have as yet made very little impression in this country, and thus far they are scarcely obtainable commercially, unless one imports foreign lamps at a somewhat excessive price. Meanwhile the tantalum lamp has come into considerable use where it has been commercially attainable. It has not to any material extent cut into the production of carbon filament lamps, but it has taken a very useful place. The tantalum lamps available in this country are claimed to have a life, on direct current, of seven to eight hundred hours, but the American manufacturer has not yet, so to speak, got the knack of the technique of manufacture so as to produce quite the degree of uniformity reached in some of the foreign tantalum lamps. There is considerable doubt as to whether the tantalum commercially obtainable for lamp filaments is of a proper degree of purity. It acts in many respects as though it were not pure, which renders uniformity more difficult of attainment. It is satisfactory to note that small tantalum battery lamps are now on the market. For this use tantalum is particularly convenient, giving a very good little lamp capable of being run easily on one or two cells of battery.

Of the new filaments, the graphitized carbon filament is the only one that has forced its way into much use. It is certainly replacing ordinary carbon at a rate that keeps the manufacturer on the jump. It is possible that the graphitized filaments are customarily rated at a specific consumption rather less than will ultimately prove desirable in attaining the most useful length of life, but they are certainly a very material improvement that is being fully appreciated. Meanwhile it is about time [illegible]

from its interesting chemical features this illuminant is the only one of the new incandescents which possesses a filament comparable in size with the ordinary carbon filament and possessing a considerable degree of mechanical strength, it therefore gives promise of lamps for use on ordinary incandescent service in small candle-powers. A 20-watt, 16-cp lamp will appeal powerfully to users, and unless some movement is soon set on foot to increase the normal unit to 25 cp or larger, the central stations may look for trouble in the future.

Grounding Alternating-Current Secondary Circuits.

The question of grounding secondary alternating-current circuits was again brought up at the recent National Electric Light convention in Washington, and the report of the committee which was adopted this year recommended that the grounding of such secondary circuits be made compulsory by the underwriters for all circuits where the potential between any conductor and ground does not exceed 150 volts. Several eminent authorities were quoted as expressing decided views to the effect that such grounding should be absolutely required in the interests of safety to human life. In view of the constantly growing sentiment in favor of such grounding and the unquestionable safeguards which it affords, it is to be hoped that the underwriters will follow this recommendation and soon make such grounding compulsory. It should have been made compulsory long ago, but there is always a certain amount of inertia to be overcome prior to mandatory action, and after all it is not so very many years since such grounding was not authorized at all by the underwriters. As to methods of best securing ground connections, the committee was not prepared to make definite recommendations except that wherever possible ground connection be made to water pipes. It did recommend, however, that more information be gathered as to suitable methods of grounding. The N. E. L. A. convention proceedings of 1906 contained considerable information of value on grounding under different conditions. We have previously noticed a number of methods for this purpose, but it will do no harm to recapitulate them here, since the subject is a very live one and should receive much more earnest attention than it does.

One of the surest methods is undoubtedly that of grounding to waterpipes at each customer's service as recommended by the committee. This, however, involves considerable expense in some cases, and until grounding is required by the underwriters there may be a few cases where the waterworks officials may object. Another method which has been found cheaper than grounding at each service in some localities is that of running a continuous ground wire from a station or sub-station over the entire distribution system, this wire being well earthed at points where good grounds can be secured. The method which has heretofore been suggested in the National Electrical Code, namely, that of burying a copper plate in the ground at each transformer, this plate to be surrounded by coke, works well in damp soils, but in New York and Boston and probably in many other cities, has been found to be a very uncertain method because of the uncertainty of permanent moisture. In soils where there is always moist clay to be found a short distance below the surface, as in many portions of the Middle West, the ground plate plan works fairly well, but even there it is a question whether equal reliability is not secured by a cheaper method, namely, that of driving 10 ft. of galvanized iron pipe into the ground and making a solid soldered connection with the top of the pipe.

The Illuminating Engineering of Small Residences*

The planning of the electric illumination in the majority of small residences must for many years to come rest largely with the central station company; that is, if the illumination is to be planned at all instead of being laid out in a haphazard way, as it is in the majority of cases at present. The specialist in illumination is not even now by any means called in as often as he should be in connection with large and important buildings, but as time goes on this condition of affairs will gradually change either by an increase in knowledge of illuminating subjects by architects, or by the employment of special illuminating engineers to supplement the work of the architects. In the case of the majority of small residences in any city, it is hopeless to expect that the owners or builders will go to the expense of employing special expert advice on the lighting. Yet it is in these small dwellings that economical and efficient arrangements are most important, both to the consumers and to the central-station company. If the electric lighting arrangements are not efficient, the company will lose this valuable class of business, which in the aggregate is one of the best classes of lighting load a central-station company can have, because of its size, stability and comparatively good load factor. Summed up briefly, the owner or builder will not appreciate the importance of good design of the lighting and will not pay for expert advice. It is therefore up to the central station, as the most interested party, to step in with such advice. If the central station company does all the wiring in a town (as is the case in some of the smaller towns) it has an excellent chance to see that the customer has an economical arrangement. Where the company does not do the wiring, it is not so easy to influence the design of the installation, but it can be done.

If the central station company is wide-awake, it has solicited every prospective residence customer before the wiring is done. The company will therefore know about the time that a house is being wired and can give the customer advice. One of the hardest propositions to handle is that of the builder who is putting up large numbers of dwelling-houses for sale or rent. The builder of such houses usually wants to make the biggest show he can for the money, and as he has no interest in the illuminating results after the house has passed out of his hands, he sometimes figures that it is a waste of money to put money into lighting circuits and fixtures, the cost of which does not appeal to the casual inspector of a new building. In other words, he asks why he should spend a few dollars extra in each house on items which do not make much of a showing and will probably add nothing to the price he can demand. The only way to overcome unprogressive arguments of this kind is to persuade the builder that it is worth while to make his buildings thoroughly up to date and to impress his customers with that fact, adding to the selling price accordingly. However, it is not always true that lighting arrangements which will be economical in operation are more expensive than those which are not. The addition of a few cents here and there frequently converts a very poor arrangement into a

[illegible] put in outlets and fixtures according to the company's recommendations. [illegible] fixtures and has certain standard fixtures with which it does low-priced residence jobs, these fixtures should be of a kind which will make good results possible. We have seen too many cases where companies which ought to have known better have clung year after year to some inefficient styles of fixtures for putting in inexpensive houses; this, too, in spite of the fact that the company had men in its employ who knew better and that the right kind of fixtures would have cost no more. If the company (which has in its employ more talent in illumination than all the rest of the community) is careless and indifferent to these things, is it in the least to be wondered at that the rest of the community is indifferent except when it comes to paying the bills? And even in the latter event it is the company wh[illegible] to take [illegible] and suffer the [illegible] patronage.

Non-Peak Loads.

The National Electric Light Convention paper of Mr. George N. Tidd, printed elsewhere in this issue, is of value as expressing the views of one of the leaders in the movement of central-station managers to secure motor business under contracts which provide for the shutting down of the manufacturing plant during the hours of the central-station peak load in order that the manufacturing plant may get the benefit of a [illegible] rate. Mr. Tidd was one of those who, at Marion, Ind., went ahead and did what many managers had solemnly asserted in convention could not be done, namely, the securing of large non-peak power contracts of this nature. Mr. Tidd had many obstacles to overcome, including the objections of union labor to changing the standard hours of work; but these difficulties were all surmounted and the results are high-load factors which might well give central-station men food for thought.

Under-Developed Central Stations.

Some of the information presented at the last N. E. L. A. convention, together with much which has been published in our columns the past year, as to the earnings of some central station properties per capita of population and per kilowatt of station capacity, should be powerful incentives to central-station companies which have not been making the most of their opportunities in times past. If the directors of the many much under-developed central station properties of this country ever get to the point where they take enough interest in the business to study some of the information referred to, it will result in a general stirring-up. Great interest was displayed at the recent convention in the earnings of a small Ohio central station which, without a contract for municipal street lighting, is said to be earning $8.50 per capita of population. Considerable has been said in the past few years about the troubles of the small central station and the way it is suffering from lack of proper management. This is perfectly true of the majority of such stations, but there is an enterprising minority which has been able to give pointers to the larger companies. Indeed, on the whole, we are inclined to think that the most under-developed central-station properties in the country to-day are those in the larger cities. There are certainly splendid opportunities for development all along the line in both large and small cities [illegible]

The Income Value of Various Heating Appliances.

It is generally accepted that of all the electric heating appliances available, the electric flat-iron is the one which will yield the best revenue to the central-station company for a given amount of money spent in introduction. This is because it is used with tolerable regularity. It is a time and work-saver, a special blessing in summer, and altogether an appliance which is bound to remain popular with users, while at the same time it consumes enough current to make a decided increase in the gross revenue from residence customers. The flat-iron campaign has been fairly well started by most progressive central-station companies, and about this time doubtless many companies will be asking what is the next heating appliance which it will pay best to push, revenue, usefulness and ease of introduction all being considered. If the vote were taken on this question, we surmise that it would be divided between the electric chafing dish and coffee percolator, very likely with the majority in favor of the coffee percolator, which has the advantage of making a beverage which is very generally used and hence is likely to be in regular service every day on the dining-room table. It must be confessed, however, that the difficulty of cleaning some of the percolators which have been put out in the past has prevented their regular use even by those who have purchased them. They are unquestionably more trouble to keep clean than the regular coffee pot.

We are inclined to think that with the proper campaign of education in any given community, the electric chafing dish can be made to go farther toward filling a popular demand and yielding a steady income than any other electric heating device except the flat-iron. The chafing dish has a great variety of uses, not only for fancy dishes and late suppers, but for common, every-day cooking. The variety of things which can be done on a dining-room table with an electric chafing dish is surprising to those who have paid no attention to the matter. It must be recognized at the outset, however, that there exists a popular idea that a chafing dish is something to stand on a sideboard and look handsome and to be used on state occasions only. Any central-station company starting on a chafing-dish campaign will have to meet this view and show what a common, every-day necessity an electric chafing dish can become. In this connection it may be noted that one of the best known works on chafing-dish cookery starts out by calling attention to the usefulness of the chafing dish for every-day cooking, but immediately and for the rest of the book devotes itself to elaborate and fancy dishes. Some of the central-station companies which have been spending money advertising electric cooking in general might do well to concentrate their efforts on demonstrations and education of their communities on this one subject of chafing-dish cookery. Once the chafing dish is introduced for common use on a dining-room table, other electrical appliances useful in light housekeeping will follow.

It does not follow from the above considerations that the companies which have made a good start in the introduction of complete electric-cooking outfits should discontinue their efforts. Where gas competition is not present or where light housekeeping is to be done, even if gas service is available, complete electric-cooking outfits stand a first-class chance if

the rates are right. But when it comes to advocating appliances like the chafing dish and other things which can be used on the dining-room table, gas competition is not to be considered, as they can be introduced whether there is gas in the house or not. There is no real competition of these devices, because cooking by gas or alcohol on a dining-room table is justly never to become popular.

Special Versus Standard Signs.

Considerable difference of opinion exists among central stations which have been pushing the sign business as to the relative merits of special designs of electric signs for customers as against regular standard forms. The advantage of the specially designed sign is pointed out to be that every large merchant likes something a little different from the other merchants in the city, and if only a few set forms are used, part of the incentive to purchase and operate an electric sign is destroyed. On the other hand, it is claimed that the regular standard forms are more durable, produce a more uniform appearance on a street if used extensively, and give a customer more for his money than can be given in a special design. We will not presume to pass judgment on this question, which is partially one of the size of the customer to be dealt with. Very large customers naturally require special signs because there are no standard forms regularly made in very large sizes. On the other hand, the small customer cannot afford to go to the expense of having a special sign made, or if the special sign is made for the price of a regular standard sign, it must be of such inferior quality that it is hardly to be considered. In the majority of electric signs, both special and standard, there is room for improvement in legibility at a distance. The heavy block letter has been used too much in the past for the good of the electric sign business. It permits too much of a blurring between the lines of a letter. More open lettering to prevent blurring will be popular in the future.

Meeting the Public Half-Way.

Almost an entire evening session at the recent National Electric Light Association convention was given to a discussion of the report of the Public Policy Committee, the acceptance or rejection of this report involving the question of what should be the attitude of the association toward regulation and control of public service corporations by state commissions or similar bodies. The report of this Public Policy Committee, which is printed in abstract elsewhere, promulgates some doctrines which would have been thought most dangerous and disloyal to the interests of corporations by corporation officers a few years ago, and it simply goes to show what an evolution has been going on the past few years in the attitude of both the public and the corporations. In the first place, it is being popularly demanded that the power of corporate wealth be kept in its legitimate channels, or, as an alternative, that corporate ownership be abolished and public, or municipal, ownership substituted in its place. We have within the past two years a number of times reflected the opinion of leading central station men that proper supervision of the business by a state commission or something of the kind is desirable, not only on account of the public, but because investments should be more secure where supervision goes so far as to prevent stock watering and unnecessary and injurious competition. The report also gives deserved condemnation to the old-fashioned limited term "franchise laws," which are so common.

In the majority of states, it must be confessed that the laws are at present very unsatisfactory as regards franchises, both from the standpoint of the corporations and the public. The usual rule is to grant a corporation a franchise for a limited term of years, usually not exceeding 25 years, which practice is likely to keep a company in a most uncomfortable state of uncertainty for at least half of the period of its franchise. Suppose, for example, a company has a franchise for 20 years. For the first 10 years of its life little thought is usually given to what is to occur at the expiration of the franchise, and money is put in freely to develop the property as it should be developed for the best good of the company and the community it serves. When the franchise period enters the second 10 years, investors will begin to ask what is to become of the investment at the expiration of the franchise. At first sight it appears that investors would shrink from putting money into an enterprise that in a few years will have no legal right to carry on its operations, but, in fact, they are usually inclined to take the chance that an extension of franchise on living terms will be granted, and needed money is forthcoming. Nevertheless, there is unavoidably a period of more or less duration near the end of the company's franchise in which this uncertainty is likely to prevent proper development. It may be contended that if the company goes ahead in good faith and keeps its property in excellent condition, there should be no difficulty in securing the right kind of a franchise at the end of its term. There is much in this argument, but, nevertheless, what with the agitation for the regulation of corporations, and municipal ownership politicians ambitious to make political capital out of squeezing corporations as hard as they can, the companies whose franchises are soon to expire are in an unenviable position.

The result of all this uncertainty during the last five years of a company's franchise is likely to be inferior service to the community owing to the fact that capital cannot be obtained for needed enlargements and improvements. This in itself is likely to stir up a feeling of unrest and dissatisfaction with the company and so matters act and react, from bad to worse. There is, in fact, no fundamental reason why a company having an immense investment in permanent property in public streets should be placed in such a position at regular intervals that it can be driven off the streets or can be made as an alternative to accept a franchise in which there is no justice. The public service company should be allowed to do business continually in a city as long as it behaves itself properly and gives good service; nor should it be allowed to give poor service or charge extortionate rates for 10 or 20 years simply because it has a franchise. Occupancy of the streets, when it is to be dependent on proper treatment of the public, involves, of course, some method of continuous regulation by commission or otherwise. This has some objections, but it seems to be the lesser of several evils. A little house-cleaning once a year or oftener is better than a frightful upheaval once in 20 years.

Work of New York Electric Commission.

The New York State Gas & Electric Commission went out of existence on June 30, and cleaned up a lot of its work before doing so, relieving the new Public Utilities Commission to that extent. The commission ordered the reduction of the price of electricity supplied by the Saratoga Gas, Electric Light & Power Company from 12½ cents per kilowatt-hour to 8 cents per kilowatt-hour, to take effect Sept. 1; the price of electricity in Mount Vernon, supplied by the Westchester Lighting Company, reduced from 20 cents a kilowatt-hour to 13 cents, to take effect Sept. 1; the price of electricity in Orangeburg, supplied by the Rockland Light & Power Company, reduced from 20 cents to a maximum rate of 15 cents a kilowatt-hour outside of incorporated villages, to take effect Sept. 1.

The commission authorized the issue by the Utica Gas & Electric Company of 5 per cent refunding 50-year gold bonds to the amount of $2,000,000 for meeting betterments heretofore incurred and in process of construction on the plant of the Utica company and its subsidiary companies.

The application of the Oriskany Hydro-Electric Company proposing to operate in the counties of Oneida, Madison and Chenango, for a certificate of authority to transact business and for consent to issue first mortgage 5 per cent 40-year gold bonds was denied. The company asked for consent to the issuance of bonds to the amount of $400,000.

The application of the village of Potsdam for a certificate of authority to establish and operate an electric lighting system for commercial purposes was denied.

A certificate of authority was granted to the Sayre Electric Company, a foreign corporation, operating in Sayre, Penn., to transact business in Waverly, Tioga County, N. Y., and also to lease the distributing system of the Waverly Electric Light & Power Company for a term of 99 years.

The application of the Champlain Electric Company for consent to increase its capital stock from $15,000 to $30,000 was denied.

Consent was given the Canton Electric Light & Power Company to increase its capital stock from $18,000 to $38,000.

The application of the Suffolk County Lighting Company for a certificate of authority to transact business in the town and village of Babylon, Long Island, was granted.

Meeting of Empire State Gas and Electric Association.

Following the annual meeting of the New York State Street Railway Association at Hotel Champlain, Lake Champlain, last week, a meeting was held at the same place on June 27 by the Empire State Gas and Electric Association, to consider the relationship of the traction and lighting interests to the new Public Utilities law. There was a good attendance, and, in the absence of President Palmer, the meeting was called to order by Mr. T. R. Beal, who stated briefly the objects of the meeting.

The first business was the reading by Mr. H. H. Curran of a paper or report on the publicity work of the association, showing how much had been done quietly to secure the publication of facts and data in the newspapers, informing the public and helpful to public service corporations. Details were given as to the wide use of a number of special articles on facts connected with the industry. On the political side also, good work had been done in combating misrepresentation as to the results of municipal ownership: alleged fires caused by electricity, etc. An average circulation of about 300,000 had been enjoyed by the articles issued by the bureau for the association. This work is estimated to cost about $10,000 a year, including the maintenance of the secretary's office and staff. Mr. Arthur Williams pointed out various useful ways in which the work could be extended and made fruitful of general good, such as the electrical sterilization of milk.

Mr. J. N. Shannahan, ex-president of the State Street Railway Association, addressed himself, by request, to a brief discussion of the scope and bearing of the public utilities law, in regard to which he felt that the companies in allied fields must work together, possibly through some joint organization that could handle the subject efficiently and present a common front for them to the people who legislate or who seek legislation at Albany. Where there was no concerted action, bad measures slipped through.

Mr. Beal suggested that as the law treated them all in the same manner, it might be well to combine all interests in one federal association. Indeed, many of the companies were interested in three or four fields of public service.

Mr. Arthur Williams pointed out that among the national associations that was virtually accomplished not by amalgamating, but through "public policy" committees that worked together. That seemed to him a better way. Each industry had its own problems. At the recent meeting of the National Electric Light Association 70 papers were read on as many topics.

Mr. W. W. Freeman returned to the main topic of the new law, which many of them, he said, regarded as unduly harsh and drastic. He thought that the association ought to have a clearing house whereby a report could be had on the general operation of the law, enabling the body to suggest proper and necessary modifications. It would be helpful to keep a complete record of every transaction of the members with the commission as a basis for future effort.

A brief discussion then ensued as to the Massachuesetts law and as to one or two features of the New York law.

Mr. J. M. Wakeman then suggested the desirability of a public utilities state committee, an idea which was generally approved. He then made a motion to the effect that the meeting refer to the executive committee of the association, for consideration and action, the appointment of such a committee composed of representatives from the association to collect information relative to the action of the public utilities commission in regard to applications made to it during the year; and that the committee suggest to the executive committee of the Street Railway Association of New York State that they also appoint such a committee; that these two committees shall meet jointly and make a report which shall be read by the secretary of each association at its annual meetings; that the committee consist of three members from each of the associations, the secretary of each being a member ex-officio; that the secretaries obtain the information presented to the committee and make reports to the respective associations. This was unanimously adopted. There was a little further discussion, but no other action on the subject.

The next matter treated was that of uniform accounting. Prof. B. V. Swenson, secretary of the American Street and Interurban Railway Association, referred to the general adoption of a standard system by street railways, recognized also by state boards and by the United States Census Office.

The subject of gas accounting in its relation to the requirements of the law was also discussed, but nothing was done, and after lunch the broad topic was taken up again in a paper by Mr. Hart, who submitted a scheme and general outline for gas and electric companies. There was a brief discussion on this dealing with technical points of reserve, operation, depreciation, etc. It was finally agreed, on motion of Mr. Arthur Williams, to recommend to the executive committee the appointment of a committee of three accountants to work in conjunction with corresponding committees of the American Gas Light Association and the American Street Railway Association for the purpose of formulating a method of accounting to meet as nearly as possible the conditions found in the various lighting companies of the state; that using as a basis the work up to the present time of the national societies, the accounting committee of the association prepare a report and a recommendation for submission to the Public Utilities Commission after approval by the executive committee.

Mr. R. A. Davidson then read a brief paper on "Fire and

Liability Insurance for Gas and Electric Companies," suggesting methods by which the companies could secure lower rates than are now accorded them. On motion of Mr. W. W. Freeman, it was recommended to the executive committee to print and distribute the paper to all lighting companies in the state. There was a brief discussion on mutual insurance, and such practice in Cleveland as to street railways and in New York as to lighting plants was cited by different members. Mr. Freeman stated that this insurance method in New York was applied also to accident liability. A recommendation was made for a committee on the subject. The meeting then adjourned.

Niagara Falls Meeting of the American Institute of Electrical Engineers.

The meeting of the American Institute of Electrical Engineers at Niagara Falls last week was a pronounced success, it being some years since so large an attendance was secured. At first it looked as though the representation would be slim, but members arrived steadily each day up to the very close of the convention and nearly 470 were registered. Allowing about 100 for local attendance and committee, this gave not less than 370 from different parts of the country and Canada, and Dr. Sheldon was very much gratified, with the other officers who had worked hard to ensure the success of the occasion.

In addition to the regular entertainments noted on the printed programme, there was an interesting special episode of the kind, due to the courtesy of the local committee, who on Friday evening took a party of over 80 by trolley car down the Gorge to the Whirlpool Rapids. There, for about an hour, a searchlight was played upon the raging mass of foam, and the vari-colored effects were wonderfully effective. The party enjoyed the spectacle immensely and were loathe to leave it.

The appeal made to the members present to contribute to the building fund, if they had not already done so, was attended with happy results. A number of members who had not previously given any thought to the matter hastened to subscribe, and the end of the week saw the fund richer by not less than $1,100, giving it a decided impetus toward the goal of $185,000. The amount now raised is about $166,000.

During the week there was not a little talk and discussion as to the next annual meeting of the Institute. It will be the twenty-fifth, and will therefore be a landmark in the history of the body. There is a general desire to make the occasion memorable in various ways.

Following are abstracts of the discussions of papers read on Wednesday, Thursday and Friday:

TRANSFORMERS.

Three papers on transformers led to an interesting discussion. One of the papers was by Mr. S. M. Kinter on "Choke Coils versus Extra Insulation of the End Windings of Transformers;" another, by Mr. Walter S. Moody, on the "Protection of the Internal Insulation of a Static Transformer against High Frequency Strains," and the third, by Mr. H. W. Tobey, on "Notes on Transformer Testing." The discussion on these papers was opened by Mr. A. H. Pikler, who expressed the opinion that neither the extra insulation of the end turns of a transformer nor the use of choke coils can be considered as a perfect preventive of troubles from lightning, when used alone. It is far preferable to provide a moderate amount of extra insulation for the end turns and to use a small amount of external inductance. Mr. K. C. Randall stated that it is extremely desirable in any event to use a certain amount of external inductance.

Mr. D. B. Rushmore discussed in detail the disastrous effect of an arcing ground in producing high potential strains in a transformer. Under some conditions a choke coil is undoubtedly desirable, but there are cases where it in itself may cause excessive voltage rises. Mr. P. M. Lincoln agreed with the conclusions of Mr. Kintner as to the value of an external choke coil, because, although there is an active voltage between each turn of a transformer, and a short circuit between such turns may produce an enormous current, an exactly equal short circuit in a choke coil due to any excessive voltage across such coil can produce no result worse than eliminating the coil from the circuit.

Mr. E. J. Berg explained the great advantage arising from cutting out unnecessary turns from the middle of the transformer rather than from the end when one wishes to vary the voltage upon a transformer whose end turns are given an extra amount of insulation.

Mr. W. M. Smith called attention to the increased expense of repairing any defects in a transformer which depends upon the extra insulation of the end turns for protection in comparison with the expense connected with replacing a damaged choke coil. The time has arrived when choke coils should be standardized. Each coil should be placed where no flash can reach it, and where it can cause no damage in itself. Mr. C. W. Stone ited that choke coils have not been found advantageous for use with cables on account of their inability to protect a cable from internal disturbances. Prof. E. E. F. Creighton explained, on the basis of resonance, the phenomenon sometimes observed of a higher voltage being produced at the transformer terminals inside of the choke coil and at the outside of the choke coils nearer the transmission line. He stated that cases have been known where inner turns of a transformer have been damaged without injuring the insulation of the end turns, even when the inner turns were equally as well protected as the outer turns. Mr. William McClellan expressed the opinion that it will be necessary to continue the use of choke coils in connection with transformers until there has been produced an arrester having the essential characteristics of a safety valve. Such a transformer is promised in the new electrolytic type.

Prof. Morgan Brooks reported the results of a series of observations which showed that excessive voltages may be produced in the secondary of a transformer by closing the primary circuit at certain points of the e. m. f. wave. Mr. W. S. Lee expressed his preference for the installation of both choke coils and extra insulation of the end turns in connection with lightning arresters. Experience has shown that the weakest point of the high potential transformer is in the terminals, rather than in either the end turns or in the choke coils. Mr. Ray P. Jackson stated that the effectiveness of a choke coil depends almost exclusively upon its inductance. The experience seems to indicate that the inductance should have a value of about .04 or .05 henries. If the end turns of a transformer are insulated and used for protection, the extra insulation should cover such a length of turn as to include this amount of inductance. It is found that with large transformers the required number of turns is not unreasonable. In spite of this fact, however, it seems more desirable to use external choke coils. If the arrester in itself is perfect there would be practically no need for a choke coil. Moreover, modern transformers are so constructed that when used in connection with proper choke coils there is no need for extra insulation.

Dr. C. P. Steinmetz said that choke coils may be advantageously located within the transformer tank when oil insulation is used. They should, however, be so placed as to protect all of the apparatus within the station or sub-station. Thus, if a switch is located between the transformer and the external line a choke coil in the transformer case will not protect the switch. For most installations it is preferable to place the choke coil out of doors and depend upon air insulation. The transformer itself should also be protected by means other than the choke coil itself. At a very high frequency, such as 30,000 cycles per second, there may be an enormous rise of e. m. f. inside of a choke coil due to resonance. It is desirable in most cases to use only that amount of inductance which is absolutely essential to the operation of the lightning arrester equipment. Mr. R. D. Mershon called attention to the fact that even in case a transformer is wound for two voltages, one having half the value of the other, it is not necessary to use an extra amount of insulation for the end turns, because the turns which are given extra insulation may be designed for the

largest current which the transformer will carry and may be used to carry such current both when the coils are connected in series and in parallel. In any event, however, the best results will be obtained when a choke coil is used and such choke coil should be of the air-insulated type and placed out of doors.

Mr. W. L. R. Emmet called attention to the fact that the best protection is afforded by a device which is non-elastic. That is to say, it is preferable for the device to absorb energy and to dissipate it, rather than to store it and then give it up to the system.

Mr. O. S. Lyford, Jr., suggested that on account of the fact that the weakest point in a transformer equipment is in the terminals all of the apparatus requiring high potential terminals should be placed within a single oil-insulated case. This case should contain the choke coil and the series transformer, when such is used.

[illegible]

Mr. D. R. Scholes presented a paper on "Transmission Line Towers and Economical Span," which was followed by a paper by Mr. Norman Rowe on "Lightning Rods and Grounded Cables as a Means of Protecting Transmission Lines Against Lightning." These papers were discussed by Messrs. Hoopes, Fleming, Neall, Mershon, Thomas, Lee, Paine and Ricker. Mr. Mershon stated that experience of the Niagara, Lockport & Ontario Power Company's transmission lines during a certain time showed that 76 per cent of the trouble was encountered on the type insulator. In view of past experiences the company is now employing horn arresters, which are so arranged as to act both as arresters and as lightning rods; that is to say, the side of the horn arrester which is connected to the ground is extended upward above the transmission line so as to act in the capacity of a lightning rod. Mr. W. S. Lee said that quite independent of any consideration of the most economical span that may be employed in a certain transmission line, the contour of the country to a large extent determines the length of the span which must be used. This is especially true in mountainous regions. Where there are numerous hills and valleys a single pole can be placed on top of each hill and long spans employed, or two poles can be placed on each side of certain hills and long spans employed across adjacent valleys with short spans over the hill-top.

At the session of Wednesday evening the following papers were presented: "The Transmission Plant of the Niagara, Lockport & Ontario Power Company," by Mr. Ralph D. Mershon. "Location of Broken Insulators and Other Transmission Line Troubles," by Mr. L. C. Nicholson. "A New Type of Insulator for High Tension Transmission Lines," by Mr. E. M. Hewlett "Some New Methods in High Tension Line Construction," by Mr. Harold W. Buck. "Switchboard Practice for Voltages of 60,000 and Upward," by Mr. S. Q. H[illegible]

Replying to a question in the discussion of the above papers as to excess strains that have been placed upon the spans across the Niagara Gorge, Mr. F. B. H. Paine said that the object in using such a strain was to permit of locating the towers near the water's edge and to prevent swinging of the wires across the Gorge. Mr. D. B. Rushmore stated that in many long-distance transmission systems an excessive amount of money is expended for insuring continuity of service. He expressed the opinion that such continuity may be obtained more cheaply by the use of a steam power auxiliary plant at the point of distribution. Mr. William McClellan stated that the durability and effectiveness of a transmission installation depend to a very large extent upon the insulators. The insulator described by Mr. Hewlett seems to be almost ideal in this respect. Mr. Hewlett stated that each of the disks of the link insulator is capable of withstanding a voltage of about 65,000 It is rated at 25,000 volts, so that a large factor of safety is used. For 60,000 volt transmission work either two or three disks are placed in series. In reply to a question by Mr. W. M. Smith as to the formation of ice, Mr. Hewlett stated that no trouble from ice is anticipated, because [illegible] forms in the pocket [illegible] without cracking the disk or damaging it in any way. When several insulators are placed in series the total voltage is not divided uniformly across the various insulators, but the lack of uniformity is not excessive.

[illegible] GRAPHITE.

A paper by Mr. E. G. Acheson on "Deflocculated Graphite," is printed elsewhere in abstract. In the discussion in reply to a question, Mr. Acheson stated that while the experience with deflocculated graphite in solution as a lubricant is limited, observations show that there is no tendency for the solution to become more dense and viscous. However, there is a slight accumulation of graphite in the bearings, so that after the supply of lubricant has been cut off the friction is not increased appreciably for a considerable time. The new lubricant has been found well suited for high-speed and high-pressure operation. He asked the cooperation of operating engineers in determining its lasting qualities under severe service.

THE [illegible]

Three papers relating to the electric railway gave rise to an interesting discussion. The titles of the papers are as follows: "Single-phase versus Three-phase Generators," and "Choice of Frequency for Single-phase Railways," by Mr. A. H. Armstrong. "Twenty-five versus Fifteen Cycles for Heavy Railways," by Mr. N. W. Storer. "Cummutating-Pole Direct-Current Railway Motors," by Mr. E. H. Anderson. The discussion was opened by Mr. Paul M. Lincoln, who said that in the electrification of steam railroads, the electrical equipment used for propulsion will not be connected in any way with other electrical equipments, so that any discussion of the limitations of a certain equipment for combined duties is irrelevant. Mr. H. G. Stott showed that a three-phase star-connected generator can supply power to single-phase and three-phase loads by using the equivalent of a four-wire system for single-phase loads, and a three-wire system for the polyphase loads. Mr. Wm. McClellan showed that some simplicity is obtained by using a T-connection, because in this event the load need be divided into only two instead of three parts, and an inequality of the two parts does not seriously affect the operation of the system.

Prof. C. P. Steinmetz explained that an induction regulator cannot be employed for supplying a balanced load on a polyphase generator when the load on the system is single phase. He showed that the effect of a single-phase load between two leads on a three-phase system tends to decrease the voltage between these two leads and between one of these leads and the third lead; the voltage between the other lead and the third lead is, however, affected very little. Any lamp load should be placed across between the latter two leads. Mr. E. J. Berg called attention to the fact that the speed limitations in low-frequency generator design have been overcome in the Stanley alternator, which is a special type of generator supplied with low-frequency alternating excitation. Mr. M. M. McClellan discussed recent developments, and stated that while for the types of motors that have already been introduced for railway work a frequency of 15 cycles is preferable to one of 25 cycles, the last word has not yet been said as to present and future developments of other types. The limited information that has been given out concerning new types would lead one to wish to wait for further developments before accepting either the one frequency or the other as the standard.

Dr. Steinmetz showed that for each type of alternating-current apparatus there is a certain range of frequency at which it operates most advantageously. Thus, for stationary transformers the economical range is very high, in fact above the frequencies ever used commercially. Generators have a limited range of frequency, the most economical frequency varying with the character of the prime mover and the output of the generator unit. Small induction motors can be built more economically for 60 cycles than for 25 cycles, while the reverse is true of large [illegible] The proper frequency [illegible] 25 cycles. The single-phase series motor operates more and more

economically the lower the frequency. Such is not true, however, of the alternating-current railway motor invented by Mr. E. F. W. Alexanderson. This motor operates more economically at 25 cycles than at 15 cycles and the commutation is excellent. In this motor the improvement in commutation is due to the neutralization of the e. m. f. in the short circuited coil, rather than to a lowering of the frequency for a given flux of the insertion of resistance to decrease the short-circuit current.

Mr. P. Junkersfeld called attention to the fact that the power necessary to operate steam roads is ordinarily grossly overestimated. Careful estimates and observations show that all of the roads radiating from Chicago for 25 miles would use only about 25 per cent of the electrical generating equipment now installed in Chicago.

Mr. Gano S. Dunn said that present trend of development seems to indicate that the commutating-pole machine will be the predominating type of the future for many purposes. It is especially suited for high-speed generators, variable-speed motors and direct-current railway motors. There are cases, however, where the extra poles and windings involve a prohibitive amount of complication, and the ordinary design is more economical. Such a case is found in the constant-speed motor.

In reply to a question as to the extent to which high-voltage railway motors have been employed, Mr. Anderson stated that although no 1200-volt railway motors are yet in service, many orders have been received for such machines and the motors have been built and tested. Even at an e. m. f. of 1800 volts the commutation has been found to be entirely satisfactory. The danger of flashing has been eliminated by removing the prime cause therefor, namely the collection of carbon dust on the commutator and neighboring insulated parts. A commutating-pole motor is subject to so little disintegration of the brushes that there is no accumulation of carbon dust.

CODE OF ETHICS.

A proposed code of electrical engineering ethics was submitted by Dr. S. S. Wheeler, the chairman of the committee on the code, who moved its acceptance by the membership of the Institute, it having already been approved by the board of directors. In seconding Dr. Wheeler's motion, Mr. William McClellan called attention to the fact that the committee, which consisted of the chairman noted above and Messrs. Steinmetz and Buck, represented all classes of interests connected with the work of the Institute, and that this committee had conscientiously considered all phases of the relation of the electrical engineer to the various persons with whom he deals professionally. Mr. H. G. Stott expressed his disagreement with several clauses as worded, and offered an amendment to Dr. Wheeler's motion to the effect that the acceptance of the code by the membership be postponed until a letter ballot could be obtained from the full membership. After a lively discussion, participated in by Messrs. G. S. Dunn, H. W. Buck, S. S. Wheeler, R. W. Pope, C. P. Steinmetz, C. W. Ricker, C. W. Stone, Carroll Thomas, C. F. Scott, W. L. R. Emmet and N. W. Stoher, an amendment to Mr. Stott's amendment, which had been proposed by Mr. Dunn, was passed, according to which latter amendment the Institute accepted the code in its present form, but will call upon the general membership for criticisms in view of making certain changes during the next year. For the purpose of conducting this work, the former committee was reappointed for another year. Dr. Wheeler announced that the Institute code was the first code of ethics to have been adopted by any engineering society in America. At a later session it was announced that the action of the convention in adopting the code was unconstitutional, as that body could only make recommendations to the board of directors on matters affecting the policy of the Institute. By vote the code was then referred to the board.

ENGINEERING EDUCATION.

Prof. H. H. Norris presented a paper on "The Attitude of the Technical School Toward the Profession of Electrical Engineering," which was followed by a paper by Prof. V. Karapetoff on "The Concentric Method of Teaching Electrical Engineering." Prof. J. A. Shaw objected to the practical exclusion of mathematics from a student's first year in college, as proposed by Prof. Karapetoff. For acquiring information concerning engineering practice a little experience in power plants and manufacturing establishments is far preferable to any laboratory course in college. It is possible to give the student an excellent idea of the relation of the several sciences if all chemical, physical and electrical transformations be discussed on the basis of energy changes.

Prof. F. B. Crocker stated that electrical engineering should no longer be considered as a branch of mechanical engineering. In many colleges electrical engineering has sprung from either physics or mechanical engineering, to which it yet remains attached. At Columbia, however, electrical engineering has always been treated as a subject complete in itself, and related to mechanical engineering just as the latter is related to civil engineering.

Mr. Gano S. Dunn expressed great satisfaction at the attitude of the Institute towards engineering education. The training which a student receives at a technical school is of such a nature as to render it valuable to a person in practically every line of work, such as banking, merchandizing, contracting, etc., in addition to the usual engineering work. No subject is of more importance than the instruction of students in engineering schools, so that the methods employed should be considered most seriously. Doubtless the best results will be obtained from a broad general training rather than a narrow specialization.

Dr. Samuel Sheldon expressed the opinion that the proper solution of the problem of instructing students in engineering can be found only in eliminating incompetent instructors and employing proper teachers. Men who are capable of becoming good teachers are in great demand in other lines of work in which the compensation is more inviting. Undoubtedly a considerable improvement would be made if the members of the teaching profession were better paid.

Prof. G. W. Patterson made a plea for education along broad lines and stated his belief that the method proposed by Prof. Karapetoff would not turn out a desirable product. Prof. L. W. Gill stated that instead of teaching theory first and then practice, as is usually done at present, or practice first and then theory as proposed by Prof. Karapetoff, it is preferable to teach practical and theoretical subjects together. The problem of rendering the subjects interesting to students can be solved readily by adopting proper methods of presentation.

STANDARDIZATION.

The revised standardization rules of the Institute, which have been changed in form and wording in accordance with various suggestions received from members during the past year, were adopted without discussion and without any dissenting vote.

ALTERNATING-CURRENT MOTORS.

In the discussion of a paper by Mr. William Cooper on the "Regeneration of Power with Single-Phase Railway Motors," Mr. W. I. Slichter said that the method outlined by Mr. Cooper is exceptionally advantageous for heavy railway work. He showed that the amount of power returned during retardation can conveniently be varied by changing the excitation of the exciting motor. Mr. L. B. Stillwell stated that the most advantageous feature of regeneration is in the minimizing of wear and tear on the rolling stock. Even with three-phase motors, the regeneration is of considerable importance. Thus it is possible with such motors to maintain an average speed equal to that with series-wound motors and yet obtain a large saving in energy. For example, instead of climbing a hill at 20 miles per hour and descending at 40 miles per hour, it is preferable to travel at the mean speed of 30 miles per hour, requiring extra power for ascending and returning power in descending. In reply to a question by Mr. J. A. Lincoln Mr. Cooper stated that when a railway motor is used both for propelling and for braking the wear on the gear is somewhat increased over that dur-

ing simple motor operation, but the increase is not large and is of no importance.

A paper by Prof. C. A. Adams and Messrs. W. K. Cabot and G. Irving, Jr., on "Fractional Pitch Windings for Induction Motors and Alternators," and one by Mr. R. E. Hellmund on the "Zigzag Leakage of Induction Motors," were discussed together.

Mr. B. T. McCormick explained by means of a vector diagram that with a fractional pitch winding the exciting magnetomotive force can be determined by a simple calculation involving the resultant of two vectors displaced from each other by as many electrical time degrees as the upper and lower half windings are separated in electrical space degrees. A similar diagram served to determine the relative increase in the leakage reactance of the embedded conductors when certain turns were placed in slots with turns of another phase.

Mr. C. W. Stone called attention to the fact that fractional pitch windings are quite generally used for motors and generators. With such windings, when high voltages are used, it is necessary to use extra insulation on the windings of different phases that are placed in the same slot.

Prof. Adams showed that the increase in exciting current with a decrease in the winding pitch is due to two factors; the flux density for a certain impressed voltage is increased, while the area over which the magnetomotive force of the current in each winding operates is decreased. Although both the exciting current and the short-circuit current are increased, the maximum power factor may not be the same, because the two do not always increase in the same ratio.

Dr. A. S. McAllister stated that the most convenient method for ascertaining the exciting current is by finding the quadrature wattless volt-amperes. Since the energy stored in any magnetic field during one-half cycle is restored during the next there is a definite interchange of energy from the electric circuit to the magnetic circuit during each half cycle. The amount of energy in each magnetic part depends directly upon the product of its volume and the square of the magnetic density and inversely upon the permeability. The total sum of the cyclically stored and restored magnetic energy per cycle reduced to power by reference to the frequency gives the quadrature exciting volt-amperes, from which the exciting current can be determined when desired.

In the discussion on a paper by Mr. W. I. Slichter entitled "The Vector Diagram of the Compensated Single-Phase Motor," Prof. V. Karapetoff showed that according to the usual theories of the compensated single-phase motor, the current locus should be a circle. Experience, however, shows that the locus is not a true circle, but departs therefrom on account of the change in magnetic reluctance, which change the usual theories fail to consider. While the simple theories are adequate for explaining the characteristics of the motor they are not sufficiently exact for predetermining the performance of a machine being designed.

TRACK SIGNALING.

A paper presented by Mr. L. Frederic Howard on "Track-Circuit Signaling on Electrified Roads," an abstract of which is printed on page ...., was discussed by Messrs. C. F. Scott and H. G. Stott. Mr. Scott outlined the history of the development of the electric track signals. Under early steam road conditions direct current was used for the signals. When track signals were first used on electric railways, one rail was reserved for signal work and direct current continued to be employed for the signal circuits. Subsequently alternating current was substituted for direct current in operating the signals and both rails were used simultaneously for the propulsion current and for the signal current. With the more recent introduction of alternating current for propulsion a separate higher frequency current has been found adequate for operating the signals without interference from the low frequency propulsion current.

Mr. Stott called attention to the fact that signal engineering is a highly specialized branch of electrical engineering requiring an intimate knowledge of the laws of electromagnetism. He stated that the signal engineer deserves a high rank among the members of the electrical engineering profession. All passenger-carrying railroads, whether steam or electric, should be equipped with complete automatic block system; no part of the working of which that may relate to the safety of the passengers should be left to human control.

A paper by Prof. F. G. Baum on "Power Transmission Economies" was discussed by Dr. Steinmetz, who showed that "satisfactory operation" is a term the interpretation of which is extremely flexible. Thus a service that would be considered entirely satisfactory for a Western mining community could not be tolerated in a large city. In the case of the former two interruptions of service per month might well be permitted, but in the case of the latter a single short interruption per year would place the power company in bad repute, probably resulting in the permanent loss of business. Prof. Baum's paper deals with conditions under which absolute continuity of service may not be the predominating requirement. It records an economical solution of the problems encountered, but the solution is not general in its application.

"One-Phase High-Tension Power Transmission" was the subject of a paper presented by Mr. E. J. Young. In its discussion Dr. Steinmetz said that in the early days of low-tension transmission, when wooden poles and cross-arms were in use, the limiting factor in the increase in the voltage was the e. m. f. between wires; on the basis of such e. m. f. the three-phase system requires only three-fourths as much copper as the one-phase. Under modern conditions the limiting factor is the voltage between each line wire and the grounded insulator pin; on the basis of this e. m. f. the one-phase system is equally as economical as the three-phase. Much discussion has arisen as to whether the one-phase and the direct-current system should be compared on the basis of the maximum, the effective e. m. f. or some value between these two. In any event, it is not probable that the direct-current transmission system will be used in this country in preference to the three-phase system.

Mr. C. F. Scott expressed the opinion that independent of any advantage in economy in transmission circuits which the direct-current system may possess over the alternating current, the former is objectionable in that means for the utilization of the power received are quite complicated and not so reliable as stationary transformers, induction motors, synchronous motors and rotary converters.

In reply to a question by Mr. E. H. Schwarz, Dr. Steinmetz stated that a one-phase generator possesses a better regulation than a polyphase generator at the same current output per phase, but at the same total power output the regulation of the one-phase generator is much worse than that of a polyphase generator.

The discussion of the above paper concluded the technical portion of the convention programme. Upon motion by Mr. Stott, a hearty vote of thanks was extended to the local committee and many operating and manufacturing companies for numerous courtesies and extra efforts for the comfort and convenience of the members and their friends.

Another Electrical Show.

An electrical show will be held in New York City, at Madison Square Garden, from Sept. 30 to Oct. 9, inclusive, excepting of Sundays. This show is termed "The First Annual Electrical Show," and will be conducted by a corporation formed for the purpose. The preliminary circulars are now out and may be had on application to the management, Electrical Show, Inc., 1212 Morton Building, Nassau Street, New York. A number of prominent companies, it is stated, have already taken space or signified their intention to do so. The New York Edison Company has given the project its support to the extent of taking large space.

The Training of Electrical Engineers.

The following article from the pen of Prof. F. B. Crocker is reprinted from a recent issue of the *General Electric Review:*

This matter, not only from the educational point of view, but also from the standpoint of the manufacturer and other employers of electrical engineers, has occupied much of my time and thoughts for the past 17 years. It is now generally recognized that a course of instruction in some technical school is an almost necessary preparation for entering the electrical engineering profession. Formally this was not so, some men having achieved eminence and many having been successful without this educational training, but the percentage of these cases becomes less and less as time goes on. It is still possible, however, for one to reach high positions in the electrical field, especially on the business side, by rising from the ranks, so to speak, just as one may become a major-general of the United States Army without graduating from West Point. In fact, some of our most prominent army officers of the present day are not West Pointers. It is even desirable, I think, that this opportunity should always remain, not only in the army, but in the engineering professions.

It is natural, however, for the writer to consider the question from the view point of the technical school and perhaps to be prejudiced in favor of it. The present discussion will, therefore, be confined to that form of training.

The advantages that such a training give, may be briefly enumerated as follows:

First: The thorough knowledge gained of fundamental subjects, such as mathematics, physics and chemistry, upon which all engineering is based.

Second: The training is systematic and teaches the student how to think and investigate logically and effectively.

Third: A special and fairly complete grasp is secured of one branch of engineering as well as of the allied subjects. The total time occupied is only four years, while it is doubtful if the same knowledge could be picked up in 10 years outside of an educational institution.

Fourth: The "practical" engineer knows certain branches intimately, but there are other equally important ones about which his mind is almost a blank. This is not usually the case with the educated engineer. The practical man simply learns from experience, and, from lack of opportunity, usually fails to fill in the gaps of his knowledge.

On the other hand, the completeness and corollation of the different branches of scientific instruction makes a technical education particularly strong and useful. The principles of science remain unchanged, so that any new invention is intelligible to a scientifically trained mind, but has to be learned as a new subject by a purely practical man. Science has now become so exact that it can be applied directly to practice without great modification, especially in electrical engineering. The apparent contrast or opposition so often pointed out between theory and practice is becoming less and less as both science and practice advance. Technical instruction should be directly based upon correct theory, but should lead up to practical results. Commercial apparatus and methods often give the most excellent examples of scientific principles.

The article by Mr. B. A. Behrend on "Engineering Education," which appeared in The Electrical World of Jan. 5 discusses this question very fully, and in a manner with which I fully agree. Mr. Behrend makes the following statement which I consider of the highest importance and perhaps the most so of any one of the points involved. He says: "The more theory in college the better. The students cannot receive good practical instruction at college, hence let them get as much theoretical training as possible. Mechanical laboratories are much better than football, but they do not at all take the place of a year's training in a shop."

In an article which the writer published in the *Columbia Engineer*, in May, 1897, it is also pointed out that "it is a fact that technical training does not give a business knowledge and I do not think it should attempt to give anything like a complete business education; it would be out of place and probably futile to do so. There is another thing that a technical education fails to give; that is, knowledge of human nature and the ability to deal successfully with superiors, equals and subordinates." These three points sum up, I think, the principal results that technical training cannot be expected to accomplish. I am in thorough accord with Mr. Behrend in insisting that after all, the inculcation of fundamental principles and correct theory is the real function of technical education, and much more appropriate than an effort to give an imitation of factory and central station methods. The writer does not mean, and I am sure that Mr. Behrend did not mean, that practical matters are to be ignored in colleges, but that the theory should be *real theory*, as he calls it, and should lead up to the practical applications.

Another point which I urge strongly is the importance of not specializing too greatly or too early in technical instruction. It is practically inevitable that an electrical engineer will devote nearly all of his time to the study and work of his profession. His time is occupied with reading electrical journals, letters, contracts, etc., in discussing electrical topics and in handling electrical apparatus. He has little or no time (and this is borne out by the experience of at least nine men out of ten) to study or even consider other branches of science or technology. For example, it is not likely and hardly possible for him to sit down and study chemistry, metallurgy or other non-electrical subjects. It is most desirable, therefore, that a certain amount of such knowledge, at least the fundamentals, should be acquired by him while he is young and has the benefit of systematic instruction. If he does not secure the knowledge then, he is never likely to, and will almost necessarily, either unconsciously or deliberately, dodge any chemical or metallurgical problem that may arise in his experience. The undergraduate student is particularly short-sighted in his views on this subject. He regards any time spent on topics that are not strictly electrical, and directly bread-winning at that, as being wasteful of his valuable time. As a matter of fact, it is not too much to say that the non-electrical instruction which he receives is more important than the special electrical work. This is because he will never have another opportunity to acquire the other subjects, while his whole life will be spent in gaining electrical information.

As a corollary to this conclusion, I would say that it is not desirable for the non-electrical subjects, such as mathematics, chemistry, mechanical engineering, etc., to be taught by electrical engineers or electrical specialists. The latter would naturally look at the subject from their own standpoint and pick out those particular parts which they consider important to the electrical engineer, and would, therefore, narrow his mind and breadth of his information at the very start. Specialization is necessary and it is hard to succeed without it, but it should not begin too early, certainly not in the first year or two of a college course.

If not too much pressed for time and money it is a good thing for a young graduate of a technical school to pursue a year's post-graduate course, which extends and crystallizes his knowledge. In the long run such a man will probably rise higher. On the other hand, some make the mistake of clinging too long to the skirts of their Alma Mater, so that they become unfitted to face the world. Business conditions are very different from the academic. It is advantageous, in fact, almost essential, for the young graduate to serve an apprenticeship of a year or more, preferably in a large manufacturing establishment. This is true even though he intends to become a power plant engineer, contractor or consulting engineer, because he will always have to deal with apparatus which originates in a factory, and it is very important for him to know how it is made. Furthermore, the inspiration and object lesson of a large manufactory are most impressive. There, in a few months, he will get plenty of the "practical" and more of it than he can acquire in as many years in any technical school or college. At every turn he will see and be able to understand applications and embodiments of the principles which he has been taught, without which he would labor under a great disadvantage.

Data on Boiler Efficiencies.

We are informed by the Technologic Branch of the Survey that the experiments now being conducted by the boiler division of the United States Geological Survey fuel-testing plant at St. Louis, Mo., on the nature of boiler efficiencies go to indicate that stationary boilers ought to be made to do 10 to 20 times as much work per unit of heating surface as they do now. This great increase in capacity is to be attained by sub-dividing the heating surface and water streams more finely, by allowing less restriction of the water inside the boilers, and by using high forced and induced draft to put a large mass of gases through the boiler at a very high speed.

Up to the present time there have been only vague ideas among engineers as to what factors influenced the efficiency of the steam boiler portion of the steam generator apparatus so as to cause it to absorb more or less of the heat generated by the combustion. Dr. John Perry, the distinguished mechanical and electrical engineer of England, went into the subject mathematically a few years ago and set forth general conclusions tentatively in his book on the "Steam Engine and Gas and Oil Engines." About a year ago, the government testing plant took up the mathematical investigation of the theory of the steam boiler and of heat absorption, and extended Dr. Perry's theory. For some weeks past, Mr. Walter T. Ray, assistant engineer, acting under the supervision of Prof. L. P. Breckenridge, engineer-in-charge of the boiler division, has been conducting a series of experiments on small multi-tubular boilers dimensioned so to enable the theory to be verified, or modified, or refuted. The boilers are fed with air heated electrically. Dr. Perry's theory states that modifying conditions being omitted from consideration, every boiler will always absorb by convection from the gases passing through it, the same percentage of heat which could possibly be absorbed by any boiler containing water at a given steam temperature. This efficiency is, therefore, independent of the temperature of the entering gases and of the amount of gases flowing through the boiler. Of course, it must be understood that the above statement of the theory is slightly subject to modification even theoretically and more so in practice.

As a practical example, let it be assumed that the water in a boiler circulates with entire freedom, which is an unwarranted assumption, and that its temperature is 300 degrees F.; let the gases enter the boiler at 1300 degrees F., then the difference between the two is 1000 degrees F. Consequently, it would be possible for a boiler infinitely long to reduce the temperature of the gases passing through it to 300 degrees F. Let us assume, however, that the gases leave the boiler at 500 degrees F., which is 200 degrees above steam temperature. The efficiency of the boiler then is 80 per cent, because it has reduced the temperature 800 degrees out of a possible reduction of 1000 degrees.

If the same boiler be supplied with gases at 2300 degrees F., the gases enter the boiler at 2000 degrees F. above steam temperature. Dr. Perry's theory states that this particular boiler will reduce these gases 80 per cent as much in temperature as would a boiler infinitely long; that is, to 400 degrees above steam temperature, which is 20 per cent of 2000 degrees, or to 700 degrees F. It will be noticed that the mass of gases does not enter into consideration at all.

This surprising deduction is being accurately verified by the special division of the Survey, from which it is found, when keeping other conditions the same and when keeping the initial temperature of the gases constant, that the final temperature of the air remains the same, whatever the amount of air sent through the boiler per second. So far the upper limit has not been reached with tubes clean inside and out, although the rate of evaporation has already been pushed up to many times that obtained even in locomotive practice.

Perry's theory takes into consideration four fundamental features affecting heat absorption at any point of the heating surface: First, temperature difference between the gases outside any portion of the boiler tube and the water inside. Second, the number of molecules per cubic inch in the gases outside the boiler tube. Third, the specific heat of the gases at constant pressure. Fourth, the velocity of the gases parallel to the heating surface. Of the four above factors, only the first has usually been considered. It will be readily seen that if we increase the temperature of the gases we decrease the number of molecules beating against any square inch of tube heating surface and thus the second factor largely neutralizes the first, especially at high furnace temperatures. The third factor can be taken as constant equal to .24.

The fourth factor is the new and surprising one. Dr. Perry considers that a high velocity of gases parallel to the heating surface scrubs off more or less of the dense film of gases adhering to the metal surface, which film of gases has already become cold by proximity to the metal. The higher the velocity of gases the more the scrubbing effect, and consequently the greater the amount of heat transmitted. This theory necessarily assumes that the ability of the metal to transmit heat is practically infinite, and when we consider that we ordinarily never put through a boiler tube more than 1/1000 of heat it could possibly carry, it will be realized that this assumption is warranted.

Dr. Perry's theory and the Survey's verification of it will result in placing the steam boiler on a fairly secure mathematical basis. Thus far the experiments check out the theory excellently. The theory and results will be embodied in a special bulletin to be published in two or three months.

The Central Station Business Problem.

In an address before the recent annual meeting of the British Municipal Electrical Association, President S. E. Fedden dwelt at some length on the subject of methods of central station business getting. The position of electricity supply undertakings is, he said, in many respects similar to that of the cultivator, who, by stress of competition, finds himself no longer supported by the natural production of his holding and must resort to methods of fertilization, in doing which he is soon confronted by the principle of "Diminishing Return" which sets a limit to the amount of capital and energy which he can profitably expend in improving the yield of his land.

"Similarly with the creation of a demand for electrical energy. The first consumers are obtained with little or no difficulty; after a time the rate of increase of connections falls to a low value, perhaps almost balanced by a few disconnections which are unavoidable. Here is the occasion for energetic effort; canvassing, price reduction—direct or indirect—and missionary work among the next circle of possible users. Once more we go ahead and secure new business, but every kilowatt connected this time has cost something to secure. Soon a steady condition is again reached. To move forward once more renewed effort is required; more educating of the public; fresh adaptations of electricity; special terms and concessions must be made to get us moving into the next larger circle of demand, and so on.

"Can we not approach this problem in our own way as we have so many others in the past, and however commercial we become by the decree of modern conditions, yet keep our enterprises free from the taint of mere huckstering? After all, the object in view is to ensure that every likely consumer shall become acquainted with the possibilities of our supply in relation to his business, pleasure, or home life, and that such information shall certainly reach him without any effort on his part. The safest and most efficient means of securing this result are by demonstrations in the form of press records of work done, showroom displays, exhibitions, and the loan of apparatus on approval, and although this method may involve considerable outlay, I think the return would be immeasurably greater than upon any extensive scheme of general advertising alone, moreover, such means inspire confidence and avoid the possibility of creating an exaggerated impression, or

overstating any particular claim. Apart from considerations of business morality, this is a most important point, where the investment by the consumer in electrical apparatus is not the end, but only the commencement of continuaos business relations, which can only be satisfactory and re-act favorably on the undertaking when the results are at least equal to the expectations of the purchaser."

CURRENT NEWS AND NOTES.

ELECTRIC SIGNS IN CHICAGO.—Overhanging electric signs on State Street, Chicago's principal thoroughfare, have been ordered removed by the Commissioner of Public Works.

ADVERTISING SIGNS.—The Rockford Edison Company, of Rockford, Ill., is trying the experiment of advertising in the Chicago daily papers for flat-rate electric sign business. Rockford, these advertisements state, offers an ideal location for this form of publicity.

GIFT TO COLORADO COLLEGE.—General William J. Palmer has given the Engineering School of Colorado College, Colorado Springs, the sum of $12,000, to be expended immediately upon additional equipment of the engineering laboratories for senior work. Prof. Florian Cajori is dean of the School of Engineering, the electrical department being in charge of Prof. J. Roy Armstrong.

LIMITING VOLTAGE OF ALTERNATORS.—In a paper presented last month before the British Institution of Civil Engineers, by Messrs. H. R. J. Burstall and J. S. Highfield, the authors in referring to alternating-current generators say: "We wish to express the opinion that at present it is impossible to construct a machine with closed slots which will work at a pressure of 10,000 volts to earth."

ELECTRIC SIGN SUIT.—A novel suit has been brought by Fred Kuhmmel against the Oliver Chilled Plow Works, at South Bend, Ind., in which he asks $5,000 damages and a perpetual injunction against the defendant in operating an electric sign 200 ft. long on the warehouse of the plant. The plaintiff says the sign, which has over 4000 incandescent lamps and requires 165 horse-power, "turns night into day, produces ill-health and discomfort to himself and family, shakes the house and induces boys and men to congregate about his premises to play ball at night and indulge in revelry."

THEATERS AND TELEPHONES.—Mr. Frohman, the American theatrical impresario, said recently in London: "Two-thirds of the communication in London that two or three years ago was settled by correspondence or calls is now done by telephone. The result is a man's work is more concentrated and he gets more time. In perhaps one hundred or more engagements I might have during the day, half are settled by telephone, even to engaging actors and listening to musical lyrics. I have decided more stage questions this year this way than by correspondence or personal meetings. In fact, I have engaged two star actors and made agreements with three authors for plays without having ever met them."

ELECTRIC FIRE ENGINES.—Leipzig, Germany, has four storage-battery fire apparatuses in the shape of engine, ladder truck and two tenders. All of the machines are driven from the front axles, so that it is possible to turn them even in the narrowest streets. Each machine is equipped with two motors, which can develop from 7 to 14 horse-power. They have five forward and two backward speeds and one electrical and one hand brake. The machines are guaranteed to run a distance of 18.5 miles on one charge at a rate of speed of 15.5 miles per hour, even upon poorly paved streets or upon four per cent inclines. As there are no hills in Leipzig and as the streets are all in good condition, the machines can cover a distance of about 24 miles on one charge.

DEVELOPMENT IN ITALY.—According to dispatches from Italy, the Edison Company of Milan is the head of the largest syndicate ever formed in Italy for the development of electrical power. The new concern, which is capitalized at $5,000,000, plans the construction of hydro-electric plants having an aggregate capacity of about 100,000 hp. The power plants are to be located in the Camonica Valley, in the Brescia district of Northern Italy. The syndicate will furnish electrical energy to operate various traction lines in and around Milan and Como, as well as supply it for industrial operations. The Edison Milan system is one of the earliest to be established on the Continent. Its first engineer was Mr. John W. Lieb, Jr., now associate general manager of the New York Edison system.

FATAL X-RAYS.—It is noted that the death of Dr. Weigel, a surgeon, of Rochester, N. Y., from a disease due to the constant use of the X-rays makes the fourth from this cause in the United States. The others were Dally, an assistant of Mr. Edison, a Boston physician and a woman of San Francisco named Fleischman. In the case of Dr. Weigel, since 1904, when his right hand and all but the thumb and a finger of the left hand were removed, there had been four operations in trying to save his life. The first removed a part of the right shoulder, then a part of the muscles covering the right breast. Mystery completely envelops the cause of death, the disease being unknown to medical science, though it is believed to involve some great principle of life. Dr. Weigel was president of the Rochester Academy of Medicine and the American Orthopedic Society.

HIGH SPEED TRAVEL.—The electric locomotive has a worthy rival as to speed in the automobile. Mr. S. F. Edge, in a six-cylinder Napier motor car, made last week on the new Brooklands track, 1581 miles in 24 hours, at an average speed of 66 miles an hour and reaching at times 72 miles. No man ever before traveled anything like as far, on or off tracks at such speed. The Brooklands track is 3 miles in circuit. Around the course are sentry boxes, which give full control of the complete circuit. These are equipped with telephones. In the event of an accident or a breakdown, the sentry in the nearest box hoists a flag, rings an electric bell, which communicates with the sentries on either side of him, and then telephones to headquarters in the official buildings for what help is required. A special staff, an ambulance car, and a breakdown gang are always in attendance, for dispatch on telephonic call or otherwise.

A NEW ENGINEERING SOCIETY.—A new engineering society has been organized in Philadelphia, called the Engineers' & Constructors' Club. Membership in this society is limited to the engineers composing the organization of Dodge & Day. Its object is to discuss subjects relating to engineering and construction and to give all members the benefit of the experience gained by each in his particular line of work. Four meetings have been held. Up to date the following papers have been presented and discussed: "Civil Engineering Preliminaries for an Interurban Trolley," by Charles Reed Marsh; "Electric Welding," by J. H. Gravel; "Gas Producers and Internal Combustion Engines," by John E. Zimmermann; "Concrete Piling," by Julian C. Smith. The proceedings of the club, giving the papers presented and the discussions, will be published regularly. The officers of the club are: President, Harold T. Moore; secretary, George Walters; managers, F. C. Andrews, H. F. Sanville, John E. Zimmermann, C. N. Lauer.

ELECTRICAL COURSE AT THE NAVAL ACADEMY.—The board of visitors to the Naval Academy, in its report to the Secretary of the Navy, has recommended that a new department be created for the study of electricity and the practical application of electric power, such department to have at its head a naval officer thoroughly familiar with all the types of electric apparatus intended for use on board vessels, and as many qualified instructors as may be necessary to teach the midshipmen the methods of construction, repair, maintenance and operation of such apparatus; and further, that an adequate equipment be provided for the department and an amount of time be allowed to this study commensurate with its importance, which the board particularly emphasizes.

THE TROLLEY IN SHANGHAI.—Advices from Shanghai, China, state that a feeling of apprehension exists among the foreign residents of Shanghai that serious disturbances will follow the opening of the new electric street railway system, which will be inaugurated in July. For some time the native press has been agitated over the installation of the electric car lines, and frequent articles of a highly inflammatory character have appeared. These have been reflected in the teahouses and in the street talk of the native city, until now a general uneasiness prevades the foreign quarter. The *South China Gazette* in a recent article told the natives that from 5000 to 6000 persons had been killed by the electric railways in Tokio. This absurd item did not tend to reassure the public.

TELEGRAPHERS UNEASY.—The telegraph situation, while relieved to some extent, is not yet quite clear, the operators being still on strike in San Francisco, and, elsewhere "letting I dare not wait upon I would." By invitation of United States Labor Commissioner Charles P. Neill, who came to New York from Washington a week ago to settle, if possible, the strike of the telegraphers against the Western Union and Postal companies in San Francisco, M. J. Reidy, J. Sullivan and S. J. Konenkamp, of the executive committee of the Commercial Telegraphers' Union, had a conference with him. The situation was gone over. The commissioner went back to Washington, but returned again to see President Clowry, of the Western Union Company. Meantime the inconvenience suffered by the people of San Francisco is said to be considerable.

THE TELEPHONIC EAR.—Attention has been called to the results of Dr. N. R. Blegvad's investigations of the ears of 418 women operators in the employ of the telephone company at Copenhagen, Denmark. Each operator attends to from 80 to 120 subscribers. The average calls are 125 an hour, increasing at times to 200. The results of the investigation may be given as follows: Of the 418 girls examined, 47 showed pronounced pathological changes of the ear drum, leaving 371 with a normal membrane. Of these 26.4 per cent showed a retraction of the membrane of the ear used for the receiver. The work does not produce a diminution of the faculty of hearing in healthy organs, neither is this sense increased, but the ear becomes accustomed to its duty and can thus accommodate itself to the conversation. The lower sound limit is higher than in the normal ear, excluding therefore the deepest sounds, while nothing can be stated about the higher sound limit. It could not be demonstrated that the work had a bad influence upon disease of the ear. But it was found that sudden noises, including that of thunder, could induce a recurrence of a chronic malady or produce a new disease. On the other hand, it was found that the work gave rise in nervous girls to headaches. Thus it would appear that the occupation of telephone operators is about as healthful and suitable for young women in good health as any other. If nervous subscribers would not cultivate the habit of communication, there would ensue a tele[illegible]

PUBLIC UTILITIES COMMISSIONS.—Announcement was made last week at Albany of the men selected by Gov. Hughes for places on the two commissions created under the New York Public Service Commissions act to take the place of the State Railroad Commission, the State Gas Commission, and the Rapid Transit Commission of New York City. The vice-commissioners were actually appointed and assumed office on Monday, when the law went into effect. The commissioners are as follows: For the First District, which takes in New York City; William R. Willcox (Rep.) of Manhattan, chairman; William McCarroll, (Rep.) of Brooklyn; Edward M. Bassett, (Dem.) of Brooklyn; Milo Roy Maltbie, (Ind.) of Manhattan; John E. Eustis, (Ind.) of the Bronx. For the Second District, comprising the rest of the State: Frank W. Stevens, (Rep.) of Jamestown, chairman; Charles Hallam Keep, (Rep.) of Buffalo; Thomas Mott Osborne, (Ind. Dem.) of Auburn; James E. Sague, (Rep.) of New Hamburg; Martis S. Decker, (Dem.) of New Paltz. The salary of the new commissioners is $15,000, and their term of office five years, but a system of rotation is provided by which one of the present commissioners only is appointed for five years and the others for four, three, two, and one year, respectively, so as to insure continuity. They are removable by the governor upon charges without the consent of the Senate. Each of the commissions will have the selection of a counsel at $10,000 a year and a secretary at $6,000. It is said that the governor had no fewer than 375 names under consideration for the commissions. None of the men named above are known prominently in connection with public utilities except Mr. Maltbie, who is regarded as a rampant "municipal ownership man." Mr. Eustis is a director of the Babcock & Wilcox Company. Mr. Sague is a railroad man and a graduate of the Stevens Institute of Technology. Mr. Decker was once a telegrapher.

MONORAIL IN JERSEY.—According to the newspapers, three of the New York Rapid Transit Commissioners who went out of office on July 1 have become interested in a project to build an elevated, four-track monorail road between Jersey City and Newark, with the intention of carrying passengers from New York to Newark for 5 cents, and from New York to Jersey City for 3 cents. A successful trial of the new monorail scheme has been made, it is said, in the Exposition grounds at Jamestown. The details of the new organization which is to build the road and the exact route the road will take are withheld for the present, but it was ascertained definitely that John H. Starin, Charles Stewart Smith and Woodbury Langdon are to give the new company the benefit of their experience. Mr. Starin, who is vice-president of the Rapid Transit Commission, expresses his unbounded faith in the enterprise generally and in the invention of the new monorail. Mr. Smith and Mr. Langdon are also members of the commission. The system is that of Mr. Howard H. Tunis, an engineer of Baltimore, Md. Briefly stated, the system consists of a long, somewhat narrow, cigar-shaped car, running on two trucks of two wheels, set tandem, each over one rail. Overhead the car is supported by an equilibrium device which holds the car upright under all possible conditions and at the same time acts as a conveyor of the current, doing away with the third rail. By reason of this device it is possible to operate extremely light cars over an extremely light structure. With such cars, the inventor and others claim that 100 miles an hour can be made easily. Supported above the car by iron bents on each side of the track are two small L-shaped rails about 30 ins. apart. The equilibrium device consists of a ladder-like trolley pole arrangement, at the end of which there are ball-bearing guide wheels that run on the L-shaped rails. The trucks on which the little wheels rest cannot be removed from the rails without taking the structure apart, so that there is no chance of the wheels "jumping" and letting the car topple over sidewise. The body of the car is of standard construction, 47 ft. long, 6 ft. wide, and the car is provided with 8 motors.

The Generating Station for the Taylor's Falls-Minneapolis Transmission System.

THERE has recently been put into operation at Taylor's Falls, on the St. Croix River, 40 miles from Minneapolis, a water-power plant of a present capacity of 10,000 kw and an ultimate capacity of 20,000 kw. It has been erected for the purpose of supplying power to the Minneapolis General Electric Company, which is the central station company of Minneapolis.

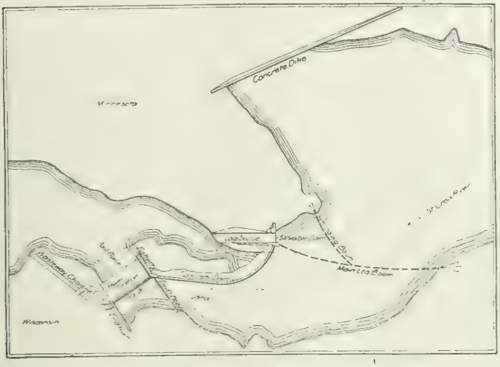


FIG. 1.—MAP SHOWING WORKS AT THE TAYLOR'S FALLS WATER-POWER DEVELOPMENT.

This water-power plant and the transmission line and distribution system connected with it are among the notable recent engineering works of the country. Its capacity is sufficient to take care of all the present electric light and power business in Minneapolis. The purpose of this article is to describe the water power development of the falls.

Taylor's Falls, on the St. Croix River, are located 40 miles northeast of Minneapolis. The St. Croix River forms the boundary line between Wisconsin and Minnesota at that point, the village of Taylor's Falls being on the Minnesota side of the river and that of St. Croix Falls on the Wisconsin side. The power station is on the Wisconsin side.

HYDRAULIC DEVELOPMENT

The St. Croix River is an excellent stream for water-power purposes because, as can be seen from a map, it is fed by many lakes which act as storage reservoirs. The dam at Taylor's Falls is 50 ft. high and 740 ft. long. A much shorter dam would have been sufficient to obstruct the flow of the river, but this length was given to provide a long spillway for flood waters. A map of the dam, power plant and river in the vicinity of the falls is shown in Fig. 1. The original course of the stream is shown by the dotted lines, the river being naturally very narrow at this point.

The power station is located on what was formerly a point of land, excavation having been made for the tail-race. By virtue of the tail-race excavation an effective head of 56 ft. is obtained, although the dam is only 50 ft. high. The location is almost an ideal one for the development of large power and storage capacity without excessive flooding of upstream land. The St. Croix River runs between high, narrow banks for the entire 11 miles up-stream influenced by this dam. The only construction work which had to be done to prevent overflowing extensive land was the building of a concrete dike on the Minnesota side of the river, as shown in Fig. 1. Eleven miles above Taylor's Falls is Never's Dam, owned by the same company and maintained for the purpose of storing water with which to supply the Taylor's Falls power plant in dry seasons.

FIG. 3.—DAM UNDER CONSTRUCTION, SHOWING SECTION.

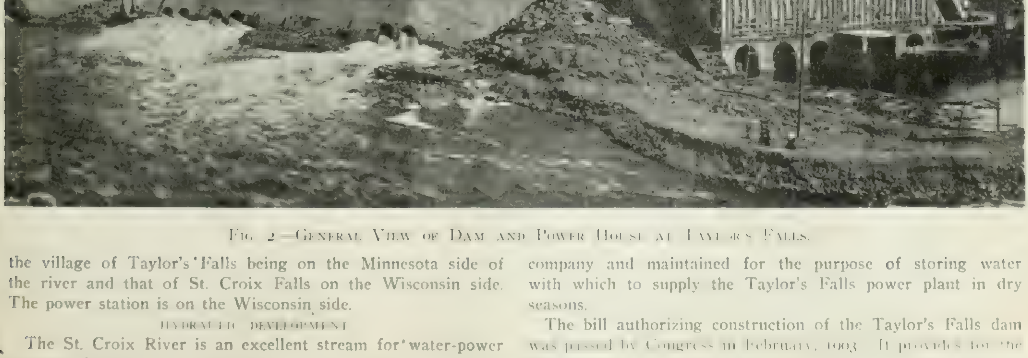


FIG. 2.—GENERAL VIEW OF DAM AND POWER HOUSE AT TAYLOR'S FALLS.

The bill authorizing construction of the Taylor's Falls dam was passed by Congress in February, 1903. It provides for the maintenance of a lock should the government ever desire to open the stream to navigation. The lock, if ever built, is designed to be cut through the Minnesota side of the river.

Fig. 2 shows the dam and the power station as they appeared

soon after completion in January, 1907. As seen by the map (Fig. 1), provision has been made for a log sluice on the Minnesota side of the river, entrance to which is through a bear-trap dam. A log boom extends across the river so as to divert logs to the sluice, and a swinging boom protecting the sluice is also placed above the bear-trap dam. A fish-way is placed at one end of the power station, as indicated.

Fig. 3 is from a photograph taken of one end of the dam while it was under construction. It is simply a piece of solid concrete

[illegible]

construction resting on bed-rock. The rock used in this construction was obtained on the spot. In many cases large chunks of trap rock were cleaned, dropped into place and surrounded by concrete, 6 ins. on all sides. The concrete used in the dam was a mixture of one part cement, three of sand and five of crushed stone from trap rock found on the place. Samples of each carload of cement were tested at the construction office at the falls. The first part of the dam was built with openings in the bottom through which the river was diverted by a cofferdam when the remaining portion of the dam was being built. The forebay is protected by a drift boom located as shown in Fig. 1. Fig. 4 is a view of the forebay showing the ice and drift racks, which are easily accessible to workmen with rakes. A crane has been left in position for the purpose of lifting heavy driftwood out of the forebay if necessary. The

[illegible] Dam at Power House.

dam proper extends clear through under the power house, and the power house building is erected on the face of the dam. Fig. 5 shows a cross-section of the dam at the power house, the power house foundation, showing the position of the intake pipe, turbines and draft tubes. The intake pipe, 14 ft. in diameter, has an elbow leading into the turbine casing. From the top of this elbow a 3-ft. air vent pipe is led off. Over the middle of the turbine casting is an opening through which parts can be [illegible]

seen from the cross-section drawing of the power house (Fig. 6), there is an I-beam on the ceiling of the wheel gallery which is located directly over this opening into the turbine casing. This I-beam carries an electric traveling hoist which can be run over any one of the turbines while repairs are going on, and with it parts can be carried to the end of the power house. From the turbine casing two draft tubes 7½ ft. in diameter drop to the tail-race.

[illegible]

Before proceeding to a description of the gates, gate-operating machinery and turbines, the general arrangement of the power

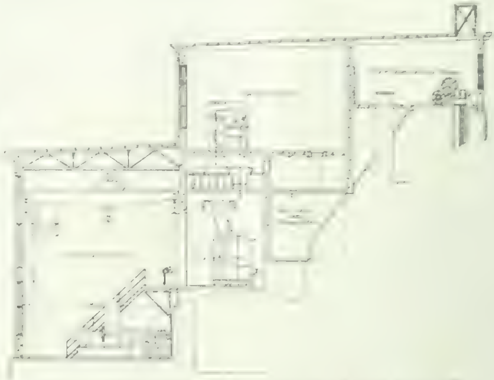


Fig. 6.—Cross-Sectional [illegible] of Power House.

station will be considered further. On the lower floor is the generator room, spanned by a Niles-Bement-Pond 25-ton, 3-motor crane. Fig. 6 is a section of the power house through one of the main generators and a transformer. On a kind of gallery or the second floor are the transformer rooms and switchboard. Each bank of three transformers is in a separate fire-proof room and arranged to roll out onto the gallery under the main crane. On the same floor as the transformers, but separated from them, is the operating switchboard located so that the attendant can see from the gallery what is going on in the generator room. The 50,000-volt leads from the transformers go up through the floor to oil switches and then into bus-compartments in a cell room. From the cell room the 50,000-volt conductors pass up to oil switches and from there to the protective apparatus and out to a steel tower, from which a span is made across the river to connect it to the pole line to Minneapolis. Half of the oil switch room is at present vacant, this space having been left for future development.

In the uppermost story of the power plant is the motor-operated gate-lifting mechanism.

TURBINES.

There are four Victor turbine units made by the Platt Iron Works Company, each direct-connected to a 2500-kw generator. Each of these turbine units has four runners 36 ins. in diameter

mounted on the same shaft. At 277 r. p. m. the turbines are rated at 4200 hp with 55-ft. head; at 48-ft. head, 3400 hp; at 45-ft. head, 3150 hp. The runners are removable in the manner described in the general arrangement of the power house. The penstock leading to each set of turbines is 14 ft. in diameter and the two draft tubes 7 ft. in diameter, the total effective head being 55 ft.

The water wheel speed is regulated with Lombard governors, these governors controlling the gates with oil pressure. The oil-pressure tanks for the four governors are connected in multiple. The wheel units can be started, stopped and controlled from the switchboard by small motors mounted on the governor heads and so connected as to raise or lower the running speed of the governor. These governors were installed under a guarantee that an instantaneous variation of 20 per cent in the load on the generator should not cause more than 2 per cent speed variation, and that only for four seconds. In the case of the opening of a short-circuit on the generators the speed is guaranteed not to change over 12 per cent and to return to normal within 7 seconds or less.

The two turbines which drive the exciters have each a runner 18 ins. in diameter. These turbines are rated at 200 hp, at 525 r. p. m. with 55-ft. head. Besides being direct-connected to an exciter, one of these turbines can be connected through a friction drive to an American Fire Engine Company rotary fire pump for fire purposes. The friction drive is of the grooved pulley type.

GENERATORS.

There are now installed four 2500-kw Westinghouse three-phase, 60-cycle, 2300-volt generators. The power house has room for one more generator of this size at the end now occupied by the machine shop, and by extending the building, three additional generators can be installed, making a total capacity of eight 2500-kw machines, or 20,000 kw. The generators are guaranteed to take a load of 2500 kw continuously and a load of 3125 kw for two hours without exceeding the usual allowable temperature rise. Although their normal speed is 277 r. p. m., they are calculated to withstand 554 r. p. m. without excessive strain. If driven at constant speed the drop in voltage between no load and full load with constant field excitation is 6 per cent. The field excitation current is 225 amperes at 125 volts. The efficiency at full load is 96 per cent; at three-fourths load 95 per cent, and at one-half load 93 per cent. The field puncture test is 1500 volts and the armature test 5000 volts.

The two waterwheel-driven exciters are 100 kw, 125-volt machines, direct-connected to the water wheels before described. These exciters, which have an overload capacity of 150 kw for two hours, are compound-wound with a series winding sufficient to maintain constant voltage from no load to full load; or, in other words, a flat characteristic. Their effective voltage can be varied by the rheostat between 90 and 130 volts. The efficiency at full load is 90 per cent; one-fourth load 80 per cent, and at 50 per cent overload, 89 per cent. In Fig. 7 is seen a general interior view of the generator room, showing the machines just described, one of the exciters, however, not having been installed when this view was taken. As seen on the plans (Fig. 8) room has been provided for the installation of a 100-kw motor-driven exciter between the two other exciters when the power house is extended.

Fig. 7.—General View of Interior of Taylor's Falls Power Plant.

TRANSFORMER ROOMS.

The transformer rooms or cells are among the most interesting features of the plant. The doors opening into these cells can be seen at the gallery on the right in Fig. 7 opposite

[illegible] generator, and ordinarily a generator and its bank of transformers are considered as a unit, although provisions for separating them are made in the wiring scheme of the station, which

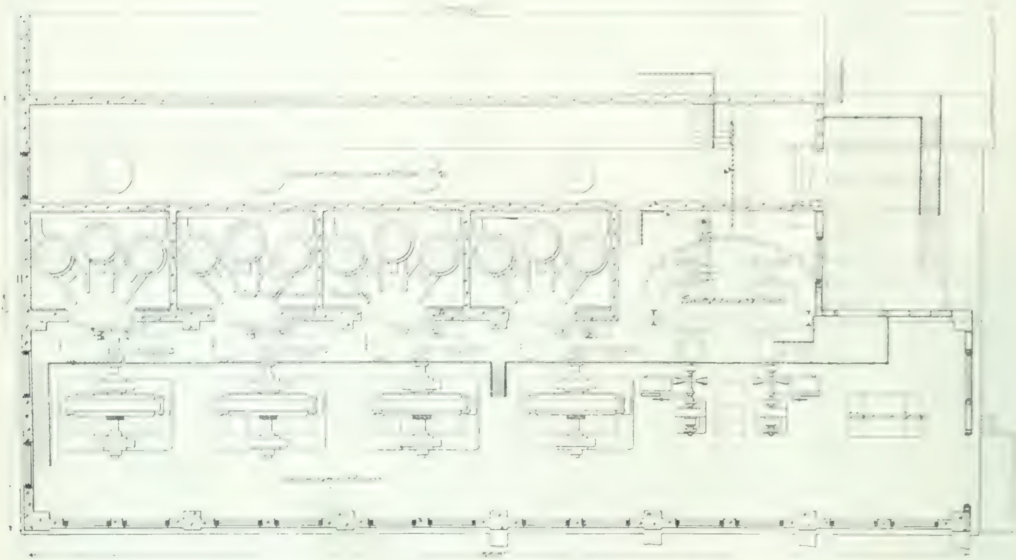


Fig. 8.—Plan View of [illegible] Falls Power House

will be described later. A [illegible] of the transformer cells is shown in Fig. 9. The transformer cells are of solid concrete with a fire-door opening onto the gallery in front. The fire-doors are held open by fusible links to allow the doors to slide shut in case of fire. The transformers are each of 900 kw. The primary voltage is 2300 and the secondary voltage 50,000. They are oil and water cooled, the water being piped from the forebay. The oil can be drained from the transformers by opening a valve which is accessible in the wheel gallery behind the transformer cells; thus, in case of fire in a

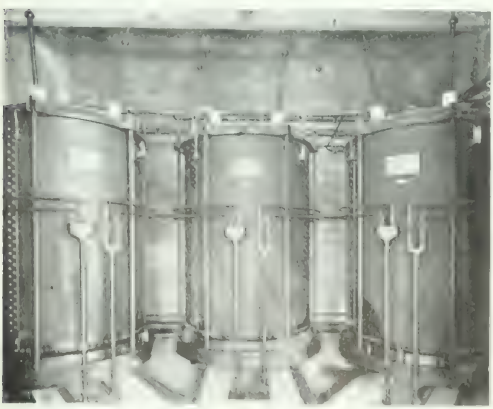


Fig. 9.—[illegible]

transformer case the oil [illegible] without entering the cell and the cell can be kept closed. As shown in Fig. 9, each transformer [illegible] and there are [illegible]

of the transformers can be run out onto the gallery, where it can be picked up by the traveling crane.

On the top floor of the building is an electrically-heated oil-treating tank 4 ft. in diameter x 8 ft. long, in which enough oil can be treated for one transformer. It contains electric heating coils requiring a maximum of 45 kw. When the oil is heated with these coils a motor-operated vacuum pump 8 ins. in diameter x 6-in. stroke pumps out the steam that may be formed from any moisture in the oil. The power station is piped for transformer and switch oil

SWITCHES AND WIRING.

Each generator is connected directly to its bank of step-up transformers without the intervention of any oil switch, although there is a set of disconnecting switches in the leads of each generator before they come to the current and potential transformers. In ordinary operation generators are connected [illegible]

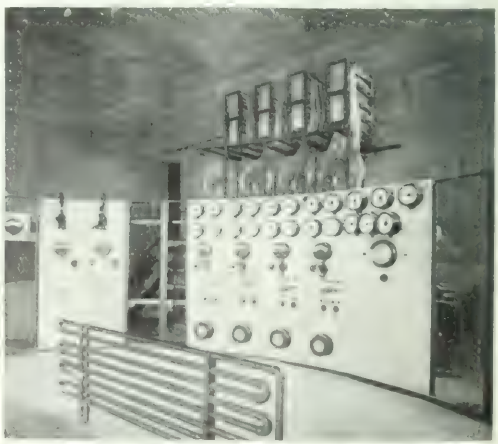


Fig. 10.—Switchboard.

the transformer, thus putting them in parallel on the 50,000-volt bus-bars. The 50,000-volt bus-bars are therefore the usual operating bus-bars of the station. One set of 2300-volt bus-bars is operated, however, and branches from the leads of each generator are taken to oil switches, by which each generator can be connected to the 2300-volt bus-bars. These 2300-volt bus-bars are ordinarily intended for use in supplying 2300-volt current in the vicinity of the power plant. They can also be

FIG. 11.—50,000-VOLT, 500-AMPERE OIL SWITCHES.

made a means of connecting a generator to a bank of transformers other than the one to which it is normally connected, as might be necessary in case of the break-down of a generator and a bank of transformers, connected to another generator. The wiring scheme is designed for the completed power station; but not all of the circuits have as yet been installed. There is now a single set of 50,000-volt bus-bars. Provision is made for a double set of 50,000-volt bus-bars and an extra set of switches whereby each generator can be connected with either set of bus-bars. Static dischargers are connected between the generators and transformers, being located in the transformer cell rooms. While provision is made for two out-going 50,000-volt transmission lines, at present there

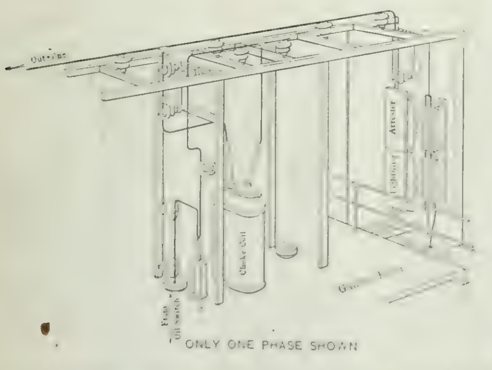


FIG. 12.—GENERAL ARRANGEMENT OF APPARATUS FOR ONE PHASE OF THE 50,000-VOLT LINE.

is only one such line. There is an oil switch between the 50,000-volt bus-bars and the line.

The 2300-volt leads from each generator are carried in fibre conduit in the floor to recesses or cabinets in the wall at the right in Fig. 7. In these cabinets are the current and potential transformers from which low-tension wires are taken to the instruments on the switchboard in the gallery, Fig. 10. The generator leads then pass up to the primaries of the step-up transformers in the transformer cell rooms above. The 50,000-volt secondary leads of these transformers are connected in delta in the transformer room and then pass up through circular openings in the floor, filled with plate glass, to the bus-bar cells or compartments to which a part of one floor of the power station is devoted. From the bus-bar cells the wires lead up through similar circular floor openings to the 50,000-volt oil switches.

The oil switches (which have a capacity of 1500 amperes at 50,000 volts) are considerably larger than are needed in this plant. They were originally built for another plant, but were sent to Taylor's Falls because of the urgency of delivery. They are solenoid operated and in reality consist of three enormous single-pole oil switches mechanically connected. At the right in Fig. 11 is seen the row of holes left for the high-tension conductors to the second set of 50,000-volt oil switches. The other openings in the floor are recesses left for oil piping. From the oil switches controlling each bank of transformers the conductors pass down again to the 50,000-volt bus-bars. In the case of the oil switch connecting the 50,000-volt bus-bars to the transmission line (which is seen in the foreground in Fig. 11) the wires pass up from the oil switches to the series transformers and choke-coils and thence out of the building. The general arrangement of current, transformer, choke-coil and lightning arrester for one phase of the 50,000-volt line is shown in Fig. 12, while the installation as it appears in full is shown in Fig. 13. Hook disconnecting switches are provided on each side of all high-tension apparatus to provide for its isolation in case work is being done upon it.

The operating switchboard is comparatively small and simple, all of the operating switches in the main circuit being designed for remote control by low-tension circuits. These low-tension circuits are obtained from the exciter. The exciter panels are the two at the left end of the board, shown in Fig. 13. There are two negative exciter bus-bars, one of which is for local miscellaneous use in the power house and the other for the field excitation. There is one common positive bus. Each exciter has simply a double-throw, single-pole switch for connecting it to either negative bus-bar and an automatic circuit-breaker. The totalizing panel for the board is shown at the right in Fig. 10, and forms the center of what is to be ulti-

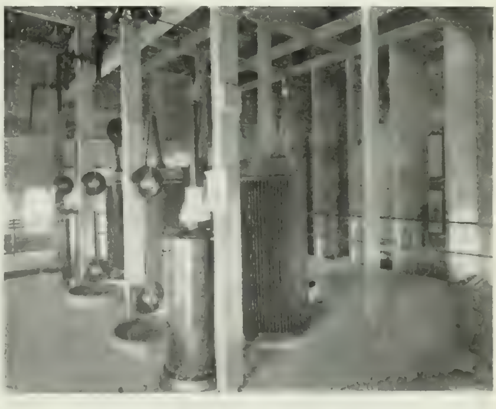


FIG. 13.—STATIC INTERRUPTERS AND SERIES TRANSFORMERS ON 50,000-VOLT LEADS.

mately a semi-elliptical arrangement of switchboard panels. This totalizing panel contains an indicating wattmeter which, by means of a commutating switch, can have its connection changed, so that when the load is light, almost a full scale reading can be obtained, applying, of course, the proper constants to the reading to give the correct result. The other fea-

tures of the board are those ordinarily found in such installations.

GATE-LIFTING MECHANISM.

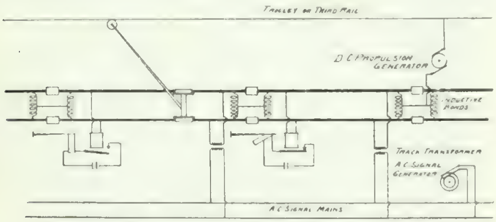
The main gates which admit the water from the forebay into the penstocks are raised and lowered by a motor-operated mechanism. The location of this mechanism is shown in Fig. 6. A motor mounted on the ceiling drives a shaft that runs the length of the power house. From this shaft is driven a countershaft at each gate. This countershaft has a worm-gear-driving pinions engaging in racks on the gate. It is, of course, intended that only one gate shall be operated at a time The mechanism for any gate can be brought into operation by throwing in a clutch. The controller for the motor is located on one wall of the building and is connected by a sprocket chain to a shaft which has two hand-wheels at every gate, so that the motor can easily be stopped and started from any point. The height of the water in the forebay is continuously indicated and recorded by a Frieze water-level recorder.

The regular operating force of this station, including both night and day shifts, consists of one chief engineer, two operators and two oilers.

The engineering and construction of the plant were carried out by Stone & Webster, of Boston, who are the general managers of the Minneapolis General Electric Company.

Track Circuit Signaling on Electrified Roads.

In his paper before the recent Niagara Falls meeting of the American Institute of Electrical Engineers, Mr. A. L. Frederick Howard gave a brief outline of the various track circuit signaling systems now in use. There



TWO-RAIL SIGNAL SYSTEM USING INDUCTIVE BONDS.

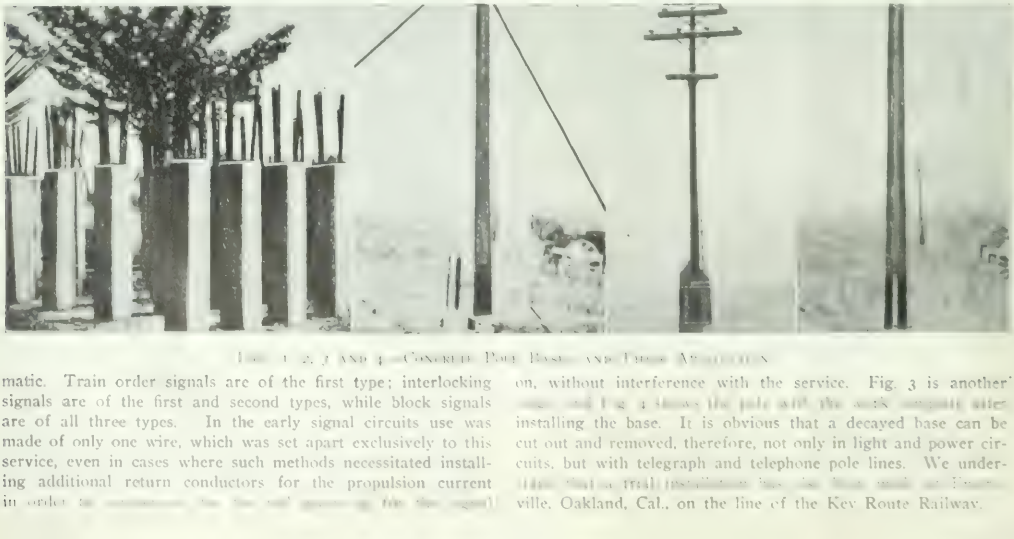
are three distinct types of signals, according to the method of control; namely, the manual or non-automatic, the controlled manual or semi-automatic, and the purely automatic. Train order signals are of the first type; interlocking signals are of the first and second types, while block signals are of all three types. In the early signal circuits use was made of only one wire, which was set apart exclusively to this service, even in cases where such methods necessitated installing additional return conductors for the propulsion current in order to [illegible] the rail [illegible] for the signal system. A more recent method allows the use of both rails simultaneously for the propulsion current and for the signal current. A path for the propulsion current around insulating joints is provided for in the latter system in the form of impedance bonds indicated in the accompanying illustration. The propulsion current divides so that each part passes around the iron core of the bond in opposite directions, its magnetizing action upon the core being zero. On the other hand, the full impedance of the bond is offered to the signal current in preventing the passage from rail to rail of the alternating current used in the signal circuits. The principal difference in the relation between the elements of the track circuit as used on direct-current and alternating-current railway systems relates merely to a higher frequency of the signaling current.

Deflocculated Graphite.

Mr. Edward G. Acheson delivered an experimental lecture at the Niagara Falls convention of the American Institute of Electrical Engineers, illustrating the properties of a recently discovered form of graphite. This graphite is produced by adding water, gallotannic acid and ammonia to unctuous graphite as produced in the electrical furnace. Under these conditions the graphite is miscible with the water. It was shown, however, that when plain water is added to unctuous graphite the graphite separates completely from the water when allowed to stand for several minutes. When it is mixed with water, tannic and ammonia the graphite assumes what is called a deflocculated condition, a condition of fineness beyond that obtainable by mechanical means—one approaching the molecular state. Deflocculated graphite in water has been used successfully instead of oil in sight-drop feed oilers and with chain-feed oilers. It possesses the remarkable property of preventing rust or corrosion of iron or steel. The deflocculated graphite has also been successfully employed with kerosene oil as an effective lubricant.

Concrete Bases for Poles.

Mr. M. H. Murray, of Bakersfield, Cal., has recently made a very interesting installation of 150 concrete pole bases for the Power, Transit & Light Company, of that city. This work was actually done while the line was carrying electrical energy at a potential of 11,000 volts. The process of construction is illustrated in the accompanying views. Fig. 1 shows a group of the bases. Fig. 2 shows the pole with the base alongside and with 11,000 volts current on the line while the operation is being on, without interference with the service. Fig. 3 is another view and Fig. 4 shows the pole with the work complete after installing the base. It is obvious that a decayed base can be cut out and removed, therefore, not only in light and power circuits, but with telegraph and telephone pole lines. We understand that a trial installation has also been made at Emeryville, Oakland, Cal., on the line of the Key Route Railway.



FIGS. 1, 2, 3 AND 4.—CONCRETE POLE BASES AND THEIR APPLICATION.

Electric Refrigeration in a Wholesale Produce House.

An interesting example of the use of automatic electric refrigeration supplied on central station service to a wholesale produce house is found in the establishment of George E. Putnam & Son, in Lowell, Mass. This firm conducts a large business in wholesale butter, eggs, cheese, flour, sugar and beans in a four-story and basement building located at 205

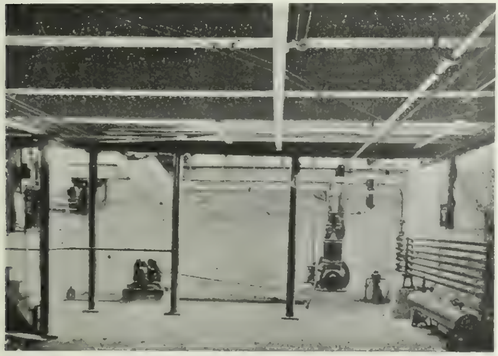


FIG. 1.—GENERAL VIEW OF REFRIGERATING PLANT.

Market Street, Lowell, and in March of this year an automatic refrigerating plant was placed in commission, operated from the mains of the Lowell Electric Light Corporation.

Previous to the installation of the plant the firm depended to some extent upon natural ice for the storage of its perishable merchandise, and to a larger degree upon the facilities offered by a large centralized cold storage organization in Boston. The extra expense of freight and teaming the butter in particular amounted to about $5 per ton. Lowell is about 26 miles from Boston, and with a double teaming at the Boston end or reshipment by slow freight to Lowell in less than carload lots and drayage from the Lowell freight depot to the wholesale house, the conditions were unfavorable to economical handling between the dairy and the store. Sometimes 10 per cent of the firkins were found to be damaged by the repeated jarring and rough handling. These points were strongly influential in the decision to install automatic refrigeration, which included the advantages of greater cleanliness, lower temperatures than are possible with natural ice, independence of the ice supply and flexibility of operation in meeting variable conditions in addition to the reduction of transportation annoyances. Slightly below 40 degrees Fahrenheit was the lowest temperature which the firm was able to secure with natural ice.

The establishment occupies all the floors of the building, but no refrigeration is required on the two upper floors, which are at present devoted to the storage of flour and beans. The refrigerating machinery is located in the basement, and it consists of a 10-ton compressor (with normal back pressure) cylinder 5⅝ in. x 8 in., belt-driven by a 10-hp 500-volt General Electric direct-current motor making 800 r. p. m. The plant was supplied by the Automatic Refrigerating Company, and its particulars in the main conform to the usual practice of that company, including in this instance a 7-pipe condenser of the double-pipe counter-current type, automatic thermostat and motor starter, etc. The direct expansion coils are all of extra heavy 1¼-in. wrought iron pipe electrically welded and tested to 300 lbs. per sq. in. before shipment. In this plant an air pressure test of 275 lbs. was applied before introducing ammonia into the system.

The compartments refrigerated include a storage room in the basement, two rooms on the street floor, and two rooms on the second floor. The basement room is 30 ft. x 12 ft. x 10 ft. in dimensions; it is kept at a temperature of 40 degrees F., and is used as a storage for lard, cheese, etc. A single quadrilateral line of pipe kept at slightly below zero suffices to cool this room. This line is in series with all the rest of the expansion coils in the system, but is provided with by-pass valves. The expansion valve of the system is located in this room. The pressure on the compressor side of this valve seldom exceeds 155 lbs. and on the refrigerating side 10 to 15 lbs.

On the street floor the larger of the two compartments is 300 ft. x 12 ft. x 11 ft. in dimensions, and it is used for the storage of eggs. The house handles a larger quantity of fresh laid eggs than any other in New England. The temperature of the egg room is kept between 30 and 32 degrees by an automatic thermostat installed on the wall, which starts the compressor motor through a relay operated switch and resistance when the temperature rises above 32 and stops it when it falls. Adjoining the egg room is a room 12 ft. x 15 ft. kept at 36 to 40 degrees, and used as a selling room. Only a small quantity of goods is kept here. Expansion coils are provided on both sides of the compartment.

The two refrigerating rooms on the second floor are designed for the storage of butter and each is 16 ft. x 22 ft. x 11 ft. with walls insulated by paper and air spaces. Access to these rooms is had through a vestibule or air lock. These rooms are ordinarily to be run at from zero degrees to 5 degrees F., but on test a temperature of from 7 to 9 degrees below zero was attained. The coils in these rooms are placed on all four sides, extending from the top to within 3 ft. of the floor on 6-in. centers, all joints being welded. In one of the two rooms the coils are divided into two sections controlled by valves on the street floor below. Either coil or both can be operated at once. There is also a second thermostat on the second floor which can be cut in and out of operation by a triple-pole switch downstairs according as it is desirable to transfer the control of the compressor motor from one compartment to the other.

Separate meters are provided for the incandescent, refrigerating and the elevator service used on the premises. Specially shielded lamps are used in examining eggs. The electric elevator is a 2500-lb. Morse-Williams machine driven by a 10-hp 500-

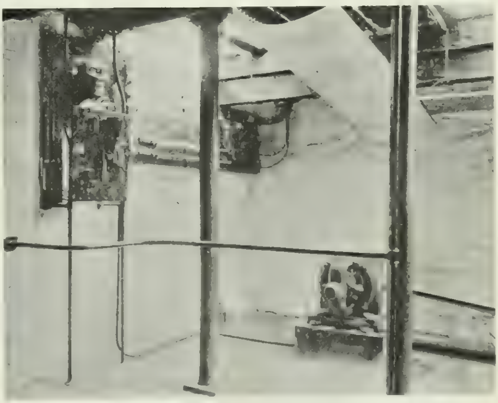


FIG. 2.—MOTOR OF REFRIGERATING PLANT.

volt, 700-r. p. m. Belknap motor. During the 13 years which this motor has been in operation the total cost of repairs has not exceeded $5. The elevator is arranged to receive trucks delivered from loaded cars brought to the house on a special siding and to carry them up or down as is desirable.

The refrigerating equipment proper is mounted on concrete foundations beneath a sidewalk skylight in the basement. A specially attractive rate was made by the central station in view of the desirability of refrigerating loads.

An Electric Plant in the Andes.

By [illegible]

[illegible] electrical energy; none, in fact, as large as that owned and operated by the Cerro de Pasco Mining Company. This 500-ton smelter is situated at La Fundicion, Peru, about nine miles from Cerro de Pasco, where the company gets its ore. It is the first in that country to convert its own copper, instead of making high grade matte and shipping it to other countries [illegible]

The ideal source of power for such a plant, where coal costs about $25 per ton, owing to the high freight rates, etc., would be some of the tributaries of the Amazon River, which have

FIG. 1.—SMELTER PLANT OF THE CERRO DE PASCO MINING COMPANY.

their headwaters on this side of the Andes Mountains. Steam power was decided upon, as the development of water power would have taken a long time, and a steam plant is always desirable as supplementary plant. Until recently coal was brought almost entirely from Australia; now, however, the company has acquired coal mines within a radius of 25 miles, from which they take out enough coal to supply their copper mines and shops in Cerro de Pasco, and their smelter with coking and steam coal.

There is a small electric plant at Cerro de Pasco. This is used for feeding lamps in the mines, offices, shops, etc., but the main electric plant is at the smelter, a general view of which is given in Fig. 1.

The electrical equipment in the power house, which is at an elevation of 13,940 ft., consists of one 440-kw, three-phase, 440-volt, Westinghouse generator, direct-connected to a 600-hp cross-compound Nordberg engine, as shown in Fig. 2. For exciting the field of this alternating-current generator, and also for testing and laboratory purposes, a 56-kw, 125-volt, direct-current Westinghouse generator has been provided, which is belted to a 75-hp Nordberg Corliss engine. Both of these sets are to be duplicated within a short time, to meet the increasing size of the plant and also to prevent shutdowns, due to failure of any part of the machinery. In addition to those above mentioned, there is a 75-kw, three-phase, 2300-volt generator, belted to a 100-hp American Ball engine. This voltage is stepped down by three transformers to three-phase, 440 volts, the voltage of the large generator and motors.

This last generator was used to run the machine and blacksmith shop motor, during the construction of the plant and also to furnish energy before there was enough night load to justify running the large generator.

For the controlling of these three sets, there are a two-panel General Electric switchboard, consisting of one generator and one two-circuit feeder panel, and a six-panel Westinghouse switchboard, consisting of one Tirrill voltage regulator panel, one exciter, one generator and three feeder panels.

This completes the electrical part of the power-house equipment, with the exception of two 7½-kw transformers, which are used for stepping down the 440 volts to 110, for the arc and incandescent lamps used throughout the building and throughout the boiler house.

The constant-speed motors used by the company are all of the Westinghouse three-phase, 440-volt induction type, with the standard squirrel-cage type of secondary. The 100-hp motors are started with an oil-immersed auto-starter, consisting of a six-point controller and two separately mounted auto-transformers, for cutting down the voltage in starting. The motors under 100 horse-power are started also by an auto-starter, the three-point switch being immersed in oil; the auto-transformers are mounted just above the switch, the entire device being contained in an iron case.

For running the crushers, rolls, elevators, etc., in the sampling mill, which is about 150 ft. from the power house, there is a 100-hp constant-speed induction motor, and for running the small sampling and grinding machines there is a 10-hp motor of the same type.

Next and most important is the smelter building, for it is here that the raw ore is taken in on one side and comes out on the other side as metal. For handling the converters, molten matte, etc., there is an electric crane, built by the Alliance Machine Company and equipped with Westinghouse alternating-current induction motors. This will soon be duplicated. The main hoist has a full-load capacity of 40 tons, and the two auxiliary hoists a capacity of 15 tons. Of other motors there are two for hauling converter slag between the pouring ladle and crusher, one for running the turntable on which the converters are lined, and two 50-hp constant-speed induction motors.

One of the latter motors runs the clay mixer, the clay being used for converter linings, and the other is used for running the slag crusher. The slag, after being crushed, is conveyed to the slag bin in an 80 ft. elevator, driven by a 30-hp motor, which is situated near the top of the elevator, while the auto-starter is at the bottom. This arrangement allows the man running the crusher to start and stop the elevator without going near the motor, thereby saving much time and many steps.

The slag from the blast furnaces is carried away from the building in launders, in which there is a stream of flowing water. This mixture of slag and water is carried through a

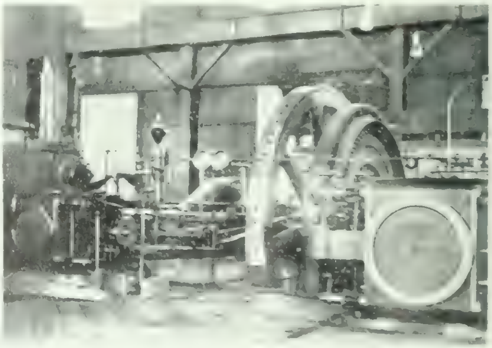


FIG. 2.—[illegible]

series of settling tanks, from which the clear water is pumped back to a tank above the furnace and used again. In this pumping station are two Worthington turbine-type, two-stage [illegible] other is driven by a 50-hp motor of the same type mounted on the same base and direct connected to the pump, as shown in Fig. [illegible]

[illegible] smelter is washed and separated from the slate and other im-

purities, there are two motors of 50 horse-power and 100 horse-power respectively, to drive the crushers, elevators, screens, pumps, etc., necessary in such a plant.

The company has also a very well-equipped set of shops, in which all of the repair work and much of the new work is done. In the foundry is an electric crane, with a main hoist capacity of 10 tons, and an auxiliary hoist capacity of three tons. This crane is of the same general type, built and equipped by the same company as the 40-ton crane in the converter building. For driving the Root blower, elevator, tumbler, etc., there is a 30-hp motor. In the machine and carpenter shops, which are in one building, there are two 50-hp motors, for driving the various machines, while in the blacksmith and boiler shops, which are also in one building, there is a 30-hp motor.

The lighting of the various buildings, including hotels, stores, etc., is mostly done with 110-volt incandescent lamps, there being about 1500 of these in use at the present time. In some of the buildings, where more light is required, and also outside among the buildings, Westinghouse alternating-current 110-volt multiple arc lamps are used. The voltage for both the incandescent and arc lamps is stepped down from 440 to 110 volts by means of transformers placed at convenient points over the plant.

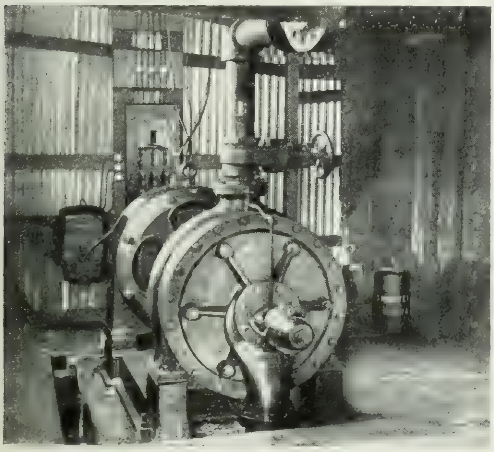


FIG. 3.—MOTOR-DRIVEN PUMP.

While all of the motor and main line circuits where they enter the buildings are protected with General Electric alternating-current lightning arresters, yet it was thought that perhaps the heavy electrical storms prevailing in mountainous regions would affect the apparatus, especially at this high altitude. However, since the first machine was installed, almost two years ago, there has been no damage whatever to the circuits owing to lightning.

The above electrical machinery, which amounts to about 2100 horse-power in motors and generators, with the addition of one of the latest types of central-energy telephone systems, including switchboards, local and long-distance telephones, completes one of the most interesting electrical equipments that can be found in that part of the world. When it is taken into consideration that all of this machinery—in fact, the whole plant—has been put up almost entirely by the native Indians or Cholos, under the direction of white foremen, it makes it still more interesting.

The Cerro de Pasco smelter has been of the greatest use to Peru, inasmuch as it has given employment to the natives at good wages, has given them opportunity to acquire knowledge of various trades, and has called attention most emphatically to the mineral resources of the country.

Electrically-Driven Sewage Pumping Plant at Salem, Mass.

A model electrically-driven sewage pumping plant has recently been placed in service at Salem, Mass., by the Sewerage Commission of that city. The plant is operated by electricity supplied by the Salem Electric Lighting Company at 2080 volts. Salem is located practically at sea level, and the pumping station was built on Cat Cove, at a point on Salem Neck, practically on the harbor's edge, where a 72-in. trunk sewer terminates in a well dropping but one foot below mean low tide water. The sewage has to be disposed of practically as fast as it accumulates. From the pumping station an outfall main, which is a 30-in cast iron pipe, extends into the harbor 9700 ft. to an outlet at Great Haste Island. In order to scour the pipes, the pumps are obliged to force the discharge through them at a rate of 6 ft. per second, or 19,000,000 gals. in 24 hours. This duty is required but about 2 hours per day, so that the pumps are underworked a considerable part of the time. The station is large enough to handle the sewage of the town of Peabody in addition to that of Salem itself.

The problem which the engineers faced in this instance was to take care of 6,000,000 gals. of sewage during 22 hours, and of 19,000,000 gals. during the remaining two hours of each day against minimum heads varying from 7 ft. to 8 ft., according to the height of the tide, and against maximum heads corresponding to the larger and more rapid discharges, varying from 49 ft. to 60 ft.

It was originally expected to operate the station entirely by steam-driven pumps, but the development of the gas engine and the wide-spread popularity of the electric motor drive led the commission to consider all three motive powers. Proposals were secured on the basis of a unit or units having guaranteed duties of 6,000,000 gals. per 24 hours against a head of 18 ft.; of 12,000,000 gals. against a head of 35 ft., and of 19,000,000 against 60 ft. head. The selection of the equipment depended more upon the basis of operating expenses and estimated cost of maintenance than upon the first cost of the plant.

On account of the limited range of speed found in gas engines, the builders of this class of machinery proposed a separate unit for each head, but this worked out so high in first cost that it was later proposed to install four three-speed units, each of 6⅓ million gals. capacity. These units were to be combined to give three duties—a duty of 6⅓ million gals. per 24 hours obtained by running one unit 300 r. p. m., and pumping against a head of 18 ft.; a duty of 12⅔ million gals. obtained by two units running 450 r. p. m. against 35 ft. head; and a duty of 19 million gals., obtained by operating three units at 600 r. p. m. against 60 ft. head—the fourth unit being a reserve outfit.

The steam engine proposition called for two cross-compound units each of 9,000,000 gals. capacity. The speed for the lowest duty was to be obtained by operating one unit with one cylinder cut out, and the higher duties were to be obtained by operating both cylinders and varying the cut-off.

The first costs of the three methods were in the following ratios:

Electric motor drive	1
Gas engine plant	[illegible]
Steam plant	3

The floor space requirements were in the following ratios:

Electric motor drive	1
Gas engine plant	3
Steam plant	[illegible]

Taking coal at $4 per ton, gas at 75 cts. per thousand ft., and electric power at 1¼ cts. per hp-hour, and figuring all station expenses on a 16-hour basis, the annual operating cost was estimated as follows:

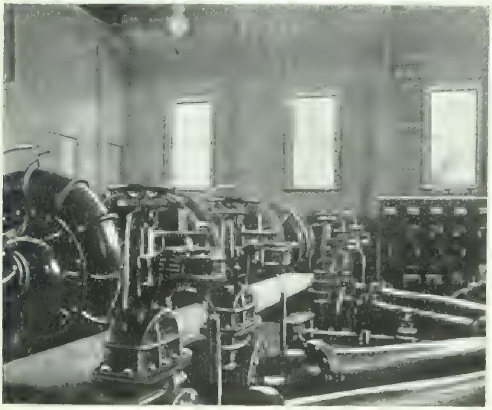
Electricity	$14,000
Gas	15,000
Steam	21,000

The electrical installation was therefore accepted, and the city secured the advantages of greater flexibility, cleanliness and

minimum attendance in addition to the lowest estimate of operating expense. The Salem Electric Lighting Company agreed to supply energy at 1¼ cts. per hp-hour (1⅔ cts. per kw-hour) only on condition that no electricity should be taken at the time of the peak load on the central station, and that the maximum demand for electricity when flushing out the sewer should occur at the time of minimum load upon the generating plant.

The accompanying illustration shows the interior of the pump room, which contains four Worthington horizontal volute centrifugal pumps, each driven by a 12-pole, 125-hp, 600/450/300 r. p. m. 2080-volt, three-phase, 60-cycle induction motor; two Knowles dry air priming pumps, each direct-driven from the lighting transformer of the station by a 5.5-hp, 110-volt General Electric induction motor; four 14-in. Chapman gate valves, one in each main pump discharge pipe, each gear driven by a ½-hp, 110-volt, 1200-r. p. m. General Electric induction motor; one 6-panel switchboard.

Each centrifugal pump motor is equipped with a pole changing controller for speed regulation, and a starting compensator. The illustration shows each motor-driven unit with delivering connection 14 in. in diameter discharging into a pair of Y's which lead into the 30 in. main outfall pipe; the motor-driven



INTERIOR OF SALEM PUMPING STATION.

valves and the switchboard appear in the view. A feature of the station is the admirable accessibility of all the apparatus. As the larger motors carry 2080 volts, a rubber mat is provided on the inspecting platform. The valves may be operated by hand if desired.

The switchboard consists of one 500-hp, 2080-volt incoming line panel equipped with indicating wattmeter, and a General Electric hand operated electrically tripped oil switch, with recording wattmeter on the back of the panel; four main pump motor panels, each equipped with indicating wattmeter, oil type controller, hand-operated alectrically tripped oil switch, and a Chapman automatic switch for operating the main valve motor. A priming pump motor and lighting circuit panel is equipped with ammeter, a lighting circuit switch and two priming pump motor switches, with a hand operated electrically tripped oil switch on the primary side of a bank of three 2-kw transformers for supplying the priming pumps and the lighting circuit. All the controlling mechanism of the station with the exception of the pump motor starting compensator is located at the switchboard, including the valves of the priming system, which was devised by Major J. E. Spencer, chairman of the sewerage board, who had general charge of the entire work. Mr. E. W. Bowditch, of Boston, was consulting engineer for the system as a whole, and the pumping plant was installed by P. B. Patten, of Salem. The installation is an excellent example of a desirable central station non-peak load.

Central-Station Electric Heating Notes from Grinnell, Ia.

The Grinnell Electric & Heating Company, under the management of M. O. K. Cole, has made notable progress in the introduction of electric heating devices. In fact, there are few if any central stations of its size in the country where such a good start has been made in the introduction of electric heating appliances. Grinnell is a college town, the population of which is practically the equivalent of about 5000, although the last census (which, of course, did not include the student population, which is in town nine months of the year) gave the town about 4600.

THE PRESENT CONNECTED HEATING LOAD.

The progress that has been made with electric heating devices so far is shown by the following figures: Electric flatirons in service, 235; complete electric cooking outfits in service, 6; complete electric cooking outfits under contract, 4. Besides this there are a lot of electric cooking appliances in homes which do not have complete outfits. Few, if any, central stations in the country can make such a showing per capita of population. It will be of value to go into the Grinnell situation thoroughly because conditions there are approximately similar to those in many other towns, and the company at Grinnell is setting an example which must be followed by many other small companies in the course of time. There is no gas plant in the town, and if the central-station company keeps up its active work in electric heating there will be no occasion for a gas plant, even should the town grow rapidly in the next few years. The conditions in a town of this kind are most favorable to the introduction of electric heating. There is no competition with gas, the cheapest cooking fuel known. Gasoline stoves and coal ranges are the only competitors found. The gasoline stove is well recognized as dangerous, and the trouble with filling and starting a gasoline stove is against it. Besides this, such stoves are very susceptible to drafts, and the kitchen must be kept fairly well closed to avoid blowing out the flame. With coal stoves there is the nuisance of taking care of the fire, and the heat in summer. A prosperous town like Grinnell has plenty of people who are willing to pay for getting rid of the nuisance of coal, wood or gasoline.

LOAD CONDITIONS.

The load conditions on the station are typical of those in many other towns, with the exception that there is probably

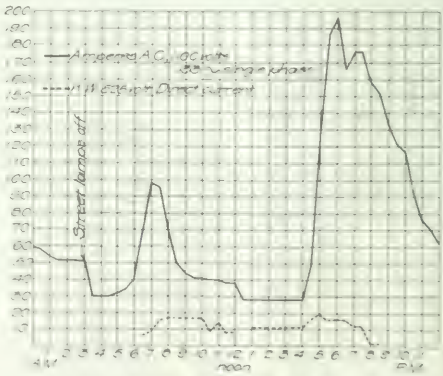


FIG. 1.—GRINNELL LOAD CURVE DEC. 11, 1909.

less manufacturing motor-load than in many other towns, and a better residence load. The station is equipped with high-speed simple engines driving two classes of generators, one a 500-volt direct-current unit, and the other 133-cycle single-phase alternators. Twenty-four hour service is given. During

the winter the engines exhaust into an exhaust steam heating system which, under previous managements, was allowed to grow until it was too large for the amount of exhaust steam that could be supplied by the day load. Several typical load curves for 24 hours are reproduced herewith, Figs. 1, 2 and 3. It will be seen that the day load is very small. The average direct-current load for the year ending in February, 1907, was

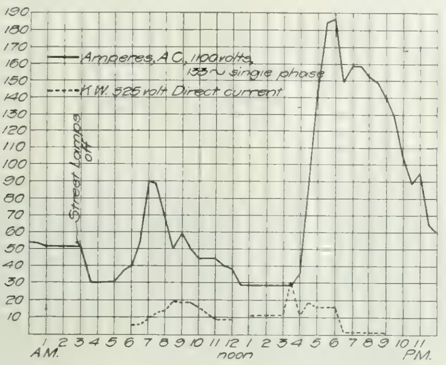


FIG. 2.—GRINNELL LOAD CURVE, DEC. 12, 1906.

5.9 kw, and the average alternating current load 36 kw, this figure being determined by dividing the total output for the year by the number of hours in the year. The peak load was 239 kw, and the load factor for the station about 17 per cent for the year. Now, the company has already exhausted most of the possibilities for motor load, as it is furnishing motors to drive nearly every industry in town except where steam is needed for manufacturing purposes, although there will doubtless be opportunity to pick up a little more power load from time to time, and the city water pumping is yet to be secured. The increase in commercial lighting load being purely peak business, would not result in better earnings on the investment, nor would it help furnish exhaust steam during the day. The company, therefore, turned to electric heating as the most promising field for improving its net revenue. In a town the size of Grinnell very little heavy cooking is done for the evening meal. Consequently, practically all of the heating and cooking load will come during station light

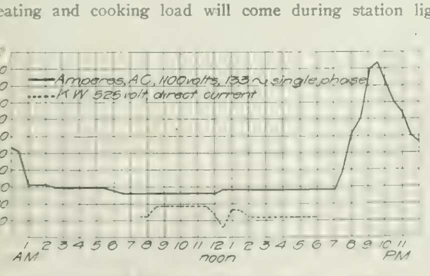


FIG. 3.—GRINNELL LOAD CURVE, JUNE 11, 1906.

load periods. The company has been strengthening its distribution system by installing large transformers and heavy secondaries preparatory to taking extensive heating business. The business done so far is, of course, only the beginning, but it is paving the way for a good load of this kind in the not distant future.

EXPERIENCE OF VARIOUS CUSTOMERS WITH ELECTRIC COOKING.

As information is being sought by central station men as to the cost of electric cooking in different sizes of families under different conditions, the results of the experiences of a number of heating customers at Grinnell may be of interest.

In one family of five, where all the cooking was done electrically, the bills at five cents per kw-hour for three months of 1907 were as follows:

January	$3.74
February	3.47
March	5.42

Another family of two has no other cooking arrangements than the electric. The gentleman being a traveling man, is absent part of the time, and both members of the family are away at other times. The results are interesting, however, as showing the expenses under such conditions, where light housekeeping is done and where electric cooking is especially applicable.

1906.	
January and February	$6.36
March and April	5.94
May and June	8.70
July	2.37
August (no cooking)	——
September	2.19
October	4.05
November	2.01
December (no cooking)	——

1907.	
January	$1.62
February (no cooking)	——
March	2.88

In a family of six, where all of the cooking was done electrically for six weeks previous to this investigation, the bill was $6.93.

In a family of seven, part of the cooking was done electrically, most of the baking being done on a coal range, and the coal range also being used in winter to help heat the house. The results in this case are also of interest, and are as follows:

1906.	
May	$4.26
June	2.38
July (family absent)	——
August	3.55
September	3.48
October	3.67
November	1.49
December	1.54

1907.	
January	$4.18
February	1.14
March	1.14

Mr. Paul P. Myers, electrician of the company, kept complete records of the cooking at his home during the month of March. There were ordinarily two in the family, with occasional visitors. The kw-hour consumption for 31 days was 115.4, which, at the five-cent rate, would amount to $5.77. This, however, included considerable experimenting, which Mr. Myers has done with new apparatus, which will be spoken of later. The other figures obtainable from this month's record, are as follows:

Total number of meals, 92.
Number of meals for which cooking was done, 81.
Number of dishes cooked, 209.
Number of times oven was used, 23.
Number of person-meals, 184.
Kw-hours per meal per person, .5.

That the number of kw-hours per meal per person are considerably higher than the usually accepted figure of .33, is, of course, mainly due to the fact that the family was so small, and it requires nearly as much electrical energy to cook for two persons as for three or four. The current used in experimental work also increased this figure. The list of utensils used was: One G. E. percolator, 1 G. E. griddle, 1 Simplex waffle iron, 1 American edgewise broiler, 1 G. E. oven, 2 2-qt. G. E. cereal cookers, 1 G. E. frying pan, 1 American 1300-watt immersion coil for the slow cooker.

The slow cooker is worthy of further notice, as it makes possible some economies which will aid the introduction of electric cooking. It will be recognized by every one familiar with electric cooking, that the success of this method of cooking must depend largely upon the efficiency, or, in other words, upon getting the maximum results possible from a given amount of energy. All are probably familiar with the device known as a hay stove, which is used extensively for slow cook-

[illegible] form of the Swedish stove, which Edward Atkinson, the economist, has strongly advocated and improved upon. The hay [illegible] the cooking utensil is set after the cooking has been started on a stove and is well under way. Its principle is simply to store enough of the heat contained in the water to keep the article cooking for some hours after it is taken off the stove. Hay is a good insulator of heat because it provides so much dead air space around the cooking vessel. What Mr. Myers has done is to adapt the hay stove principle to electric cooking. A 6-qt. tank of water is set in a tight box with plenty of heat-insulating material between the tank and the walls of the box. A tight-fitting heat-insulating cover is also provided. In the tank is placed a 1300-watt American immersion heating coil, the end of the coil resting in grooves in the top of the box and tank so that the coil can be left in the tank and the lid shut down tightly. The plan is to start the water boiling in this tank by turning on the electricity in the immersion coil for a few minutes. The vessel containing the thing to be cooked is then set in the boiling water and the lid is shut down. There are thus four or five quarts of boiling water, the heat of which is being sufficiently stored to do the slow cooking. For example, oatmeal is started cooking in the evening, and when allowed to stand over night in the slow cooker after a preliminary boiling is found hot and well-cooked, ready to serve in the morning without further heating. The temperature of the water in the heat storage tank after standing over night is from 110 to 140.

Another line of experiment Mr. Myers is carrying out is to determine the value of extra heavy heat insulation for the electric oven. Some ovens have been constructed with walls 3 to 4 ins. thick, and it has been found that these ovens can be kept at a baking temperature with much less electricity than is required for regular electric ovens with thin walls. While the heat radiation from the ordinary electric oven does not seem to amount to much, yet the fact that the temperature of such an oven does not rise very much after reaching a certain point indicates that there is considerable radiation. Evidently one of the problems to be solved in connection with electric ovens having better heat insulation than is common, is that of preventing them from getting overheated in case the electricity is left on unintentionally for a long time. In the ordinary electric oven this is to a large extent taken care of by radiation, while in the ovens with thick walls this might not be the case. However, since the electric oven is by far the largest energy-consumer of the entire array of electric-heating appliances, and since it is of most vital importance to reduce its consumption, this line of experiments with better heat insulation of ovens is considered as having a very important bearing on the growth of the business.

The company recently offered to donate to the Ladies' Congregational Society the necessary electric cooking outfit for serving suppers given by that organization at regular intervals during each winter season. This offer has been accepted, and the company will put in two five-gallon coffee urns, one ten-gallon water-heater and one large oven. Heretofore this cooking has been done on a number of gasoline stoves, and the ladies will welcome the exit of these stoves from the church kitchen.

HOUSEHOLD MOTORS.

Although the household electric motor can hardly be called [illegible] similar to that of heating appliances, and it is, therefore, considered in this article. Some time ago the company had an opportunity to pick up a job-lot of nameless single-phase 133-cycle, ½-hp motors at an absurdly low price. Twenty-four of these were purchased, and all were soon placed among residence customers in Grinnell. They are belted to a short line shaft, and this line shaft is used for running washing machines, wringers, ice cream freezers, etc. Mr. Cole, the manager, tells an exceedingly good story on himself in this connection. It seems that for some reason his own house had not been equipped with one of these motors at the time they were distributed. His wife recently was bargaining for a woman to do the weekly washing. The bargain had almost been closed when the candidate for the position said, "Of course, you have a motor to drive your washing machine?" "No, we haven't," was the reply. "Oh, well, I can get plenty of places to wash where they have motors; I don't believe I want to do your washing," was the candidate's answer. Mr. Cole is now aware of the fact that the more washing machine motors he gets in the town the harder it will be for those not provided to resist when forcible arguments of this kind are brought out by the washerwomen.

The accompanying photograph, Fig. 4, gives a very inadequate idea of the very neat little office which the company recently opened on one of the principal business streets. The

FIG. 4.—OFFICES AND COOKING DISPLAY AT GRINNELL, IA.

office had before been in unattractive quarters at the plant, in an out-of-the-way place. Electric heating appliances are the most prominent things in the window display. Across the back of the window are the words, "Light, Heat and Cook with Electricity." All of the heating appliances shown in the window bear placards explaining what they are, as seen in the photograph. Some complete electric ranges are kept in stock for display. One of these is shown at the right.

Establishing Day Circuits in Towns of 10,000 Population and Under.

One of the papers on the "New Business Day" program of the National Electric Light Association at Washington, June 7, which attracted the most attention and provoked the most discussion was that of Mr. F. H. Plaice, of New Bremen, Ohio. This paper, although by the manager of a very small and heretofore obscure central station, probably gave the commercial department men at the convention as much to think about as any paper presented, because it showed what can be done under what would appear to be most adverse circumstances. Following is an abstract of this paper and discussion:

In opening Mr. Plaice said that the possibilities of the smaller locality have been overlooked or neglected until to-day the average central station management is honest in the belief that a day service in the little town is impossible. While it may be admitted that the average electric company operating in small localities has a precarious existence, still there are examples to prove the contention that the companies are themselves entirely to blame for such a condition, and that the communities at large can in no way be held as being responsible. It is this subject of seeking for profitable new business by a small company which has undertaken the task of maintaining a 24-hour service in a town of less than 1500, to which the paper relates.

First, electricity is generated by gas engines using natural gas. Coal costs $3.40 delivered, while natural gas for all purposes is supplied at 25 cents per 1000 cu. ft.

There are no public contracts, the company being dependent upon commercial work alone. The earnings at time of beginning day service, May 1, 1904, were somewhat less than $4 per capita per year. With these conditions it was determined for various reasons that a 24-hour service should be attempted, and with that in view, future plans were laid.

A sliding scale of rates on a basis of the number of hours of service was decided upon with some variations.

This rate is, for the 7½ hours' use of the maximum demand, 20 cents; next 7½ hours, 10 cents; next 15 hours, 9 cents; next 20 hours, 6 cents; next 30 hours, 3 cents; all after that, 2 cents, or 7 cents for a 3-hour service and 2 cents thereafter. There is no minimum, no meter rental. Renewals are free.

The hours of service were determined neither by the actual maximum demand nor by the maximum rated load installed but by a figure based more particularly on the area to be lighted and approximating ¾ watt per square foot of floor area. A customer was allowed to install as many and as large units as might be desired. The one using the large energy per square foot pays a much lower rate for his energy than the economical customer who preferred smaller illumination. The object was to encourage or force liberal use of electricity and the rapidly falling rate was to enable long hours of service.

This system has been very satisfactory. The average output per month has been 20,000 kw-hours for a 250-kw plant. The average return to company is 5 cents per kw-hour gross and 1¾ cents per kw-hour net.

Free wiring has been done for some years and it was decided to extend this principle to all applications that a possible customer might desire to use; but, it was decided to make such installations on a rental basis and a charge of 1 cent per month for $1 invested was decided upon. This method has been highly successful with the company, and under it are included all classes of equipment, such as motors, shafting, pulleys, belts, wiring, lighting fixtures (except arc lamps for which no rental is charged), heating utensils of all kinds; in fact, everything that will assist in the increased sale of electricity. The only contract that is required on such installations is one showing the itemized ownership of the same by the company and the rights of removal at the company's option. The extent to which this plan has been followed is shown by the fact that of the 370 service taps connected to the lines, nearly three-quarters feed installations belonging to the company.

The service is as near high grade as most cities maintain and this is best proven by the fact that during a two-year bitter franchise fight between the company and the town, not one word has ever been said against it.

Very little money has been spent in the usual forms of advertising, and while there is no doubt as to the great value of printed advertising in large places where the public must be reached indirectly, the fact that in small localities the person doing the soliciting is or should be personally acquainted with every person in the territory, renders this form of advertising unnecessary. Personal work may take many forms. For instance, the electric company can, with profit to itself, become the consulting engineer for all mechanical enterprises in its field even though at the time there may be no opportunity to add any additional service thereby. Again, if an illuminating engineer is almost a necessity in a large city, how much more important is some knowledge of that art in a little town where customers have no conception whatever of colors and light, and but one idea, that of getting lots of light for little money.

Installing service on trial is another form of effective advertising. Trading in equipment that electric service renders unnecessary is another, and an excellent form, for it eliminates equipment from future possible competition. Along this line it has been the practice of the company to dismantle gas or gasoline lighting outfits as soon as electricity is installed and in this way do away with a future unpleasant possibility.

The policy of the company has been to take special pains to secure the little customer, both lamp and motor, and it has never refused to place its service into premises on any service of 16 candle-power or over. One result of this has been that the Standard Oil Company has sent one of its special agents into the town to see why the oil sales were running so low.

Flat irons are especially profitable as day load and with something over 60 irons in service the company can claim a new kind of peak load. This strikes the station about 10 o'clock on Tuesday morning, and on a hot summer morning has been known to reach over 150 amperes above normal and last, with a drop at noon, until 4 or 5 o'clock. On more than one occasion, this load, through coming on with the motor peak, has necessitated starting a second engine. Although using very little energy singly still collectively, sewing machines and washing machine motors are good household energy salesmen.

The company has been making experiments as to rural service with a view of extensive work in that line, having 6 miles of such lines in operation supplying a 24-hour service under same conditions and rates as apply within the town. Fifteen motors, aggregating 50 horse-power and about 150 lamps are connected with these lines and the results are very encouraging. In all, the company has at present connected to its lines, 7000 incandescent lamps of all sizes, 45 enclosed arc lamps and 90 horse-power of motors, earning on a capitalization of $15,000, no bonds, an average income of $1,000 per month in a town of less than 1500.

In conclusion, the experience of this company indicates that some form of demand system of rates is desirable; that great energy be used in securing many little customers; that some form or method of free installation of equipment is desirable; that a personal rather than an impersonal form of advertising be used but that the advertising allowance be of liberal proportions to the income; that co-operation in everything electrical is to be desired and that the little company should by all means join the electrical associations, both State and National.

In the discussion of this paper, in answer to a question, Mr. Plaice said that the largest customer the company consists of six concerns located in an arcade, with which a contract amounting to a minimum of $900 per year was made. This concern rarely took more than the minimum called for. The next largest customer paid about $150 per year. About 85 per cent of all the buildings in the town were wired. The rural service spoken of was taken care of with 550-volt, direct-current service. This rural service covered an area about five miles in diameter. Bare wire was used outside of town. For lighting from this service two 250-volt lamps were connected in series. Only seven lamps were connected on each branch circuit, each circuit being fused with a cut-out placed outside of the building. Every customer's service was provided with kicking coils and a lightning arrester. Some time ago, before these precautions were taken, there was considerable trouble from lightning, but no trouble since then. On one dairy farm near town there has recently been installed a milking machine operated by a motor. This milks four cows at a time. The operation of the motor costs $6 per month. Formerly three men were hired to do the same work that is now done by the machine.

He described one rather unusual practice, the object of which is to give customers plenty of light for their money and prevent the use of inferior lamps, as well as to make customary the use of lamps of over 16 candle-power. The company purchases 16-cp incandescent lamps taking four watts per candle on 110 volts. The company's service, however, is 120 volts, so that the lamps operate actually at 22 candle-power. A similar practice prevails with lamps of lower candle-power. The result is that customers have practically a lamp of about 3.1 watts per candle. This gives high efficiency and at the same time causes more liberal use of electricity than if a 3.1 watt, 16-cp lamp were purchased. The company furnishes free lamp renewals. The scheme of rates is such as to encourage the liberal user. In answer to a question as to what had become of natural gas competition, Mr. Plaice said that there was no gas lighting left in the town. There were, however, several gas engines in the town.

Electric Heating Applications.

In a paper presented at the Washington convention of the National Electric Light Association entitled "Electric Heating Without Special Concessions from the Central Station," Mr. C. D. Wood gave an account of the experience of the New York Edison Company in introducing electric heating without making special concessions in rates.

In introducing the electric iron cards are distributed, telling about the steps saved by the electric iron, to the employment agencies, and left at the kitchen entrance; circular letters, with return postal cards, are then mailed to the lady of the house. No matter how ignorant and superstitious the laundress may be, after she has once used an electric iron she will refuse to return to the old one—in one case, the domestic threatened to leave if the electric iron were not purchased after it had been used on a ten-days' trial. An average family of five persons, where the collars and cuffs are sent out to be ironed, consumes about 13.2 kw-hours of energy per month, which represents, at a 10-cent lighting rate, an income to your station of $15.84 per year. The automatic handle attachment, which cuts off the electricity when the iron is not in use, has proved a failure, as the operator invariably ties down the handle. A satisfactory automatic cut-off has yet to be developed.

For summer use, there have been installed in several high-grade dwelling houses electric clothes-dryers, the heating units varying in capacity from five to ten kilowatts, depending on the size of the dryer. A cabinet eight feet high, eight feet wide and eight feet deep, may be built in sections, each section equipped with a unit of two kilowatts; this division makes possible a saving of energy when a small amount of work is to be done. During the months of July and August, 1906, a dryer of this capacity consumed about 100 kw-hours per month, which was billed to the customer at a 10-cent rate. The dryer was satisfactory in every respect.

Plate warmers of 800-watt capacity are included in the specifications of the architects in many houses. The New York Edison Company has connected as many as 25 plate warmers in as many different houses in one month. The average consumption of these devices is 24 kw-hours per month.

Of the small home devices, the water cup has been the most pleasing, with the possible exception of the heating pad. The medical fraternity has been approached with electric sterilizers, and was found waiting for just such a device. No doctor likes to use gas; his sterilizing consumes about 800 watts, and the average office use of this device is in the neighborhood of 20 kw-hours monthly.

The bookbinding industry affords an excellent opportunity for electric heat. It is possible to supplant the gas-heated embossing press with electric heating units, and make a very fair comparison with gas, when electricity is sold for five cents per kw-hour. Steam is generally purchased by the month—a 24-hour expense, regardless of when the heat is needed. On the other hand, gas is not clean, nor is the desired heat steady enough for high-grade work. The New York Edison Company has several good installations of this class of apparatus; one having been operating steadily for two years. There are three embossing presses in this equipment. The head of the largest is 19 ins. x 12 ins.; the machine has a small panel-board placed within easy reach of the operator, on which are placed two double-throw switches. There are four resistance units in the press head, placed at equal distance from the center, and by means of a change of connection from series to parallel eight different degrees of heat are obtained. The large press is rated at 220 volts and 16 amperes. The resistance units may be placed in the holes left vacant by the extraction of the old steam pipes. Some manufacturers supply a hot steel plate, which may be placed next to the die; these plates take about five amperes and are connected to the lighting circuit. The machine, 19 ins. x 12 ins., referred to above, reached a temperature of 354 deg. F. with an expenditure of 4.07 kw-hours, starting with a room temperature of 75 deg. The "running" power or low heat was 0.6 kilowatt, which kept the head at the proper temperature while making 480 impressions of the die per hour. The monthly cost of energy for the past year for this work at a seven-cent rate was $8.05 per machine. The Association of Bookbinders is demanding these electric heads.

Twenty-five inversion coil glue-pots, two-quart capacity, were installed in a bookbinding house Feb. 1, 1906, and thus far only one has been replaced. The energy consumption has been 812.5 kw-hours monthly, or an average of 1.3 kw-hours per pot per working day. Figuring the energy at five cents per kw-hour, a wholesale price, the cost per month was less than when the company used gas and the work was identically the same. The operators will regard a heat-regulating switch when they will not turn down the gas.

The New York Edison Company is supplying electricity for the purpose of welding iron bands used in the trunk industry. The welding machine receives alternating current at 110 volts and, by means of a transfer mounted on a frame of the machine, reduces the e. m. f. to 22 volts. The cross-section of the work is a quarter-square inch. The current consumption of the welding machine under pressure runs from 25 to 35 amperes. The energy consumption of the machine while making 480 welds per hour is about 1.16 kw-hours, costing 0.02 cent per weld at a 10-cent rate. In this particular case, a motor-generator set was used to generate the alternating current, which materially lessened the efficiency of the whole plant. This work should be particularly interesting to managers of alternating-current systems.

Electricity was used in the recent construction of the Hoffman House in New York City, for cutting steel piling. Alternating current at 50 volts pressure was utilized by connecting one cable to the steel piling itself and the other to a carbon electrode that was fastened by a copper plate to a wooden guiding pole. Six hundred and fifty amperes were developed at the arc, which represents 32.5 kilowatts. In an eight-hour day, 10 feet of piling could be cut, at an expenditure of 260 kw-hours. At 10 cents per kw-hour, the work cost $26 plus the wages of the attendant, which made the total cost exactly $3.00 per foot of piling. It required two men at $4.50 per day, and two electric drills consuming 44 kw-hours, to drill one foot of piling per day, costing $13.40 per foot. The heating method shows a saving, regardless of time, of $10.40 per foot.

The milk supply of New York City is governed by tests made in the city laboratory by means of electric stoves. Twenty-five 3.5-inch disk stoves, of 60-watt capacity, are used to boil the ether used in the test. Fourteen times per hour these little stoves cause the ether to vaporize and rise from the containing flask to a condensing chamber that holds the milk to be tested. The ether after condensation is released by a siphon and conducted into the original flask. An open gas flame could not be used for this work. The medical officer in charge was so well pleased with the operation of these stoves that he wished to heat and regulate his incubator, or germ cabinet, with electricity. The germ producer is 22 ins. x 22 ins. x 22 ins., and the temperatures to be maintained are 100, 110, 120 and 130 deg. C. The cabinet is made of sheet copper with three jacketed walls, having a maximum current consumption of 16 amperes. The heavier current is used only 15 minutes of the hour, as three amperes are sufficient to keep up the desired temperature. A thermostat with four contact points furnishes the automatic heat regulation. The regulation has been perfectly satisfactory.

The cocoa and coffee trade has applied electric heat to its [illegible] x 5 ft., requiring a temperature of 150 deg., will need about 74 watts per cubic foot when properly jacketed. One heater of this kind has returned a revenue of $11 per month. The cocoa and coffee beans are particularly susceptible to the odors arising from combustion, hence the advantage of electric heat. For drying kilns about 40 watts per cubic foot are advised.

Warming tables and chocolate dipping pots have proved successful in the candy trade. Fifty watts, or the power of a 16-cp carbon-filament lamp, produces enough heat to keep the chocolate in working condition. Wherever these chocolate [illegible]

consumed in the device itself is not large, but it will surely lead to more business along this line. An estimate has been given a manufacturing concern to heat a 30-gal. batch of caramel paste to a temperature of 285 deg. F. The operation will consume 10 kw-hours of energy, and each melting will cost about 65 cents. The service is intermittent, hence the adaptability of electric heat. Where high-grade candy is made there is always a chance for electric heat.

The manufacturers of switchboards and telephone supplies find a useful, economical tool in the electric soldering iron. A soldering iron equal to a 1.5-pound soldering copper will consume 70 watts. The operator will accomplish more work with this tool, thereby saving time. Heaters of 110-watt capacity are now made, into which a soldering iron may be thrust, thereby doing away with the connecting handle cord. One thousands hogs per hour are stamped "Inspected" by the government meat inspectors in Chicago, by means of a 400-watt branding tool that is nothing more than an electric soldering iron with a die inserted in place of the copper tip.

Electric heat economies are not fully appreciated. A certain manufacturer in New York City has been paying $30 per month for a steam supply that is used in a secret wood-working process. He was persuaded to try electric heat and found that he could do the same amount of work as before with a monthly consumption of 50 kw-hours. He was buying energy at 10 cents per kw-hour, and his yearly saving was $300.

Following are details of the operation of a 44-cell storage battery outfit, mounted on an automobile truck, and used for thawing out frozen water pipes in winter, in comparison with those obtained by the use of a rheostat in series with a direct-current, three-wire system with the neutral wire grounded. The figures represent the average amounts in each case.

	Amp.	Kw-hours.	Time, Min.	Pipe, In.	Voltage.	Cost per Case.	Revenue per Case.
Storage battery...	513	1.39	5.44	5/8	31.5	$10.85	$16.40
Three-wire	275	10.4	19.0	5/8	120.0	14.43	16.93

The three-wire system is used until the season has so far advanced that the number of cases will warrant the exclusive service of an automobile truck.

Although little has been done in New York City in the introduction of electricity for complete commercial ranges, there are six or eight kitchens in operation, where one meal per day is prepared for the officers and clerks of the various business houses to which the kitchens are attached. The average capacity of these outfits is 10 kilowatts. There are a few restaurant broiler sets used for broiling meats during the noon luncheon hour. These broilers, which are not to be considered complete kitchens, bring a revenue of $12.50 per month, at an average rate of 8 cents per kw-hour. The Waldorf-Astoria Hotel contains the largest cooking unit in the United States, comprising 19 upright broilers, four warming ovens and four regular ovens, with a total capacity of 460 amperes.

One manufacturing company in central New York is preparing food daily, all cooked by electricity, for 2000 employees.

The greatest difficulty in residential work has been the absence of adequate carrying capacity in risers, special circuits and available extra circuits. The customer will often be willing to pay the first cost of the device; he will accept the consumption figures, but he will flatly refuse to stand the expense of special wiring. To overcome this difficulty an agent has been appointed whose business it is to interview architects and contractors for the sole purpose of advising with them regarding the extended use of electricity for heating work; in other words, making it possible for the future owner to use the various heating devices that he desires. There are several residences in the city of New York to-day that are wired with separate heating and power circuits. A heating and power circuit, 220 volts, in a four-story city residence having basement and sub-basement will cost about $850, exclusive of the devices. The figure is based upon a new house with the heating circuit independent from the lighting circuit. The irons might be placed on the 110-volt lighting circuit, which would reduce the cost.

Persons Entitled to Patents.

By JOHN EDSON BRADY.

A patent may be lawfully granted only to an original inventor and letters patent issued to any other are invalid. The patentee must not only have an honest belief that he is the originator of the device, the production of which he seeks to control under the patent laws, but he must in reality be the first and original inventor. If the knowledge, necessary to perfect a patentable device, was obtained by the patentee from another, then the patentee is, of course, not the original inventor, and a patent issued under such circumstances is void. The same is true if some one other than the patentee has anticipated the device, even without the knowledge of the person claiming to be its inventor, by a prior use of the patented article in the United States or by a published description of it at home or abroad. Subject to these and other limitations laid down by the patent act, which have been previously discussed in these columns, any person may become a patentee. Foreigners are accorded the same rights under the patent act as are citizens and married women stand upon the same footing as all others. The one exception operates against the officers and employees of the patent office and is to the effect that they shall be incapable, during the period for which they hold their appointments, to acquire, except by inheritance or bequest, any right or interest in any patent issued by the office. This provision, however, does not disqualify a commissioner of patents from obtaining a patent after his term of office has expired for an invention made by him while holding such office and, in such case, the invention will date back to the time when it was actually made, although he could not have obtained a patent for it at that time. Foote vs. Frost, 3 B. & A. Pat. Cases, 607.

The term "original inventor," in patent law, is used to designate a pioneer in the art; one who evolves the original idea and brings it to some useful, successful and tangible result. And, to be entitled to a patent, a person must come within this definition. Norton vs. Jensen, 90 Fed. 415. No one can be an inventor unless he has performed a complete inventive act, that is, conceived an idea of means and reduced it to practice in some art, machine, manufacture, composition of matter, or design. If one is granted a patent upon an idea which did not originate with him, his letters are worthless, even though he had obtained the consent of the original inventor before applying for the patent. The rule is illustrated in the case of Hartshorn vs. Saginaw Barrel Company, 119 U. S. 664, in which it appeared that Hartshorn and Campbell, at about the same time, had invented substantially the same improvement for shade rollers. They employed the same solicitor to protect their rights by obtaining letters patent, and the solicitor erroneously, but in good faith, assigned the priority of invention to Hartshorn, because his claim was received first, when as a matter of fact Campbell was the original and first inventor. A patent was secured for each inventor, but Campbell's claim was limited to an attachment not included in the invention of Hartshorn. The mistake was not discovered until nine or ten years later, when it was brought out in the testimony offered in an action brought for the purpose of restraining an infringement of one of the patents. Upon the discovery of the mistake an attempt was made to correct it by a simple exchange of claims. But in the present action by Hartshorn against the Saginaw Barrel Company it was held that Hartshorn's patent was void. Campbell's acquiescence in Hartshorn's claim to priority was regarded, as far as he was concerned, as an abandonment of any right on his part to a patent for the broad and real invention, and, having deliberately rested in that acquiescence for a period of between nine and ten years, it was too late, according to the settled course of decisions, to resume his rights. It was no answer to this to say that, in the meantime, the invention had not been dedicated to the public by virtue of Campbell's abandonment because it was covered by Hartshorn's patent, as Hartshorn's patent was invalid for the reason that Hartshorn was not the original inventor.

But mere priority of conception, without more, will not confer priority right to a patent. That is, if a person conceives it a patentable device, but either because he does not consider it of sufficient consequence, or for some other reason, neglects to put his invention into a fixed or practical form, his conception will not defeat the rights of another who subsequently makes the same discovery and obtains a patent thereon. In 1870 one Allison conceived the idea of an improvement in rotary drills. At that time he made several pencil sketches of his device, none of which were preserved, but he did not think the invention important enough to warrant its reduction to permanent shape. In 1881 a patent covering the same device was issued to Albert Ball, and in 1882, after the market was being supplied with machines equipped with the device invented by Ball, Allison applied for and obtained a patent. His application was made at the solicitation of a company, which afterwards took an assignment of the patent and brought action against the assignee of the Ball patent to restrain what was claimed to be an infringement. It was held that the rightful priority of invention must be accorded to Ball and that his patent was not invalidated by the fact that Allison had thought out the device and made rough sketches of it before letters were issued to Ball. Here, Allison was the first to conceive of the invention; but mere conception, which is not seasonably followed by some practical step, counts for nothing as against a subsequent and independent inventor, who, having complied with the patent laws, obtains a patent. It would indeed be a strange perversion of the patent laws if one who had conceived of a new device, and proceeded so far as to embody it in crude sketches or even in finished drawings, could there stop, and yet hold that field of invention against all comers for a period of twelve years. The law does not so reward supineness. Hence in Reeves vs. Keystone Bridge Company, 5 Fish. 456, Judge McKennan declared the established rule to be "that illustrative drawings of conceived ideas do not constitute invention, and that, unless they are followed by a seasonable observance of the requirements of the patent laws, they can have no effect upon a subsequently granted patent to another."

In the case of Standard Cartridge Company vs. Peters Cartridge Company, 77 Fed. Rep. 630, the question arose in a somewhat different form. An inventor, named Hisey, applied for a patent upon a cartridge loading machine in which an endless chain was substituted for the circular table of the older machines as a means of conveying the empty shells to the loading apparatus. Before the patent office had acted upon the matter, Ligowski, another inventor, filed an application for a patent of the same device. In an action to determine which of the two was vested with priority, Hisey testified that the invention was original with him, having been suggested to him by "observing a bicycle go by that had an endless chain to transmit the power." Ligowski testified that, prior to the time when Hisey claimed to have hit upon the idea, he (Ligowski) had made sketches of the machine which he showed and explained to Hisey. Hisey flatly denied this so far as it concerned him and the question became one of veracity which was determined in favor of Ligowski. It was assumed from the evidence that Ligowski had disclosed to Hisey all that he had done or conceived concerning a cartridge loading machine, embodying an endless belt carrier, before the time when Hisey claimed to have made the invention. If Ligowski's conception, at the time of its being communicated to Hisey, was sufficiently developed and perfected to enable one familiar with the construction and operation of the old type of machine to construct a machine equipped with the novel improvement in question by the mere exercise of mechanical skill and without further invention, he, and he alone, would be the first inventor and Hisely would be in the position of appropriating the conception of Ligowski. On the other hand, if Ligowski had only an inchoate idea that in some way an endless belt carrier, suitably actuated, might be devised, which could be substituted for the old rigid circular carrier, but did nothing towards developing or demonstrating the utility of his conception, he would not be an inventor at all and Hisey's rights would not be impaired by reason of any such indefinite suggestions made to him. The mere existence of an intellectual notion that a certain thing could be done, and, if done, might be of practical utility, does not furnish a basis for a patent, or estop others from developing substantially the same idea. It was held that Hisey had gained all the knowledge necessary to enable him as a good mechanic to construct the machine from Ligowski, that the fact that Ligowski had failed to promptly file his application for a patent could not, under such circumstances avail Hisey, and that Ligowski was entitled to the patent. The rule, as it appears in the American and English Encyc. of Law, Vol. XXII, p. 347, is as follows: "Of two or more rival inventors the one first conceiving the idea of the invention is entitled to the patent, provided he uses due and reasonable diligence in perfecting it and adapting it to use, and in fact does so, although a subsequent original inventor may be the first to reduce it to actual use." Between two inventors, one just as early in his conception as the other and equally meritorious otherwise, the one who first gets the patent is to be favored.

The first inventor does not forfeit his priority by taking a reasonable time to experiment and test his invention, but he loses his right to priority by an unreasonable delay in perfecting and adapting his invention or applying for a patent, if in the meantime some one else gets in ahead of him. An improvement in grain binders was conceived by John Appleby in June, 1879, and at that time was orally explained by the inventor to several persons skilled in the construction and operation of harvesting machinery in a manner so clear that any good mechanic could have made the device from the descriptions given.

Later, in the summer of 1879, Charles Jewell worked out the same device and had it attached to one of his machines. He applied for a patent in April, 1880, and in June, 1881, Appleby filed his application for a patent. It was held that Appleby had not waived his right of priority by delay. He was entitled to a reasonable time, to be judged of according to the circumstances of the case, in which to perfect his invention and reduce it to practice, without impairing his claim to priority. His invention was an important one, and he had a machine with it on in the field before the harvest of the year following its conception. He might have been more expeditious in having a machine made embodying his invention, but the court was of the opinion that he had not delayed for an unreasonable period and that he was entitled to the patent, notwithstanding that Jewell got his application into the patent office first. McCormick Harvesting Machine Company vs. Minneapolis Harvester Works, 42 Fed. Rep. 152.

A case in which the inventor lost out as a result of his indifference in the matter of securing a patent is that of Wright vs. Postel, 44 Fed. Rep. 352. The plaintiff was in court for the purpose of enjoining an infringement of a patent which he had secured on a gilding machine. The proof showed that, in the winter of 1883-1884, he had described the device in general terms to his solicitor, and that in 1886 he repeated the description more fully, but it seems that he did not intend at either date to reduce the invention to practice. His only concern was to protect himself in the construction and sale of the machine as made under an earlier patent. His monopoly in this served his interests as well as the taking out of a new patent would, provided competition could be avoided. Being advised that the earlier patent covered his new invention, which was in the nature of an improvement, and would keep all others off, the plaintiff rested content until February, 1887, when he became alarmed at something observed or heard of the defendant's movements and resolved to apply for a patent. The patent was issued but it appears that some months prior to the application therefor the defendant had devised and constructed the machine which the plaintiff complained of as an infringement. It was held that the plaintiff had not exercised sufficient diligence in reducing his invention to practice and that a reduction

of the plaintiff's application rendered the plaintiff's patent invalid. In Christie vs. Seybold, 55 Fed. Rep. 69, it appeared

that the person who first conceived a comparatively simple improvement in power presses for book binding made a rough sketch of it within a few months thereafter. Three years later he had working drawings made and six months after that a machine was manufactured. He excused the delay by saying that he could neither afford to buy the necessary tools sooner nor use them in his small shop. His reason for not having the machine made at another shop was that he would have realized no profits on machines made by others according to his invention. It was held that he had not so conducted himself as to be entitled to a patent against one who had conceived the invention later but who had reduced it to practical use without delay.

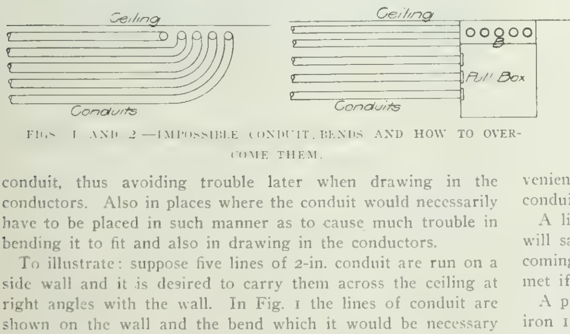
The cases which have been referred to will serve to bring out the proposition that one who desires a patent must be vigilant in reducing his invention to practical form, and in applying for letters. The patent laws are intended for the benefit of the public as well as of patentees. They are designed to stimulate invention for the common advantage. It is, therefore, the duty of inventors to use reasonable diligence in putting their inventive ideas into actual practice and in securing their rights under the patent act, and they cannot neglect this obligation without danger to their own interests.

Pull Boxes in Conduit Work.

By T. W. Poppe.

A most convenient article used in connection with conduit work is the "pull box," so called because the conductors are pulled into the conduit to the pull box and pulled from the pull box to the place where they are connected to the apparatus.

It is convenient because with it one can overcome the possibility of having too many bends in one continuous line of conduit, thus avoiding trouble later when drawing in the conductors. Also in places where the conduit would necessarily have to be placed in such manner as to cause much trouble in bending it to fit and also in drawing in the conductors.



FIGS. 1 AND 2.—IMPOSSIBLE CONDUIT BENDS AND HOW TO OVERCOME THEM.

To illustrate: suppose five lines of 2-in. conduit are run on a side wall and it is desired to carry them across the ceiling at right angles with the wall. In Fig. 1 the lines of conduit are shown on the wall and the bend which it would be necessary for them to make in order to run close together and parallel when carried across the ceiling.

Some of these bends it would be impossible to make. If it were possible to bend the conduit as shown it would be a difficult matter to draw in the conduits. Fig. 2 shows a pull box placed on the wall; the top being close to the ceiling. On the front of the box and close to the ceiling is fastened a board *B*. This should be wide enough to enable the proper sized holes to be bored for the conduit. After the conduit enters the pull box at the side it leaves it from the board *B*. The conductors when drawn into the conduit as far as the pull box in one direction are pulled away from the box into the corresponding conduits. This is an easy means of overcoming a disagreeable and difficult task.

It might be necessary at times to run conduit through two partitions, one at right angles to the other. Fig. 3 shows the partitions and the way it would be necessary to run the conduit. This would necessitate the cutting of running threads on each line of conduit, a laborious and unsatisfactory method, as a running thread on a horizontal line of conduit is never as firm a job as when the conduit is run vertically. The weight of the conduit in the latter case will aid in keeping the running thread firm, but when run horizonally the weight of the conduit itself will cause it to sag at the running thread. A pull box can be placed in the corner, fastening it to the ceiling and the conduit brought into it and out of it, as shown in Fig. 4.

A pull box should be placed on lines over 100 ft. in length or having four or more bends equal to four elbows. The bends and the distance necessitate a means for taking the strain from the conductors when drawing them into the conduit; and there is no better way than to draw in a portion of the conductor at a time. A pull box permits this.

Pull boxes can be designed and constructed to suit any conditions. Where a number of large conduits are to run parallel on the ceiling and all are to be bent at the same point and means of bending them are not at hand, a box can be constructed and made to take the place of the bend as shown in Fig. 5. This saves time and labor and the avoidance of bending large conduit which means a saving also of material.

In Fig. 6 conduit is shown running on the ceiling and also on the side wall. The conduits on the wall are a continuation of the ones on the ceiling. *B* is an L-shaped pull box, the conduit being brought into the box on one side and taken out on the opposite side on the wall. This box is particularly convenient as it avoids the use of three elbows in each line of conduit and saves much labor fitting and cutting the conduit.

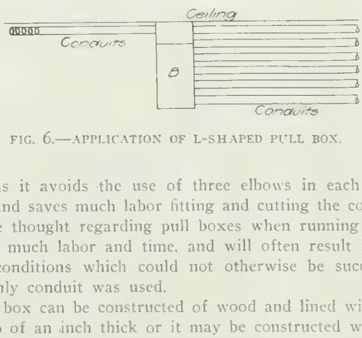
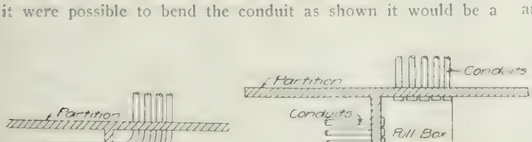


FIG. 6.—APPLICATION OF L-SHAPED PULL BOX.

A little thought regarding pull boxes when running conduit will save much labor and time, and will often result in overcoming conditions which could not otherwise be successfully met if only conduit was used.

A pull box can be constructed of wood and lined with sheet iron 1/16 of an inch thick or it may be constructed wholly of iron. If made of cast iron it should be made thick enough to be mechanically strong. If the box be made of wood, the holes through which the conduit will enter the box should be bored and a templet made. This is usually done by cutting stiff paper the size of the side of the box and marking on it with a pencil the position of the holes. This templet is used for the purpose of drilling the holes in the sheet iron with which the box is to be lined.



FIGS. 3 AND 4.—CONDUIT BENDS AND THEIR ELIMINATION BY MEANS OF PULL BOX.

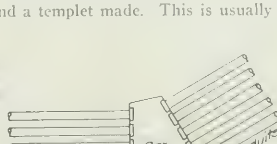


FIG. 5.—MEANS OF ELIMINATING BENDS IN CONDUIT.

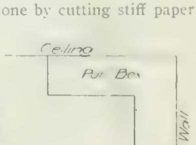


FIG. 7.—L-SHAPED PULL BOX.

Locknuts should be placed on all conduit entering or leaving the pull box, both inside and out, so as to prevent any displacement of the conduit when drawing in the conductors.

Break-Down Service.

BY CHARLES F. HUNTER.

The question of so called "break-down service" involves two main considerations: First, if an electric public service corporation can be compelled to install its service in premises supplied with electricity by a private or individual plant, such service to be normally unused and only called into requisition in case of failure of the private plant; and, second, what equitable charge should be made for such service.

As to the duty of an electric corporation to install its service in such cases, the Transportation Corporation law of the State of New York, article VI, section 65, provides that any electric light corporation shall supply electricity to any building or premises within 100 ft. of the lighting mains, upon written application of the owner or occupant of such building, and upon the payment by him of all money due from him to the corporation, and the deposit by him, if required, in advance with the corporation of a sum of money sufficient to pay the expense of installation; provided that the ground in which the leading in wires must be laid is not frozen, nor otherwise presents serious obstacles to the laying of same. This section of the law does not allow an electric corporation to discriminate between customers using electricity for long or short periods of time, in respect to making installations on such premises.

The second consideration, that of equitable charges for "break-down service," is strictly technical in character. The main points to be considered here are, the amount and cost of apparatus to be held in reserve by the corporation to supply the demand of the consumer in the event of a break down of his private plant; and the value of such break down service, considered as insurance against costly interruptions, to the consumer.

The cost of delivering a kw-hour of energy to any consumer depends upon two factors; first, the fixed charges per kilowatt capacity of generating plant upon the investment of the corporation in its plant, salaries, etc.; and, second, the production and distribution charges, which depend directly upon the number of kw-hours produced. The first charges include among others the items of interest on investment, depreciation charges, general expenses, such as office salaries and rentals. These constitute a fixed sum for any given plant or system, which is the same for all conditions of operation, whether the plant is standing idle, but in readiness to run, or operating at full capacity. The second factor is approximately a constant for each unit of energy, and the total charge under this factor is proportional to the total number of units sold. The latter charges comprise the items of fuel and wages in the production and distribution departments, repairs to plant, oil, waste, etc.

A mathematical expression for the above factors would be:

[illegible]

Where K = total cost per kw-hour
b = cost of production and distribution per kw-hour
a = fixed charges per kw-capacity
c = maximum demand of consumer in kilowatts
n = total number of kw-hours used.

It is evident that as the number of kw-hours used increase, the cost per kw-hour becomes less, and vice versa. The minimum cost per kw-hour will be when the consumer uses his maximum demand continuously for 24 hours of the day. The maximum cost is in the case of a "break-down service" installation, when no need has arisen for use of the service, when the cost per kw-hour would be mathematically speaking, infinite. The total cost, in the latter case, may be represented by the equation:

[illegible]

Where T = total cost of service. $T = a\,c$.

The conclusion of the writer is that in a "break-down service" installation, it is unfair to the electric company to set (by law or otherwise) a fixed rate per kw-hour for such service, since the demand for electricity is occasional, and it is impossible to foretell at what time or for how long a period, the operating company will be called upon to furnish such electricity to the consumer; the chief value of such service to the consumer being of the nature of insurance against costly interruptions of service. Rather, a flat rate per connected kilowatt of capacity should be charged, and any use of energy charged for at very low rates. This would take care of the fixed charges on the equipment of the operating company, and at the same time encourage the use of electricity by the consumer.

Lamp Trimmer's Wagon.

The lamp trimmer's wagon in use by the Knoxville Railway & Light Company, shown herewith, has several special features. The wagon was built especially for the service and according to designs furnished by Mr. P. E. Mitchell, general superintendent and electrical engineer of the company. The lamp trimmer who drives the horse occupies a seat in the rear. The lines

[illegible]

extend through the wagon and the brake is placed within convenient reach. The body of the wagon is utilized for drawers and chests containing felt-lined compartments for the globes, and other compartments for carbons, tools, brushes and small repairs. The trimmer's seat folds down against the side of the wagon to permit a drawer to be opened.

Electric Work in Mills.

BY ARTHUR J. WEEKS.

There is much room for improvement in the wiring of mills of various kinds, and this work is not receiving the attention it deserves, and the work is not ordinarily up to standard. There is no system, the size of wire is guessed at, especially if alternating-current circuits are needed, and power circuits are so run that it is next to impossible to find which is which in case of necessity. A new man would be compelled to begin at the power house and trace each circuit to its end. Should a fuse blow, throwing out a section of a mill, a long search would be needed to locate the fuse blocks.

It is the policy of some men to cover up their work and keep every one in the dark as to their movements. Often fuses are so placed that they are not accessible except from the top of a long ladder, and no ladder is at hand. Sometimes they are located in lofts or unused storage nooks, as the wires chance to be run through such a place. In steel mills they are hidden away in all sorts of places, seldom accessible, sometimes being found 20 ft. or more from the ground on a block of wood alongside an iron girder. The work is often done by contractors with no one to oversee the details. Poor wire enters into such contracts. In one instance wire which had been

up but a short time was almost entirely bare, the insulation having dropped off in great lengths. Cheap lamp sockets and lamps of undesirable construction are often used. Sometimes two or more sets of fuse boxes are found on one circuit, because a wireman finds a few circular mils difference in size due to an odd size in wire and follows the rule, "Where there is a change in size of wire, a cut-out must be used." So, though the wire is practically the same as the former, another set of fuse blocks is used. This happens in extension work. Some wires and open fuses are located openly in places where the blowing of a fuse might easily cause a disastrous fire. Cross-wires are a frequent source of annoyance, as are wires run too close to belts and hot pipes, or pinned down by later work, or pulled loose to allow the putting up of a countershaft; many such cases could be cited. There should be as complete and efficient a system for the wiring of mills as in the wiring of houses or offices; in many cases iron conduit should be used, in others, molding.

When street-car wiring was done in a slipshod manner there was continual trouble, but since an improved system is used troubles from that source are very rare in well-regulated lines. The writer would recommend for mill work a thorough going over and tracing of every circuit, the eliminating of old unused circuits, recording the size of wire, and keeping a set of blue prints of wiring in each department, with fuses and sizes so located. Mark also location of motor, indicating horsepower. The system thus installed will be well worth while for several reasons: The superintendent can more readily keep tab on the business, and the workmen will give better service and take more interest because of the fact that they do not hold the "secrets" of the place hidden under their hat.

It may not be practical to keep a record of every lamp circuit, but it will be a good thing to state there are so many lamp circuits in such a room, giving the number of lamps in each building. This is important, too, for the superintendent will be surprised to know that certain departments are using more lamps than others, when the reverse should be the case. He will find lamps in use where some machines have been taken out, and will often find two lamps where one is sufficient. Often motors will be found unlighted, and darkness is sure to include neglect.

It is a good plan for the superintendent to make an occasional visit of inspection, to ascertain for himself the condition of the electric apparatus. Give no material to any department except on requisition; this will decrease lamp breakage, waste of tape, etc. What is too easily obtained by the common type of man is not appreciated and is wasted.

In such plants as flour mills, grain elevators, varnish and paint manufactories, etc., extreme care and caution are needed in every detail of wiring and choice of materials. Inspect periodically the entire electric installation and keep it up in shape. This can be done systematically with no extra expense to the system, and the time charged to inspection will be far less than expense charges under the former régime.

Sometimes things are put in such systematic condition that an electrician feels uneasy lest his services should be considered no longer necessary, and many times an injustice is done to the man who is responsible for the smoothness of the running. Sometimes, too, the man who recommends and attempts to carry out this rule of system meets with only rebellion and dissatisfaction; yet a little time will usually serve to bring things around in order. When bad work is the rule, and the head of the department, however good himself, has a poor assistant, the business may be so organized that a feeling of "If you don't like it, get out" prevails. A prompt sifting out is here indicated; and the superintendent of a large department should take the time necessary to look after things and see that thereafter the reports coming to him are correct. Such conditions usually right themselves with time, though often several good men are first sacrificed. Certain it is, however, that more system is required in the electrical department of shops and factories, as outlined above, when much waste, risk and extravagance will be promptly checked.

The Regulation of Boiler Feeders—V.

By Charles S. Towne.

Having illustrated and explained several thousand dollars worth of machinery and appliances for the regulation of boiler feeders, the writer concludes the series with further consideration of the benefits to be derived from the practical use of these devices.

Fig. 1 is another pump governor in which light mineral oil is pumped from one chamber to another through an adjustable orifice. Fig. 2 shows an application of it to a boiler feeder. So long as the speed for which the regulator is set, is not exceeded, the regulation amount of oil circulates through it, but a slight increase in this speed throws more oil accordingly, and this raises the piston shown in Fig. 1, closes the balanced valve in the steam pipe, or at least reduces its capacity until normal speed is restored.

Fig. 3 illustrates a combined pressure and speed governor that can be readily adjusted to meet various requirements in service. It may be used in a horizontal or in a vertical pipe, according to which is the most convenient for the engineer, and best adapted to the place where it is to be located. Steam enters at 2, comes in contact with the balanced valve shown by which its pressure is reduced to suit the service required, and it then passes out at 3 going to the steam chest of the pump. Pressure from the discharge pipe enters 4 and is conveyed to the cylinder, 5 (which is stationary), where it acts

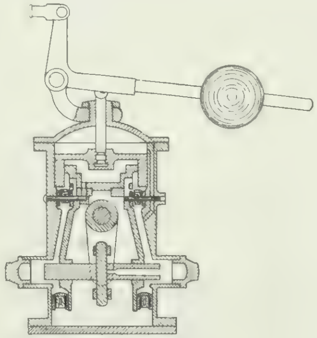


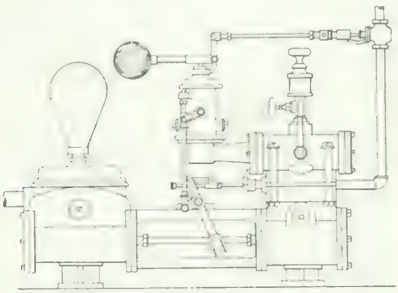
FIG. 1.—PUMP GOVERNOR.

on the piston, 6, and thence through the rod, 7, and the crosshead, 8, motion is imparted to the balanced valve in the steam pipe. This would be quickly closed were it not opposed by the spring, 9, the tension of which may be adjusted at pleasure by the nuts, 10; therefore if more water pressure is wanted in the discharge pipe of the pump, loosen the outer nuts, screw down the inner until the desired increase is secured, then replace the outer as check nuts to prevent the others from becoming loosened by the vibration of the pump. If less pressure is wanted, unscrew the nuts and thus reduce the spring tension.

If the pump runs too fast with a full load, remove the cap, 11, loosen the check nut, 12, and turn the screw, 13, to the right, thus screwing it in, and the speed will be decreased It naturally follows that if greater speed is wanted under full load, the screw, 13, must be turned toward the left, or, in other words, loosened, for this purpose, after which the check nut, 12, should be tightened and the cap, 11, replaced. In Fig. 3 a check nut is shown at 14, an enlarged view of which is presented in Fig. 4. When this nut is loosened the face of the gauge disk, 15, is exposed to view. It is also illustrated in Fig. 5. If it is desired to run the pump faster when the load is off turn 15 towards the letter F, as this indicates "faster." If the speed is to be reduced, turn 15 towards S, which indicates "slower."

A few points on the circulation of water in steam boilers on general principles and without regard to any special type will

[illegible] heretofore has not been known to engineers, but rather by way of reviving interest in conditions that are familiar, and whose familiarity breeds the contempt that is unwarranted when all things are considered. When the circulation of water in a well-designed steam boiler is not affected by external conditions, such as the entrance of feed water, etc., it follows a course that is plainly indicated by the rise of heated and the fall of cooled water. Of course, all water in such a boiler is hot, but still all of it is not the same temperature, and furthermore the terms "heated" and "cooled" refer to relative conditions only. The economy of a steam boiler is influenced directly by the rapidity of the circulation in it; therefore the introduction of a disturbing element must always be determined in a greater or less degree. If the feed water for a steam boiler is heated to the boiling point by exhaust steam, under atmospheric pressure, it is still much cooler than the water already in the boiler, which is heated until much of it is practically ready to pass into steam at working pressure, which may be anywhere from 100 to 200 pounds, according to conditions. The introduction of this cooler water interferes with the circulation; therefore in the discussion of this subject, we ask, "Is it better to feed continuously and thus interfere with the circulation at



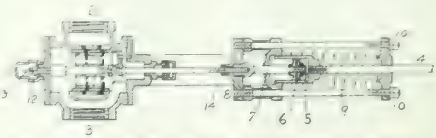
all times alike, or shall we feed, say, one-half of the time that a boiler is in use, and leave it free to do its best work for the remainder?"

If the degree of interference was the same per unit of time, the latter plan would be the best, but this is not the case, because the faster that water enters (in comparison with the rate at which it is evaporated), the greater the interference becomes, not because the water is necessarily much cooler when it is pumped more rapidly through a good heater, as some writers would have one believe, but because the greater bulk of water under its highest attainable temperature from exhaust steam settles to the lowest parts and its tendency is to stay there until thoroughly heated by the fire, which prevents free action.

If all the exhaust steam from an engine is used to good advantage in heating water, it will raise to the boiling point about six times as much as was required to make the steam used, which not only illustrates the action of the latent heat, but proves that exhaust steam can be made to maintain the temperature of feed water under abnormal conditions. If a feed water heater is too small for the duty required of it these results will not be secured; therefore in order to be on the safe side a continuous feed should be maintained, as the circulation is sure to be better.

Although it is laid down as a general principle that steam cannot be superheated while in contact with the water from which it was generated, it is a statement that applies only to steam that is not in rapid motion, as otherwise any surplus of heat tending to accumulate in the steam would pass to the water at once, hence superheating would be prevented. However, there are several kinds of boilers in general use that deliver slightly superheated steam as it flows rapidly through some of the upper parts that are exposed to the direct action of hot gases, and the superheat so obtained is greater in direct proportion to the regularity with which the water level is maintained at a given point.

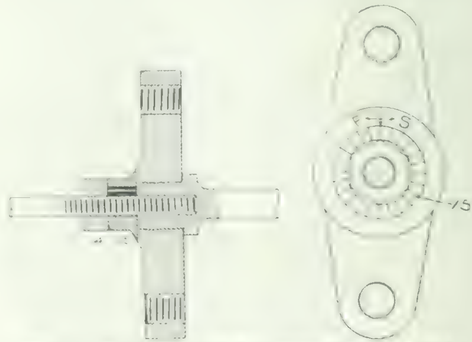
The principle of expansion by heat and contraction by cold (both relative terms), is very much in evidence in steam engineering, and it greatly affects boilers in every-day service; for if a certain part is covered with water on one side to a given height, and only steam touches it above that point, while



the whole is exposed to the action of fire on the other side, the strains due to difference of temperature may be severe, even to the point of rupture in special cases, and while superior design modifies these strains, they can never be wholly eliminated.

What effect does change in water level have on steam boilers? Admitting that it does affect the metal, then which is proper, to keep the strain at one point continually by maintaining an absolutely constant water level, or to change the location of it by allowing the water level to rise and fall?

As strains cannot be avoided it is better to maintain them along a given line because the metal will become "set" to meet the prevailing conditions, hence the strain will be greatly reduced, and if the water level is never changed it is possible for it to be entirely eliminated. At the present time the attention of engineers and steam users is being called in a most forcible manner to the fatal defect existing in every boiler that is fitted with a lap jointed seam, whether it is double or single riveted, as many of them are failing with disastrous results. Is it not a significant fact that nearly every such seam is located where it is alternately covered with water and left bare, according to whether there is high or low water under conditions commonly found where boiler feed regulators are not in use, and where a picayune policy forbids the use of high and low water safety water columns? Of course, there are plausible reasons given for failure to install these safety devices, but in practically every case such a dangerous condition of affairs is due to the opposition of an engineer who does not want to have his failures along this line exposed, or to the penuriousness of an owner who had rather spend the amount involved in attending a fancy dress ball, or in some other equally use-



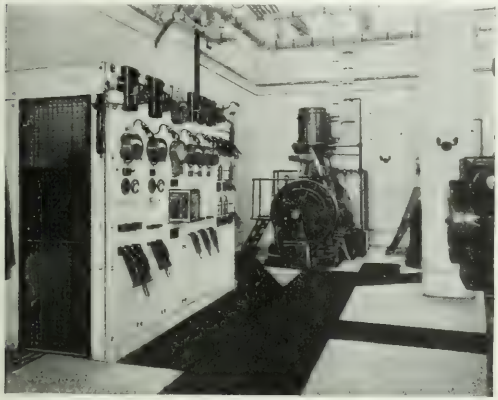
less manner, when compared with the vital interests involved in his steam plant. If the conditions are such that with hand regulation of boiler feeders it is not practicable to prevent frequent alarms on account of too much or too little water, do not muffle the whistles, but install good boiler feed regulators without delay.

LETTERS ON PRACTICAL SUBJECTS.

THE TILED ENGINE ROOM.

Tiling is now quite generally used as a covering for the floors and walls of engine rooms. Its advantages are numerous and should be realized by architects, builders and others, who may be interested in the erection of modern up-to-date power plants of any description.

Tiling properly set in hard cement is durable, fireproof, non-absorbent and easy to keep clean and neat looking. It is made of clay, baked so that it becomes harder than any natural stone or even cement, and being non-porous it cannot absorb moisture, dirt or any other foreign substances which so frequently disintegrate the walls and floors of less substantial material. Even a sharp steel blade cannot scratch a vitrified tile any more than the ordinary knife scratches a dinner plate. In flooring materials this fact is of great importance because the most destructive agent of all floors is the hard steel nails of the shoe which soon wear deep indentations into marble, granite, slate and other flooring materials in common use.



TILED ENGINE ROOM, FILTRATION PLANT, WASHINGTON, D. C.

With particular reference to the engine room, one of the specific values of tiling the floors and walls is that it cannot absorb the lubricating oil, grease and other similar materials that are necessarily dropped upon the floor, or spattered upon the walls by the revolving crank shafts. Wood, of course, readily absorbs this oil or grease which causes it to emit a more or less disagreeable odor, and, furthermore, renders it highly inflammable. This last condition is all the more dangerous because of the necessary proximity of fire which, in many instances within the past few years, has destroyed many large power plants which would have been standing to-day had the walls and floors been made of an inorganic material.

The modern machinery of the engine room is usually a model of mechanical perfection. Among the important duties of the engineer is to see that this machinery is kept in first class condition and above all scrupulously clean. One of the greatest aids in doing this is to have the machinery housed in a room, the floors and walls of which can be easily kept spotless. Cement, for instance, although one of the greatest of modern building materials, does not make a good floor or wall covering because it is more or less porous, wears rough and the countless small crevices on its surface become clogged with foreign material and filth of all kinds, which is virtually impossible to remove.

The decorative and artistic properties of tiling, although not so essential in an engine room as in other places, are nevertheless of considerable importance. There is something of magnificent dignity about gigantic modern machinery, and it should be housed in a room, the attractive appearance of which is commensurate with this dignity. Furthermore, the moral effect of attractive looking floors and walls should not be underestimated. An attractive appearing room offers a strong inducement to the men in charge of the machinery to live up to the appearance of their surroundings, and keep their engines in the same immaculate condition, as far as cleanliness is concerned, as is the room in which they work.

These numerous considerations have been taken into account by many builders of high-class power plants, who now realize that the slight increase in the initial expense of the tiling of the floors and walls of the engine room is in the end a permanent economy and a wise investment.

WASHINGTON, D. C. C. J. FOX, PH. D.

NEW USE FOR A GASOLINE LIGHTING PLANT.

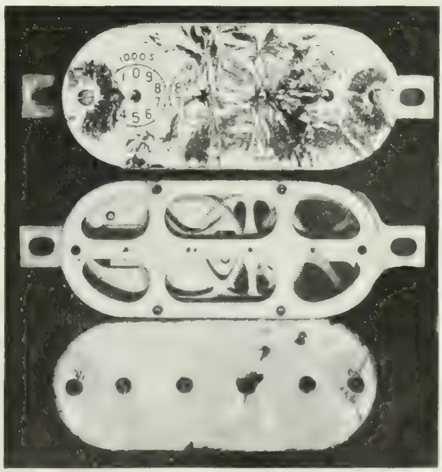
It seems that the insurance companies must be fond of meeting losses due to gasoline lighting plants, as they are still taking risks on stores using gasoline at the same rate as stores lighted by electricity. The latest use of such systems is reported from an Iowa town as follows:

A merchant who was using gasoline lighting decided that he would rather have the insurance called for by his policy (with permit attached) proceeded to extinguish his gas, but made sure that the generator was left turned on; he then lit an oil lamp to be left as an all-night lamp, locked his doors and went home. There was, of course, something doing in due time as the insurance company became aware. The store room was set ablaze all over the inside at the same time. However, the insurance companies are still looking for business at the same rate regardless of the source of light used.

LAKE CITY, IA. OTTO E. BROWNELL.

A METER INJURED BY LIGHTNING.

The accompanying illustration shows the dial face of a Westinghouse watt-hour meter (5 amperes, 200 volts), injured from lightning which struck the overhead network of wires about 1000 ft. from the meter. The meter was inside a wooden structure of one floor, with a corrugated iron roof, well grounded by water and vent pipes. It was installed on a dry side wall, was insulated with one-inch porcelain knob insulators and was 10 or 12 ft. from any ground conducting body. The house is one of the nearest to the bay water edge.



METER INJURED BY LIGHTNING.

The porcelain dial being enameled was insulated from the body of the meter. The dial hands were fused, and the

celain chipped off mostly underneath the hands, and at the screws holding the dial in position. The glass face in front of dials was not broken. The revolving disk was slightly bent, but the windings of the meter were uninjured.

[illegible] [illegible]

[illegible]

The oiling of high-speed units correctly is a problem that is receiving serious attention from various manufacturers and mechanicians. Many methods are employed to oil automatically the bearings, and as a matter of business, the system or method which involves the least amount of cost in erection and requires the minimum amount of attention is the one in most cases adopted. Oiling by hand is now seldom employed and in modern plants this system is considered obsolete. Oiling by gravity is a system that is used in numerous places and another method also used considerably is known as the direct system. In this system the oil is discharged through piping to each bearing by means of a pump that is actuated from a rocker shaft or other convenient connection on the engine. The oil after being fed through the bearings flows back by gravity into the oil well, where it is again taken by the pump and discharged through the different bearings. This cycle of oiling continues as long as the engine runs or until the water of condensation accumulates in the oil well, when the pump will discharge this water through the different bearings.

With the system illustrated in Fig. 1, it is impossible under ordinary conditions to have the supply of oil cease. This sys-

FIG. 1.—OILING SYSTEM FOR HIGH-SPEED ENGINES.

tem of oiling can be erected at a very moderate cost and where trouble is experienced with other methods of oiling it will be found expedient to adopt this plan. In Fig. 1, T is a cylindrical tank made from a piece of steam pipe; the size of the tank being proportional to the amount of oil required for a given run. Thus, if the engines should require one-half barrel of oil during the run, the tank T can be made large enough to contain this amount of oil, or more. The pipe from which T is made can be about 4 or 5 ft. in length and 12 or 14 ins. in diameter, capped at both ends and placed in a vertical position as shown. Pipe W is connected to some source of water supply and pipe M is connected to a waste pipe or sewer. Pipe P is connected to the oil tank T' and pipes N are connected with the various oil cups and bearings of the different engines. Valve V is provided for the purpose of washing out tank T whenever necessary. The oil filter F is elevated above the open oil tank T' and as the oil runs back from the bearings it is deposited in this filter, and thence into tank T'. Tanks T and T' are fitted with gauge glasses to enable the engineer to see the amount of oil they contain. To operate this oiling system, pour a barrel of oil into tank T' and fill tank T with water by opening valve A. When T is full of water, shut A, open valve B, and open valve C. The water flowing out through M induces a vacuum in pipe P and thus draws the oil into tank T. The oil pipe P extends almost to the bottom of T' and the opening of this pipe is pro- [illegible]

entering tank T. When sufficient oil is drawn into T, shut valves B and C and open valve A. Water pressure will now be exerted on the oil and by opening valve D, the oil will be forced through the various pipes that are connected on the different bearings. To stop the system from oiling, shut valves A and D. No more oil will be circulated after those valves

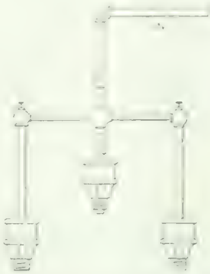


FIG. 2.—[illegible] CRANK PIN AND MAIN BEARINGS.

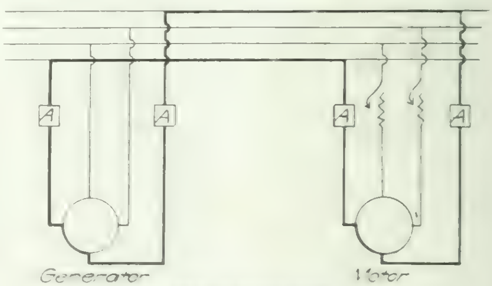
are closed and if sufficient oil remains in tank T for the following run it will be only necessary to open valves A and D, when the oil will again begin circulating through the various feed pipes.

Fig. 2 shows the method of connecting the pipes to the crank pin and main bearings. This method is also employed in supplying the oil cups for the crosshead and slide. It will be seen from the drawing that the oil is fed directly to the cups and by properly manipulating the small valves as shown, a constant supply of oil is insured. It will be understood that the oil supply pipes extend through the caps to the cups, holes being drilled for this purpose. The oil is fed from the cups in the usual manner and should the cups refuse to feed oil for any reason the constant supply entering through the pipes will overflow and run down the outside of the cups and into the bearings thus insuring a double feed, hence a hot bearing from this system of oiling is a remote possibility. Should the cups need cleaning, it will be only necessary to lift out the pipes and screw out the cups for this purpose.

BUFFALO, N. Y. KINGSLEY WILLIAMS.

STARTING A TWO-PHASE ALTERNATOR AS A SYNCHRONOUS MOTOR

A very interesting, and at first, a very puzzling phenomenon occurred recently in an attempt to start up a two-phase alternator as a synchronous motor. Two similar 150-kw alternators were at hand and it was desired to start one as a motor



[illegible]

from the other running as a generator. Accordingly a variable resistance was put in series in each phase of the motor circuit and the voltage of the generator was slowly raised. A large current was indicated on all four ammeters, which was not interrupted in the least when the circuits were entirely broken at the variable resistances. This phenomenon was very [illegible]

and found to be continuously wound. The solution was then simple enough, as shown by the accompanying diagram. The four ammeters were all indicating the same current which flowed through a quarter of each armature. The circuit is shown in heavy lines. By using instead, a generator with two separate windings, the difficulty at first experienced was overcome, and the motor satisfactorily started. Had the resistances been inserted in the other two leads, the current would not have been observed until it had demonstrated itself in the blowing of fuses or circuit breakers.

COLUMBUS, GA. E. RAY SHEPARD.

THE TOOL CHEST AND THE MECHANIC.

Mr. Charles L. Rafferty, under the above caption, in the first issue in June, hands a whole basket of lemons to those mechanics who have seen fit to purchase more tools for their chests than Mr. Rafferty thinks is necessary for an able workman to own. As I am foreman in a manufacturing machine shop (notwithstanding the fact that I am the fortunate possessor of three tool chests full of tools), and am in constant touch with mechanics, I feel that it is my duty to dispel a little of the halo of mystery with which Mr. Rafferty has surrounded the "genuine article—the real mechanic."

He says that "any able mechanic will, of course, have the fundamental tools required in the proper execution of his work." Just what tools may be classed as "fundamental" is largely a matter of opinion and environment. Tools that would enable a man to work the year through without borrowing, in a shop manufacturing textile finishing machinery for instance, would be of hardly any service in a shop where the product was typewriters or sewing machines. Take my own shop, where we make wire stitchers of "Boston" quality and the man without tools must buy, borrow, or steal, for without good tools he cannot possibly keep up his end.

I suppose that Mr. Rafferty's mechanic of ability would come right in with a hammer, monkey wrench and two-foot rule and a large quantity of self-reliance and hold our work up to the half-thousandth limit, which is necessary in some parts. Perhaps he would, but none has arrived to date.

Some come in bearing all the Rafferty earmarks, including the hammer and monkey wrench, which latter tool, being built along the same general lines as a vernier caliper, could no doubt be substituted for one, provided the owner of same was an "experienced mechanic" of the Rafferty type.

As a matter of fact, we do have to loan many of the men tools which we would prefer not to leave our own hands because of the abuse they might receive; but if the men make good, they generally purchase the required tools themselves as soon as they see the necessity for doing so.

Now to get back to Mr. Rafferty's first statement concerning the policy of first trying a mechanic with a view to discovering his worth, I beg to say that it is not an "expensive process" if properly conducted and is certainly "practicable," and furthermore, it has been done in every shop in which the writer has ever worked. I wish to say further that if the material on which I tried out new men was "total waste," it would not be long before there would be a man about my size, tool chests and all, looking for a job.

That Mr. Rafferty's "electrician" was allowed to work three days on a "special job" before his "disgusted employer" discovered that he was no good, speaks very highly for the said disgusted employer's powers of observation.

If I too might be allowed to "reflect for inspiration," I can recall but one instance in my experience of an unskilled mechanic following the trade who was not a walking delegate for a labor union, and this one requested the loan of a "tin rule" about 20 minutes after he began work, because the two-foot wood affair he carried was too far gone to read anything from finer than inches.

My experience with skilled labor has always proved that mechanics cannot be judged by either clothes or tools, but by results alone. Some fine workmen never own a decent set of tools and depend on the kindness of their acquaintances for what they need, while others equally fine have excellent sets and know how to use them to the best advantage. Therefore I say give every man you employ a square deal and a chance to make good, but do not leave him to his own devices for a week with a thousand dollars worth of part-finished product to work on, with which he is entirely unfamiliar and then blame him for spoiled work.

EAST GREENWICH, R. I. L. L. ARNOLD.

CUTTING AND FITTING STEAM PACKING.

It certainly seems to be a very easy matter to cut a piece out of a sheet of packing and place it between two flanges which are to be fastened together by means of bolts. As simple as the matter seems, some people make very hard work of it, not only spoiling much packing, but the job when finished is far

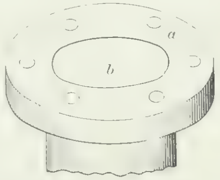


FIG. 1.—FLANGE TO BE FITTED WITH GASKET.

from being steam tight. Recently the writer watched a man attempting to cut a piece of steam packing from a sheet of the material. The man first marked out the shape with a pencil and then attempted to cut the packing with a knife. Such work should be discouraged. The proper way to cut steam packing is with a hammer. To illustrate: Let Fig. 1 represent a flange to be fitted with a gasket. The hole, *b*, is a steam pipe opening, while holes *a*, *a*, are for bolts which fasten the flanges together. Some mechanics first mark out a paper pattern, then transfer the pattern to the sheet of packing and laboriously mark the packing with a pencil and finally cut out the gasket with a penknife. This is a waste of time and of material. A much better way of cutting packing is shown by

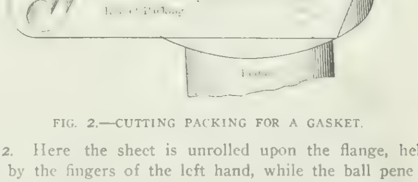


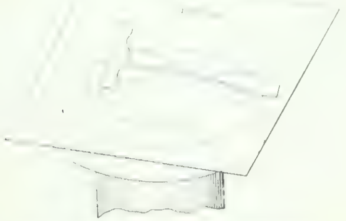
FIG. 2.—CUTTING PACKING FOR A GASKET.

Fig. 2. Here the sheet is unrolled upon the flange, held in place by the fingers of the left hand, while the ball pene of a machinist's hammer is applied as shown at *c*. A hole already made, is represented at *a*. As fast as the packing is hammered through it drops into the opening and after a few inches have been cut, the packing holds the sheet in place, so there is very little trouble in preventing its slipping around on the flange, especially after the first hole has been cut. As simple as the matter seems, there is one right way and several wrong ways of doing the work.

Care should be taken not to hammer the packing to pieces. Fig. 3 represents very bad practice, the edge of the packing adjacent to the holes being hammered into shreds as shown. It will be noticed in this engraving that the face of the hammer is being used for cutting the packing [illegible]

the ball pene as noted elsewhere. The hammer is laid too flat upon the packing. This arrangement can only result in damaging the edge of the packing next to the hole. In pieces where the surface to be covered is very narrow there is danger that the packing will be so badly destroyed that it will permit steam to pass through between the fibers of the material.

Fig. 2 shows how to do the cutting properly. The ball pene of the hammer is used—an ordinary blacksmith's forging hammer—and each blow is struck at an angle of 45 deg. with the face of the flange and the surface of the packing, so that the force of each blow comes upon the sharp corner of the casting under the gasket, which is cut in two almost as clean as could be done with a pair of scissors. There is no danger of fraying or otherwise spoiling the edge of the gasket when it is cut in this manner.



[illegible]

Some users or owners of machinery seem to think that almost any kind of packing will work on almost any surface, but they are apt to be mistaken, as the results show, when packing blows out of one joint, while the same kind of material stays in another joint. One is fitted for its work, the other is not.

Fig. 4 shows a very hard place for packing—that is, the water end of a duplex steam pump. The space a is some distance from any supporting bolt and it is also very narrow. A great deal of trouble was experienced by the packing blowing out across this narrow space. The first time the writer saw this pump, it had been packed by a man who cut the packing with the large face of a hammer. The narrow neck of packing at a had been almost completely hammered to pieces during the cutting act, the hammer blows showing entirely across the strip of packing from one hole to the other. The strength of the stuff, over the long space between the bolts b and c, caused the packing to be poorly supported and to move each way slightly under the steam pressure as it was applied alternately from one side of the packing and the other in the working of the pump.

[illegible]

A clean-cut packing, by the ball pene hammer, cured the trouble entirely. When a piece of packing of this character [illegible] slightly when cutting along the sides between the holes. Care should be taken to move the packing in the right way to leave it a little wider than the space it is to cover. If there is nothing to prevent, the packing may well be left ¼ in. or ⅜ in. wider than the space; then, when pressure is applied to the packing, that [illegible] becomes swollen and thicker than the rest of the packing, and aids materially in keeping it in place between the bolt holes.

It is the custom of some engineers, when there is trouble in molding a [illegible] into the joint a strip of corset steel a few inches long. This acts in two ways. It not only serves to anchor the packing in place, but the steel reinforces the thickness of the packing right where there is need of it.

NEW YORK CITY. JOHN JACKSON.

[illegible]

In a power plant connected to a manufacturing establishment, it is desirable to keep the plant in operation during working hours and if additions are desired to the plant or switchboard, it is important to make these at a time that will least interfere with regular operation. At the plant where the writer installed a Bristol recording wattmeter, there were in operation two 100-kw, 250-volt generators and one 75-kw unit having the same potential. It was necessary to install the wattmeter without interfering with the regular generation of electricity, which was used for lighting the factory and operating over 100 motors of all kinds, and used for various purposes. If the meter were connected on the main switchboard, it would involve the drilling of three holes for the instrument and two for the resistance, and also the cutting of one bus-bar and the drilling of holes in it for the connection of the terminals, not to mention the various other connections. The amount of time in which to complete the work was limited and the plan finally adopted was as follows: A slate slab of sufficient size and similar to those in the main board was obtained and drilled to receive the bus-bar bolts and terminals of the meter. Holes were also drilled for the legs which were to support the slab and for the wattmeter resistance. Flat copper bars

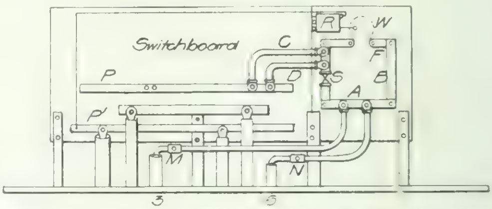


FIG. 1.—CONNECTING A RECORDING WATTMETER TO A SWITCHBOARD.

2½ ins. in width and ½ in. thick were cut to fit the required dimensions and drilled to receive the bus-bar bolts, terminals of the recording wattmeter and leads from the generators. The separate slab with the meter, bus-bars and resistance connected in position was then erected beside the main board and when an opportune time presented itself the leads from the generators were connected to the wattmeter bus-bars as shown at A in Fig. 1. Referring to this sketch, it will be seen that leads 3 and 6 from the dynamos are connected to the bus A which is connected to one terminal of the wattmeter through the medium of the bus-bars B and F; the other terminal being connected to bus-bar P by means of cables C and D. These latter cables being somewhat lighter than those at M or N, it was considered expedient to employ two of these in this connection. A single-pole switch was connected at S, so that if repairs or inspection of the wattmeter were required, the switch could be closed. The resistance which accompanies the wattmeter is shown bolted to the same slab as the wattmeter

[illegible]

at R. The meter is connected to this resistance and the latter is in turn connected to the bus-bar P^1. Thus it will be seen that the wattmeter has its potential coils properly connected. The back of the switchboard is shown in the engraving and the current flows through the leads 3 and 6, cables M and N, [illegible] the generators are connected to the cables connecting with bus-bar A. Solid brass lugs were cast of sufficient diameter

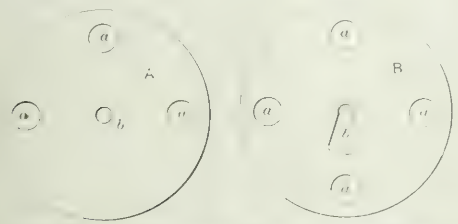
to receive the 1-in. cables leading from the dynamos. The lugs were drilled to receive connecting bolts and were also bored to receive the leads. The lugs after being bored were heated and filled with melted babbitt metal and the ends of the cables were then forced down into it and allowed to cool. In this way the cables *M* and *N* were connected to 3 and 6 and bus-bars *A* and *P*. Before the cable ends were inserted in the brass lugs, they were cleaned and tinned, then heated and inserted as before described. After cooling, the lugs were tested for loose connections by placing them in a vise and endeavoring to twist the cables free. One lug was found defective, and, of course, was resoldered.

New York City. W. Kavanagh.

METAL CUTTING BY STEAM.

An engineer of the writer's acquaintance recently complained that steam cut out numerous valves in his engine room. He stated that over a dozen different valves in various parts of the establishment had to be renewed every year on account of cutting of the disks or the seats. The writer was rather skeptical in regard to this matter, whereupon the engineer produced sundry valves, the seats and disks of which had been grooved out in most erratic fashion. The engineer claimed that the cutting was done by the passage of steam and proceeded to set forth in detail the particulars concerning the cutting of the valves. The writer took occasion to state to the engineer that while he had seen many cases of metal cutting by water and by dirt, he never knew of a case where steam had worn away any of the metal.

After considerable discussion, it was decided by the engineer and the writer to put the matter to test. To this end, a ¾-in. pipe was selected where it was known that a good deal of water would pass through from time to time, on account of the drainage of a long line of pipe which passed through the particular pipe selected. Another pipe was selected, or rather erected, for the test, through which no water could possibly pass. The pipe



FIGS. 1 AND 2.—SHEET IRON DIAPHRAGM CUT BY WATER.

where the water was expected to pass was used for delivering steam to several glue-pots where glue was heated. The pipe passed near the floor of the factory. The pipe which was arranged so as not to pass any water was taken direct from the top of the boiler for the purpose of the test to be made.

This pipe passed vertically upward about four feet, then horizontally a dozen feet or more, from which point it descended vertically to a trap in the lower part of the building. At the point where the pipe dropped to the trap, a tee was placed and a valve and nipple opened direct into the atmosphere. This opening was bushed down to ⅛ in. in diameter and was left open for six hours a day, for six weeks. A couple of bolted flange unions were placed, one in each of the pipes above mentioned, the couplings being introduced where the pipes ran horizontally. Between the flanges were placed, in each union, a disk of thin sheet iron, and a ⅛-in. hole was drilled directly in the center of the thin piece of metal.

When the unions were made up in the pipe, the holes came directly in the center of each union. At the expiration of the time allowed for the test the unions were disconnected and the thin metal plates removed. The plate in the upper pipe where nothing but steam could pass was found to be intact. The hole was ⅛ in. in diameter and was just as round as when the metal was put into the union. The other plate, the one in the glue heater supply pipe, was found to be badly cut. The upper portion of the hole was as round as when originally drilled. The lower portion, however, was cut in a peculiar manner; the enlargement began about the middle of the hole and became larger toward the bottom, where it was two or three times the diameter of the hole originally drilled in the pipe. To the writer this was conclusive evidence that the cutting was done by water and not by steam.

The writer was still further corroborated in his assertion by the appearance of certain valves, the seats and disks of which had been cut to pieces while in use by the passage of steam; so it is alleged by several engineers. These valves showed that water and not steam did the cutting, for, in every case, the lower side of the valve was found to be cut, and that portion of the disk which was above the water line—when the valve was lying on its side while in use—was found to be almost entirely free from any cutting action whatever. The disks of the valves, being free to turn, were cut in any old place.

The engravings herewith illustrate the manner in which the disks were made and one of them cut by the water which was carried along by the steam. Both diaphragms were exactly alike when placed in the pipes. The one in the steam, came out exactly as it went in. The other diaphragm came out as shown; the orifice *b* being enlarged many times, and in a downward direction only. It is pretty safe to claim that of the cutting and wear in steam engine valves and cylinders, nine-tenths of it is due to the presence and passage of water over the parts.

Willoughby, Ohio. James F. Hobart.

CLEANLINESS IN THE DYNAMO ROOM.

Dirt anywhere out of its proper place is objectionable, but I do not believe there is any other machine in which dirt is as troublesome as in the dynamo or motor, or in fact, any electrical machine. I recently took charge of a plant having one 150-kw and one 75-kw, two-phase generators delivering current at 2200 volts. During the first week of my service I was compelled to work until midnight myself on account of the peak load and the absence of my assistant for that watch. The first night, about 10 o'clock, I started the small engine driving the 75-kw machine and after bringing up to speed could not get the generator to "pick up." Cutting in all resistance I made an examination, going first to the exciter, and found two of the brushes stuck up in the holders and entirely out of contact with the commutator. I loosened the brushes and the machine got to work at once. Needless to say, before the machine was started again I removed the dirt and obtained fully two gallons of dirt from the armature and fields. The brushes were so gummed up I could hardly remove them from the holders. There had been on both machines heavy sparking. The commutators on the exciters ran in a ring of fire, and the temperature of the machines was very high with only moderate loads.

I inaugurated a campaign of inspecting and cleaning, doing the work myself. In cleaning up this plant I had to wallow around in grease and dirt like a rat. I found switchboard connections loose, and tightened them up, then smoothed up commutators and fitted brushes properly and the machines run cool and without sparking. So much for cleanliness. No "expert" work at all, just what we might call "flunky" work. It is with the greatest difficulty that we can get assistants to do this easy, and yet most important, work.

I was recently called to examine a small dynamo which had refused to work. It was a compound-wound machine. I found the collector rings grounded to the shaft of the machine *by dirt*. I cleaned this off in about one and one-half hours and had the machine running nicely. My work cost $10, and should have been done by any assistant having good sense and a little experience at no extra cost whatever. About two months later the machine was burned out from the same cause. It is my belief that nine-tenths of the trouble experienced with dynamos is due to dirt.

St. Louis, Mo. William Eastman.

QUESTIONS AND ANSWERS.

Will you kindly advise us if it is possible to use uninsulated aluminum wire for winding magnets? S. U. J. M. Co.

For moderate voltages, the natural oxide which forms upon the aluminum wire furnishes sufficient insulation for the purpose mentioned. The chief difficulty in the use of aluminum wire is that it cannot be soldered easily by ordinary methods, although there are many fluxes on the market which are claimed to be reliable for this purpose. For voltages over 200, paper should be wound between the layers.

I have been [illegible] that two [illegible]-phase, 133-cycle, [illegible]-volt alternators cannot be run in parallel. Why cannot this be done? C. A. S.

The parallel operation of 133-cycle alternators is not impossible; but owing to the imperfections in the governing powers of the small engines to which such alternators are usually attached, this is not always possible. Where the alternators are driven from water-wheels better results are usually obtained. The fault is not in the alternators; but in the prime movers driving them.

Kindly inform me how the size of a safety valve may be found for a boiler using gas instead of coal as fuel? E. H.

The only logical way to ascertain the size of safety valve required is to estimate the pounds of steam per hour the boiler can produce and then make the area of the safety-valve opening such that it will discharge steam at that rate. We would suggest, however, that you communicate with the authorities under whose supervision the boiler would naturally come for inspection, regarding the matter.

We desire to run a bellows by means of an electric motor, and only single-phase current is available. What is the best arrangement under the conditions? S. B.

The best type of single-phase motor for the purpose is one having an auxiliary stator winding. The ordinary single-phase induction motor is not self-starting under load. In the former arrangement, the auxiliary winding is only used while starting, being cut out when the motor has attained its full speed. If the motor is to be started and stopped quite frequently, it is preferable to have some shifting devices arranged so that the motor may operate continuously.

I have an alternating-current fan motor circuit which I desire to run during the day; but inasmuch as the load is so small and the alternator so large it is out of the question to run the alternator. Could not a 5-hp induction motor be used for this purpose if run as an alternator; and if so, how may this be run as an alternating-current generator? H. K.

An induction motor driven above synchronous speed and having its field excited from an alternating-current source, will act as an alternating-current generator. Being without an alternating-current source, however, it would be impossible to operate the induction motor as a generator without rebuilding it. It would be cheaper and more satisfactory to buy a small alternator for this purpose.

Please give me the answer to the following question and the formula by which it is derived: What size cable is necessary to carry 650 amperes, 5250 feet with 250 volts at the generating end, the line to have a 10 per cent drop? J. K. K.

The formula for ascertaining the size of cable is as follows:

[illegible]

where A is the circular mils; D, the distance in feet both ways between the points in question; v, the volts to be lost in the line; I, the current in amperes carried by the wire, and 11, a constant, being the resistance of one mil-foot of copper wire at 75 Fahr. Substituting the values in the formula, the size of cable in circular mils is found to be 3,003,000.

Why is it necessary to have moving parts in a frequency changer? Would not [illegible] for 10 poles transform from 60 cycles to 25 cycles? A. R. T.

When the stator of an induction motor [illegible] poles, or in fact for any number of poles, and the [illegible] stationary, the frequency of any e. m. f. produced in any conductor connected in any way for any number of poles will be the same as the frequency impressed upon the primary circuit. An induction motor can, however, be used as a frequency converter for changing from 60 cycles to 25 cycles by winding the two elements with the same number of poles and driving the rotor at 25/60ths of the synchronous speed.

In an alternating-current system, if the lamps and motors connected to the secondary of a transformer are cut out of circuit, will the primary still draw current from the alternator? H. H. C. B. Co.

The amount of current passing through the primary winding under the conditions noted would vary from one to five per cent depending on the full-load efficiency of the transformer. This small amount of current causes repeated reversals on magnetic flux through the iron core and these reversals of magnetic flux induce electromotive forces in both coils. The electromotive force thus induced in the primary coil is opposite in direction and very nearly equal to the electromotive force applied to the primary coil. Only the difference between the applied electromotive force and the opposing induced electromotive force is available for producing current through the primary coil and since this difference is small, the primary current at no load is also small.

In the formula for calculating the voltage drop in a circuit given in the Questions and Answers column of the April number, where does the 22 come from? Or is this a typographical error? Please give a formula for finding the carrying capacity in amperes of a conductor. J. A. G.

The resistance of a mil-foot of commercial copper, that is a wire having a cross-section of one circular mil and a length of one foot, is taken as 10.8 at ordinary temperatures. As there is no need for such refinement in wiring calculations, the value is usually taken as 11 ohms. There being two wires to a circuit, it would be necessary to multiply the distance by two; but where the formula specifies the distance one way, the constant is doubled instead, hence the 22. The permissible current in amperes which a wire may carry is fixed by the National Board of Fire Underwriters, and a table of current-carrying capacities may be found in any hand book or in the National Electric Code. Kennelly's formula for ascertaining the heating of bare copper conductors suspended in still air by a current is as follows:

$$T^\circ = \frac{I^2}{d^3} \times 90{,}000 + t^\circ$$

where T°, is the temperature of wire in F°; t°, the temperature of air in F°; I, the current in amperes, and d, the diameter of the wire in mils.

What causes the enormous rise of the secondary voltage of a series transformer if the secondary circuit be opened while the transformer is in service? F. L.

An article in our issue of Sept. 1, 1906, goes quite fully into the operation of the series transformer. When the secondary of such a transformer is on short circuit, a considerable current flows in the secondary circuit and the magnetomotive force of this current is opposed to that of the primary current so that the flux which is produced by the resultant of these two magnetomotive forces is small in value; being just equal to the amount necessary to generate an electromotive force sufficient to produce the required secondary current in the local secondary impedance. Thus under normal operation, the secondary current is practically equal to the primary current and the flux is extremely small in value. If the secondary circuit be opened and the primary current continues to have its former value, the flux in the core increases enormously because there is no magnetomotive force to oppose the primary magnetomotive force. The secondary electromotive force varies directly with the flux so when the secondary circuit is opened the voltage across its terminals is extremely large. It is noteworthy moreover that the voltage across the primary terminals will be correspondingly large, and that the series transformer with its secondary circuit open interposes a considerable impedance in the circuit.

CENTRAL STATION SALE OF CURRENT

Report on a Uniform System of Accounting for Electric Light Companies.

At its Washington convention, the National Electric Light Association heard the first report of its committee on "A Uniform System of Accounting for Electric Light Companies." This committee consisted of Mr. H. M. Edwards, chairman, auditor, New York Edison Company; Mr. A. S. Knight, Edison Electric Illuminating Company, Boston; Mr. G. W. Curran, assistant general agent, United Gas & Improvement Company, Philadelphia; Mr. C. N. Jelliffe, auditor, American Light & Traction Company, New York; and Mr. Paul R. Jones, auditor, Henry L. Doherty & Company, New York.

It is manifestly impossible here to give the full report of this committee with its blanks and forms, but the general classification can be given and those desiring the report more in detail are referred to the original document, obtainable from the offices of the National Electric Light Association, 33 W. Thirty-Ninth Street, New York. No final action was taken on the report, but the committee was continued.

The report is devoted to the discussion of the following subjects, viz.:

General accounts, with form of balance sheets; construction accounts; operating accounts, with form of expense report; income accounts, with form of summary of operation report.

To carry out the scheme of accounting recommended, the following records subsidiary to the general ledger are necessary:

Consumers' ledger, containing an account with each customer and a detail of the bill rendered. Abstract of expenditure, showing the amount of each debt incurred and in adjoining columns the account to be charged. Operating ledger, containing an account with each sub-classification of the operating expenses. Investment ledger, containing an account with each construction account. Accounts payable ledger, containing an account with each dealer.

A balance taken from the consumers' ledger should equal the balance appearing on "Accounts Receivable" in the general ledger; a balance taken from the operating ledger should agree with the amount of the "Operating Expense Account" in the general ledger; a balance taken from the "Investment Ledger" should agree with the amount of the "Plant and Property Account" in the general ledger; and a balance of the accounts payable ledger should agree with the amount of "Accounts Payable" in the general ledger. Some of the above records may be consolidated where the volume of the transactions does not warrant so diversified a system.

CONSTRUCTION AND PROPERTY ACCOUNTS

Organization: Cost of effecting organization and such capital exploit expenses as may be properly connected therewith.

Royalties, Franchise and License: Royalties or licenses paid to licensors, payments to city, town or state for franchises (other than taxes) or on capitalization and rights of way, easements, etc.

Generating Plant—Steam: Real estate, station structure, steam and electrical plant and all apparatus and devices, to generate electricity and conduct same to the terminal board in the station.

Generating plant—Gas: Real estate, station structure, gas making apparatus, gas engines, and all apparatus and devices to generate electricity and conduct same to the terminal board in the station.

Transmission plant: Subways, overhead lines, conductors, sub-station real estate and buildings, converting apparatus and devices in sub-station to transform electric current and deliver same to the distributing system.

Storage Batteries: Including compensators and boosters, and real estate and buildings, if latter are devoted to this purpose exclusively.

Distribution Plant: Subways, overhead lines, feeders and mains, house services and all apparatus and devices to deliver electricity to customer's premises.

Arc Lamps.

Converters.

Meters.

Municipal Street Lighting: Lamp posts, services and cost of installation of system ready to light lamps.

Furniture and Fixtures: In general and branch offices.

General Office and Branches: Real estate, buildings and appointments.

Miscellaneous Equipment: Coal storage facilities, repair shop, store rooms, laboratories and apparatus, tools and instruments.

OPERATING ACCOUNTS.

1. *Generation—Steam:* Cost of electricity delivered to station terminal board.
2. *Generation—Hydraulic.*
3. *Generation—Gas Eng.*
4. *Transmission:* Cost of conducting electricity to substations and cost of delivering to distribution system.
5. *Storage Battery:* Cost of storage, including depreciation.
6. *Distribution:* Cost of conducting electricity from substation terminal board to customers' premises and metering same therein.
7. *Consumers:* Costs in customers' premises.
8. *Municipal Street Lighting:* Cost of operation of street lighting system.
9. *Technical:* Costs in laboratory, draughting room, engineering, testing and all investigation and engineering exploit expenses which may not be pro-rated over any of the foregoing classifications or charged to construction.
10. *Depreciation:* The amount which may be appropriated for this purpose.
11. *New Business:* Canvassing, advertising, free wiring, signs and all expenses in connection with securing business.
12. *Commercial:* All office expenses in connection with customers' accounts, reading meters, rendering bills, collection bureau, bill question work, installation and contract records, bad debts.
13. *General:* Administrative and miscellaneous.

Under operating accounts the reports give index and sub-index numbers for different items, which enable a company to carry its sub-division of accounts as far as may be desired.

INCOME CLASSIFICATION

Sale of Electricity: Commercial Lighting, Commercial Power, Municipal Street Lighting Arc, Municipal Street Lighting Incandescent, Municipal Building Lighting, Sales to other Public Service Corporations.

Profit on Merchandise Sales.

Rents from Real Estate.

Interest and Dividends from Investments.

Solicitation of Motor Load.

In a paper presented at the Washington convention of the National Electric Light Association, Mr. George N. Tidd took up the subject of increasing the central station motor load. He pointed out that an examination of the steam plant of the average manufacturer will show many examples of poor steam engineering and a high cost of energy delivered for actual production. One will usually find they are using comparatively expensive coal and frequently teaming the coal in and the ash out. They are probably purchasing their water from the city and feeding it to the boilers with injectors. The boilers are frequently poorly set and operating at poor efficiency. The en-

gines are probably of inferior design, old and in poor condition; usually slide-valve or high-speed automatic, and in many instances either over or under-loaded.

The frictional load of shafts and belts frequently will represent 20 to 50 per cent of the power produced. Their labor cost will be high when considering the amount of power actually consumed in producing useful work. It would therefore appear that with high-efficiency generating plants, methods of burning low-grade fuels, low labor costs (due to large outputs and labor-saving devices), together with the savings one can secure by the elimination of a larger portion of the frictional line losses due to motor drive, one should take over all the power business of the district, and not be confined to a comparatively few short-hour, low-load-factor class of consumers. Among the methods suggested for attaining this desired end are the following:

Solicitors.—Secure the services of a good operating engineer for the work, a man, if possible, who has been in charge of a central-station plant, and one who can appreciate quickly the points involved in good and poor steam engineering. This man should be a good salesman, and with one or more assistants, can cover a good deal of ground by devoting his entire attention to the work. There are many men operating the smaller plants who are admirably adapted for the work. The varied experiences secured by such men in operating these plants, with the numerous difficulties encountered and overcome every day, make them particularly resourceful and valuable for the work.

Canvass of District.—Have your power man make a thorough investigation of every power-producing plant in the district, no matter how large or small. Keep a systematic record of every case along lines suggested in plant data sheet herewith shown. A thorough study of each motor problem should be made, which, supplemented with a study of the process of manufacture, will develop business that at first sight would be deemed impracticable to secure, owing to steam or fuel conditions. This analysis prepares the representative to meet the owner or manager, in a measure, upon his own ground, and having a close approximation to the total costs of the plant, conditions of operation and load-factors, puts him in a position where he can talk and argue most effectively. His grasp of the situation is tremendously increased. These records are invaluable, as in some instances it is not possible to close a prospect until he has a break-down, and when it comes all the data are instantly available.

Secure a Large Representative Installation.—The first large customer comes hard. After the ice is broken, others have more confidence in your proposition and are easier to handle. It will therefore be of great aid to secure one of these customers to whom you can send and take prospects. The customer should if possible be one of the leading manufacturers. There are always one or more manufacturers in a district who are naturally the leaders, and others are very apt to consider whatever *they* do the proper thing. Make the most important manufacturer your friend and a booster; make his installation a model one and you will find his aid invaluable. There is nothing so effective in arousing the interest and desire of a prospect as having him examine and see a large installation in operation, and talk with the owner or manager on the many advantages over the old steam drive.

Trial Demonstration.—One frequently meets prospects who are dubious as to the advantages of central-station drive in their particular business or conditions. In these cases, I would install the complete equipment and furnish electricity to operate [illegible] sum, representing their acknowledged costs for the service and in many instances will further agree to provide the motor foundations and belts. Under these conditions the expense of such a trial is merely nominal, as all the apparatus can be removed and used elsewhere. Fully 95 per cent of these trial installations are finally closed.

Methods of Selling.—Be liberal with your prospects in regard to terms of payment for the [illegible] advisable to sell on the [illegible] years to pay for the installation. The small manufacturer especially needs the money in his business and cannot afford to make the necessary outlay in cash for the proper installation. By taking a lease upon the apparatus and insuring it against fire, you are pretty well protected. In some instances it may be necessary to install a motor free, if it secures a particularly favorable business. The rate per kw-hour can be easily increased enough to cover the cost of the motor. In other words, allow nothing to stand in the way in the line of a reasonable investment in securing good motor business.

Rates.—Remember every power prospect, especially if it be a large one, must be considered largely as an individual proposition. You can not make a hard and fast system of rates which will apply to all cases. Do not be afraid to go down on high-load-factor business, simply because your present cost with its low-load-factor is higher than perhaps you will be called upon to quote. I would suggest dividing your costs up into readiness-to-serve, and output expense; dividing the connected load into the total readiness-to-serve expense, and the output expense by manufactured current. This will give an indication of the value of high-load-factor business and what it can be sold for.

Off-Peak Business.—This class of business does not seem to have been given the consideration it deserves. Many stations believe it is not possible to secure any amount of this character of business. If, however, every power prospect be carefully analyzed and working hours studied, it will astonish you to find how much business can be secured on this basis. Wherever a manufacturer works two shifts it is usually possible so to arrange the hours that they will avoid your 6 o'clock overlapping peak. The proposition requires care in presenting to the manufacturer, for at first thought he will say that it is not possible, but if your man has his conditions thoroughly in mind (and he should not talk until he has) he can in many instances persuade the prospect to shorten the noon hour, start one-half hour earlier in the morning and shut down early enough during the winter months to avoid the overlap. For instance, flour mills can easily shut down during overlapping peak hours, foundries by getting out their iron somewhat earlier, and many others are in the same class. Flat rates in connection with this off-peak business work in very advantageously. I am aware of the prejudice of all central stations against flat rates and to some extent I share this for unlimited flat-rate lighting. However, I do not believe flat-rate motor business is in the same class. The manufacturer will not pay for labor or wear and tear upon machines simply to waste energy. He has a clearly-defined number of hours to operate, a certain maximum production to obtain in these hours, and a definite number of machines to operate. A contract can thus be easily drawn which will cover the situation fairly well. The contract says nothing about the horse-power required. The company merely agrees to furnish energy in sufficient quantities to drive a certain number of carefully-described machines a certain number of hours per day. This contract is very useful in landing certain classes of men and business which could not be otherwise obtained.

Some of the results on the station curve of the off-peak business may be of interest. One plant in a city of 25,000 has now a day load of 1500 kilowatts and has upon its circuits over 90 per cent of the total power business in the city, the only exceptions being the paper mills. Another plant, in a city of 30,000 has a day load of 1000 kilowatts and is closing down plants as fast as station capacity can be installed to take care of it. Fully 50 per cent of the power contracts in both these cities contain this peak load clause.

The value to the central station of a good, heavy, long-hour motor load can not be overestimated. It furnishes a steady income for every month of the year. The amounts received per customer are relatively large and difficulties of collection very small. This power business will represent a satisfied class of customers, the most influential and best element of the city, and they will influence public opinion in your favor and largely minimize the danger of municipal ownership agitation.

Electrical Solicitor's Handbook.

The following extract from a paper by Mr. R. S. Hale, of Boston, on "The Value and Use of a Solicitor's Handbook," will be of interest to those who are already competing for the prizes as well as to others who may now contemplate to do so. The paper above referred to was presented on the commercial programme of the National Electric Light Association at Washington on June 7. "I want now to make a brief announcement of a change in plans in connection with the prize contest for the best electrical solicitors' handbook. The Co-operative Electrical Development Association wrote to all of those who had manifested an interest in the proposed contest last April to find out how they felt about an extension of time in which to submit the competing books.

"By general agreement the time was set for Oct. 1 next, and all of the competitors must have their work turned in to the Co-operative Electrical Development Association, Cleveland, Ohio, by that time.

"I am sure you all appreciate the value of this contest to central stations and others because of the stimulating of interest everywhere and a fixing of the minds of a great many agents upon the details of their own handbooks through a desire to think up some way by which they could get into this contest.

"I hold in my hands a New York draft for $2,600, which represents the total amount to be awarded in prizes to the successful competitors in this handbook contest. The money will be placed in a bank where it will draw interest until the time the awards are made in October, so that the winners will not only get their prize money, but interest on it as well."

Those interested in this subject will be furnished promptly a pamphlet giving full details and particulars upon application to the Co-operative Electrical Development Association, Cleveland, Ohio.

The Value of the Service of the Advertising Agency or Specialist.

Mr. Lawrence Manning, before the last National Electric Light Convention at Washington expressed the opinion that advertising is a vocation in itself, and that the busy manager of any business has not the time or skill to plan and carry out the details of an effective advertising campaign. The advertising agency or specialist takes in hand the situation of the central station which is very similar in general the country over and adapts an advertising campaign to the individual station needs with mere suggestions from the central-station official as to the special local conditions to be considered. The agency can produce an enormous amount of advertising matter with only a few changes or additions for local conditions at a price far below that at which it would be possible for the individual central station to produce it. The specialist turns out advertising in wholesale quantities, while the central station uses it in comparatively retail quantities. In a city in the Middle West having a population of about 150,000, there was sent to 1000 residences a systematic course of advertising matter from June to December, at which latter time two solicitors were put out on this list of 1000 residences for the purpose of determining what results the advertising had accomplished by way of having the householders wire their houses. In April these solicitors reported that 243 houses were found wired and that during the period of their work from December to April, 653 of the occupants made request for wiremen to call and give them figures. The occupants of 82 houses of the 243 found wired voluntarily stated that the wiring of their houses resulted from the advertising literature.

Commercial Results in Different Sized Cities.

Comparative results are usually interesting and stimulating. The following table, compiled from figures obtained by Mr. J. E. Montague and presented at the Washington Convention of the National Electric Light Association on "Commercial Day," June 7, will doubtless prove an interesting study to many companies, both large and small. The figures relate to the past year of operation. The paper also gives some indefinite data on other objects. In some cases there are cooking rates, usually 5 cents per kw-hour.

Population of City	Number of Customers	Increase last year per cent.	Sales cost of adding 16-cp. 50-watt, equivalent. Cents	Gross Income	Gross Income per Capita	Gross Income per kw. Station capacity	Connected load, 50-watt, 16-cp. equivalents	Rates per kw. hour. Cents		
								Lamps Flat	Motors Flat	
1,350	415	33 4	..	$11,500	$8.50	$48.00	5,000			Very Variable
5,000	567	41.05	..	31,540	6.30	78.76	... .	10	8	
15 000	872	23.7	35	64,000	4.27	80.00	30,000	10	5	Discounts
20,000	1,300	30.	37	119,000	2.98	119.00	31,215	12 to	6	
35,000	1,291	20.	..	31,953	.. ...	75.00	....	......	......	
35,000	513	8.	..	107,590	3.07	53.80	42,000	20-10	10-1.8	Sliding Scale
80,000	3,000	20.	12	453,000	5.44	51.17	102,000	15	8	Discounts
100,000	2,412	302.	21	225,000	2.25	45.00	125,000	12-5.3	7-3.3	Discounts
278.000	6,964	18.5	21	994,339	3.57	142.05	440,775	10-	10-	Sliding Scale
300,000	6,839	47.7	39	702,744	..... .	......	380,832	10-3	10-3	Sliding Scale
1,425,000	10,192	37.5	34	2,848,822	2.00	93.63	1,167,595	12-	10-	Sliding Scale

Hartford Experiences with Electricity for Automobile Charging.

Mr. Robert W. Rollins gave some interesting experiences of the Hartford Electric Light Company on catering to electricity for automobile charging at the Washington convention of the National Electric Light Association. November, 1904, the company ordered ten mercury-vapor rectifiers for automobile charging and now has in use on its alternating-current system 44 of these equipments, which are giving excellent satisfaction. The gross receipts during 1905 for both alternating and direct-current systems for charging apparatus were $3,381.81, and in 1906 these gross receipts were $4,441.90. Of these gross earnings about $1,400 were derived from flat charge for a supply of energy, together with the maintenance of batteries for three electric vehicles, two of which belonged to the police department and the third was a bus belonging to a hotel. Contracts were made with these people to manufacture batteries complete for one-half their cost to the company and to supply charging energy and maintain the batteries at a cost of $1.75 per day for each vehicle for 365 days in the year. The scheme has proved to be profitable to the company and satisfactory to the customers. The Hartford Electric Company has a 17,000-amp.-hour battery floating on its direct-current system, for the maintenance of which and for the manufacture and up-keep of vehicle batteries, skilled battery men are employed. These batteries are manufactured under a patent owned by the Hartford Electric Light Company. Pure lead is bought in the form of lead wire [illegible] in diameter, cut into the proper length. [illegible]

lead strips are passed through a die which gives the desired surface. The parts are then burned together, forming the plates, after which the plates are electrochemically formed. Approximately 75 electric vehicles are in use in the streets of Hartford. The average cost of energy for 17 pleasure runabouts for 1906 was $3.19 per month, among these customers being several doctors, who wish their vehicles ready for service at all times. This year the call for charging equipment very materially exceeds the record for the past two years, and Mr. Rollins feels confident that automobile charging will in the near future become quite a prominent factor in central station power business.

Determining Results from Advertising.

Mr. E. S. Marlow, in a paper presented on Commercial Day at the National Electric Light Association Convention at Washington, put in a very sound and sensible plea for a systematized effort on the part of central-station companies to keep track of the results obtained from advertising. He states that, of course, there are some forms of advertising from which it is practically impossible to trace direct results, such as newspaper, billboard and street-car advertising; but as the majority of the companies which advertise make use of the direct-by-mail method, it seems that at least a part of the results can be traced which would help the advertising manager to judge the best pieces. His experience in trying to get information on this subject from member companies as well as that of a reporter to the Association of Edison Illuminating Companies in 1906, shows that central-station companies are not keeping such records as well as they should. Hit or miss methods can only be eliminated when the various companies have applied themselves to the work of keeping account of the direct replies to each piece of advertising sent out, the contracts closed as a result, the value of the business thus received and the net expense of securing it.

The New York City Ordinance Taxing Electric Signs.

By Carmelita Beckwith.

On May 7, 1907, Mayor McClellan approved an ordinance adopted by the Board of Aldermen, "regulating the placing of electric signs in the City of New York and providing that the same shall be licensed."

The ordinance adopted, a very important one in many respects, is worthy of being quoted in full, as follows:

Section 1. Any electric letter, word, model, sign, device or representation in the nature of an advertisement, announcement or direction erected at right angles to any building shall be deemed to be an electric sign.

Section 2. Electric signs may be hung or attached at right angles to buildings, and extend not to exceed six ft. therefrom in said space, and to be ten ft. in the clear above the level of the sidewalk in front of such building, upon the payment of an annual license fee of 10 cents for each square foot of sign space or part of square foot of such sign space, to be collected by the City Clerk of the City of New York. The square feet of sign space on one side of an electric sign, however, shall be deemed to be the entire number of square feet of sign space for the purpose of computing the license fee herein referred to and required to be paid. All electric signs shall be constructed entirely of metal, including the uprights, supports and braces for the same, properly and firmly attached to the building, and shall be so constructed as not to be or become dangerous. Before any permit is issued by the City Clerk, plans and statements of the proposed sign and method of attachment to the building must be filed with the Superintendent of Buildings having jurisdiction, as provided in Part 2, Section 4, of the Building Code, and his certificate of approval be obtained as to the sufficiency of the construction and method of attachment to the building. A certificate must also be obtained from the Department of Water Supply, Gas and Electricity certifying that the proposed electric wiring and electric appliances are in conformity with the rules and regulations of that Department.

Section 3. No certificate shall be given by the Superintendent of Buildings, and no permit shall be issued by the City Clerk, for the erection of electric sign or signs on any building when such building adjoins a building occupied exclusively as a private residence unless the written consent of the owner or owners of said private residence for the erection of such electric sign be first obtained.

Section 4. No electric sign shall be placed, hung or maintained, except as in this ordinance provided, under a penalty of ten dollars for each offense, and a further penalty of ten dollars for each day or part of a day the same shall continue.

Section 5. All ordinances or parts of ordinances inconsistent or conflicting with the provisions of this ordinance are hereby repealed.

Section 6. This ordinance shall take effect immediately.

This ordinance has been welcomed by the several lighting companies of Greater New York, for at last the electric sign is recognized and established in the eyes of the law. For some time past signs have been erected under the old ordinance which allowed a projection of but three feet. Almost all of the signs in place have overstepped this limit. It was necessary, for what does three feet mean in this connection? Any one with half an eye for distance can see that not one sign in a hundred met these requirements. The companies have been treading lightly, not knowing exactly what was proper and law abiding practice. This ordinance now settles the matter in the opinion of the companies and they are going ahead under its provisions.

"While at first sight the new ordinance looked as though it might be objected to by the central stations," said Mr. M. S. Seelman, Jr., of the Brooklyn Edison Company, "since it has been enacted we are pleased, inasmuch as it gives the electric sign a legal standing. Heretofore we have been putting up signs and taking chances; if the Bureau of Encumbrances chose to object, it could do so and we were helpless. This ordinance for the first time gives the electric sign a legal right to exist up to within six feet from the building line, so that signs conforming to this requirement will not be a source of trouble in any way. Of course, the adoption of the ordinance means a tax of between $1,500 and $2,000 a year to this company, but we are willing to pay the sum to secure for the electric sign a sure standing in court.

"This company welcomed the act and there would have been no trouble in connection with it were it not for the last clause which stated that the ordinance would go into effect immediately. The Police Department instantly notified our customers that unless they complied with the requirements of the law inside of 24 hours they would be fined $10 a day. You can imagine the result. We were besieged, by telephone, messengers and personal calls.

"Mr. W. T. Fairvain, the company's general inspector, immediately communicated with the City Clerk, whose duty it is to collect the tax under the ordinance, and Commissioner Bingham, arranging a conference at which it was decided that the enforcement would be postponed until the first of August. This makes the change possible for our company, for we now have 30-odd days in which to get a list of these signs, have them measured and send checks to each of our consumers covering his tax.

"The method of making application for permission to hang a sign has become greatly complicated by this new act. To begin with, an application in triplicate must be signed by the owner of the building on which the sign is to be placed and by the tenant desiring the sign; the signatures must be witnessed by a notary. This triplicate application is then taken to the Building Department with a sketch of the method of construction and attachment. It is next taken to the Department of Water Supply, Gas and Electricity to be passed upon for the proposed wiring equipment of the sign. With the approval of these two departments application is made to the City Clerk who is the final arbiter."

Mr. Seelman said in conclusion: "Naturally this complexity involves an interminable amount of work in connection with merely one feature of our business, and therefore we are making every effort in Brooklyn to simplify the process. However, so far there has been little difficulty, as we have nowhere run counter to any disposition to insist on technicalities, and we believe that it is only a matter of experience and development when these trying details will be eliminated."

In talking about the new law, Mr. Arthur Williams, of the New York Edison Company, said: "Nowhere else in the world is there such an effect as the electric signs present in the Borough of Manhattan, on Broadway south of Forty-Second Street and on Forty-Second Street itself, east and west of Broadway. While this is the largest center it is only one of the many brilliant displays. These electric signs are the talk of the whole world. Investigating committees of civic bodies have been referred here, not only from our own country but from abroad, and the whole display is regarded as a permanent exhibition. It brings visitors to the city, brings them out when they are here, and when they are out, they buy. Anything that increases trade brings prosperity; increased rents raises the value of real estate; this all should mean increased taxes, and the Board of Aldermen have acted wisely in passing the new law, allowing the electric signs to project six feet from the face of the building, and at the same time levying a small tax to be paid either by the supplying company or the consumer. The present law limits the size of the signs somewhat more than many persons think is proper; but while the City Fathers appreciate the desire of the public they are ever mindful of the best interests of the city, and we are sure they do not intend to put any needless burden on the people or the public."

The United Electric Light & Power Company immediately reprinted the new ordinance in a neat little folder, and distributed it among its consumers, that they might be advised, at the same time stating that the company would pay the tax on these signs, which amounts to about $500, distributed in various parts of the city.

Mr. Frank W. Smith, secretary of the company, said that the new ordinance would make a material difference in its sign business, as it has put it in a position to comply with the law in furnishing and erecting free signs. Said Mr. Smith: "This new ordinance really legalizes what heretofore has been done in violation of the existing law, which never met the requirements. We shall go right ahead and where the company maintains and provides signs, necessary permits will be obtained and the license paid. We were very active in our co-operation with the City Departments in connection with the new law and are applying for permits for all the signs we now have installed. A pamphlet containing the ordinance is being freely distributed among contractors and builders, that they may also be familiar with the new requirements."

The general consensus of opinion is that while this new ordinance makes it necessary to pay an annual fee on the signs, it really legalizes electric sign work and allows the consumer to get the benefit of all of the requirements of the law, which heretofore has not been the case.

Publicity: or, How I Bought a 5-hp Motor.

We reprint the following amusing criticism of present-day publicity methods from our London contemporary, the *Electrical Review*. The writer avers that it is based on facts.

I was in want of a 5-hp motor for driving a small machine, and sent the following inquiry to a large Americanized motor manufacturing company: "Kindly quote me, by return post if possible, for a 5-hp shunt-wound motor, to run at about 1200 r. p. m. on a 200-volt continuous current circuit, complete with sliding rails and pulley."

In reply to the above I received the following: "We are much obliged by receipt of your valued inquiry for motors, and enclose you herewith our Motor Enquiry Form, and on receipt of this duly filled in we shall be able to quote you by return of post."

This form was one of the new publicity documents, and contained about 125 columns or spaces to be filled in with various particulars, and covered every conceivable detail that might apply to a motor of any description, continuous or polyphase. I thought it best to fill this form in, although I could give no more information than was contained in my original inquiry.

By return of post I received the following:

"We are duly in receipt of yours of yesterday enclosing our Motor Enquiry Form filled in, which we have handed over to our Estimating Department, who will quote you in due course. As you are in the market for motors, we enclose you herewith our pamphlet on Motor Driving, which will show the absolutely unique position we hold in the motor world. There is no branch of this extensive industry which we have not touched, and the services of our vast technical staff are fully and freely at your entire disposal. Awaiting your further inquiries, we are, etc."

After waiting two days, I sent a post card to remind the firm that I had not received the quotation yet, and received the following reply:

"Your postcard came duly to hand, and we regret that, owing to extreme pressure of business in our Estimating Department, your inquiry has not yet reached its turn. We receive thousands of inquiries daily for motors, and these must, of course, be taken seriatim. We are now within a few hundred of yours, and have every hope of reaching it to-day. We take the liberty of enclosing herewith our pamphlet on Electric Ventilation. We know that 99 per cent or more of the offices in London would be equipped with our electric fans if we had the chance of personally discussing the matter with the tenants, and if, after perusing the enclosed, you would like a call from us, we will send round one of our salesmen who will go fully into the matter with you, and positively convince you that it is physically impossible for you to successfully carry on your business without one of our electric fans on your desk."

Then, after a day or two, I sent another postcard, saying "Do please let me have that quotation by return." But instead of the estimate I got the following:

"We regret that our quotation has not reached you, but the whole of our engineering staff have been working night and day on it, and hope to have it completed by midnight to-night, and it shall be sent round by special messenger in the morning. We find that we have not yet heard from you on the subject of electric fans. We have tried our best to make the advantages clear to you, and to show you how much more life would be worth living during the hot weather, if your office could be kept cool and fresh by electric fans. If we had the descriptive powers of Sir Walter Scott and the force of Sandow, we might succeed in making the thing stronger, but being simply salesmen with nothing but our knowledge of the real beauty of fans to tired, overheated humanity, we can only repeat that it is our firm conviction that you cannot possibly be happy until you get them."

By the same post I received also an appeal from the supply company, who had evidently been told by the motor company that they had had inquiries from me for motors, and that in all probability I had a private plant. The circular was to the following effect:

"Why make your door a dump-heap? Customers will not push into your office past dusty, greasy stokers; and coal and ash carts on your curbstone do not look well. Let us do the shovelling. Let us make the noise, grease, smells and dirt, miles away from your office. That is our business; yours is to keep clean, cool and quiet. We are experts in the shovelling business. Our men like it. It is second nature to them. On receipt of the enclosed card, one of our salesmen will be round by motor-car in five minutes."

Another postcard from me to the motor company, saying that unless I got the quotation by return I should go elsewhere for my motor, brought forth the following reply:

"We know how tired you must be waiting for that quotation,

but we [illegible] be delighted. No motors are like our motors. Every horse-power given by our motors is worth at least five horse-power given by any one else's. What about arc lamps? Surely you want some arc lamps, and we enclose herewith our bulletin which tells you all about them. Electric light is one of the great discoveries that go far towards making this twentieth century life of ours better worth living—fuller of refinement, comfort and culture."

Just as I had finished reading this, my clerk brought in a traveler's card. He represented a motor maker. I don't usually see travelers, but just as a drowning man clutches at a straw, so I grasped the chance of seeing this man.

"Do you make motors?" I asked. "Well, then, can you give me a quotation for a 5-hp, shunt-wound motor, 200 volts, 1200 r. p. m.?"

"Oh, yes," he said. "I can give you a quotation for that now." And in about two minutes he had figured it out from his list, and taken off the discount.

"Now, then, how soon can you deliver?"

The traveler turned up his stock list, and said, "We have one in stock—could send it off to-day if I wire the works."

"You are not an engineer, I suppose, just a traveler, and know nothing about the technical details of these motors. Don't know a motor from a rheostat, I suppose."

"Oh, yes," he said, smiling, " I am an engineer, and can tell you anything you like about the motor."

The result was that this representative took the order with him, telegraphed for the motor, and it was in my place and running within two days.

I am still receiving weird pamphlets and bulletins from the motor company, and I suppose their engineering staff are still working night and day on that quotation, for I have never received it.

Commercial Methods of Exploiting Heating Appliances.

Mr. I. K. Jackson, general manager of the Mobile Electric Company, presented a paper on Commercial Day at the Washington convention of the National Electric Light Association on "Commercial Methods of Exploiting Heating Appliances," telling of the work done at Mobile. The Mobile Electric Company begain in August, 1906, a campaign for the introduction of electric irons. This campaign was started by extensive news paper advertising for the first 30 days, making a 30-day free trial offer. This was followed up by house to house canvassers, who left electric irons wherever possible, with the request that they be tried. The only thing required from the customer when the iron was left was a receipt which called for the payment of $4 at the end of 30 days or the return of the iron. Conjointly with this the literature of a well-known advertising company was sent out very freely. Between August, 1906, and April 30, 1907, 640 electric irons had been accepted and paid for. At no time was there more than one man engaged in this work, and only for a period of 30 days was his time exclusively devoted to canvassing for electric irons. This man, or boy, rather, received $45 per month. During the time he was putting out irons he placed on an average 20 irons per day. Of these irons 805 were accepted. The rest were returned, burnished up and redelivered. While the percentage of irons accepted originally by the consumers at whose premises the irons were left averaged about 80, the real average of the ultimate users of these irons was higher, as in many instances irons were returned and subsequently the same people called at the office and purchased new irons.

One laundry in the city, operated entirely by electricity, uses 35 irons and electrically heats the rolls on the larger machines. Another laundry uses 18 irons. To introduce the iron to these laundries the company took its chances on the success of the installation, bought the irons, and did the wiring subject to a 60 days' trial and approval. In one of these laundries a rate of 2.75 cents per kw-hour was made and in the other 3 cents. These rates made the cost of electric ironing, as compared with heating the irons by gas, about three times as great as the cost of gas, but the owners of the laundries say that four of their girls can turn out as much work with electric irons as five could turn out with the irons heated by gas or other methods. It therefore pays them to use the electric irons. Aside from this, it was found that there were fewer garments scorched or under-ironed with electric irons than with others. For this class of work a very much higher grade of solicitor is required than for residences. One of the company's show-windows was decorated to represent a high-class dining room. On the dining-room table was placed an ironing board, and inside a girl was kept for a time with a white gown, ironing with an electric iron. A placard was placed in the window with this statement: "She does not have to wear her old clothes to do her ironing."

The company's contract department consists of three men, besides the man at the contract window—one man on power, one man on store illumination and signs, and one man on residence lighting and electric irons. The power department has contracted on an average for 185 horse-power per month since its organization. The sign department has increased flat-rate sign business $7,200 per year since Jan. 1, 1907. The number of contracts written from Jan. 1, 1907, to April 1, 1907, was 650 in the face of an increase in lighting rates. The population of Mobile is between 60,000 and 70,000.

Sizing Up the Territory.

Mr. George Williams, of Cincinnati, in a brief paper presented at the Washington convention of the National Electric Light Association gave some good advice, based on extensive experience in sizing up solicitors' territories and preparing lists of possible customers from which to work. His suggestions are as follows:

The solicitor's district is ordinarily found to contain a variety of prospects that call into use nearly all standard electrical appliances and types of lighting. If the population of the territory is exclusively resident and numbers over 10,000, the district will be of a high character of dwellings and will offer many possibilities of power and electrical appliances that would not find so ready a sale in districts composed of poorer dwellings. The latter district will contain a greater variety of possibilities because of the intermingling of stores, saloons and factories. While some districts will unavoidably produce greater revenue than others, any district can be cultivated at a profit regardless of the character of its population, class of dwellings, or nature of the commerce.

The necessity of knowing who and what it is desired to sell, in advance of the attempt, is quite apparent in the sale of anything and especially true in the sale of energy. The process alone of compiling the list of prospective customers will warrant the work entailed. The actual number of possibilities for various appliances and forms of lighting far exceeds the number usually closed, and we are all inclined to underestimate this or the increasing number caused by growth of population and growth of possibilities through education, so that a frequent analysis of the possibilities is advantageous, if only used to decide the plan of campaign or the provision for supply.

In an undeveloped district a hit-or-miss method may result in success, but with the progress of a campaign the importance grows for listing the possibilities systematically. As no example exists of completely developed sales, the proportion of sale to possibilities can not be precisely estimated, but there is sufficient proof that geographical location or size of city does not prevent development of sales. Likewise in the solicitor's district wherever light and power are already applied by less convenient agencies, or new uses created, it is simply a matter of locating the prospect and conveying the information of the merits of the electrical method.

The rapid improvement in electrical appliances has made elec- [illegible]

prospects for sale. The retailer now has ample precedent regarding the merits of electrical advertising, and the resident demands an illumination for comfort rather than bare necessity for safety.

A few years ago the name and address of house occupants might suffice for a list of prospects; now a list of a score of items can be recorded to one household and all worked on to advantage, because electricity has been applied with efficiency at a more rapid rate than the central station has educated its public.

We are apt also to underestimate the purchasing ability of the prospect. It should be remembered that in the majority of instances the same amount of money, or greater, is already being expended by the prospect for the same object, while nearly every difference is in favor of electricity.

If every customer possessed the knowledge of the merits and possibilities of the accomplishments by electrical application, there would be little need of solicitation or advertising; hence the importance of classifying the possibilities and promoting the intelligence in the most economical manner.

For canvassing a district, the form of a directory listed in the order of streets and house numbers, allowing for indication of equipment or possibilities of sale, is perhaps the most convenient. This book is especially valuable to acquaint the solicitor with the name and equipment, avoids uselessly questioning the prospect, and forearms him with useful information before interview. The book may be maintained by checking with office records, observance of changes of residence, and routine canvass.

A card index or tabulated list of prospects, classified by the nature of the business or class of articles for which they are desirable prospects, is a simple record for mailing lists or for solicitation by special talent.

Methods of Securing Residential Business.

A paper on this subject, by Mr. R. C. Hemphill, Jr., of Ann Arbor, Mich., was among those on the programme of the National Electric Light Association at its Washington convention, June 4 to 7. The paper relates to policies adopted in residence districts in cities with a population of from 5000 to 20,000. Selecting from the employees two or more good-looking, bright-witted chaps, a canvass is started to obtain information on the following items from each house: Number of rooms, occupant, owner, kind of service used, if customers, have they an iron, wired or piped, kind of fixtures, remarks as regards prospects. From the field book in which these notes are taken a card index is started in the office. The line of talk these preliminary canvassers are trained to give during this canvass is as follows: "I am the representative of the electric company. Do you have our service?" "No, we use gas." "Can I not interest you? A number of your neighbors are using our service. Our rates have been materially reduced and the management thought that this spring you would be interested in having us explain its advantages."

If he finds the house is connected, the talk runs something like this: "I am a representative of the electric company and called to see if our service is entirely satisfactory, and if there is anything we can do for you. The management wants your co-operation in giving good service, and if you can suggest anything along that line we will be glad to hear of it."

It is certainly astonishing what a pleasant feeling is at once established between the company and the consumer, indirectly paying more than the entire cost of the canvass.

We are now ready to begin work. A certain street is selected and the cards are examined. You decide to send your men after all dwellings not wired. A list is readily made and the replies brought in are added to each card. Different lists are made up in different districts of houses wired, but not connected; wired, but no fixtures; kerosene-lamp houses (a greater proportion in each town than most people realize); a list of houses using gas, and a great list of houses using combinations of all systems.

This is the regular grind of the soliciting department in the residential districts. We have also a scouting or special department consisting of one man who looks out for new houses, extensive repairs being made on houses, and inquiries from our direct-by-mail advertising. He gets his ammunition from building permits, contractors and newspaper clippings. The rest of each day he puts in, during this time of the year, on irons, and a little later on fan motors; in the fall, on porch lights, and so forth. Small cards are printed for him on the addressograph and these are arranged according to street numbers. He sorts out those that are supplied and goes out after the others.

ADVERTISING.

We carry on various advertising campaigns, trying to supplement the work of our canvassers.

Newspaper Advertising.—We carry a double-column 5-in. space with each daily paper, changing the advertisement every week.

Direct-by-Mail Advertising.—We mail to 50 per cent of our residences monthly bulletins. We get good results not only by pleasing our present customers, but also in getting others to discussing various appliances.

Exhibition Room.—We have in connection with our office a large display window and exhibition room, kept attractive by frequent changes. We endeavor each month to adopt a special feature, as for instance, in January, small-cp and Hylo lamps; February, motors; March, fixtures; April, irons; May, cooking and heating appliances; June, fans, and so on during the year. We endeavor to have on exhibition and in operation every article mentioned in our advertising or spoken of by our canvassers.

We endeavor during April of each year to give a week's practical demonstration of heating and cooking devices. In conducting a demonstration the chief aim should be to give it tone. The class of people you want to attend is not the class that goes to free exhibitions, and the class that goes to free exhibitions is not the class you want.

You first engage your demonstrators. It is better to have two and on their arrival lodge them in the leading hotel and have an interview or local notice in all the papers. Secure a hall that will seat about 200, if possible connected with some church or society. Build a small booth in the center of the room and arrange the chairs around the booth. On the sides of the room have in operation every device that you can get your hands on. Trim the room and booth with flags, bunting and flowers.

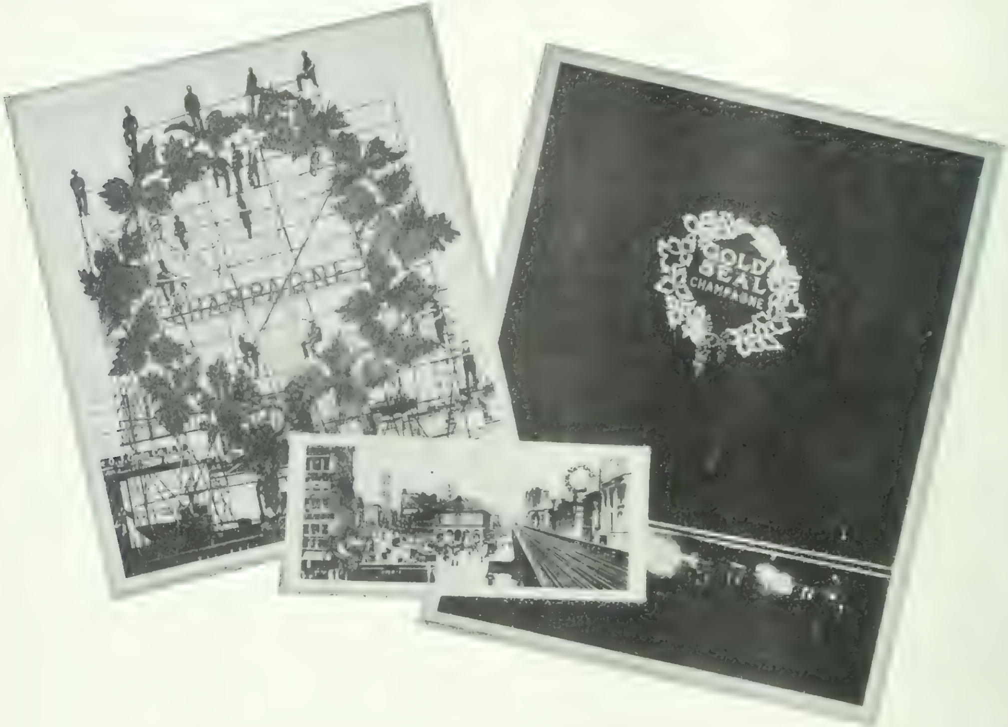
First, great care should be exercised in the invitation lists. The invitations themselves should be in good taste, with no advertising features whatever, but entirely complimentary on the part of the electric company. Care should be exercised that the ladies of the same neighborhood should receive invitations for the same afternoon. Having two demonstrators, two meetings can be held each day, one at two in the afternoon and one at eight in the evening. The meetings take two hours or two hours and a half and begin with a short talk by one of the demonstrators or by the manager of the company. We interest the teachers in the manual training schools, and they very kindly assign sets of four girls for each meeting, who serve the guests; thus at each meeting four different families become interested in electric cooking. After the *menu* has been served the guests are invited to inspect the various articles on exhibition around the room. The manager, superintendent and solicitors should be in daily attendance, and one of them receives the guests while the others should be ready to answer all sorts of questions. No effort should be made to sell articles on exhibition. Eliminate the business feature as much as possible and make it a purely and strictly complimentary social function.

This is the outline of the campaign we are carrying on for new business. We propose to spend 3 per cent of our gross income on this department. We are getting satisfactory results.

Increases of gross incomes are from 18 to 30 per cent, and in the case of one town of 8000 people, 38 per cent. In every prosperous American city the electric business can be increased 25 per cent or more by a systematic effort; or, in other words, the electric business can be doubled every four years.

Part of the Great White Way.

In a recent issue we published an illustration of the "Gold Seal" electric sign, erected on the roof of Engel's Chop House at Herald Square, New York, indicating a new departure in sign



Immense Electric Sign Removed from New York's "Great White Way.

work. As several new stories are to be added to the old building the sign had to be removed. Our picture was made as the framework was being taken apart, preparatory to storing it for the summer. Some idea of the size of the sign may be had, as the 15 men at work on it appear as midgets. The group shows the sign at night and its location on Herald Square, in the very heart of New York's "Great White Way." So many highly effective signs have recently been made by the O. J. Gude Company, and put in place, that to-day this one which occasioned so much favorable comment when erected, will hardly be missed.

A Public Service Corporation's Statement as to Business Methods and Public Policy.

The Brooklyn Edison Company has printed as an advertisement the following statement of its policy as relates to the public:

The Edison Electric Illuminating Company of Brooklyn believes and acts upon the theory that any permanently satisfactory business must be built upon the basis of mutual advantage, and that this mutual advantage consists in giving the public the best service possible at a price consistent with the maintenance of such service, and a reasonable profit to stockholders upon their investment.

The company's securities represent capital actually invested in the business. The company's rates are so arranged as, with careful and economical administration, and the maintenance of a high and even liberal standard of public service, to permit of the payment of a reasonable return on this investment.

These rates differ in accordance with quantitative consumption as governed by minimum guarantees on the part of the customer, and in accordance with certain broad divisions of application, as being, for instance, lower for power energy than for lighting energy, but there are no secret rates and no discrimination as between customers in the matter of rates, all rates being public and the same rate being charged in every case for similar service under similar conditions.

These facts being as stated, this company believes itself entitled to the good will and confidence of the Brooklyn public.

Letters to the Editors.

Motors for Household Uses.

To the Editors of Electrical World:

Sirs:—We noted with interest the editorial suggestion in a recent number of the Electrical World that it is now time to devise methods whereby one motor may be used for several household purposes. This is interesting as illustrating one line in which electricity has not made the advance that was predicted in its earlier history. Some 15 years ago the writer prepared an article discussing the generation and application of electricity for farm use. In this, attention was called to the fact that while the farmer had his many horse-propelled labor-saving machines, electricity afforded the housewife an easily adaptable power for saving labor in several directions

It was contended that with some little forethought the kitchen, laundry, dairy, sewing-room and possibly a little workshop could be so located or in some respects combined, that a comparatively short shaft running in graphite bearings, driven by a motor of not to exceed one-half horse-power could be installed in an inconspicuous location, but from which power could be conveniently taken for the operation of washing machine, ironing rolls, meat chopper, dish washer, bread kneader, sewing machine, fan, pump, churn, milk separater, butter working table, etc. In the country one room is often used to serve two or three purposes. The kitchen often serves as laundry, and the dairy contains the pump, and possibly some shop tools, and the sewing room could be located just on the other side of the partition from the kitchen, so that all the power-driven appliances could be closely grouped. It would seem that with some planning similar results could be secured in a city home.

The furnace and laundry being located in the basement would indicate the placing of the mechanical transmission in the basement, with control of the motor and appliances from both basement and first floor. For this purpose magnetic clutches, if properly worked out, would be especially desirable. Several should be provided, allowing the motor to operate on a ventilating fan without operating the shafting. From the line of shafting it would be comparatively easy to make connection to a couple of points in the kitchen and one or two in the sewing room, if such were located on the first floor. If, however, the sewing room and dressing rooms were on the second or third floor, it would be a more difficult matter and the use of one or two extra motors of very small size would doubtless be preferable to mechanical transmission for that distance. Here again, if desired, combination could still be effected to some extent by so designing the motors that one end of the shaft should operate a fan with deflector and the other end some mechanical appliance, both being attached to the shaft by suitable clutches.

Each house equipped will require different arrangements to secure desirable results. No standard outfit can be devised suitable for selling as an article of supply, that will cover all requirements. A combined laundry and kitchen equipment with pump attachment would be practicable. The various appliances would be attachable to a framework to be bolted to the side of the room and supporting the motor and mechanical transmission. The more cumbersome appliance would be removable when not in use.

Fifteen years ago we had expected these problems to be largely solved within four or five years, and electricity to become the household drudge. Development, however, has been along other lines, of which switchboard construction may be mentioned as a conspicuous example.

In the article referred to, which was followed in a short time by a series of articles in the Electrical World by Mr. Black along much the same line, it was suggested that a fairly cheap source of power for generating the current needed could be secured through use of farm animals shut into a stall upon an inclined rolling floor which should operate a small generator with speed control. With recent advances in the use of gasoline and alcohol engines this appears a very crude source of power, but it promised to be more reliable than wind power or water power secured from country rivulets.

It would now seem that for such locations a small internal combustion alcohol engine would offer the most practical solution. This would be used to drive the small main shaft direct when needed, and through a clutch to drive a very small generator for supplying fans or lamps. It would seem that we are warranted in looking for considerable development along this line in the near future. The company that first puts out a compact, practical outfit of this kind at a reasonable price will lay the foundation of a large and growing business, this field so far as we know not being now worked to any extent.

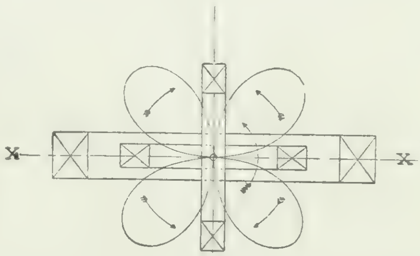
Toledo, Ohio. R. R. Miller.

The Synchronoscope.

To the Editors of Electrical World:

Sirs:—In your first issue of May, 1907, you publish an article by Mr. D. H. Cohen on the "Synchronoscope." I would like to call your attention to what seems to be an error in the discussion of this instrument given by Mr. Cohen.

Referring to Fig. 1 of his article, he states that the rotating field south pole on the right will be drawn toward the north pole of the pulsating field, as indicated by the small arrow.



THE SYNCHRONOSCOPE.

Evidently this is incorrect as the two fields will tend to become parallel with similar poles in the same direction.

If the large arrow showing the direction of the rotating field be reversed, then the direction of the impulse as shown by the small arrows will be correct. In discussing the relation of the fields, he states further as follows:

"It is thus evident that under all conditions the armature will so place itself that its flux will coincide with that of the field south to north pole at the instant when the latter is at its maximum value." This is correct as it stands, but taken in connection with Fig. 1 it may be interpreted to mean just the opposite of its true meaning. The whole matter is made clear by stating that the two fields tend to become parallel with like poles in the same direction

Ithaca, N. Y. S. R. Dodds.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Series-Shunt Motor.—A description of a compensated single-phase commutator motor of the Felten & Guilleaume-Lahmeyer Company. The motor is a compensated series motor and has two sets of commutator brushes. "It has a primary stator winding the magnetic axle of which coincides with the direction of the short-circuited power brushes. In quadrature with these are the excitation brushes which are connected in series with the stator winding, and simultaneously in parallel with the network by means of a shunt transformer. The excitation brushes are, therefore, connected in a double way to the network and for this reason the new motor is called a series-shunt motor (Doppelschluss motor)." The special feature of this motor is its high starting torque; with double the normal current it developes up to about 4.5 times the normal torque.—*Elek. Kraft. u. Bahnen,* May 24.

Turbo-Alternators.—An illustrated description of the pair of 2000-kw, three-phase turbo-alternators for the municipal station of Sydney.—Lond. *Elec. Eng'ing,* June 6.

Hjorth.—An article, illustrated by diagrams, giving historical notes on Sören Hjorth, a Dane, who is the original inventor of machines embodying the dynamo-electric principle and who in 1851 filed a provisional specification for a machine embodying this feature.—Lond. *Elec. Eng'ing,* June 6.

Lamps and Lighting

[illegible] electricity committee to adopt Nernst lamps in preference to [illegible] cables are already laid. Tests were made which were attended to by gas companies' representatives with their instruments. The details of the tests are given in a table.—Lond. *Elec. Eng'ing*, June 6.

Power

Development of Large Power Stations.—T. C. McBride.—His presidential address before the Engineers' Club of Philadelphia on recent developments in large electric power plants using coal as fuel and supplying lighting and traction systems. The author gives an outline of the gradual development of large high tension alternating-current distribution systems with substations, and the gradual rise in the transmission voltage. Storage batteries are rapidly assuming an important place in the organization of large power plants, and it is said that the usefulness of the storage battery has been much increased, particularly during the last year, by a great increase in the possible discharge rate for short periods. The author thinks it likely that the near future will see the storage battery applied to alternating-current plants, since for single-phase railways it may be advisable to supply distant stations with batteries and rotaries which will run inverted and also possibly with automatic boosters. The development of large steam engines is then traced and some data are given on the design of steam engines of 7500 horse-power at their best efficiency which are thought to represent the final development in size of the steam engine for electrical power-house work. The great progress made in steam turbines is then described and the development, together with the steam turbine, of the use in the United States of the superheater and of a special form of condenser for high vacuum. The large gas engine has not made any impression on strictly central station practice in the United States, but is now making rapid progress in steel works, and from the advantages it has to offer to central stations its extensive adoption by them in the near future seems assured. The author makes a comparison between the cost of installation and the cost of operation of a 16,000-hp plant using either steam turbines or gas engines. The load factor is assumed to be 60 per cent. The cost of installation per kilowatt of nominal rating of a gas plant consisting of four 4000-hp gas engines, four gas producers and four 3000-kw generators, with accessories, etc., is given as $90.98. The results of the comparison of cost of operation are given in the following table. As no charge is made against the gas engine plant for the cooling water, the steam turbine plant is charged with only its make-up [illegible]

	Cents per kw. Hour. Turbine.	Gas Engine.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
	.388	.216
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]		
[illegible]		[illegible]
[illegible]		
[illegible]		[illegible]
	[illegible]	[illegible]

The author then figures that even looked at in its most disadvantageous light the gas-engine plant in capitalized saving in operating expenses has a very considerable advantage over the steam plant in first cost. In the discussion, C. E. Lucke thought that the figures of cost for the first installation of the gas-engine plant and for its operation given in the paper are far too low, and that each cost should be increased by 50 per cent. He thinks the question whether it is advisable to use the gas engine instead of the steam engine depends on local conditions and especially on two factors, the cost of coal per ton and the load factor. When coal is expensive and the load factor is high, it will be advisable to use gas engines, and they will earn good dividends on the increased first cost over a steam station. H. P. Childs gave some facts on the very successful operation of gas-engine driven alternators in parallel, with frequencies of 25 and 60. One of the independent operating companies at Hazleton, Pa., has a culm pile consisting of about 2,000,000 tons that has been stored up for a great many years. It does not pay them to ship this coal, so recently a plant has been installed to generate electricity directly at the mines. While this is merely a beginning, the expectation is to put in a large plant, and from careful engineering figures, the investment will pay handsome dividends. There is a large market for energy within 30 miles of Hazleton, and while there is no market for the culm, the culm is being charged to the plant at 50 cents per ton, so it enables the mining property to realize on what was heretofore practically a waste product and also to make money on the electric plant. C. Hering referred to the freight charges for coal on railroads. If it is a fact that the cost of transportation of coal is about two-thirds of the whole cost to the consumer, then the efficiency of this kind of transmission is 33⅓ per cent, which is poor compared with the efficiency of electric transmission from a power plant located at the mines to distant cities. Moreover, the cost of the railroad with all its equipment is much greater than the cost of the electric plant to transport all of that energy in the form of electrical energy rather than to transport the coal on freight cars. In other words, the carrying of coal on freight cars is certainly a very poor and antiquated system at the present day, and it is surprising that it has continued to exist so long. Concerning the Thury direct-current high-tension system, he thinks that its chief sphere is in connection with a river that has a series of cataracts some distance apart. A central station can then be erected on each large fall, and all connected in series together. E. G. Perrot brought up the question of electric power transmission from a power plant located in the Pennsylvania mining district, say, at Hazleton or Wilkes-Barre. Heat is needed in winter time and the question is whether the cost of heating houses by electricity generated at the mines would be any more than if the heat were generated in stoves or heaters. H. K. Myers replied that "figuring on the cost of fuel for gas producers with the idea of getting down to about 1 lb. per kw-hour would mean 2000 kw-hours from a net ton of coal; based on a 10 per cent loss with the transmission line would mean a charge of $2 per ton to get that fuel to its destination based on energy at 1 cent per kw-hour, while coal is now being shipped to Philadelphia at a much less price. Energy is produced in Philadelphia, after paying freight on coal, cheaper than it would be if it were transported over transmission lines from the mining centers." J. Christie stated that the records of cost of electric energy at the Pencoyd and Ambridge plants of the American Bridge Company show six-tenths of a cent per kw-hour. The fuel cost is less at Ambridge than at Pencoyd, but other expenses are greater, and the totals average alike at both places. This cost is made up of prices paid for all material and labor, etc., and to these is added 10 per cent per annum of the entire cost of the generating plant and the distributing lines, but it does not include the losses in the lines; that is, it is the cost of energy delivered at the switchboard. When to this cost is added the pro rata of all the general distribution charges of the works, the entire cost of energy is very close to nine-tenths of a cent per kw-hour. These figures represent the costs for direct-current electric stations of not less than 1000 kilowatts. In his reply, T. C. McBride said that his estimate of first cost is based on actual selling prices of manufacturers. If Prof. Lucke thinks that the plant would cost twice as much, his estimate is probably based on the consideration of smaller sized units than have been selected in the example given.—*Proc. Engineers' Club of Phila.*, April.

[illegible] An illustrated description of the new power station of the Northern Colorado Power Company. It will be steam driven, coal being obtained from two mines near the plant. The first steam-turbo-genera-

tor installation consists of two 2000-kw units, to supply power for about 15 towns in northern Colorado, which are to be served by the company. The generators are six-pole, three-phase, 60-cycle machines, delta-connected. They are rated at 2000 kilowatts at 13,200 volts and 1200 r. p. m. and guaranteed to carry 50 per cent overload continuously without injury. Two 1000 kilowatt units of the same general type as the 2000 kilowatts units are later to be installed to care for the electrification of the Colorado & Southern Railway. The generators will be 1000-kw, 11,000-volt, 25-cycle, one-phase machines. The power will be distributed by two high-tension plants at a voltage of 13,200 and 44,000 respectively and by several 2400-volt lines. There will be seven sub-stations.—*Jour. of Eng'ing*, University of Colorado, No. 3, 1906-7.

Power Station.—An illustrated description of the new power station of the Great Eastern Railway Company at Stratford for the supply of their local power and lighting requirements. The station is a good example of modern cheap construction. Steam turbines are used.—Lond. *Elec. Eng'ing*, June 6.

Charging Apparatus.—G. MEYER.—The first part of an illustrated description of new electrically-operated charging apparatus for blast furnaces.—*Elek. Kraft. u. Bahnen*, May 14 and 24.

Internal Combustion Motors.—BOCHET.—A paper read before the Society of Electricians in Paris on the various types and the advantages of internal combustion motors.—*L'Ind. Elec.*, May 10.

Traction.

One-Phase Railways.—F. E. WYNNE.—A general discussion of one-phase traction discussing the subject under the following heads: The electric motor, control, collector, trolley line, transformer stations, transmission lines and power station. The relative advantages and disadvantages of the one-phase system in comparison with the ordinary direct-current system and in comparison with the three-phase railway system are then summed up and it is thought that the one-phase system is not adapted to all branches of traction work. For instance, in cities the trolley voltage would probably be limited to a value that would preclude the use of one-phase apparatus. Again, it is evidently not suited to mine haulage in general, where space is limited and the necessary high-voltage trolley would be within easy reach of the workman. Also, certain short interurban roads may show an advantage in favor of the 550 to 650 volts direct-current system. However, the one-phase system is especially suited to general interurban work for moderate and long distances, chiefly because of the reduction in the number and cost of sub-stations and low-tension distribution system, and because of the absence of constant sub-station attendance. It is also well adapted to heavy service, frequent or infrequent, such as the electrification of an existing suburban steam service, branch lines of steam roads, through steam lines and mountain grades. On lines with numerous heavy grades recuperation of energy is of importance. Finally some illustrated notes are given on one-phase locomotives. —*Proc. Engineers' Club of Phila.*, April.

Installations, Systems and Appliances.

Shunt Resistances for Speed Regulation of Motors.—J. WAGNER.—The lefthand diagram of Fig. 1 shows the usual arrangement of a shunt motor for variable speed. It is usual to interlock the levers of the starting and of the regulating resistances in such a way that when stopping the motor the lever of the regulating resistance is brought back to its original position, so that when the motor is started again it is started with a strong field. For motors with high voltage and small output the regulating resistance becomes quite cumbersome with this method. For instance, in case of a 440-volt motor with a field resistance S = 520 ohms, corresponding to a shunt curve i_2 = 0.85 amperes, a regulating resistance may be desired for regulating i_2 from 0.85 to 0.13 amperes. The required resistance would be 2880 ohms. Although only a weak current flows through this resistance, its mechanical construction will make it rather cumbersome and expensive. The present author shows an arrangement well known from the potentiometer method can be used here to advantage; this arrangement is shown in the righthand diagram of the illustration. The regulating resistance R is connected across the total supply voltage and the field circuit S is connected in parallel with only a part a of the regulating resistance R. The author shows that under this

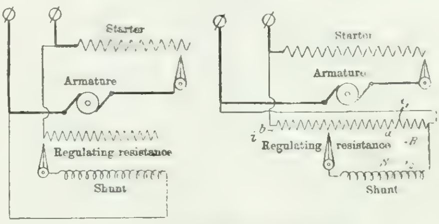


FIG. 1.—MOTOR SPEED REGULATION.

condition the current which flows through the part a of the regulating resistance R is approximately constant. If in the numerical example mentioned before R is made only two-thirds of the resistance which would be required with the other arrangement or about 1700 ohms, then the maximum shunt current i becomes 1.11 ampere or 30 per cent more than i_2. Further, i_1, which is constant, is 0.26. The maximum speed i is 0.39 ampere or about three times the minimum current with the former connections. The method proposed by the author involves therefore a diminution of efficiency, but in most cases this is of small importance compared with the saving in the construction of the regulator.—*Elek. Zeit.*, May 30.

Protection of Compound-Wound Generators in Parallel.—G. H. B. BERNARD.—An article in which the author discusses the protection of compound-wound generators when operated in parallel and in which he points out the ineffectiveness of some of the elaborate arrangements sometimes used. The results of his discussion are summed up as follows: A set of compound-wound generators working in parallel and feeding to common bus-bars will be adequately protected if the series coil resistance between the equalizer and the bus-bar is so proportioned that the full-load voltage drop is the same for each coil, and the other side of each armature is protected by an automatic overload and reverse-current circuit breaker, which will open (1) instantly when the reverse current reaches a predetermined value, usually 10 per cent to 20 per cent of full-load current, and (2) after an interval of from one to five seconds (according to the overload rating of the generator), when the forward current reaches a value equal to about four times the full load. The ends of the series coil may with advantage be connected through a double-pole switch to the equalizer and bus-bar. There is then no chance of the generator being paralleled in with the equalizing switch open. Finally, it is entirely unnecessary to connect an automatic cut-out between the series coil and the bus-bar.—Lond. *Elec. Eng'ing*, June 6.

Hose Resistors.—An account of a system of electric resistors recently patented by R. von Brockdorff. Electric resistors for converting large quantities of energy into heat are employed as load-resistors for portable work and in laboratories, and also for starting large motors in the working of electric railways and central stations, and for many other purposes. Tubular resistors cooled with water comprising a metallic core surrounded by wires or conductors suitably insulated have been used in the past. The author proposes the use of metallic hose instead of such tubes, since metallic hoses possess much greater resistance than tubes of the same material, length and weight. Thus, for example, the resistance of a steel hose of 8 mm internal diameter and 130 grammes weight per lineal meter is 33.8 times that of a steel tube of the same length and weight. The carrying capacity depends primarily upon the quantity of water flowing through. With a flow of some 10 liters per minute a steel hose of 8 mm internal diameter and 1 meter length may be loaded without danger with 400 amperes at 125 volts. This property of metallic hose enables extremely compact resistors to be constructed. By the employment of hose

of large internal diameter and correspondingly increased surface and large cross-section, or in the event of connection in parallel of such resistor hose-section, quantities of electric energy with very great strengths of current can be converted into heat by the use of long hose, or with series connection of the hose-sections, such as with high tensions. In the case of very large permanent loads the water, if it should have to run through the entire length of the hose, would be unduly heated. In such cases the hose may be sub-divided, so that the various parts receive a separate supply of water, while they may be electrically connected in any desired manner. Some illustrations of such resistors are given.—Lond. *Elec. Eng'ing*, May 30.

Paris.—An article giving particulars on the agreement arrived at between the Paris Municipal Council and the Electricity Supply Companies in Paris, under which their concessions are extended to 1940. At this date, all the buildings, mains, machinery and plant will become the property of the municipality without payment. The companies must pay the city initially a minimum of $600,000 a year as royalty; and this sum may be increased considerably, in accordance with a sliding scale, if the new company, which takes over the companies' concessions from 1914 to 1940, makes more than 6 per cent dividend. There are other stringent conditions, one of which refers to the constancy of e. m. f. and frequency. Penalties may be enforced if the e. m. f. varies more than 3 per cent above or below 110 volts, or if the e. m. f at any particular point of the network rises or falls more than 1½ per cent The same limits of variation of frequency are imposed.—Lond. *Elec. Eng'ing*, June 6.

Electric Equipment of Workhouse.—An illustrated article on the electric equipment of the Brownlow Hill Workhouse in Liverpool which has an inmate population of about 4000, apart from the officers and nurses. The results of working point to a considerable saving in costs over the former arrangements, in which the laundry machinery was driven by steam engines and the lighting was by gas.—Lond. *Elec. Eng'ing*, June 6.

Central Station Running.—E. V. Shaw.—Some practical notes on the attention to be paid to special matters in the boiler house, engine room and switchboard.—Lond. *Elec. Eng'ing*, June 6.

Great Britain.—The annual statistical list of electricity supply stations of the United Kingdom. Statistical data are given on 428 stations, their equipment, etc.—*Supplement* to Lond. *Elec. Rev.*, June 7.

Wire, Wiring and Conduits.

Fireproof Cables.—An article on some tests of fireproof electric cables made by a British company. The cable is made up of the ordinary conductor insulated with a thick lap of pure Para rubber and vulcanized rubber, and taped. This is surrounded with several layers of manila paper with a solution to render it non-inflammable. Over this is a strong, flexible woven braiding of small steel wires, which in its turn is covered with more of the manila paper, the whole being finished with braiding of jute, also impregnated to render it non-inflammable. It is stated that the tests were quite successful and that the makers' claim proved true that the cable is amply able to hold the first flash and prevent ignition of the melted rubber. Even when red hot at one point, no flame was present nor did any of the incandescent portions tend to fall away from it.—Lond. *Eng'ing*, June 7.

Slide Rule.—R. D. Knight.—An article describing some of the uses to which the ordinary pocket slide rule may be put in solving the following electrical engineering problems: Given the size number of the wire; to find its resistance per thousand feet; to find the resistance per foot when the diameter of the wire is known in mils; to find the area in circular mils of a given number of wire; to find the weight per thousand feet having been given the B. and S. size number; to find the size of wire for a given drop due to resistance; to find the capacity of copper wire in amperes for open wiring as approved by the national Board of Fire Underwriters; to calculate the resistance of copper with the change of temperature.—*Jour. of Eng'ing.* [illegible]

Units, Measurements and Instruments.

Measuring the Slip of Induction Motors.—H. Schultze.—An article contributed from the German Reichsanstalt on a new stroboscopic method for measuring the slip in induction motors. It is based on the phenomenon of electrically-excited capillary waves on dielectric liquids. The arrangement is shown in Fig.

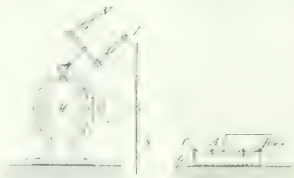


Fig. 2.—[illegible]

2. A cylindrical glass vessel G of about 20 cm diameter and about 10 cm height contains two electrodes, one electrode B of tinfoil, which is pressed by means of glass clamp C against the wall of the vessel and the wire electrode A of platinum which touches the surface of the water just at the center. If the two electrodes are connected to the terminals of a source of alternating current, there begins to start from the wire electrode a system of propagating ring-formed surface waves, of the double frequency of the alternating current. According to the laws of stroboscopic methods these waves appear to be at rest if the surface of the liquid is lighted with a light of the same frequency as the waves. To apply these capillary waves to a measurement of the slip of an induction motor, a stroboscopic disk is placed on the rotor of the motor. This disk has as many slits as the motor has poles. A parallel bundle of light rays passes through the slits, coming from the Nernst lamp N through the lens L and projecting the capillary waves of the water surface on a white porcelain disk on the bottom of the vessel. If the rotor would run synchronously with the revolving field which is produced by the alternating current, the bundle of light rays which fall on the water surface would have double the frequency of the alternating current. Under this supposition the system of annular capillary waves would appear to be at rest if the two electrodes a and b were connected to the same alternating current supply. Since, however, the rotor lags behind the revolving field on account of the slip, the system of waves seems to be propagated from the electrode A. If a dark rings pass per second a certain sharp mark on the porcelain disk and if n is the frequency of the alternating current which drives the motor, the slip in per cent is $100a$ divided by $2n$; if n equal 50, as is often the case in practice, slips up to 4 per cent can be easily measured, four dark rings then passing the mark per second. A slight modification of the method enables one to measure slips up to 8 per cent for a frequency of 50. This is due to a special phenomenon in the production of the capillary waves due to the fact that at the boundary of two dielectrics of different dielectric constants (like air 1, water 80) the dielectric with the higher dielectric constant tends to attract as many electrostatic lines of force as possible. For this reason the water is slightly raised at the wire electrode during the positive as well as during the negative phase of the alternating current. After having been raised, it drops and produces the waves. At the large ring-formed electrode no waves of conceivable amplitude are produced on account of the low density of the lines of force. If the capillary waves are produced on the surface of petroleum, the positive and negative half waves act with about equal force on the dielectric. But this is not the case with other dielectrics, like water and turpentine. At the surface of pure distilled water, the water is raised to a higher level during the negative half wave than during the positive one. With turpentine the reverse is the case. The result is that two succeeding capillary waves have very different amplitudes. If the surface of the liquid is instantaneously lighted after every $1/n^{th}$ second (n being the frequency of the alternating current) this difference in the amplitudes of the two waves is strongly marked. If the surface is

not lighted for an instant only, but somewhat longer so that in every $1/n^{th}$ second the surface is lighted for about $\frac{1}{2}n^{th}$ second and not lighted for the same period, then a special stroboscopic phenomenon is observed. Only the waves of large amplitude are seen. The appearance is as though there were a system of waves of equal amplitude with double the former wave length, that is, a system of waves of the frequency of the alternating current. To use this system of waves for a slip measurement the rotor of the induction motor is supplied with a stroboscopic disk with half as many slits as the motor has poles and the width of each slit is chosen so as to fulfill the above condition. If now a rings pass the mark on the porcelain disk and if n is the frequency of the alternating current the slip in per cent is 100 a divided by n. For instance, if four dark rings pass the mark per second and if the frequency is 50, the slip is 8 per cent. The waves are strongly marked as may be seen from Fig. 3. Distilled water as dielectric is most

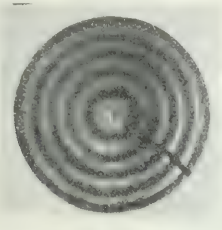


FIG. 3.—WAVES.

suitable for voltages between 200 and 4000, the most advantageous voltage being 500. If the voltage under test is higher it is easy to produce this favorable voltage of 500 between the electrodes of the vessel by connecting a large resistance in series with the vessel which has itself a resistance of 1,500,000 ohms. An adjustable water resistor in U-form is recommended. For turpentine oil the most favorable voltage is between 5000 and 8000. For higher voltages a resistor of turpentine oil having a variable resistance should be used.—*Elek. Zeit.*, May 30.

Slip Indicator.—A. S. DENNISON.—An illustrated description of a slip indicator used by the General Electric Company for taking the slip of induction motors with not more than 14 poles. (See our issue for June 10, 1905, p. 1076.) The slip

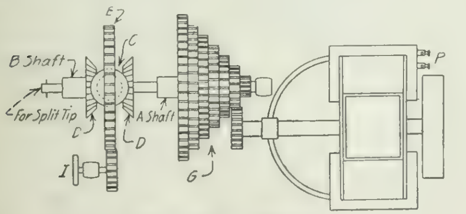


FIG. 4. SLIP INDICATOR.

machine shown in Fig. 4 provides a synchronous shaft and a non-synchronous shaft, with a mechanical means for determining the difference between their speeds. The synchronous shaft is called the A shaft, and the non-synchronous shaft the B shaft. In preparing to take slip on a machine under test, the slip indicator is set up on a small adjustable stand, so that its shaft may be in line with that of the motor being tested. The plugs in the ends of the two shafts are connected by means of a flexible leather coupling known as a "split tip," which has a notched brass socket at each end to fit the plugs. The binding posts, P, are then connected, through a switch, across one phase of the supply circuit, on the secondary side of the transformer used for stepping down the line voltage for the voltmeter. Now the motor on the slip indicator is a four-pole machine, while the motor under test may be of almost any number of poles from two up. As the synchronous speed of any alternating current machine is equal to the number of alternations of the supply circuit divided by the number of poles, it is necessary to provide some means by which the A shaft may revolve at a synchronous speed under different circumstances. For this purpose, use is made of the nest of seven gears, denoted by G in the figure. The gear wheels have a number of teeth in the ratios of 2 : 4 : 6 : 8 : 10 : 12 : 14, beginning on the right in the figure; that is, in the ratio of the number of poles on the more usual machines tested. The pinion on the synchronous motor shaft is the same size as the gear for the four-pole motor, and the figure shows the synchronous motor pinion on this gear, but the synchronous motor may be shifted on the base of the machine and fastened down by pins, so as to run with any gear of the set. Thus for a two-pole motor it would be geared to the smallest wheel, and for a 14-pole to the largest wheel of the set. Between the A and B shafts there is the differential gear, which is the essential part of the device. The differential gear consists of two opposing bevel gear wheels, D D, Fig. 5, holding between them two bevelled

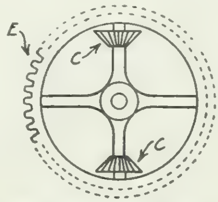


FIG. 5.—DIFFERENTIAL GEAR.

pinions, C, set on the diameter of a larger gear wheel, E, used for starting. If the central wheel carrying the pinions is held fast by grasping the starting wheel I, the rotation of the B shaft is transmitted to the A shaft and thus the motor is brought up to the speed of the motor under test. Now when the switch is closed and the synchronous motor falls into step, the A shaft begins to travel faster than the B shaft. The pinion wheel is then immediately released, whereupon it will revolve at one-half the difference between the speeds of the A and B shafts. That is, to get the slip, count the revolutions of the pinion wheel and multiply by two. The action of the differential gear is made plain by considering a cylinder, C, Fig. 6, revolving between planes N and S. If N travels at the rate of 10 ft. per second, and there is to be no slipping, C must displace its center of gravity so that the points of contact will revolve at the same rate of speed. Hence, an equal amount will be added to the speed of N and subtracted from that of S, or C

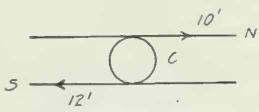


FIG. 6.—DIAGRAM SHOWING PRINCIPLE OF DIFFERENTIAL GEAR.

will move to the left at the rate of 1 ft. per second.—*Jour. of Eng'ing*, University of Colorado, No. 3, 1906-7.

Testing Lamps.—H. PEDIHEUX.—An article discussing in detail the precautions which must be taken in the use of torsion or rotation wattmeters for measuring the power consumed in tests of incandescent lamps. The formulas of the general cases are given and numerical examples are added.—*L'Eclairage Elec.*, June 1.

Miscellaneous.

Electric Industry in Germany.—An account of a report by Schwabach on the electric trade in Germany during 1906. Business was exceedingly brisk, the chief customer being the German mining and metallurgical industry, which is assiduously replacing steam by electric power. The most noteworthy developments in this connection are the success of electrically-driven reversible rolling mills and the construction of a con-

tinuous-current motor for a converter blast, having a rating of 2000 horse-power and operated at 500 volts to run at speeds of 80, 40 and 22 r. p. m. Electric railways are also being extended, especially for suburban traffic. The Felten-Guilleaume-Lahmeyer Company has practically absorbed the Swiss firm of Escher-Wyss & Company, whose specialty is the construction of turbines. The Allgem. Elek. Ges. in Berlin has paid 11 per cent dividends in 1906, against 8 in 1903. Their number of employees has increased from 15,000 in 1902 to 34,000 in 1906. The telephone system, which is owned and operated by the government and belongs to the Post Office Department, has also made rapid progress. The number of towns with local telephone exchanges has increased from 2157 in 1901 to 4062 in 1906, the number of public pay stations from 13,000 to 22,000, the number of telephone instruments from 250,000 to 537,000. At the end of March, 1906, the rural population of Germany had more than 8700 "public telephone stations" at their disposal, while Berlin had 77,000 and Hamburg 32,000. The number of telephone conversations in 1906 exceeded for the first time 1,000,000. With respect to foreign trade, Germany is to be considered chiefly as an exporting country, her principal customers being Belgium, Great Britain, the Netherlands, Sweden, Argentina and Italy, while imports are derived exclusively from France, Great Britain and Switzerland.—Lond. *Elec. Eng'ing,* May 30.

Electrotherapeutics.—A note on experiments made by E. R. Morton at the London Hospital with the high-frequency spark as a local application. He considers the high-frequency spark as a very valuable form of local stimulant with properties peculiar to itself, while it is always under perfect control in the hands of somebody who is accustomed to its use. He first mentions a case in which he applied the high-frequency current to treat the head of a patient for alopecia areata. He used a vacuum glass electrode connected to the top of the resonator, rubbing the electrode over the bald patches until a bright erythema was produced, which in this case took not more than three or four minutes to each patch. Treatment in this manner was carried out three or four times a week, and after about six months hair was growing vigorously all over the previously bald patches, and finally the patient had "a splendid head of hair, which has maintained its good condition ever since." This was in 1904. It is also mentioned that "port-wine stains or marks, which at times constitute a very serious disfigurement, can be entirely removed by this method when they are only of moderate depth and extent, while the more severe cases can be at least very greatly improved. A great advantage of the method is that the normal texture of the skin is quite unimpaired, thus differing from chemical agents and electrolysis." —Lond. *Elec. Engineer,* June 7.

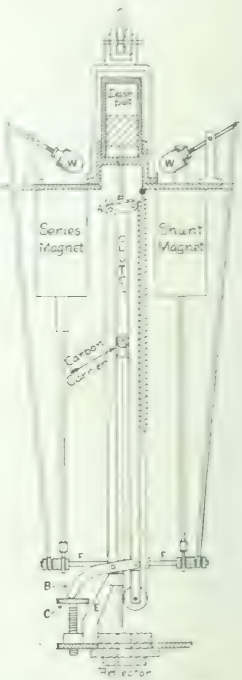
(British) Institution Electrical Engineers.—An account of the annual report. The total number of members has increased from 5973 in 1906 to 6186 in 1907. J. J. Thomson has been elected an honorary member. The work of the organization of the library has been continually carried on.—Lon. *Elec. Eng'ing.* May 30.

British Municipal Electrical Association.—This year's convention is to be held at Sheffield under the presidency of S. E. Fedden, electrical engineer to the Sheffield corporation. Some notes are given on the electricity supply and tramways in Sheffield with an outline of a programme of the convention and personal notes with portraits of prominent members. Considerable electric power is used in Sheffield for industrial purposes, electric heating, etc.—Lond. *Elec. Eng'ing,* June 20.

Constant Potential Luminous Arcs.

A new luminous arc lamp known as the "Flamor" has been brought out by Mr. P. H. Klein, Jr., of 33-37 Bethune Street, New York City. It is herewith illustrated in Figs. 1 and 2. It is arranged to burn two in series on 100 to 125 volts and two, three or four in series on 200 to 250 volts; and it uses for standard size 15¾ in. (400 mm) carbons.

The "Flamor" consists essentially in a simple, practically frictionless mechanism for maintaining a flame arc of constant voltage at the tips of a pair of downwardly pointed carbons by simultaneously raising or lowering them along their converging paths. With the current off, the carbons butting at their tips sustain each other. When the current is turned on, the series magnet (and counterweights *WW*) lift the clutch which grips the carbon-carrier, the moment the extended link *B* leaves the table *C*. This movement separates the carbon at their tips and strikes the arc, drawing it out till the shunt magnet holds it at the adjusted voltage. The suspending means now slowly sinks till the carbon-carrier is released by the clutch, when the link *B* again bears on the table *C* to feed the carbon. In the "Flamor" this operation is practically "sneak-feed." As



FIGS. 1 AND 2.—CONSTANT POTENTIAL LUMINOUS ARC LAMP.

the carbons when not in operation are supported by each other and when in operation are supported from the clutch, the "Flamor" has no shadow casting device below the carbons, which the arc might attack. As will be observed the clutch is direct-acting and operates simply by gravity. The carbon suspension practically floats in the magnetic field of the regulating solenoids, so that it is free from frictional, sluggish conditions in the mechanism.

The "Flamor" lamp is supplied also in the double form, at slight extra cost; and in iron and copper or all copper casings; although other casings, such as burnished or polished copper or oxidized, can be specified.

Liquid Conveying by Ejectors.

Attention has been called recently to the use of ejectors as liquid elevators and conveyors, serving in this manner as a substitute for steam pumps, siphons, etc. Anything in the nature of a liquid of low fluidity or viscosity, can be transported by ejector from one level to another, or horizontally any limited distance. This field of work, as occupied by the "XL-96" type of the Penberthy Injector Company of Detroit, Mich., includes

wells, tanks, factories, ships, distilleries, dye works, paper mills and other industrial plants, where compactness and portability

EJECTOR.

allow the appliance to be placed near the work to be done, and where there is notable resultant economy.

Power Plant at the Charleston Navy Yard.

Piles have just been driven to support the foundations of what is to be known as Building No. 32 at the United States Navy Yard, Charleston, S. C. This is to be the central power plant which will supply electrical energy first of all for the operation of the new concrete and granite dry dock, the largest of its kind in the world, then for the lighting of the yard and the various buildings, and also for the driving of the machine tools and other apparatus in the various shops distributed throughout the yard. The plant will be erected with an appropriation authorized by act of Congress April 27, 1904. The several small and scattered generating stations will now be replaced by the one large central power station and the improvement thus instituted will greatly enhance the present facilities at this yard. The contract for the entire mechanical equipment of this plant is in the hands of Muralt & Company, engineers, of New York. The work to be carried out comprises the installation of a complete generating equipment aggregating 1600 kilowatts and miscellaneous auxiliary apparatus, such as air compressors, pumps for the dry dock, capstans, etc.

The power plant building is a structure of steel and masonry of the latest and most approved design. It will occupy a site 120 ft. x 220 ft., the boiler and engine rooms having about the same floor area and being divided by a wall which runs the entire length of the building. The roof is of the usual trussed girder type. Many large windows afford excellent daylight illumination to the interior. There will be four main generating units of General Electric make; two of 500 kilowatts and two of 300 kilowatts capacity each. They are to be of the standard Curtis type, the large size being vertical and the small size horizontal. The generators are all wound for 2300 volts, three-phase alternating current, of 60 cycles per second. The turbines operate with steam at 150 lbs. pressure, 100 deg. F. of superheat and with 28 ins. of vacuum, and are guaranteed to have a steam consumption at full load not exceeding 18.4 lbs. per kw-hour for the 500-kw unit and 19.5 lbs. per kw-hour for the 300 kw-unit. A complete central oiling system is provided for the lubrication of the present turbine units and 1000 kilowatts in future additions. The two exciter sets are each of 35 kilowatt capacity, compound wound for 125 volts. One is driven by a simple non-condensing vertical steam engine of the self-lubricating enclosed type; the other is driven by a 50-hp. three-phase, 60-cycle, 2300-volt induction motor.

To provide a direct-current supply, two motor generator sets will be installed, each consisting of one 150-hp, three-phase, 60-cycle, 2300-volt induction motor directly connected to two 50-kw, 110-volt, compound wound, direct-current generators. The field rheostats are designed to vary the generator potential from 90 to 135 volts.

A bank of three 37.5-kw, oil-insulated, single-phase transformers, stepping down the potential from 2300 to 230, furnish a low voltage supply for station lighting and other purposes.

There will be four water-tube boilers of 350 horse-power nominal rated capacity, the four boilers set in two batteries of two each. The boilers are designed for a working pressure of 200 lbs. per sq. in. and they will withstand operating at 50 per cent above their rated output for periods of 12 hours continuously without showing signs of strain or deterioration. The boilers are now furnished by the Heine Safety Boiler Company. Each boiler has 3500 sq. ft. of actual heating surface below the waterline and about 80 sq. ft. of effective stoker grate surface. Each boiler will be provided with a Foster superheater of sufficient capacity to add 100 deg. F. to the steam at 150 lbs. gauge. Arrangements are made so that both superheated and saturated steam can be drawn from the boilers. These boilers will be fitted with Murphy automatic mechanical stokers, guaranteed to burn bituminous coal without smoke and to burn sufficient bituminous coal to maintain the boiler in operation under a continuous overload of 50 per cent. An enclosed steam engine of the proper size will drive the stoker mechanism. The evaporative efficiency of these boilers, with feed water at a temperature of 150 deg. F., boiler pressure of 150 lbs., steam at a 100 deg. F. of superheat, fuel (bituminous or semi-bituminous) of a calorific value not less than 13,500 B. T. U.'s per pound dry, draft at damper not exceeding 0.5-in. water gauge, will not be less than the equivalent of 10 lbs. of water from and at 212 deg. F. per pound of dry coal.

There will be a brick smokestack, aided by an induced draft apparatus. A fuel economizer of the Sturtevant make will be installed on a supporting frame work of steel I-beams construction. It will consist of 28 sections of 10 tubes each, with a total heating surface of about 3400 sq. ft. Induced draft will be provided by the installation of two full housing, steel-plate exhaust fans, each driven by a direct connected vertical enclosed engine. This equipment, which is made by the American Blower Company, is designed to create a draft of not less than 0.5 in. of water when discharging 52,000 cu. ft. of gas per minute at about 550 deg. F., or when discharging 21,500 cu. ft. at about 300 deg. F. The fan housings are of the usual standard steel plate and angle iron construction. The fans themselves consist of eight blades and are 9 ft. 6 ins. in diameter. The flue connecting the boilers, economizer, fans and stack will be constructed of ¼-in. steel plates with angle iron stiffeners. The entire surface of the flue will be covered with 2 ins. of asbestos (or 85 per cent magnesia) blocks, and a ½-in. coat of hard plaster on wire netting leaving a 1 in. air space between it and the first covering. The arrangement of the dampers in the flue is such as to allow the gases to pass entirely through the economizer, entirely through a bypass around the economizer, or partly through both.

A thoroughly up-to-date feed water set is provided, consisting of one hot well, two boiler feed pumps, the economizer mentioned above, two feed water heaters and a water meter. The hot well consists of a vertical cylindrical steel shell, 4 ft. in diameter and 7 ft. high, provided with an automatic float valve. It is covered with non-conducting material in the shape of magnesia blocks and asbestos-magnesia cement. The feed water heaters are of the closed vertical type, with straight water tubes contained in a cylindrical cast-iron shell. These heaters are of the C. H. Wheeler Manufacturing Company's make and consist of 1¼-in. seamless drawn brass tubes, presenting an effective heating surface of 265 sq. ft. The water meter, of the Worthington make, has 4-in. inlet and outlet connections and has a capacity of 150 gals. of hot water per minute. The boiler feed pumps are of the duplex outside packed plunger type, Blake pattern, having 6 in. x 10 in. water cylinders, designed to operate against a boiler pressure of 200 lbs. The steam cylinders will operate at a steam pressure of 50 lbs.

Each 500-kw turbine unit will be provided with a complete condensing equipment. The two 300 kilowatt units will have one equipment in common. Each equipment is to consist of a surface condenser, hot well, cooler, hot-well pump, circulating pump and dry vacuum pump. The equipment is designed to condense 12,000 lbs. of steam per hour, and to maintain a vacuum of 28 ins. at the turbine exhaust, with con-

[illegible] of the horizontal cylindrical pattern. The tubes are seamless drawn tinned brass, and present a cooling surface of about 2000 sq. ft. per condenser.

The hot-well pumps are of the horizontal centrifugal type, arranged for direct connection to a 3-hp motor. They are capable of delivering 30 gals. per minute against a total head of 80 ft. The circulating pumps are 8-in. horizontal, volute, centrifugal direct connected to a vertical, fully enclosed, automatic oiling steam engine. These units will deliver 2000 gals. of water per minute continuously against a head of 20 ft. The dry vacuum pumps are of the rotative steam-driven type, having a displacement of 150 ft. per minute.

In addition to the electric generating plant, the engine room of the power house will contain two air compressors of Laidlaw-Dunn-Gordon manufacture. They will be of the horizontal steam-driven type, with Corliss type across compound steam and air cylinders. These machines will deliver 1200 and 2500 cu. ft. of air per minute respectively at a gauge pressure of 100 lbs. per square inch. For condensing the steam from these air compressors a condenser equipment will be installed similar to that provided for the turbines, except that this condenser will have 1000 sq. ft. of cooling surface and a combined air and circulating pump with a 10-in. steam cylinder, a 14-in. air cylinder, a 14-in. water cylinder, and a 12-in. stroke.

The present appropriation does not cover the coal handling equipment, but there will be ultimately installed complete facilities, including coal pockets of 50 tons capacity each, weighing scales and chutes for each of the four boilers, a receiving hopper, belt conveyor capable of delivering 950 lbs. of coal per minute, a coal crusher to reduce run-of-mine bituminous coal to 2½-in. size, bucket elevator, flight conveyor, runways, etc. This equipment will elevate the coal from the bunkers in the basement to the crusher and distributing troughs above the hoppers, whence the coal is to be fed directly through the chutes to the stokers.

In a separate building surrounding the pump well for dry dock No. 1, there will be installed a series of electrically-driven pumps for drawing the water out of said dock. Building, as well as pumps, will be furnished by the Camden Iron Works, The four main pumps will rest on a raised concrete foundation at the bottom of the pump well and will have a capacity of 140,000 gals. per minute when pumping out the dock against a head from zero to 33 ft. This performance will be attained with the motors consuming not more than 1000 kilowatts. These pumps are proportioned for suction and discharge pipes 36 ins. in diameter. The two 12-in. drainage pumps will be located on the floor at the top of the pump well and will have a capacity of 3500 gals. per minute when operating at 500 r. p. m., against an average head of 38 ft. The suction pipe is 16 ins. in diameter. The pumps when operating under the conditions mentioned will require about 50 kilowatts of electrical power. These pumps are all of the centrifugal type with vertical shafts, direct driven by electric motors. The latter are three-phase, 60-cycle, variable speed induction motors, the large ones wound for 2200 volts and the small ones for 220 volts.

There are to be seven electric dock capstans, located around dry dock No. 1, three on each side of the dock and one at the head. These capstans will be of the latest improved type with gearing in the base for reducing the speed. They will be mounted on pedestals firmly bolted to the foundations and operated by a worm secured to the motor shaft. Motor gearing and connections will be located entirely below grade so as to offer no obstruction to lines being laid to the capstans. The six small capstans will be capable of developing and sustaining a pull on the rope of not less than 12,000 lbs. at a speed of 17 ft. per minute, or 29,000 lbs. at a speed of 7 ft. per minute. The larger capstan at the head of the dock will be capable of developing and sustaining a pull on the rope of not less than 14,000 lbs. at a speed of 30 ft. per minute or 35,000 lbs. at a speed of 12 ft. per minute. All capstans will be arranged for driving in either direction by hand or by electric motor. The motors to be of the variable speed, three-phase induction type, completely enclosed, water tight, and designed for operation on 60 cycles, 220 volts. The leads from the rotor windings are carried through a hollow shaft to the collector rings. The speed control is effected by varying the amount of external resistance introduced across the collector rings. Each motor is provided with a reversible three-phase controller, adapted for cutting resistance in or out of the secondary circuit of the motor. Controllers are so designed as to permit of continuous operation at reduced speeds.

The control of this entire work is in the hands of the Bureau of Yards and Docks of the Navy Department, Rear-Admiral R. C. Hollyday being chief of the bureau, and Dr. N. M. Hopkins, electrical engineer. The officer in immediate charge at the Charleston Navy Yard is Mr. W. H. Allen, civil engineer, U. S. N. Mr. J. F. W. Bunsen is resident engineer in charge of the work for the general contractors.

Electrification of the Largest White Lead Factory in America.

The National Lead Company owns the largest white lead plant in America. It is known as the Atlantic White Lead & Linseed Oil Works and covers two entire city blocks in Brooklyn, at the foot of Gold Street, not far from the Brooklyn Bridge. This factory, in addition to producing the highest grade of carbonate of lead or white lead, turns out sheet lead, tin and lead pipe, solder, babbitt and type metals, and linseed oil. There are several other factories of the National Lead Company in the vicinity of New York, one known as the Bradley Works, in Brooklyn; another plant known as the Jewett Works, at Port Richmond, S. I., and the Crooke Smelting and Refining Works on Long Island. The National Lead Company has for some time been introducing electric power distribution in its several factories. About four years ago, the Jewett Works built an extension, in which electricity was used exclusively; the Bradley Works were completely electrified about two years ago, and within the last year the Atlantic Factory has been entirely transformed. All these changes were carried out under the direction of Mr. Henry Floy, consulting engineer, of New York City, who has been acting for the National Lead Company for the last eight years.

Comparatively recently, but preceding the electrification of the Atlantic Factory, the boiler plant was reconstructed and five 250-hp Babcock & Wilcox water-tube boilers were installed, together with a 150-ft. self-supporting steel stack. Until last year these boilers supplied steam to some 15 different engines and 20 steam pumps, scattered through the various departments of the factory, in addition to furnishing necessary steam for oil refining. A year and a half ago Mr. Floy was requested to submit a complete report covering the estimated cost and probable saving to be effected by substituting electric motors for the various steam engines and steam pumps. Upon receipt of this report the executive committee adopted in general the recommendations and appropriated about $60,000 to carry out the work. The report of the engineer contemplated abandoning practically all of the engines and steam pumps then in use, and substituting therefor an economical engine located close to the boiler room and of sufficient capacity to furnish all the power required throughout the establishment.

The boiler plant having been recently installed was found, upon test, to be giving satisfactory results, therefore, no changes were made in the boiler plant; although the engineer reported that its economy could be somewhat increased by introducing economizers. Formerly there was a small engine room adjoining the boiler room in which a compound engine was located, driving, by direct connection, the main shaft in the basement of the adjoining white lead mill. By means of

bevel gears and vertical shafts, power was transmitted from this main shaft to the floors above and thence further distributed by belts and gears. There was also another small engine room about 200 ft. from the boilers in the basement of the oil mill, where was located a simple Corliss engine, which furnished power for the oil mill by means of belts, shafting and chain drives. The engine room adjoining the boiler plant has been reconstructed and enlarged to accommodate the entire power generating equipment.

The new main unit, in the reconstructed engine room, is located so as to drive by direct-connection through a 200-hp friction clutch, the main shaft in the first floor of the white lead mill, to which are directly belted or geared all the large and heavy, slow-moving machinery required in the manufacture of white lead. The new and economical engine installed is an 18 in and 36 in. x 42 in. tandem compound, 100 r. p. m. condensing Corliss engine, manufactured by the Harris Corliss Steam Engine Company, of Providence, R. I. The engine is supplied with steam at 150 lbs. at the throttle, the safety valves on the boilers being set at 160 lbs. On the engine shaft, connected to the mill shaft, is mounted a massive flywheel, as well as the rotor of a 350-kw, two-phase, 60-cycle, 240-volt revolving field generator and a pulley driving, by means of belt, a 22½-kw exciter, both electrical machines being of Bullock manufacture. The condenser used is of the "jet" type, manufactured by the Watson Machine Company, of Paterson, N. J. Salt water is used for condensing.

The auxiliary generating unit, which is used as reserve or at times of very light load, consists of a simple 20 in. x 42 in. Corliss engine that was formerly used for driving the machinery in the oil mill. It has been removed to the present engine room and belted to a 200-kw, two-phase, 60-cycle, 240-volt revolving armature "compensated" type, Westinghouse generator and belted exciter. Increased demands for power have recently led the company to conclude to install a larger direct connected unit in place of the belted rig.

Along one side of the wall has been erected a very complete Stanley G. I. marble switchboard, equipped with a full line of ammeters, indicating and recording wattmeters, synchronizers, voltmeters, circuit breakers and switches.

As it will be seen from the foregoing, the new engine furnishes, by direct-connection to the main shaft, a large part of the power required in the white lead mill, as under the old régime. Instead, however, of transmitting the necessary power to the third and fourth floors by means of bevel gears and vertical shafts, motors belted or geared directly to the machines which they drive, or in some instances, to a countershaft driving a group of machines, have been substituted. The main shaft now furnishes power only to the machinery on the first floor, and such on the second floor as may be conveniently and economically belted to it. There are 13 two-phase induction motors, ranging in size from ¾ horse-power to 30 horse-power employed in driving machinery in the white lead mill. Some of the motors are of special slow-speed design in order to meet the requirements of the slow-moving machinery necessarily employed in the white lead industry. The conditions of service are varied, the motors operating elevators, conveyors, pumps, pulp machines, mixers, screens and various other apparatus.

In the oil mill there are 24 two-phase motors varying from ½ horse-power to 50 horse-power. The motors driving direct-geared triplex power pumps of Dean manufacture, used for forcing the oil at high pressure into accumulators, are one of the most interesting features of the electrical installation. When it is recognized that a constant pressure of about 4000 lbs. per sq. in. must be maintained steadily day and night in the accumulators, that the requirements are intermittent, at one time oil in large quantities being required, while at another time no oil is being used, that the entire feed supply must be automatically maintained, regulated and controlled—the intricacies of the problem will be acknowledged. Each pump is equipped with a by-pass valve, thereby permitting continuous operation of the motors, the valves being actuated by the height of the accumulators. Thus the motors and pumps are running practically idle when the accumulators are full, but are instantly prepared to take care of any maximum demands to meet requirements.

Two motors furnish all the power for the lead-pipe departments. One motor is belted directly to one of the three triplex pressure pumps which operate the lead presses; the second motor is belted to a countershaft which drives the other two pressure pumps, a small lead roll and a few machine tools, also the elevator used in the lead trap department. The load on these lead press motors is fluctuating and varies from no-load to 25 per cent overload, but is satisfactorily carried by the motors installed. Induction motors are also used to drive the dock hoist, machine shop tools, the blacksmith forge blower, and even the horse clipping machine in the stable.

The electric drive has already proven a profitable and satisfactory improvement at the Atlantic branch; a large part of the belting and shafting, which encumbered the factory in the old régime, has been removed, thus securing additional floor space, better lighting, economizing the danger to employees; while the greater economy of the new system already shown promises to effect the saving of the annual operating expenses estimated by the consulting engineer.

The 47 induction motors installed were furnished partly by the Westinghouse Electric & Manufacturing Company and in part by the General Electric Company. The wiring installation complete, including both the power and lighting systems, was carried out by L. K. Comstock & Company, of New York; the engine foundations and receiver pit were built of concrete by the Turner Construction Company. The Berlin Construction Company furnished the heavy plate girders and iron work for reconstructing and enlarging the engine room.

In view of the complexity of the installation and the successful carrying on of manufacturing while the changes were being made, great credit is due the various contractors for their co-operation with the consulting engineer and the local representatives, H. P. Cavarly, superintendent, and A. L. Larwill, chief engineer of the Atlantic Factory.

Ventilation of the Boston Subway.

In the Boston subway the change of air once in ten minutes, which is produced by a number of fans, is sufficient to meet all ordinary conditions. But the corresponding rate of flow which is only one linear foot per second from each station toward each center of discharge is extremely low. Such a low rate of flow (which is a measure of the vacuum produced) would leave any ventilating system practically powerless to overcome the effect of ordinary atmospheric changes. A difference of only .01" of water is sufficient to produce a velocity about six times greater than that planned for the subway. The result when large open portals and numerous entrances and exits, to say nothing of moving trains, afford ample opportunity for the creation of pressure differences much greater than .01" has been to render the ventilation decidedly erratic.

Under these conditions the fan becomes merely local in its effect. It is practically powerless to control the direction of such currents at such differences as exist in the subway. In a word, so long as the subway connects through large openings with the outer atmosphere it is impossible for fans of the capacity here installed to properly control the flow of air. The trouble in the case of this installation is not, it is stated, with the individual fans, which are of the Sturtevant open cone-type, but with their size as determined by the subway engineers, for a fan can mechanically meet any desired requirements. The problem is one of volume and velocity, which must be sufficient to insure the maintenance of a pressure difference which cannot be overcome by atmospheric conditions. The entire installation suggests the false economy which is all too likely to be observed when ventilation is to be provided.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—General trade during the week was good, especially in summer specialties, and there was a liberal amount of increase in goods shipped over the various transportation lines. Improvement has become more pronounced in distribution of seasonable merchandise, and with the reduction of retail stocks there is a broadening of interest in jobbing and wholesale shipments of fall and winter lines. Weather conditions have again favored both trade and agriculture, rapid development of the crops being potent for good in commercial departments. Taken as a whole, leading wholesale lines will show a six months' business 5 to 10 per cent at least in advance of 1906. Very much the same report is made by leading industries, which have generally surpassed records made in the first half of a year ago. There was a distinct sentiment of confidence, and mercantile collections are much more prompt. Little machinery is idle in the leading industries. New wage scales for July 1 have been arranged with little friction, few controversies of importance remaining unsettled. Building operations are large, although less than contemplated, owing to financial conditions. In the pig iron trade there was a further slight easing in prices of third quarter iron and furnaces were reported catching up with orders on their books. Business in steel bars was good. Cast-iron pipe was fairly active and structural material was in fair request, the demand being mostly for railway bridge work. New business in steel rails was not heavy, but some large contracts are pending a settlement of negotiations for an improved rail. Metal markets were generally a little lower. Copper went off about ⅜ cent. and demand was light, even at the decline, but large sellers are talking confidently of the future. The closing prices are 23½ cents for lake, 22⅛ cents for electrolytic and 21⅛ cents for casting stock. *Bradstreet's* reports 150 failures in the United States during the week, against 165 for the previous week, and 146 for the corresponding week last year.

ALLIS-CHALMERS TURBOS.—According to advices from the company, Allis-Chalmers turbo alternators are now in operation in the power houses of Utica Gas & Electric Company, Utica, N. Y.; Westchester Lighting Company, New Rochelle, N. Y.; New York Edison Company, Bronx station; Dayton Lighting Company, Dayton, Ohio; Brooklyn Edison Company, Gold Street station; Memphis Consolidated Lighting & Power Company, Memphis, Tenn.; city of Jacksonville, Fla.; Western United Gas & Electric Company, Aurora, Ill.; Kokomo, Marion & Western Traction Company, Kokomo, Ind.; Meriden Electric Company, Meriden, Conn.; Electric Company of America for Canton, Ohio; Interstate Railway Company, Wilmington, Del.; National Cash Register Company, Dayton, Ohio. Other units ranging in capacity from 500 kilowatts to 6000 kilowatts, many of them being on repeat orders, are in process of erection or nearing completion in the shops of Allis-Chalmers Company for the Western Canada Coal & Cement Company, Calgary, Can.; Jamestown Woolen Mills, Jamestown, N. Y.; Savannah Lumber Company, Savannah, Ga.; Flatbush Gas Company, Brooklyn, N. Y.; Indianapolis, New Castle & Toledo Railway, New Castle, Ind.; Helderberg Cement Company, Howes Cave, N. Y.; Kings County Electric Company, Gold Street station, Brooklyn, N. Y.; Citizens' Light, Heat & Power Company, Johnstown, Pa.; Delaware, Lackawanna & Western Railroad Company, for the Hampton Collieries, Scranton, Pa.; Bisbee Improvement Company, Bisbee, Ariz.; Binghamton Light, Heat & Power Company, Binghamton, N. Y.; Brush Electric Light & Power Company, Galveston, Tex.; Northampton Lighting Company, Northampton, Mass.; Calumet & Arizona Mining Company, Bisbee, Ariz.; Pacific Mills, Lawrence, Mass.; American Thread Company, Watuppa, Mass.; Virginia Passenger & Power Company, Richmond, Va.; and Milwaukee Electric Railway & Light Company, Milwaukee. Recent sales include units for the Illinois Steel Company, South Chicago, Ill.; Brush Electric Light & Power Company, Galveston, Tex.; Savannah Lumber Company, for Savannah Lighting Company; American Gas [illegible] Company, Madison, Wis.; Cedar Rapids & Iowa City Railway & Lighting Company, Cedar Rapids, Ia.; L. L. Numm, Provo, Utah.

A TELPHER MAIL SYSTEM has been devised by Mr. W. C. Carr, of Buffalo, N. Y., and the Automatic Transportation Company is incorporated with an authorized capital of $2,000,000. The offices are in Buffalo, N. Y., at Nos. 7 to 9 Lewis Block. The officers of the company are: William C. Carr, president; Joel H. Prescott, secretary-treasurer, and Eugene L. Falk, attorney. The directors are the following: W. C. Carr, Joel H. Prescott, George W. Carr, Geo. H. Winkinson and A. C. Buell, all of Buffalo. Branch offices have been opened in Cleveland and Pittsburg. The development of the system is already under way. Orders have been placed with the Carnegie Steel Company for rails, and other details for construction are being attended to with expedition. Within the next few months the first out-door line will be completed. The system comprises a series of Y-shaped metal poles supporting a double steel track, the length of which is limited only to the necessity. Save at the stopping places the tracks are from 12 to 20 feet above ground—far enough so that even extraordinary traffic is not interfered with. At the stations it is depressed and entirely accessible. Where used to supplant the present free delivery service, these lines will run in loops from a central station, the whole being in shape not unlike a daisy, with its petals. From the central point, the motored carriages are sent out, the mail and parcels for each farmer being arranged in boxes and attached to the carrier in the order in which the farmers' residences are located. The carriers are sent on their way at the rate of 25 miles an hour. Approaching a house for which it has mail, the carrier slows down automatically, deposits the mail in a box and locks it, picks up the mail the farmer has deposited in the outgoing box, rings the bell in the farmer's house, announcing the delivery, then proceeds on its way, instantly picking up its speed of 25 miles an hour. The cost of each round is said to be 5 cents. The point of contact between the motor car and the rail is underneath, in an inverted-V-shaped groove, thus protecting it from the elements.

ADIRONDACK SINGLE PHASE.—The Paul Smith Electric Light, Power & Railroad Company, which is the owner of a seven-mile spur from Lake Clear Junction to Paul Smith's, is proposing the equipment of the line by electric power. A single-phase locomotive will be used with catenary overhead construction. The potential of the trolley wire will be 5500 volts and the locomotive will be equipped with mercury arc rectifiers which will deliver direct current to four General Electric 57 motors. Twelve 40-ampere rectifier tubes will be used with the necessary transformers. This locomotive, it is expected, will be able to haul three Pullman cars on a level at the rate of thirty miles per hour. Electrical energy will be taken from the power plant of the Paul Smith Company, which is developing a water power at Union Falls, eighteen miles distant, from which power will be transmitted at 22,500 volts. It is hoped to have the line in operation this summer.

HUDSON RIVER TROLLEYS.—The Hudson River & Eastern Traction Company, which is proposing to build an electric railway to connect Peekskill, Ossining and other towns along the Hudson River with the county seat at White Plains, won a victory last week at a special term of the Supreme Court at Nyack, when Justice Tompkins dissolved the injunction against it obtained by the Westchester Traction Company. The Hudson River company recently gave a mortgage for $5,000,000 to the Colonial Trust Company and will now proceed with construction. The road will first be completed in Ossining and then extended to Briar Cliff Manor, Pleasantville, Sherman Park, North White Plains and White Plains proper. The company was awarded a franchise last week which takes it to the White Plains line, and an application will be made to enter the village this week, as a certificate of public necessity has been filed.

IMMENSE ORDER FOR GAS ENGINES.—The largest single order for gas engines ever placed in this country, and for the largest engine of this type ever built, has recently been awarded by the United States Steel Corporation to Allis-Chalmers Company, Milwaukee, Wis. Within the past year this company has taken orders for 36 gas engines of 4000-hp each, or an aggregate of 144,000-hp, 25 of which are to be installed as a part of the mammoth new plant now in course of construction by the Steel Corporation, at Gary, Ind.; seven for the Homestead Plant of the Carnegie Steel Company, and four in the South Chicago works of the Illinois Steel Company. These large gas engines weigh 1,500,000 pounds apiece. Their great size is also demonstrated by the fact that the shaft of each measures three feet in diameter. It will require 2300 cars to transport these machines from the works of the Milwaukee company to the different plants of the Steel Corporation, where they will be installed. The wide use of gas engines by the United States Steel Corporation marks an important step in the progress of steel manufacture in this country, as they are designed to operate upon the hitherto "waste" gas developed by the blast furnaces; thus inaugurating an important economy in steel production. The majority of the Allis-Chalmers gas engines on order will drive electric generators of standard Allis-Chalmers type, 25 cycle, three-phase. In addition to the gas-driven electrical units, orders have also been placed with the Allis-Chalmers Company for 12 gas-driven blowing engines. The Indiana Steel Company, Gary plant, will have eight blowing engines, and the Homestead plant of the Carnegie Steel Company has ordered the remaining four units. Each blowing engine has a capacity of 3500 hp, and will deliver 30,000 cu. ft. of free air per minute against a pressure of 18 lbs. per sq. in. which is ordinarily the maximum. All of the gas-driven blowing engines purchased by the Steel Company's plants will be equipped with "Slick" type blowing tubes, the American patent rights covering which are owned by Allis-Chalmers Company.

LONG ISLAND TROLLEYS.—The New York State Board of Railway Commissioners has given its certificate of necessity to the Queens Borough Street Railway Company for a trolley road to run along Van Alst avenue, Astoria, from the present center of the district, at Flushing avenue, through East River Heights, to the new settlement of the Astoria Light, Heat & Power Company. The line will be less than a mile in length, and for 3000 feet will run through the property of the Rickert-Finlay Realty Company, whose officers comprise most of its board of directors. It will be an independent company, but will either extend its line down to the Ninety-second street ferry or arrange for transfers to that point, only six blocks distant. In either case, the time from East River Heights to the ferry will be only five minutes. The road's application for a franchise has been filed with the city's bureau of franchises, and will be heard by the Board of Estimate and Apportionment on July 8. The Astoria Light, Heat & Power Company is at present under the necessity of transporting some 1500 of its employees every day from Manhattan to Astoria on tugs, on account of the lack of housings for them near their work. This condition is, of course, anomalous with families living in the congested part of the city while the bread winner earns his living amid suburban surroundings, but must continue until the company builds its groups of flathouses and the buyers at East River Heights finish their construction work. In the meantime the new trolley line will be of enormous benefit to both properties, and, in fact, to the whole section of Astoria lying along the East River north of Ninety-sixth street.

THE CARSTARPHEN ELECTRIC COMPANY, Denver, Col., has removed its entire establishment to larger and more commodious quarters at Broadway and 20-22-24-26 Colfax Avenue. The steadily increasing demand recently for panel boxes, cabinets, switchboards and other products which this firm manufactures, together with a general growth in all departments, has made this move necessary. This company has a reputation throughout the entire West as manufacturers of large switchboards and as having constructed some of the largest and most elaborate X-ray coils in the country; and is practically the only establishment in that territory which undertakes the construction of any kind of electrical, experimental or scientific apparatus generally supposed to be produced only in the extreme East. This was demonstrated by its pioneer work in wireless telegraphy, some of their apparatus having been in daily operation for the past six years on the Pacific Coast. In the new location, provision has been made for an electric garage and charging station, where it will also handle the agency for an electric automobile, storage batteries, etc. W. P. Carstarphen, Jr., is president and manager and D. M. Gray secretary and treasurer of the firm. L. M. McBride is retained in the capacity of assistant manager and engineer. The recent expansion makes it the largest exclusively electrical house in Denver.

INDUCTION MOTORS FOR GRINDING SHOPS.—Deer & Company, Moline, Ill., one of the largest manufacturers of plows and agricultural implements in the world, recently purchased a number of 20-hp and 30-hp, 60-cycle, 3-phase, 440-volt, Allis-Chalmers induction motors, for use in the grinding shop where the mould boards, shares and other plow parts are ground. The service to which these motors are to be applied is intermittent in character, and the application itself is something out of the ordinary. Each motor is arranged for a pulley on either end of the shaft, but the pulleys are left off and the shaft is extended by coupling to it a piece of shaft about 6 ft. long carrying pulley and having extra bearings. From each pulley is belted a grinding machine, each machine having two emery or carborundum wheels, as desired, for the special type of steel to be ground, making a total of four grinding wheels to each motor, allowing four men the service of one motor, which gives a group drive effect. The pieces of steel to be ground are laid on the frame, and the operator presses the steel against the wheel by lifting the frame up so the desired part of the steel can be ground. Thus there is a possibility of four men grinding at once, but rarely more than two wheels are working at once, because of time consumed in shifting the steel pieces on the frame so as to get them in position to be ground.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company's instrument statement for the month of May and five months ended May 31 compares as follows:

May.	1907.	1906.	1905.	1904.
Gr. output	153,835	211,575	168,7[illegible]4	103,897
Returned	70,577	59,343	53,21[illegible]	51,721
Net output	74,258	152,230	115,[illegible]	52,176
5 mo. gross output	777,743	644,614	777,[illegible]65	508,372
Returned	453,870	303,36[illegible]	231,115	2[illegible]3,[illegible]46
5 mo. net output	323,873	341,252	545,0[illegible]	3[illegible]5,326
Total outst.	7,431,7[illegible]0	6,236,5[illegible]	5,026,814	4,084,843

This indicates a steady gain but well below that of 1905-6, which was abnormal as compared with 1904.

LONG DISTANCE OIL PUMPING.—An interesting installation will shortly be made in the San Joaquin Valley, Cal., when an oil-pumping plant 285 miles in length will be installed. The Southern Pacific Company have recently awarded to the George E. Dow Pumping Engine Company contract for this work. There will be twenty-four separate stations, and each station will be equipped with 750 horse-power of Edge Moor water tube boilers, built by the Edge Moor Iron Company, Edge Moor, Del. This will make the largest water tube boiler installation in the country for pumping oil. The Tracy Engineering Company, of Los Angeles and San Francisco, the Pacific Coast agents of the Edge Moor Company, will erect these boilers.

FUEL ECONOMIZER ORDERS.—The Boston Elevated Railway Company, Lincoln Power Station, Boston, Mass., and the Wood Worsted Mills, Lawrence, Mass., have recently placed repeat orders with the B. F. Sturtevant Company, of Boston, Mass. for their new metal-to-metal fuel economizers. In the case of the Boston Elevated Railway Company, a special form has been adopted to meet special requirements. The Syracuse Malleable Iron Works, Syracuse, N. Y.; Russia Cement Company, Anacortes, Wash.; Glen-Lowry Mfg. Company, Whitmore, S. C., and Union Light, Heat & Power Company, Fargo, N. D., are also installing fuel economizers with metal-to-metal joints manufactured by the B. F. Sturtevant Company.

CHICAGO SUBWAY.—Advices from Chicago state that all connections between the Illinois Tunnel and the various railroad freight houses will be completed within 90 days. President MacRoberts says that the mail service will be extended but no passenger service is in contemplation. Work is being pushed on the construction of switches to 30 additional business houses. Vice-president Collins says it will be completed within 30 days. Last month the company operated 28,000 trains. Facilities now permit of the operation of three times as many. The company operates 47 miles of underground track. Ultimately the system will cover 75 miles.

MOTORS IN PAINT FACTORY.—Some months ago the Wadsworth-Howland Company, of Chicago, large paint manufacturer, suffered the loss of its plant through fire, and instead of rebuilding upon the old site, purchased the paint works of George W. Pitkin & Company, then in process of building, and equipped it with Allis-Chalmers induction motors for driving the entire plant. The electric motor equipment comprises forty-odd motors ranging from 1 to 30 horse-power and aggregating over 300 horse-power. Four 30-hp motors operating at a speed of 900 r. p. m. drive six lead mixers, five 10-hp motors at 1200 r. p. m. drive the white lead and putty chasers, three of the number being used on tandem mills. Fourteen 5-hp machines are used on sampling mills and others for driving 20-in. water cooled mills. Nine 3-hp motors at 1800 r. p. m. drive water cooled mills, two 1-hp motors drive seamers, individual tanks and other auxiliary apparatus throughout the plant. All motors are belted to paint machinery built by Kaestner & Company, of Chicago, which in most cases run at slow speed, for which reason it is necessary to belt to each machine or group of machines through a countershaft in order to reduce the speed. An interesting test was made recently on this plant, when it was found that 86.75 lbs. of paint were ground with an expenditure of 24 kw-hours. With the millstones in better condition, this would have been improved considerably as to output, without any increase in energy consumption.

AUSTRALIAN MATERIAL.—*The Commonwealth of Australia Gazette* announces that tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to Aug. 14, from persons desirous of contracting for the supply and delivery at the Departmental Stores, Sydney, of telegraph, telephone and electric-light material. The country in which the copper for copper wire items is produced must be stated. The *Gazette* also announces that tenders will be received at the office of the Deputy Postmaster-General, Perth, Australia, until Aug. 6, for the supply of a desiccating apparatus with motor-driven air pump for telephone cable work. Tenders must be accompanied by a deposit or receipt for deposit, lodged with the Deputy Postmaster-General in a state other than Western Australia, of 5 per cent on the amount thereof up to $5,000, or 2½ per cent on any further amount in excess of $5,000. In connection with the foregoing announcements it is stated that specifications and descriptions can be obtained at the Commonwealth Office in London, 72 Victoria Street, S. W., and that tenderers can arrange to have the preliminary deposits on their bids paid there.

CENTRAL ELECTRIFICATION.—Another important step was made in the electrification of the New York Central Railroad this week, in the complete abolition of steam at the Grand Central terminus for all its trains. The last ten steam locomotives were dropped July 1, and thus the whole Central terminal business is now handled electrically, marking a significant date in electric railway work on the large scale.

N. Y. EDISON PLANT.—Tenders for constructing the new plant of the Edison Electric Company on 201st Street, which is to be a duplicate of the plant on Fifty-Ninth Street, have been made, but no award is announced as yet. The plant will require upward of 8000 tons of structural steel, it is reported, which contract will be subsequently let by the general contractors.

Financial Intelligence.

THE WEEK IN WALL STREET.—Early in the week the stock market was dull, but became more active with general advances after the middle of the week. Good crop prospects, as well as an apparent ending of the gold-export movement, were largely responsible for this, while the market disregarded the advance of money rates at 7 @ 10 per cent on call as being a natural and temporary result of the enormous July 1 disbursements, which amount to over $180,000,000. The failure of the New York City bond sale to be fully subscribed for caused a break on Friday afternoon. Incidents of the week were scanty, but on the whole favorable. Rumors of a fresh bond issue by the United States Steel Corporation were emphatically denied. The favorable report for the year ending April 1, issued by the American Car & Foundry Company, attracted considerable attention. The decline in copper prices had but little effect on Amalgamated, but the Interborough stocks were again a weak feature in the face of the general improvement. All the other traction stocks and the electric list were more active and made substantial advances in many instances. In a general way the curb market showed a better tone, with twice as large a volume of business as during the previous week. Following are the closing quotations of July 2:

	June 25	July 2		June 25	July 2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Locomotive...	58	58¼	Mackay Cos.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] pfd.	[illegible]	[illegible]
[illegible]	[illegible]	10	Western Union [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	—	Westinghouse com.	[illegible]	[illegible]

BOSTON

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PHILADELPHIA.

	June 25	July 2		June 25	July 2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Elec. Co. of America...	9⅝	9⅞	Phila. Rapid Transit....	23⅞	24¼
Elec. Stor. Battery pfd..	—	—	[illegible]		[illegible]

CHICAGO.

	June 25	July 2		June 25	July 2
Chicago City Ry.......	150	160	[illegible]	[illegible]	[illegible]
Chicago Edison	140	144	National Carbon pfd....	—	—
[illegible]			[illegible]		[illegible]
Chicago Tel. Co........	—	125	[illegible]		[illegible]

*Asked.

PHILADELPHIA TRACTION LAW.—Mayor Reyburn, of Philadelphia, has signed the new ordinance whereby the city becomes a partner in the management of the Philadelphia Transit Company, and in 50 years will become sole owner of the entire traction system. Subsequently the City Councils elected two representatives on the board of directors of the Transit Company. The mayor also becomes a member of the board. Under the ordinance the city is to have half of all the company's profit over 6 per cent. The company must establish a sinking fund to extinguish its capital of $30,000,000 at the end of 50 years. It is required to call in unpaid capital and expend the whole amount in improvements. The city will have a right on any July 1 to take over the whole property upon six months' notice after paying the amount of its outstanding capital stock. This right is assignable. The ordinance to regulate passenger railways approved July 7, 1857, together with all other ordinances on this subject are repealed, but the city retains the right to make all rules and regulations relating to the operation and management of the company's lines necessary for public health and safety. For paving of streets and car licenses the company will pay an annual charge running from $500,000 in the beginning to $700,000 in the last 10 years of the contract. Other fixed payments are provided. The company cannot assume further leases or obligations or part with its property without the consent of the city. It cannot issue stock or bonds without the consent of the Councils. Councils may determine upon routes of new surface, elevated or subway lines, and if the company fails to accept the same within 90 days the city may offer the franchises to those who will undertake them. As a means of assuring payment of part earnings to the city, the controller is to have access to the company's books, accounts and vouchers to verify its financial statements by examination and report result to the Councils.

MR. SPEYER ON THE OUTLOOK.—At the opening of the Hampstead section of the London Underground "tube system" last week, a project in which American capital is largely interested, owing to the flotation here of $15,000,000 of the Underground 5 per cent notes through Speyer & Company, Sir Edgar Speyer, of the London banking house of Speyer Brothers, made an address containing the following remarks regarding the investment situation: "I alluded at the beginning of my remarks," said Sir Edgar, "to the depression and disturbance that prevail in the investment markets, and I must say that the want of sympathy for, not to say hostility to, private enterprise has had an unfavorable effect generally. While the main causes of this depression are what we may call natural causes, I cannot but agree with the view of that eminent financial authority, Lord Rothschild, that the talk of what is loosely termed Socialistic tendency has had a frightening result in many quarters. I consider these fears exaggerated and hardly warranted, but it should be remembered that there is a very narrow margin between fear and caution in business and that capital

is timid. I trust and believe that those in authority are fully alive to this danger, and will realize that in the financial situation as it exists all over the world it is imperative that all impressions of capital being threatened or not sufficiently protected should be dispelled."

DIVIDENDS.—Directors of the Detroit United Railway Company have declared a regular quarterly dividend of 1¼ per cent on the capital stock, payable Aug. 1. The Manchester Traction, Light & Power Company has declared a regular quarterly dividend of 1½ per cent, and an extra dividend of 1 per cent, payable July 15. The Nebraska Telephone Company has declared the regular quarterly dividend of 1½ per cent, payable July 10. Directors of the Mexican Telegraph Company have declared the regular quarterly dividend of 2½ per cent, payable July 16. Dividends have been declared by the United States Telephone, regular quarterly, ¾ of 1 per cent on the common and ½ of 1 per cent on the preferred, payable July 10, and the Havana Electric Company quarterly 1½ per cent on the preferred. The National Light, Heat & Power Company has declared a regular quarterly dividend of 1¼ per cent on the preferred stock, payable July 1. The New York & New Jersey Telephone Company has declared a regular quarterly dividend of 1¾ per cent on the capital stock, payable July 15. The United Traction & Electric Company of New Jersey has declared a dividend of 1¼ per cent on the capital stock, payable July 1. The directors of the Multiphone Operating Company have declared the regular monthly dividend of 1 per cent, payable July 1. The East St. Louis & Suburban Company has declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable July 15. The board of directors of the Havana Electric Railway Company has declared a dividend of 1½ per cent for the quarter ended June 30. The Cincinnati, Newport & Covington Traction & Light Company has declared a dividend of ¾ of 1 per cent on the common and 1⅛ per cent on the preferred stock, payable July 15. The Newburyport, Mass., Citizens' Street Railway Company has declared a dividend of 2½ per cent, payable July 1. The Dayton, Ohio, City Railway has declared the regular quarterly dividend of 1¾ per cent on the common stock and 1½ per cent on the preferred, payable July 1. The Cleveland, Ohio, Electric Railway Company has declared the regular quarterly dividend of ¾ of 1 per cent, payable July 1. The Forest City Railway Company, of Cleveland, Ohio, has declared the regular quarterly dividend of 1½ per cent, payable July 1. The Northampton, Mass., Street Railway Company has declared a semi-annual dividend of 3 per cent, payable July 1. At the meeting of the Hall Signal Company, the dividend of 1 per cent and ¼ per cent extra on the common stock was declared, payable July 1. The directors of the Philadelphia Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable Aug. 1.

WESTERN UNION.—With regard to the recent decline of Western Union Telegraph 7 or 8 points to 78½, and the issue of bonds, the *Wall Street Journal* says: "The surplus available for dividends after deducting bond interest is equal to 5.16 per cent earned on the $97,340,600 capital stock outstanding. Out of this, the company is paying dividends at the rate of 5 per cent, leaving a surplus for the year which is equal to only .16 per cent on the stock, a very close margin. Some comment has been caused by the issuance of $10,000,000 of additional bonds with a consequent addition of $400,000 per year to the fixed charges when the balance sheet shows a surplus of $17,019,898. Such action was justified, however, because the surplus funds have been invested in new plant and extensions and new funds were needed in order to restore the surplus account to its proper relation to the other items in the balance sheet. The capitalization of tangible property such as these additions was entirely proper. An avenue of explanation of the earnings and future probabilities of the company may be followed in the comparative figures, given below, which are practically self-explanatory:

	Receipts	Expenditures	Net.
1906	$30,675,655	$23,60[illegible],071	$7,070,582
1905	29,033,635	21,845,570	7,188,064
1904	29,249,390	21,361,91[illegible]	7,887,471
1903	29,167,686	20,95[illegible]	8,[illegible],471
1902	28,073,095	20,780,766	7,[illegible],328

From the foregoing figures it will be seen that as the company's business has increased during the last five years with but one exception, the ratio of operating expenses to gross income has been greater each year and the balance available for charges and disbursements to stockholders has gradually decreased

WESTINGHOUSE ACTIVITY.—The statement of income of the Westinghouse Electric & Manufacturing Company and its subsidiary concerns for April and May, the first two months of the company's current fiscal year, seem to indicate that unless there is a material falling off in business the company will establish a new high record in earnings, orders received, collections and production for the 12 months ending March 31, 1908 The manufacturing profits in April and May aggregated $1,248,786, and miscellaneous income $155,837, making the total income $1,404,623, which was at the rate of $8,427,738 a year. The following table, from the *Wall Street Journal*, gives the orders, shipments and collections of the Westinghouse Electric & Manufacturing Company over a series of years, and the possible shipments and orders in the current fiscal year, based on shipments valued at $3,880,000 in May:

	Orders	Shipments	Collection
1907-8	$40,000,000	$40,560,000	$40,000,000
1906-7	34,170,047	26,18[illegible],844	30,[illegible]94
1905-6	24,038,631	[illegible]	[illegible],184
1904-5	26,570,617	[illegible]	20,540,478
1903-4	28,701,054	21,12[illegible],640	[illegible]
1902-3	19,5[illegible]2,144	21,4[illegible],708	[illegible],445,443
1901-2	17,027,330	17,804,18[illegible]	16,[illegible]47,774
Totals	$180,638,432	$175,266,401	$178,111,601

The current year figures are based on May shipments. A favorable feature of the Westinghouse Electric's showing in April and May, was the increase in its manufacturing profits on shipments. For example, shipments in May aggregated $3,880,000, and the total net earnings, in that month reached $720,713. Its earnings were equivalent to something like 18½ per cent of shipments in that month.

MEXICAN TELEGRAPH.—The statement of estimated earnings of the Mexican Telegraph Company for the quarter ending June 30, 1907, shows only a small increase in gross earnings and a decrease in net caused by the estimated increase in operating expenses. According to the estimated figures, the gross earnings this quarter will show an increase of approximately 1.1 per cent, while net earnings will show a decrease of 1.3 per cent, the decrease in the latter being caused by the estimated increase in operating expenses, amounting to 14.2 per cent. The item of total income shows an increase of 1.2 per cent, while the quarter's surplus is estimated to be only .05 per cent greater than that of the like quarter of 1906. The total surplus at the end of the quarter will be $212,999, or 9.7 per cent less than the same quarter of last year. Part of the surplus decreases was caused by the increased payments to the Mexican government on concessions. The showing of gross and net earnings of this quarter does not compare very favorably with the same quarter of previous years. In 1905 gross increased $16,500 and net $12,500 and in 1906 gross and net increased approximately $34,500, while for this quarter the estimated increases are only $2,000 each.

CENTRAL & SOUTH AMERICAN TELEGRAPH.—The statement of the Central & South American Telegraph Company for the quarter ending June 30, 1907, partly estimated, reveals a satisfactory increase in gross and net earnings, but the operating expenses as estimated by the company show a large increase, greater in proportion than either gross or net. Gross earnings are estimated to increase 11.9 per cent for the quarter, but the increase of 23.3 per cent in estimated operating expenses makes the showing of net earnings not quite so good as gross, being 6.9 per cent. While the item of total income is increased 6.3 per cent, the quarter's surplus shows a decrease of 9.5 per cent, when compared with the surplus for the same quarter last year. The total surplus as of June 30, compared with the surplus at the same time last year will show an increase of $490,577, or 29.6 per cent. The increase of 25 per cent in the item of dividend requirements is caused by the payment of dividends on the $2,000,000 of stock which was issued on June 1 to stockholders as a 25 per cent dividend.

J. G. WHITE & COMPANY, of London, England, have just presented their seventh report, up to Feb. 28, 1907. It shows a profit for the year of £38,378, the available balance being £47,811. When the year closed the value of contracts on hand was in excess of £1,500,000, and the business included work in Buenos Ayres, Para, Montevideo, Caracas and Bombay. There was carried forward a sum of £18,311, with £20,000 to reserve account, while £9,500 was paid out in dividends and bonus. The allied Waring White Building Company is showing progress

BELL TELEPHONE CAPITAL.—Advices from Boston are to the effect that the success of the American Telephone & Telegraph Company stock subscription has far exceeded the estimates of the management. Final figures will, of course, not be ready for several days, but enough is known at present to make it certain that less than $2,000,000 of the entire $22,000,000 of new stock will remain unsubscribed for. In the early days of the subscription the opinion was freely expressed by many students of the telephone situation that the company could not possibly sell at this time more than $5,000,000 to $10,000,000 new stock. A telephone official says: "The splendid success of the new stock issue proves one thing—that in the midst of a period of universal depression in the security markets of the world the stockholders of the American Telephone & Telegraph Company may be counted upon to support the company by taking a new issue of stock. If the New England investors will loyally support the company at such a time as the present, it is almost self-evident that they will at other seasons when capital is flowing more freely into investment channels." One of the most important results of the new subscription has been the increase in the number of stockholders. Although it will be a week or two before the exact results are known, it is practically assured that the stockholders list now crosses the 20,000 mark. Last January the company had 18,194 stockholders. According to William W. Cook, general counsel for the Mackay Companies, that organization exercised its right to the full proportion of new stock of the American Telephone & Telegraph Company, which will be allotted to it according to its present holdings. As the Mackay Companies hold approximately 70,000 shares, their proportion of new stock at the rate of one share to each six shares already held will be about 11,600 shares, and would entail the payment of $1,160,000.

NEW JERSEY PUBLIC SERVICE.—Last week a 4 per cent dividend, payable quarterly, was declared by the board of directors of the Public Service Corporation of New Jersey. It was the first time the company has taken such action since its organization, May 9, 1903. At a meeting of the directors of the United Electric Company, a subsidiary concern, previous to the meeting of the Public Service board, a special 5 per cent dividend out of the accumulated surplus was declared. The United Electric Company was organized June 1, 1899, but never paid a dividend before. The authorized capital stock of the Public Service Corporation is $25,000,000. Of this amount $12,250,000 has been issued. Besides this there are outstanding in 5 per cent convertible notes $6,250,000, on which two more instalments of 10 per cent each are due from their holders. It is mandatory upon the corporation to convert these notes into stock. When the Public Service Corporation was formed it took over gas, electric lighting and trolley corporations whose outstanding stock aggregated approximately to $60,000,000. Under the terms of the merger this capitalization was lowered to $20,200,000, certificates being issued in exchange for the stocks in ratios as follows: United Electric Company, 30 per cent; Orange & Passaic Valley, 30 per cent; Elizabeth, Plainfield & Trenton, 30 per cent; Jersey City, Hoboken & Paterson, 35 per cent, and North Jersey Street Railway, 40 per cent. The interest charge on these certificates under the merger agreement was to begin at 1 per cent and rise by degrees to a maximum of 6 per cent. Mr. Thomas N. McCarter, president of the Public Service Corporation, after the meeting said that the United Electric dividend represents a division of the present cash assets of the company available for distribution, and as no dividend has heretofore been declared it is at the rate of 5/8 of 1 per cent for 8 years of the company's existence.

STATE LINE TELEPHONE COMPANY.—The filing of a collateral trust mortgage for $5,000,000 by the State Line Telephone Company made to the Commercial Trust Company of New Jersey against which $1,000,000 of 5 per cent bonds will be immediately issued is seemingly the first step of that company to provide funds to finance a fight for an entrance into New York City. The company is one of a group of independent companies which are building lines in New York State and also in New Jersey to compete with the various Bell companies. It is stated that it already has a service as far south as Peekskill and the proceeds of these bonds will enable it to extend its system. The Great Eastern Telephone Company, which is affiliated with this company, is now an applicant for a franchise in New York City, claiming rights under a franchise granted the New York Electric Lines Company in 1883. The corporation counsel has reported adversely, however, on the validity of the franchise and the courts have refused to grant a writ compelling the city authorities to give permission to open the streets for the purpose of building subways for its wires.

WESTINGHOUSE EARNINGS.—The consolidated and condensed statement of income for the Westinghouse Electric & Manufacturing Company and its subsidiary companies for the first two months (April and May) of the present fiscal year is as follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The management, under the direction of E. M. Herr, first vice-president, has been making radical changes in manufacturing methods having for their object an increase in output, a decreased percentage in amount of material carried in stock and in process of manufacture, and a general improvement in quality of apparatus. All sales of the company are substantially for cash and monthly collections are substantially equal to the amount of the shipments.

GOVERNMENT REVENUES.—According to official statistics from Washington the fiscal year of the Government has closed with a surplus of substantially $87,000,000, one of the largest net balances ever shown. In the fiscal year 1902 there was a surplus of $91,287,275, but that was the largest since 1890. In the year just closed the income from the various sources of revenue was $369,306,133 and expenditures $578,376,709, as compared with receipts of $589,574,286 for the last fiscal year, and expenditures of $568,784,790, the surplus in that year being $25,669,322. There has been a tremendous increase in receipts in the year just closing, while the expenditures have been only about $10,000,000 in excess of last year. The largest increase in receipts has been from customs, although internal revenue has shown a big gain. The receipts from the different sources this fiscal year have been as follows: Customs, $333,230,126; internal revenue, $270,309,388; miscellaneous, $61,766,619.

NEW YORK BONDS are not wanted in these days of municipal plants and ownership. Last week the city offered $29,000,000 of 4 per cents and had takers for less than $2,000,000, on which the highest offer for small lots was 101.50. The city offered $20,000,000 of corporate stock for various municipal purposes, $5,000,000 of corporate stock for water supply, $1,500,000 of stock for rapid transit, and $500,000 of stock for the public library. All these issues were for the 50-year term. There was also an issue of $2,000,000 of assessment bonds, payable in 1917. There were received 62 bids from 56 bidders. The total amount of bids received was $2,121,840. The average price of the 1957 stock was 100.091, making the income basis about 3.994 per cent. The average price of the 1917 bonds was 100.02, and the income basis of the latter about 3.997 per cent. The lowest price offered was par and the highest 101.50.

BOSTON EDISON PROSPERITY.—The Edison Electric Illuminating Company declared last week a regular quarterly dividend of 2½ per cent and an extra dividend of 1 per cent. President Edgar said: "By reducing its prices in the last year the company has reduced the bills of its customers by $200,000. Notwithstanding this it finds itself able to pay an extra dividend of 1 per cent, thus adopting in a tentative way the general principles involved in the operation of the so-called sliding scale."

ILLINOIS CONSOLIDATION.—The St. Clair County (Ill.) Gas & Electric Company recently formed by the consolidation of the Belleville Gas & Electric Company and East St. Louis Gas & Electric Company, and controlled by the American Gas Company of Philadelphia, has issued $1,200,000 1st consolidated 5 per cent gold bonds. The capital stock is $3,350,000 common and $150,000 preferred.

LARGE TRACTION MORTGAGE.—A mortgage of the properties of the Chicago City Railway Company was placed on [illegible], due in 20 years, at 5 per cent interest. The money is for use in the general improvement of the company.

CHICAGO EDISON GROWTH.—Special Chicago financial despatches state that the details of the plan to consolidate the Chicago Edison and the Commonwealth Electric companies will be worked out before the adjourned annual meetings of both companies July 15. Directors believe that they can go ahead without the consent of the city, but as the merger proposition became involved a year ago with the question of rates, it has been decided to go before the council again. The so-called Chicago Subway-Chicago Edison deal is regarded by the Edison management as though it never existed. At no time was the management in favor of it or willing to admit its existence as a tangible development. Chicago Edison's franchise expires in 1912, while the Commonwealth's franchise runs to 1947. The Commonwealth in case of merger would naturally take over the Edison properties. All the Commonwealth stock is held for the benefit of the Edison stockholders. Short term notes recently issued by the Edison were guaranteed by the Commonwealth. When the Commonwealth franchise was taken over a contract was entered into by which the Chicago Edison agreed to purchase enough energy from the Commonwealth to pay the interest on its bonds. Since then the Commonwealth has outgrown the original company in importance, but it still sells it energy as at the beginning. A consolidation would mean little in the actual affairs of the two concerns. Combining the assets and liabilities of the two, the capital stock is shown to be $23,614,115. Should the Edison increase its capital to $15,000,000, the consolidated company's capital stock would be $25,000,000. Under the new municipal régime all such public utility systems stand better financially, and if well run like the Chicago Edison will enjoy better treatment than heretofore. The Chicago Edison board is composed of the following: Henry A. Blair, Edward L. Brewster, Samuel Insull, Robert T. Lincoln, Joseph Leiter, John J. Mitchell, Erskine M. Phelps, A. A. Sprague, Lambert Tree. Under the Insull régime the Chicago Edison system has seen wonderful but solid growth.

UTAH-NEVADA POWER.—Articles of incorporation have been filed with the Colorado secretary of state for the Utah-Nevada Power Company with a capital of $7,500,000, by Orlando B. Willcox, Horace G. Lunt, D. B. Ellis, L. B. Johnson, George A. H. Fraser, W. A. Reef, Charles I. Hawthorne and J. C. Darling. The company, of which note has already been made in these columns, is an auxiliary of the Central Colorado Power Company, which has a capital of $22,000,000. Behind the parent company are Former Governor Myron T. Herrick, of Ohio; Thomas F. Walsh, David Moffat and other Colorado capitalists. Its purpose is the construction of one of the largest power plants in the world in the Gore cañon, Colorado, on the line of the Moffat road, supplemented by similar plants on a smaller scale near Glenwood Springs and down in the Gunnison. Another auxiliary power plant is projected in Boulder County and known as the Eastern Colorado Power Company, with practically the same people behind it. The purpose of the parent concern is to develop enough energy to furnish electric power not only to most of the mining districts of Colorado, but also to many of its chief cities for street railways, lights and other commercial enterprises. The organization of the Utah-Nevada Company is intended to furnish electric power to the mining districts, cities and towns in Utah, Nevada and Idaho, as well as in Colorado. The plan is to cover as much territory in the contiguous states as will be feasible and profitable. Seventy-five thousand shares of stock will be issued at $100 a share, 25,000 of which will be preferred and 50,000 common. Six per cent cumulative dividends will be guaranteed annually on the preferred stock.

CINCINNATI LEASES.—In order to comply with the requirements of the Ohio laws in the lease of the Cincinnati, Newport & Covington Light & Traction Company, those interested in the Columbia Company will shortly incorporate the Columbia Gas & Electric Company, of Ohio. The lease will be made to this company and assigned to the Columbia Company, of West Virginia. The lease is for 99 years and will be dated April 1, 1907. The [illegible] the interest on all outstanding bonds, the 4½ per cent dividend on the preferred stock and a [illegible] stock beginning with 3½ per cent the first year and increasing to 6 per cent in the sixth year, which is the rate to be paid thereafter. The first quarterly dividend on the common stock will be paid on July 15. Holders [illegible] of the original railroad stock may subscribe for bonds of the Columbia Company on the basis of 90 per cent of the face value of such bonds to the extent of 50 per cent of their holdings and the same amount of common stock as a bonus. Those who have less than ten shares of stock may subscribe for one $500 bond, paying for it $450 and receiving $500 stock as a bonus. A statement to the stockholders shows that the bond issue of $25,000,000 of the Columbia Company will be used for the following purposes: $9,000,000 for the purchase of the Cleveland gas properties; $6,000,000 to build a pipe line to Cleveland; $6,500,000 to build a pipe line to Cincinnati; $1,000,000 to acquire gas field in West Virginia and $2,500,000 to provide a guaranty fund and take care of future developments.

INDEPENDENT TELEPHONY.—A special dispatch from Rochester, N. Y., gives the following news as to negotiations which still seem to be all in the air: "All negotiations with the St. Louis people for the purchase of the United States Independent Telephone Company for $6,000,000 were declared off this afternoon without result, and the telephone company managers state that the company will be reorganized by its present bond and stock holders. Edward F. Geltra and E. A. Faust, of St. Louis, arrived here from New York for a conference with the option committee of the telephone company. It is understood they were negotiating with New York financiers, represented by the Phenix National Bank, to take over the properties. The St. Louis men told the committee that their deal for taking an option on the properties of the United States Independent Telephone Company at a sale price of $6,000,000 must be declared off."

TELEPHONE EARNINGS.—The Cumberland Telephone & Telegraph Company shows gross earnings for May of $477,753, and a net of $151,534, an increase of $6,004. The United States Telephone shows gross for April of $34,927, and a net of $22,715, a gain of $579. The Cuyahoga Telephone Company's report for the year ended Dec. 31, 1906, compares as follows:

[illegible]	[illegible]	[illegible] Inc.	[illegible]
[illegible]	[illegible]	[illegible] Inc.	[illegible]
[illegible]	[illegible]	[illegible] Inc.	[illegible]
[illegible]	[illegible]	[illegible] Inc.	[illegible]
Surplus	$46,136	$16,014 Inc.	$30,122

ELECTRIC LIGHT EARNINGS.—Several of the systems operated by Stone & Webster report good April earnings. The Lowell Electric Light Corporation shows $24,727 or $3,337 better than in 1906. The Minneapolis General Electric Company reports $71,705, a gain of $9,568. The Edison Electric system of Brockton reports $14,380, a gain of $1,442. The Houghton County Electric Light Company of Houghton, Mich., reports $19,241, an increase of $2,004. A decline is shown by the Cape Breton Electric Company Line, the earnings being $16,880, a falling off to the extent of $1,498, but for the twelve months there was an increase of $14,767.

TOLEDO CONSOLIDATION.—The directors of the Toledo (Ohio) Railways & Light Company have approved the contract by which the company is to take over the properties of the Toledo Gas, Electric & Heating Company. The company guarantees $2,200,000 of $2,500,000 bond issue of the lighting company. The exchange of stock is on the basis of three shares of Toledo Railway & Light for four shares of the lighting stock. The directors authorized an increase of the capital stock of the company from $12,000,000 to $15,000,000 to take care of the payment for the gas companies.

ALLIS-CHALMERS ORDERS.—The recent cry of "dull times" finds no echo in the business of Allis-Chalmers Company, which continues to show a steady gain. During the month of May this company shipped from its works 553 cars of machinery, which was a gain of 20 cars over the record established for April. In April, the aggregate weight of shipments was 21,680,847 lbs., while for the month of May the figure had risen to 23,772,242 lbs., making a total by weight for the two months of 45,463,089 lbs.

WEST INDIA ELECTRIC.—The West India Electric Company, which operates the electric railway and lighting company, Kingston, Jamaica, with Canadian capital, for the year ending Dec. 31 shows gross earnings of $165,776, an increase of $266,013, while the net earnings totaled $87,251, an increase of $17,623. The total loss sustained by the company by the earthquake in Kingston was $15,000. This is the best year the company has ever had.

GENERAL NEWS

Construction News.

[illegible]

[illegible]

UNIONTOWN, ALA.—S. T. Townsend, superintendent of the municipal electric light and water plant, writes that the city is contemplating installing meters next year, and will also install larger hydraulic pumps.

BISBEE, ARIZ.—The City Council has granted a franchise to the Warren Company to operate a street railway through certain streets of the city.

PINE BLUFF, ARK.—The Pine Bluff Water & Light Company has decided to build a new electric light and water works plant on West Fourth Avenue.

LOS ANGELES, CAL.—The Los Angeles-Pacific Railway Company has purchased the franchise for an electric railway from Fourth and Western Avenues, on Western Avenue, to the city limits of Hollywood, for which it paid the sum of $100. The company is also applying for a franchise within the city of Hollywood, which will be a continuation of this proposed line.

LOYALTON, CAL.—Henry Goering is making investigations in the Beckwith section in connection with the erection of an electric plant for the purpose of furnishing this valley with electricity for light and power. The plans of the company also include an electric railway in the project later on.

MAGALIA, CAL.—The Steifer Mining Company is making arrangements to furnish electricity for operating its mines. The company is planning to erect a plant on the Feather River, about 1¼ miles above the Magalia bridge, and about 100 feet below the mouth of Empire Gulch. The plant will have a capacity of about 600 horse-power, and it is expected to have it in operation about Aug. 1. Machinery for the plant has already been purchased.

MODESTO, CAL.—The St. Elmo Construction Company, of Turlock, has applied to the Board of Supervisors for a franchise to erect poles and wires for the purpose of transmitting electricity in this town.

RED BLUFF, CAL.—H. H. and J. J. Hammer have filed notices of their intention to take 10,000 inches of water from the South Fork of the Cottonwood Creek, near the mouth of Maple Creek. The water will be used for mechanical purposes and to generate electricity.

SAN FRANCISCO, CAL.—The General Electric Power Company of California will hold a stockholders' meeting in San Francisco on Aug. 14, to consider and act upon a proposition to increase the capital stock from [illegible] is secretary of the company.

DENVER, COL.—The Silver State Laundry will erect a power house on Walnut Street at a cost of about $2,000.

DANBURY, CONN.—The Danbury & Bethel Gas & Electric Light Company has recently received a 750-kw turbo-generator set which will soon be placed in the power house on Pahquioque Avenue, and arrangements are being made for the purchase of a second generator. Two new 300-hp boilers will be soon installed. Two additional boilers will be purchased, making four in all. The boiler house will have to be enlarged to make room for the two new boilers.

NEW LONDON, CONN.—The State Legislature has passed the bill allowing the Groton & Stonington Street Railway Company permission to furnish electricity for power purposes.

STAMFORD, CONN.—The Stamford Gas & Electric Company is now installing a 650-kw, three-phase alternator, direct connected to a Bass engine in its plant. R. Crawford is manager.

TORRINGTON, CONN.—Extensive improvements and additions are being made to the plant of the Torrington Electric Light Company. A 300-kw turbo-generator set and also a 300-kw General Electric belted type generator is being installed. The system is being changed to 2200-volt, 60 cycles. C. E. Smith is manager.

WINSTED, CONN.—The Winsted Gas Company is contemplating increasing its power plant and will install two 100-kw Curtis steam turbines and 250-hp boilers, and will also change the system to 60 cycles. Henry Skinner is manager.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts until July 16 next to furnish supplies at the navy yards as follows: League Island, Pa., schedule 59, electrical conductor and conduit; New Orleans, La., schedule 63, electrical supplies, etc. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster General, U. S. N.

COLUMBUS, GA.—Extensive surveys are being made along the Chattahoochee River between Columbus and West Point. The first development will be at Clapp's factory just north of Columbus. The company already has [illegible]

[illegible]

ALTON, ILL.—The Alton, Jacksonville & Peoria Railway Company will soon establish an electric railway service from Alton to Godfrey. Electricity for operating the road will be furnished by the Alton, Granite & St. Louis Traction Company until the company can build its own [illegible]

[illegible] E. Rhoads, city clerk, for reconstructing the electric light plant. There will be required one 350-kw generator, 400 series alternating current, 6.6-amp. arc lamps, with regulators and transformers; one surface condenser, with air and circulation pumps; also one smaller direct connected unit, consisting of simple automatic engine and 60-kw generator. A. T. [illegible]

CHICAGO, ILL.—The Chicago Telephone Company is contemplating the construction of an exchange building at 87 and 89 Franklin Street, to cost about $300,000.

[illegible] electric light plant, writes that he is now erecting a new building, and contemplates changing the system from 125 to 60 cycles, and will also install an exhaust steam heating system this season.

KILBOURNE, ILL.—E. H. Parker has decided to establish an electric light plant in this village.

LEMONT, ILL.—The Village Board of Trustees is considering the proposition of purchasing the electric plant of the Lemont Electric Light & Power Company with the purpose of operating it as a municipal plant.

ARGOS, IND.—A new 100-kw Fairbanks & Morse alternator is now being installed in the city electric light plant. A. A. Yarick is manager.

CORYDON, IND.—The Corydon Light, Water & Ice Company will install a new engine and dynamo in its plant this fall.

DANVILLE, IND.—The Town Council has granted a 25-year franchise to the Danville Light, Heat & Power Company.

FT. WAYNE, IND.—It is reported that all bids opened on June 24 by the Board of Public Works for the construction of a municipal electric light and power plant have been rejected, and new bids will be received. Owen Ford, of St. Louis, Mo., is the consulting engineer.

GOSHEN, IND.—The Hawks Electric Company is preparing to erect a plant on the west bank of the canal at a cost of $25,000.

GOSHEN, IND.—The City Council is considering the proposition of adding new equipment to the municipal electric lighting plant.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company will install a new 1000-kw turbo-generator set in its plant.

LAFAYETTE, IND.—The Lane-Pike Company, of this city, has secured the contract for an electric light plant for the Indiana State Soldiers' Home for about $10,000.

PETERSBURG, IND.—The Cumberland Telephone Company has decided that it would not pay the $500 and 2 per cent of its receipts annually [illegible]

WINCHESTER, IND.—The Citizens' Water & Light Company is planning to change its system from direct to alternating current, and will need 1500 incandescent lamps, two 500-light transformers and one 300-light transformer.

ATOKA, I. T.—The Atoka Light & Power Company is contemplating installing a street lighting arc circuit, establishing a day service and [illegible]

DUNCAN, I. T.—The Duncan Light & Power Company is contemplating installing before fall an alternator of 75-kw capacity, and will also install an ice plant.

MUSKOGEE, I. T.—An electrical plant will be installed in the basement of the new Barnes Building.

[illegible] the capacity of its plant to furnish electricity for street railway service. An engine, generator and pump will be installed.

BURLINGTON, IA.—The Burlington & Bonaparte Interurban Electric Railway Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000 for the purpose of constructing an electric railway from Burlington to Bonaparte via West Point, a distance of about 38 miles. The officers of the company are: J. A. Johnson, of Bonaparte, president; John Blual, of Burlington, vice-president; H. H. Meeke, of Bonaparte, secretary and T. L. Lampe, of Burlington, treasurer. Preliminary surveys have been made and work on construction of the road will begin at an early date.

DAVENPORT, IA.—The Davenport & Suburban Railway Company and the Tri-City Railway Company have been consolidated. The first named company has been purchased by the latter for the sum of $1,000,000, to be paid in stock of the Tri-City Railway Company. The directors of the Tri-City Railway Company have voted to increase the capital stock [illegible] Surburban line.

DES MOINES, IA.—Preliminary steps have been taken to increase the lighting facilities in the business section of the city.

MANCHESTER, IA.—Plans are being made to install a new 80 to 100-hp horizontal return flue boiler in the power house of the E. W. Hoag electric light and power plant. Estimates are now being received.

MASON CITY, IA.—The People's Gas & Electric Company will soon place a contract for a 500-kw generator direct connected to a 26 x 48 Corliss engine. The company is planning to furnish after Aug. 1 a three-phase power circuit and an alternating-current day service in addition to the direct-current day service which it now furnishes. The company has secured several contracts to furnish electricity for power purposes. A. W. Zahm is manager.

OSKALOOSA, IA.—The Oskaloosa Traction & Light Company is planning to increase the capacity of its plant and will purchase a 500-hp engine, a 300-kw, three-phase, 60-cycle alternator, and a 200-kw railway generator and to increase station equipment.

SIOUX RAPIDS, IA.—The citizens are considering the proposition of installing storage batteries in the municipal electric light plant.

ARGENTA, KAN.—The Argenta Light & Power Company expects to install a commercial incandescent and arc lamp service by 1908, and also to furnish electricity for operating a street railway line which is now under construction.

JEWELL CITY, KAN.—The Jewell Milling Company is making improvements to the street lighting service, and is installing 53 16-cp street series incandescent lamps. A. G. Blankenship is manager.

MARYSVILLE, KAN.—Extensive improvements are being made to the plant and system of the Marysville Light, Power & Water Company. The Brush arc machine and Thomson-Houston exciter have been discarded, and replaced by a 75-kw, 2200-volt, 60-cycle Westinghouse generator. Two Ball engines, of 110 and 125 hp. respectively, and a 20-hp motor to operate a triplex pump are also being installed. Work on the plant will be completed in about 30 days. G. D. Meyers is manager.

TOPEKA, KAN.—The Water Works trustees are contemplating installing an electric light plant at the pumping station.

DE QUINCY, LA.—C. H. Jenks, of Fayette, Miss., has been engaged as engineer for the proposed water works and electric light plant. Nothing definite has yet been done.

JEANERETTE, LA.—Edward C. Stokes, owner of the Jeanerette electric light plant, writes that he is contemplating adding a Corliss engine direct connected to a 100-kw Bullock generator to his plant.

BALTIMORE, MD.—The stockholders of the Baltimore Electric Company have authorized an issue of $1,000,000 in capital stock, the proceeds to be used in developing the electric business of the company.

BALTIMORE, MD.—The United Railways Company has closed a contract with the McCall Ferry Power Company to supply electricity to operate its system from the Susquehanna River plant. The contract calls for 10,000 kilowatts. The power will not be available until September, 1908. The Consolidated Gas, Electric Light & Power Company recently made a contract with the McCall Ferry Power Company for exclusive use in this territory of all the electrical energy of the company with the exception of that required by the United Railways Company.

HOLYOKE, MASS.—The Holyoke Street Railway Company and the Hampshire Street Railway have applied to the State Railroad Commissioners for approval of sale of the Hampshire Company to the Holyoke company, and for an increase in the capital stock of the Holyoke Company by 600 shares, par value $60,000.

BERRIEN SPRINGS, MICH.—Work has commenced on the $1,000,000 dam across the St. Joseph River at Pardee Island to furnish power for the Berrien Springs Power & Electric Company. The dam will be 21 feet high and 400 feet long.

CHARLOTTE, MICH.—The Commonwealth Power Company is contemplating extending its lines to this place, and the line will probably be carried through to Bellevue, where the company will furnish electricity for light and power in that city.

GALESBURG, MICH.—A private lighting plant is being installed at the Kalamazoo County farm and electricity to operate the plant will be secured from the Commonwealth Power Company.

HANCOCK, MICH.—The Common Council has decided that it is better to pay the Houghton County Electric Light Company $80 per street lamp per year than to invest $33,000 in a municipal lighting plant and has made a contract with the company for five years.

HOUGHTON, MICH.—We are informed that Prof. O. P. Hood, of Houghton, has completed plans for the power house and service tunnel for the Michigan College of Mines and bids for same will be received on July 11. The cost of plant is estimated at $43,000.

MASON, MICH.—A bill has passed the State Legislature enabling the city to purchase electricity from the Commonwealth Power Company to operate the municipal electric lighting system. The municipal plant is in need of repairs, and if kept in operation will need new machinery at once. Some action will probably be taken soon by the City Council and the proposition of purchasing electrical energy from the Commonwealth Company will probably be submitted to a vote of the people.

MT. PLEASANT, MICH.—Work has commenced on the construction of the dams across the Chippewa River five miles east of Mt. Pleasant, to supply power for an electric plant in Shepherd, nine miles south of this place. C. C. Field, of Shepherd, is interested in the project.

PAW PAW, MICH.—The contract for constructing a hydro-electric power plant and dam on Paw Paw River and certain electric light and water works improvements has been awarded to the Falkenau Electrical Construction Company, of Chicago, Ill., for $34,964.

MARSHALL, MINN.—John R. Gray, city recorder, writes that J. B. Robertson, of St. Paul, has secured the contract for improving the electric light plant for $14,407.

HARLOWTON, MONT.—John K. Bright, president and manager of the Citizens' Electric Light & Power, of Lewistown, is considering the proposition of constructing an electric light plant in this place.

ST. LOUIS, MO.—B. H. Matthews and a number of residents of Wellston and Clayton are interested in a project to form a mutual electric lighting company, consisting of the residents of Clayton, Maplewood, Greenwood, Wellston, Webster Grove, DeHodiamont and other thickly populated towns of St. Louis County.

UNIVERSITY PLACE, NEB.—R. E. Shelley, city clerk, writes that Baker & Early, of Lincoln, are preparing plans for an electric light plant, to cost about $15,000.

ELY, NEV.—J. B. Perrine and Major Fred E. Reed, owners of the Twin Falls power plant at Twin Falls, Idaho, recently visited this city and stated that they will extend a transmission line from their electrical system into this city and into other mining camps of White Pine County. If the present plans are carried out a line from the power plant at Twin Falls will soon be running into this city.

FALLON, NEV.—A contract has recently been closed with the United States Government by J. B. Daniel, general manager of the Nevada Wonder Mine and representative of the Brock syndicate, of Philadelphia, Pa., capitalists, for the right to operate the water power at the end of the Truckee-Carson irrigation canal, 15 miles from Fallon. The primary object of the company is to generate electrical power for its [illegible] mill, work on which will commence at once. The company will also furnish the towns of Fallon, Fairview and Wonder with electricity, which will require the construction of a transmission line 75 miles long. The plans of the company also contemplate the immediate construction of an electric railway from Fallon, Fairview and Wonder.

YERINGTON, NEV.—Extensive improvements are being made to the Halachite property under the superintendency of O. H. Sonne. The company has ordered equipment, consisting of an air compressor, power drills, hoist, etc., which will soon be installed and placed in operation as soon as the transmission lines of the Truckee River General Electric Company are completed to this place.

ALBANY, N. Y.—The State Railroad Commission has granted the Suffolk Traction Company permission to construct a surface railroad in Suffolk County, from the town of Brookhaven to Babylon. The line will be 27 miles long.

ALBANY, N. Y.—The Buffalo, Genesee & Rochester Railway Company has been granted authority by the State Railway Commission to construct a double track street surface railroad 60 miles long from Depew to Rochester. The company has a capital stock of $7,500,000, and has been given consent to issue a mortgage for $5,000,000, the proceeds to be used for financing its construction.

AUBURN, N. Y.—The Auburn & Northern Electric Railroad has filed certificates of extension of its line from this city to Aurelius, a distance of about nine miles, and from there to the village of Seneca Falls, about two and one-half miles distant.

BABYLON, N. Y.—The Suffolk County Lighting Company has been granted a certificate of authority by the State Commission of Gas and Electricity to transact business in the town and village of Babylon.

BROOKLYN, N. Y.—The Board of Estimate has approved the franchise for the construction of an electric railway on Livingston Street.

BROOKLYN, N. Y.—Bids will be received until July 8 by C. B. J. Snyder, superintendent school buildings, New York City, for installing electric light wiring, fixtures, etc., in School 54, Borough of Brooklyn.

BUFFALO, N. Y.—It is reported that the Buffalo Southern Railway Company is contemplating the construction of a line from Buffalo to East Aurora, a distance of about 13 miles. Work on the road will be started this year.

CANANDAIGUA, N. Y.—It is stated that the Rochester & Eastern Rapid Railway Company will soon remove all high tension wires which are now within the limits of the corporation, and place them outside the corporate limits of the town.

CANANDAIGUA, N. Y.—The Ontario Light & Traction Company has placed contracts for the rebuilding of its electric light plant at Littleville, from which Canandaigua, Shortsville and Manchester are supplied with electricity. The present arc lighting system now in use will be replaced with luminous arc lamps.

CANTON, N. Y.—The Canton Electric Light & Power Company has been granted permission by the State Commission of Gas and Electricity to increase its capital stock from $18,000 to $38,000.

CHITTENANGO, N. Y.—The Board of Village Trustees has granted a franchise to the Syracuse & Chittenango Railway Company for a street railway system in the village.

HORNELL, N. Y.—The Hornell, Bath & Lake Keuka Railway Company has received authority from the State Board of Railroad Commissioners to build an electric railway from Hornell through Bath and Hammondsport to Branchport.

[illegible] operating in this place. The village is taking steps to condemn the plant of the Wetmore Electric Company, intending to operate it as a [illegible]

MT. VERNON, N. Y.—The State Commission of Gas and Electricity has ordered the Westchester Lighting Company to reduce the price of electricity furnished in Mt. Vernon from 20 cents to 13 cents per kw-hour, to take effect Sept. 1.

NEW YORK, N. Y.—The State Board of Railroad Commissioners has granted a certificate of necessity for a proposed electric railway to run on Van Alst Avenue, Astoria, from Flushing Avenue to the proposed new settlements of the Astoria Light, Heat & Power Company.

NIAGARA FALLS, N. Y.—William C. Thayer, of East Aurora, has secured the contract for installing the outside electric lighting system for the State Reservation for about $13,000.

ONEIDA, N. Y.—The Railroad Commissioners have approved of an increase of the capital stock of the Oneida Railway Company from $15,000 to $2,000,000. This increase is for the purpose of further construction and equipment and improvements already made, and which are now being made by the construction company for the Oneida Railway in connection with the electrification of the West Shore Railroad between Utica and Syracuse.

ONEONTA, N. Y.—The Hudson River Electric Power Company is contemplating extending its lines to this place. A representative has been in city recently making investigations with a view of applying for a franchise to furnish electricity for lighting and power purposes.

ORANGEBURG, N. Y.—The State Commission of Gas and Electricity has authorized the Rockland Light & Power Company to reduce the price of electricity furnished in Orangeburg from 20 cents to a maximum rate of 15 cents per kw-hour outside of incorporated villages, to take effect Sept. 1.

PATCHOGUE, N. Y.—The Suffolk Traction Company has been granted another franchise by the Town Board of Brookhaven and Highway Commissioners for a cross island route connecting Patchogue and Port Jeffer- [illegible]

POTSDAM, N. Y.—The State Commission of Gas and Electricity has denied the application of the village of Potsdam to establish and operate an electric lighting system for commercial purposes.

RICHMOND, S. I., N. Y.—Bids will be received by C. B. J. Snyder, superintendent school buildings, New York City, until July 8, for installing electric equipment in addition to and alteration in School 13, Borough of Richmond.

ROME, N. Y.—The directors of the Rome City Railway Company have voted to increase the capital stock of the company from $150,000 to $500,000. A small part of this increase will be used to pay for improvements recently made and the balance held in the treasury to pay for extensions that are contemplated.

SARATOGA, N. Y.—The State Commission of Gas and Electricity has ordered a reduction in the price of electricity supplied by the Saratoga Gas, Electric Light and Power Company from 12½ cents per kw-hour to 8 cents per kw-hour, to take effect Sept. 1.

UTICA, N. Y.—It has been announced that the Utica & Mohawk Valley Railway Company will soon commence work of electrifying the Deerfield horse line, a franchise for which was recently granted by the Village Board of Trustees.

WAVERLY, N. Y.—The State Commission of Gas and Electricity has granted the Sayre Electric Company, of Sayre, Pa., permission to transact business in Waverly, N. Y., and also to lease the distributing system of the Waverly Light & Power Company for a term of 99 years.

TRYON, N. C.—G. Hamilton Holmes, chief engineer of the Tryon Electric Light, Water & Power Company, writes that the water works plant is nearing completion, and surveys have been completed and plans are now being prepared for power development. The cost of the proposed power plant is estimated at about $65,000.

FARGO, N. D.—The Northwestern Telephone Company is planning extensive improvements to the Fargo territory, which will involve an expenditure of about $25,000.

FARGO, N. D.—The North Dakota Independent Telephone Company is planning a number of improvements in North Dakota, which include the building of a new toll line to Carrington and the remodeling of the Jamestown and Bismarck exchanges, and additional circuits from Fargo to Hillsboro, Casselton and Valley City.

CINCINNATI, OHIO.—Gustav and Nicholas Wolf are contemplating the construction of a six-story power house to be erected at Pearl and Lawrence Streets.

COLUMBUS, OHIO.—The Columbus Citizens' Telephone Company has installed automatic telephones at Canal Winchester and Worthington and it is said that calls may be made from these points to the subscribers' telephones in this city, thus making a very convenient arrangement. If the plan proves a success the same thing will be adopted at a number of other points where the company has exchanges. So far, there seems to be general satisfaction with the automatic system in use here. As people become more accustomed to it, they like it better, although at first there was considerable complaint.

CRESTLINE, OHIO.—The Crestline Local Telephone Company has increased its capital stock from $50,000 to $75,000.

JOHNSTOWN, OHIO.—The capital stock of the Johnstown & Croton [illegible] $80,000.

LIMA, OHIO.—Plans have been drawn for an auxiliary light plant [illegible] $30,000. The contract for lighting is now held by the local company, which is controlled by the Schoepf syndicate.

LORAIN, OHIO.—Plans are being prepared by Architects Ford and Rossman for the new power house of the American Shipbuilding Company.

SANDUSKY, OHIO.—The Sandusky Gas & Electric Company is contemplating installing a 120-kw. alternating-current generator this year. E. A. Beckstein is manager.

EL RENO, OKLA.—An ordinance has been passed by the City Council granting an electric light and power franchise to G. E. Bright for a term of 21 years.

LAWTON, OKLA.—Messrs. Larsh & Render, owners of the Norman Light plant, have purchased the Lawton electric light plant and will take charge July 1.

GRANITE, ORE.—It is stated that arrangements have been completed for the building of a transmission line from the Fremont power plant to the Greenhorn district. Work will be commenced this summer after the line is completed to Bourne.

PORTLAND, ORE.—The Oregon & Washington Lumber Manufacturers' Association will co-operate with the Cottage Grove Commercial Club in plans for the building of a railway from Portland to Cottage Grove via the Coast Fork of the Williamette River to connect with the road to be constructed from Roseburg to Marshfield. A. C. Dixon is chairman of the railroad committee of the Cottage Grove Commercial Club.

BRADFORD, PA.—W. R. Page, general manager of the Western New York & Pennsylvania Traction Company, states that the company proposes to rebuild the entire system in Bradford, and also to rebuild and extend the Lewis Run line. The company is also contemplating the construction of an electric railway from Eldred to State Line. Mr. Page also states that the company is to construct a line from Bradford to Carrollton.

BUTLER, PA.—The Butler, Saxonburg & Tarentum Street Railway has applied for a charter to build a road 26 miles long, which will open up a mineral spring territory.

CARMICHAELS, PA.—The Town Council has granted a franchise to the Masontown, Smithfield & Brownsville Street Railway Compnay. The company proposes to build a street railway from Masontown to Carmichaels; also from Carmichaels through Clarksville and Zollarsville.

CHAMBERSBURG, PA.—It is reported that a new electric light and power company will soon be formed by interests closely identified with the Blue Ridge Land & Hotel Company for the purpose of supplying electricity for both power and light in the vicinity of Monterey, Blue Ridge, Summit, Buena Vista, Highfield, Pen Mar and other resorts in the Blue Ridge section.

HAZLETON, PA.—The Consumers Electric Light & Power Company has decided to build a sub-station.

IRWIN, PA.—The Manor Valley Railway Company expects to place contracts during the next four weeks for the construction of an extension to the Pittsburg & Westmoreland Railway Company line, a distance of four miles.

KITTANNING, PA.—F. A. Moesta, general manager of the Kittanning & Leechburg Railways Company, writes that the company has recently purchased all the stock and franchises of the Kittanning Electric Light Company, and that the present plant will be dismantled as soon as the additional unit is installed at the Garretts Run power station.

LANSDOWNE, PA.—The Borough Council is considering a proposition from the Sharon Hill, Lansdowne & Upper Darby Railway Company for a franchise to operate a street railway on certain streets in the borough, in connection with a direct line from Philadelphia to Chester via the Market Street subway and the elevated line to the Union Station.

NORRISTOWN, PA.—The Schuylkill Valley Traction Company has filed a certificate with the State Department showing an actual increase of capital stock from $250,000 to $500,000 for the purpose of acquiring property. The company is authorized to increase its capital stock to $1,000,000.

READING, PA.—The United Traction Company is planning to build a new electric railway to Temple, to be operated in conjunction with the present line.

WEST CHESTER, PA.—It is reported that the officials of the Lancaster, Oxford & Southern Railroad are contemplating electrifying the line. It is said that power will be supplied from the McCall's Ferry plant when completed.

WILMERDING, PA.—Application will soon be made to the State Department at Harrisburg for charters for the North Braddock Electric Light Company, the Braddock Electric Light Company and the East Pittsburg Electric Light Company. Henry Harris, W. J. Hailey and Philip Geiss are the applicants. The three companies will complete their organization as soon as the charters are granted, and then will become affiliated with the United Electric Light Company, of Wilmerding, which

will supply the companies with electricity. The company has had considerable demand from East Pittsburg, North Braddock and Braddock for electricity for lighting purposes, and the charter under which it operates does not allow it to operate in these towns.

CHARLESTON, S. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until July 16, to furnish at the navy yard, Charleston, S. C., a [illegible] outfits, conductors and conduit outfittings. Applications for proposals [illegible]

GREENVILLE, S. C.—The City Council has granted street railway franchises to the South Carolina Public Service Corporation, the Greenville-Anderson Interurban Line and a proposed line from Greenville to Williamstown.

ARMOUR, S. D.—Plans are being made by the Wagner, Lake Shore & Armour Traction Company to establish an electric lighting system in this place. Contracts for the machinery have been awarded to the Minneapolis Steel & Machinery Company.

BRISTOL, TENN.—The Bristol Belt Line Railway Company is planning to place contracts for the construction of about one and one-half miles extension to its line. The company is also on the market for a 250 to 300-hp engine and for two cars. S. M. Vance is superintendent.

CHATTANOOGA, TENN.—Official announcement has been made that the Chattanooga Railways Company will construct a surface line to the summit of Lookout Mountain. Other extensive improvements will be made by the company immediately. Surveys have also been made for a line to Lula Park and Minnehaha Falls.

LEBANON, TENN.—Work has commenced on the construction of the new power plant for the Cedar City mills, which will furnish the mills and the town with electricity for power purposes. The company is also contemplating extending its lines to Watertown.

AUSTIN, TEX.—The Home Telephone Company, of Los Angeles, Cal., which is controlled by Charles H. Huntington, has acquired a number of independent long-distance telephone lines in Texas, and local independent telephone exchanges at Fort Worth, Ennis, Waxahachie, Cleburne and a number of other towns. It is stated that the company will connect up several long-distance lines and invest not less than $5,000,000 in building extensions of the system in this state.

FT. SAM HOUSTON, TEX.—Bids will be received until July 24 by L. J. Fleming, constructing quartermaster, U. S. A., for the following work at this post: for furnishing and installing electric lighting fixtures in the following buildings: Post exchange and gymnasium, post hospital, officers' club, and two double stable guards and shop buildings; for electric wiring in two double stable guards and shop buildings; for furnishing pole lines and making service connections to all buildings before mentioned. Bidders are required to furnish names and places of business of manufacturer or manufacturers whose goods they propose to furnish.

PALESTINE, TEX.—The Palestine Electric Company has been reorganized as the Palestine Electric & Ice Company with a capital stock [illegible]

MANCHESTER, VA.—The electric light committee of the Council on June 27 recommended the City Council to construct a municipal electric light plant, to cost about $40,000. E. W. Trafford, of Richmond, is engineer.

PETERSBURG, VA.—Announcement has been made that Judge Edmund Waddell has entered a decree in the United States District Court authorizing the Virginia Passenger & Power Company to expend about $50,000 for improvements to its Petersburg service. It is understood that in addition to installing new arc lamps for street lighting, the money will be used to increase the capacity of the water power plant at the locks from 1500 to 3000 horse-power by installing an additional generator and water wheel, and to install a new generator at the steam plant in this city to use in case of emergency, and also to improve the old head dam on the canal.

SEATTLE, WASH.—The Seattle Electric Company is planning to erect two sub-stations, to cost $20,000 each.

SEATTLE, WASH.—The extension of the [illegible] power plant on Cedar River is assured by the sale of the $2,250,000 [illegible] bonds to the Seattle bank. The [illegible] supply system from the Cedar River.

SPOKANE, WASH.—The Spokane Falls [illegible] British Columbia, has filed a water right and is arranging to erect a tower and electric plant to supply the city of Trout Lake and nearby mines with electricity for light and power. The plant will cost about $10,000. [illegible]

VANCOUVER, WASH.—[illegible] franchise to construct a street railway on certain streets in this city.

[illegible] Light & Power Company [illegible] to operate its entire plant.

MAYVILLE, WIS.—The F. Paustian Milling Company has sold its [illegible] plant [illegible]

NEENAH, WIS.—The Wisconsin Telephone Company has recently [illegible] company is planning to extend its underground conduit system to Mill Street, Menasha. The improvements contemplated will involve an expenditure of more than $[illegible]

WASHBURN, WIS.—The City Council has authorized the lighting committee to purchase the outside electrical equipment and business of the Washburn Electric Light & Power Company. The city is contemplating the erection of a dam on Sioux River, two miles east of Washburn, to furnish power to operate the electric plant.

STRATHCONA, ALB.—The Strathcona Radial Railway Company is applying for incorporation to build electric car lines in and around the city. Messrs, Jamieson & Rutherford are solicitors for the applicants.

CRANBROOK, B. C.—The Cranbrook Electric Light & Power Company will install a 700-kw, 6000-volt generator, with step-down transformers reducing the voltage to 2250 volts. A dam will be constructed at St. Mary's River.

VICTORIA, B. C.—The British Columbia Electric Street Railway Company has found it necessary to develop extra electrical power in the vicinity of this city. Address R. H. Sperling, superintendent.

SYDNEY, N. S.—The Cape Breton Electric Company expects soon to place contracts for the construction of a new sub-station in North Sydney. Contracts have recently been placed by the company with the Canadian General Electric Company for the following equipment: two 250-kw, two to three phase, high tension, oiled cooled transformers, from 2200 to 22,000 volts; two 250-kw oiled cooled transformers three to two phase 22,000 to 2200 volts; one 300-kw synchronous motor, coupled to a 300-kw, 500-volt railway generator, with necessary switching apparatus; Eugene F. Phillips Electrical Works, of Montreal, for 45 miles No. 4 semi-hard drawn copper wire; C. S. Knowles, Boston, Mass., for necessary insulators and hardware for a 14-mile transmission line between the main generating station in Sydney to the sub-station in North Sydney.

WINDSOR, ONT.—The Detroit United Railway Company, owner of the Sandwich, Windsor & Amherstburg Railway Company, has let the contract for the construction of a power house adjacent to the plant of the Canadian Salt Company. This building is to be a small one, as the company wishes to secure more power at once. In the fall a new building will be erected adjoining the new plant, and will be large enough to accommodate all of the machinery of the Windsor street railway system.

MEXICO CITY, MEX.—The Mexican Light & Power Company has sold the equipment of the plant San Lazaro of the old Mexican Gas & Electric Light Company to L. B. Speyer & Company, which will be installed in the plant of the Campeche Light & Power Company at Campeche. The price paid for the machinery was $150,000 and consists of a McIntosh & Seymour cross compound condensing engine of 600 hp, with condenser, steam pump, etc., a 400-kw, three-phase, 2300-volt, 60-cycle General Electric generator, a 75-kw marine type engine driven exciter, switchboard, feed panel and other accessories.

Company Elections.

AURORA, IND.—The directors of the People's Telephone Association have elected Col. Jacob M. Bauer as president to fill the vacancy caused by the death of the late George M. Roberts.

SVEA, MINN.—At the annual meeting of the Kandiyohi County Telephone Company held recently the following-named officers were chosen: J. O. Lundberg, president; F. C. Petersen, secretary and manager, and [illegible]

New Industrial Companies.

THE M. W. DUNTON COMPANY, of Providence, R. I., [illegible] M. W. Dunton & Company. The new company will devote its attention [illegible]

THE TELEPHONE USERS GUIDE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000. The directors are: L. M. Ridgeway, T. L. Pryor, and C. W. Ridgeway, of New York, N. Y.

THE TIDEWATER CONSTRUCTION COMPANY, of Wilmington, N. C., has been incorporated with a capital stock of $100,000 by J. C. McEachin, Thomas W. Davis, J. W. Little, and J. A. McGeachy, all of Wilmington. The objects of the company are to build, equip and repair all kinds of railroads, electric power plants, telephone and telegraph lines, water power plants, and to buy and sell all kinds of materials needed for such work.

THE UNITED GAS ENGINE BUILDERS, of New York, N. Y., has been incorporated with a capital stock of $5,000 by F. P. Stillman, of New York; F. Conrad, of Newburg, and T. J. Barber, of Syracuse.

New Incorporations.

[illegible] Telephone & Telegraph Company of Alabama has been incorporated with a capital stock of $5,000 by George R. Knox, Jr., Charles Carter and John C. Eyster.

CHEYENNE WELLS, COL.—The Cheyenne County Telephone Company has been incorporated with a capital stock of $3,000 by H. Y. Tarwater, W. P. Love and H. H. Lotz.

DENVER, COL.—Incorporation papers have been filed for a new electric line to connect Denver and Greeley, which will be known as the Den-

[illegible] Mosher, of Greeley, president; E. J. Decker, of Greeley, vice-president; J. D. Housman, of Denver, general manager. The capital stock of the [illegible]

ARTHUR, ILL.—The Arthur Mutual Telephone & Telegraph Company has been incorporated with a capital stock of $20,000 by Marion Watson and others.

LISBON, ME.—Articles of incorporation have been filed with the Secretary of State for the Lisbon Falls Gas & Electric Company with a capital stock of $50,000. The company proposes to manufacture and distribute gas and electricity for lighting, heating, traction and power purposes in the towns of Lisbon and Durham. The officers are: William H. Plummer, president, and H. E. Plummer, treasurer.

[illegible] with a capital stock of $1,000,000 by James E. Manter, Clarence E. Eaton, Charles D. Fullerton, James H. McCann, C. W. Burnell and Millard W. Baldwin, of Portland.

RICHMOND, ME. The Richmond Light Company has been incorporated with a capital stock of $10,000. The officers of the company are Benjamin F. Curtis, president, and A. E. Small, treasurer, both of Richmond.

KANSAS CITY, MO.—The Joplin & Pittsburg Railroad Company has been chartered with a capital stock of $5,000,000. J. J. Heill is president and A. J. Prescott is secretary, both of Kansas City.

SOUTH ORANGE, N. J.—The South Orange Illuminating Company has been incorporated by Ira A. Kipp, Jr., B. Leach and others. The company proposes to petition the Council for a franchise.

CORINTH, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Corinth Electric Light & Power Company, with a capital stock of $25,000. The incorporators are Warren Curtis, of New York City; Warren Curtis, Jr., of Corinth, and E. B. Coolidge, of Glens Falls.

LEWISTON, PA.—The Juniata Valley Electric Company has been incorporated with a capital stock of $5,000.

Legal.

SUIT IN SEATTLE.—Mr. Charles H. Baker [illegible] the [illegible] Power Company, [illegible] Superior Court at Seattle, Wash., for an injunction to prevent the sale of the Seattle-Tacoma Power Company, in which he is interested, to the Seattle Electric Company, which action he declares is contemplated [illegible]. He also demands an accounting from the officers and directors of the Seattle-Tacoma Power Company and a restitution of moneys expended by the company in acquiring the Diamond Ice & Fuel Company, and the Mutual Light & Heating Company, which deals, Mr. Baker claims, were made fraudulently.

RIGHT TO RESCIND CONTRACT FOR PURCHASE OF TELEPHONES.—Under a contract of sale the plaintiff shipped 104 telephones to the defendant. Half of the telephones were installed by the defendant and were found to be useless. The remainder of the shipment was not opened or tested in any way, and the defendant notified the plaintiff that it would not install any more phones until those already installed were remedied. It was held that the defendant was entitled to rescind the entire contract and was not liable for any part of the purchase price. Chicago Telephone Supply Company vs. Marne & Elkhorn Telephone Company, Supreme Court of Iowa, 111 N. W. Rep. 935.

LIABILITY FOR ACCIDENT RESULTING FROM UNGUARDED STREET EXCAVATION.—The defendant gas and electric company, while excavating for a trench in one of the streets of Council Bluffs, Iowa, left a pile of unprotected earth in the street. The plaintiff, chief of the city fire department, while being driven along the street in the night time in response to an alarm, was thrown out and injured by the vehicle in which he was riding coming in contact with the excavated earth. In reversing a judgment in favor of the plaintiff, the court said: "Cities and public service corporations having the right of entry, are privileged to tear up or obstruct a street, even to the full width thereof, if necessary, in the course of making public improvements or repairing the same; and it ought not to require discussion or argument to make it clear that the bare exercise of such a right may not be distorted into an act of negligence. Indeed, it is in the very nature of things, and hence fundamental, that negligence cannot begin until the limits of right have been overstepped. As there was no law, by statute or ordinance, governing the subject, we must assume that the defendant had the right to throw the dirt either way." Citizens' Gas & Electric Company, United States [illegible]

ALLEGATIONS AND PROOF IN ACTION AGAINST ELECTRIC COMPANY [illegible] company having resulted in a verdict in favor of the plaintiff for $1,000, the company appealed on the ground that there had been a variance between the allegations in the plaintiff's petition and the proof offered at the trial. The accident was a result of the negligence of the company in permitting [illegible] which the plaintiff thereafter came in contact. The plaintiff alleged that the defendant negligently constructed and used "its said wire for the transmission of electricity over and upon the plaintiff's premises," and the evidence introduced indicated that the wires were suspended along the [illegible] plaintiff. It was held that, if there was any variance, it was immaterial. [illegible] in allowing a wire heavily charged with electricity to fall upon and remain in contact with the gate and the exact location of the wire was unimportant. The courts will disregard such petty, immaterial variances as [illegible]

[illegible] railway company was authorized by legislative and municipal action to [illegible] and to place the poles along near the track in the center of the street; but the line was required to be constructed in compliance with a city ordinance which provided that "The laying, construction and maintenance of all wires, poles, or cables shall be under the supervision of the chief of the electrical bureau and subject to his approval." One of the poles, which the company erected pursuant to the authority obtained, stood upon a base about 2½ feet in diameter and 18 inches high. There was no light upon the pole, and a milk dealer, driving his wagon along Eleventh Street some time before daylight, ran into it and died as a result of the accident. It was held that, conceding the right of the railway company to place its poles in the center of the street, yet there was a duty imposed upon the company to exercise the power conferred by the municipality in such manner as not unnecessarily to obstruct the highway or to interfere with the purpose for which it was primarily constructed. The city of Philadelphia was held liable in damages for the death.—McKim vs. City of Philadelphia, Supreme Court of Pennsylvania, 66 Atl. 340.

TELEPHONE COMPANY LIABLE FOR INJURIES TO LINEMAN [illegible] GER. The plaintiff was engaged at the time of the accident with other employees in erecting a large circle pole about sixty-five feet high and in [illegible] general undertaking had been inaugurated before the plaintiff entered into the employ of the defendant company. At the direction of the foreman the plaintiff went up the pole to remove two of three cross arms which were rendered unnecessary by the installment of the cable, and in removing the second cross arm, which was just underneath the clamp to which the messenger wire had been attached, the pressure of the messenger wire which had rested on this cross-arm was relieved, so that the [illegible] by the messenger wire. This caused the safety strap which the plaintiff was using to snap and, as a result, the plaintiff fell backward to the ground. To recover damages for the injuries sustained the plaintiff brought action against the telephone company. It was held that the company was liable. If the plaintiff was in as good a position as the foreman to know what the consequences of removing the cross arm might be expected to be, then the plaintiff would have assumed the risk of the operation and would not have been entitled to recover. But it was shown that the foreman knew of the danger involved, which was not apparent to the plaintiff, and that he did not inform the plaintiff of this danger. And the failure of the foreman to give proper warning to the plaintiff before allowing him to ascend the pole and so place himself in a dangerous position constituted negligence for which the defendant telephone company was responsible in damages. Long vs. Johnson County Telephone Company, Supreme Court of Iowa, 111 N. W. Rep. 984.

RIGHT OF MUNICIPALITY TO EXCLUDE ELECTRIC COMPANY, ALREADY HOLDING FRANCHISE, FROM BIDDING ON NEW FRANCHISE, SOLD FOR PURPOSE OF PROMOTING COMPETITION.—The city of Louisville, Ky., advertised for sale a franchise or privilege to string wires along the streets of the city for the purpose of distributing and selling electricity. On the ground that the object of the sale was to secure competition, and that the Louisville Lighting Company already enjoyed a similar franchise, it was provided that no bid, received directly or indirectly from that company, would be considered. It was required of each bidder that he file a sworn statement to the effect that he was not acting in any way in the interest of the Louisville Lighting Company, or of any other person or company desiring to suppress or prevent competition in the sale of electricity. The franchise was sold to one Lawrence Jones for the sum of $100,150, and thereafter an action was brought for the purpose of having the sale declared invalid under section 164 of the constitution, which provides that no municipality should grant any franchise without publicly advertising for bids and awarding the franchise to the highest and best bidder, provided, however, that the municipality should have the right to reject any and all bids. It was held that the sale was not invalid under section 164. The evident purpose of this provision of the constitution was to prevent to councils of cities from giving away or selling at an inadequate price the rights and privileges belonging to the citizens. Thus construing the constitution, it is evident that it was the duty of the city council to take steps to relieve the people of the city from paying exorbitant prices for electricity for lighting purposes by establishing a competing plant and fixing a maximum price.—Stites vs. Norton, 101 S. W. Rep. 1189. Court of Appeals of Kentucky.

NEGLIGENCE OF TELEPHONE COMPANY IN LEAVING WIRES IN DANGEROUS CONDITION AND LIABILITY FOR ACCIDENT RESULTING THEREFROM.—[illegible] trix against a telephone company to recover damages for the death of the person whose estate she represented it was shown that the deceased, while walking beneath a tree in a suburb of Mobile, Ala., touched a wire fence that was nailed to the tree and was killed by an electric shock trans- [illegible]

trolley pole of the Mobile Light & Railroad Company projected into the branches of this tree; that the span wire, attached to an eye bolt which ran through the pole, was heavily charged with electricity; that the defendant telephone company had formerly maintained a line along the trolley route and that, in removing its system, had left several wires dangling down through the branches of the tree under which the accident occurred; and that one of these wires became jammed between the washer and nut of the eye bolt and hung down almost to the ground, where it was "kind of hooked to the fence as though somebody had bent the end of it to keep it from swinging." It was shown that when a trolley wire is properly suspended the span wire is dead and that one should be insulated from the other by means of a bell, but that, in this instance, the trolley wire ran through the bell to the span wire and out to the eye bolt, where the telephone wire was jammed and the current was in this manner communicated to the wire fence. It was held that the act of the telephone company in permitting its wires to hang down constituted negligence and that the company was liable in damages. It was said: "It is the creation and maintenance of a dangerous situation without the warranting occasion for it which may exist when the lines are in use—without any occasion whatever, in fact; and the company is liable in damages for whatever injuries may result to persons and property rightfully on the premises."—Home Telephone Company vs. Fields, Supreme Court of Alabama.

STATE CONTROL OVER PATENTS.—In an opinion rendered by the Justices of the Supreme Judicial Court of Massachusetts, in answer to questions propounded by the Senate with a view to legislating upon a question involving the State control of patents, it was declared that the State has power to pass a general law, prohibiting licensees and owners of patents from leasing patented machines to others by a contract, prohibiting the lessees from obtaining from any other person similar machines to perform the same operation as that performed by the leased machine during the term of the lease. It was also the opinion of the Justices that the Legislature has authority to pass a general law providing that, where a patented machine is designed to perform two successive steps in the making of an article or product, the owner of the patent or license shall not lease or license the use of one of the machines designed to perform one of the steps on conditions in effect prohibiting the lessee or licensee from using in the manufacture of the article the leased machine, if a machine not obtained from the lessor is used to perform the other steps of the process during the term of the lease. It is well settled, as stated by Mr. Justice Harlan in Patterson vs. Kentucky, 97 U. S. 501, "that the right which the patentee or his assignee possesses in the property created by the application of a patented discovery must be enjoyed subject to the complete and salutary power with which the States have never parted, of so defining and regulating the use and sale of property within their respective limits as to afford protection to the many against the injurious conduct of the few. The right of property in the physical substance, which is the fruit of the discovery, is altogether distinct from the right in the discovery itself, just as the property in the instruments or plate by which copies of a map are multiplied is distinct from the copyright of the map itself." The patentee's right is a monopoly of the invention, but this does not protect from State legislation any monopoly in other commercial ventures which the patentee may attempt to establish.—In re Opinion of the Justices, 81 N. E. Rep. 14[illegible].

Personal.

MR. RALPH D. MERSHON, the consulting engineer, has gone to England again in connection with the Zambesi River power transmission project.

MR. JOHN A. HOLMBERG, of Denver, Col., is installing electrical machinery at the Bellevue-Hudson mine, Idaho Springs, Col., for the operation of compressors and hoists.

MR. H. W. WRIGHT, of Shreveport, La., is in charge of the construction of a generating plant at Stamford, Texas, embodying the latest ideas in power station design.

MR. J. P. MANYPENNY has been appointed the general representative of the Philadelphia Electric Construction Company, who have their headquarters at 914 Filbert Street.

MR. D. B. HERRING, manager of the Southwestern Telephone & Telegraph Company at Yoakum, Tex., has resigned to accept a position with the Missouri & Kansas Telephone Company at Kansas City.

MR. HENRY D. BRADLEE has been admitted as a member in the well known Boston financial and engineering firm of Stone & Webster, the other partners being Charles A. Stone, Edwin S. Webster and Russell [illegible].

MR. HENRY L. DOHERTY has gone abroad for a rest and vacation, and sailed for Europe on July [illegible] on the Cunarder "[illegible]." Mr. Doherty has been extremely busy of late with several lighting companies, which [illegible] incessant travel, [illegible] to recuperate [illegible].

MR. WILLIAM L. DERR has been appointed general superintendent of the New York City Railway Company. He will have general charge of the street railway system of the city after July 1. Mr. Derr is a graduate of the Pennsylvania Polytechnic College at Philadelphia and has been in railroad work since 1876.

MR. H. M. BEUGLER, formerly superintendent of railways for Ford, Bacon & Davis, operating department, operating the Newman properties in Houston, Tex., Memphis, Little Rock, Birmingham, Nashville, and Knoxville, has taken a position with the firm of Dodge & Day, the well-known engineers and constructors of Philadelphia and New York.

MR. DUNCAN R. CUMMING, of Denver, Col., has been in and about Benson looking for tungsten ores. Tungsten has been discovered in the mountains surrounding Benson, and shipments were made by the Premis Chemical Company at Dragoon, from placer ground, but that company has opened up copper deposits and turned its attention from tungsten to mining the red metal.

MR. LEWIS B. STILLWELL was the recipient of two honorary degrees at commencement exercises this year—Master of Science from Lehigh University and Doctor of Science from Wesleyan University, at Middletown, where Mr. Stillwell pursued part of his undergraduate course. The degree from Lehigh was the third honorary distinction conferred by that university in its existence.

MR. C. H. HOLLINGSWORTH, superintendent for the Great Western Power Company, at Island Bar, Cal., has resigned his position and will return to his home in the East. His successor is Mr. B. S. Roberts, who has resigned from the Southern Pacific to take the place. Mr. W. H. Bissell, formerly purchasing agent for the Great Western Power Company, has been promoted to the position of assistant superintendent.

MR. W. H. COWELL.—Mr. A. D. Hatfield has resigned as secretary and treasurer of the Wellman-Seaver-Morgan Company, Cleveland, Ohio, and has been succeeded by W. H. Cowell, who was connected with the Algoma Steel Company, Sault Ste. Marie, Ont., of which Willard H. Sawyer was general manager before going to Cleveland to become president of the Wellman-Seaver-Morgan Company.

MR. GEO. F. ADAMS and Mr. Jas. R. Downs, who have been connected with the Westinghouse Electric & Manufacturing Company for the past ten years, have resigned from the Cleveland selling organization and have opened an office in the New England Building, Cleveland, under the style of Adams & Downs. They have an agreement with the Burke Electric Company, as selling representatives, to handle the complete line of alternating and direct current dynamos and motors manufactured by that company.

MORSE-THOMPSON.—The *New York Herald* has the following from Poughkeepsie, dated June 29: The Episcopal Church of St. Margaret in Staatsburg, Dutchess County, was the scene at noon to-day of the wedding of Miss Anna Thompson, cousin of Mr. Louis S. Thompson, of New York, whose summer home, Stonehurst, is in the town, to Mr. Samuel F. H. Morse, grandson of Professor Samuel F. B. Morse, who, when a resident of this country, invented the telegraph in 1841. The newly married couple will live in California.

MR. THOMAS TAIT, chairman of the Victorian Railway Commission, reached this country June 29 on his return to Melbourne. Mr. Tait has made an extensive tour in Europe, where he has visited the important railways which have been changed from steam to electric power and has been very much interested in this subject, as the electrification of the Victorian steam railways and the cable system in Melbourne is under consideration by the railway commission. The details of the system to be adopted have not yet been selected as this will be left to the expert of the system, Mr. Charles H. Merz, of London, who has been engaged to make an exhaustive report on the subject.

MR. FRANK KOESTER, a contributor to these columns, has a book now in the hands of D. Van Nostrand Company, to issue in the fall, devoted to the design of light and power central stations. Mr. Koester is an experienced power plant designer, having been in Europe connected with the design of plants for Europe, Asia, Central and South America, as well as the construction and operation of plants of from 1000 to 24,000-kw capacity. For the purpose of studying American power plants on a broader scale, their methods of design, construction and operation, he has been in this country for a number of years, identified with some of the largest plants, varying from 3000 to 60,000-kw capacity.

SIGNAL CORPS PERSONNEL.—The following orders have just been issued affecting the U. S. Signal Corps: Captain George S. Gibbs, to army of Cuban pacification as chief signal officer, relieving Captain William Mitchell. First Lieutenant Walter H. Smith, from Army Staff College, to command Company A, signal corps, Fort Leavenworth, relieving First Lieutenant George E. Kumpe, who will proceed to Havana for duty under chief signal officer, army of Cuban pacification. First Lieutenant E. Alexis Jeunet, from Signal School to Havana, for duty under chief signal officer, army of Cuban pacification. Major George O. Squier, Signal Corps, from Fort Leavenworth, to office chief signal officer at Washington.

MR. JOHN H. SMART, who has just retired from the position of superintendent of the Commercial Cable Company of New York, was given a farewell banquet recently in Brooklyn, when he was presented by his many friends with a solid silver service and tray, accompanied by an illuminated address. The presentation was made by Mr. Frank Mason, who made a highly appropriate speech. Mr. Smart was born at [illegible], England, in 18[illegible]. In 18[illegible] he came to the United States and for three years was in the employ of the French Cable Company at Cape Cod. Subsequently he filled a position with the Western Union Cable at Canso, N. S. His service with the Commercial company began [illegible] he was appointed [illegible] superintendent, [illegible] to the [illegible] January 1, 1906.

MR. B. S. JOSSELYN.—At a meeting of the directors of the [illegible] Electric Company, last week, Mr. [illegible] resigned [illegible]

[illegible]
Mr. Josselyn was also vice-president of the Maryland Telephone Company. which position he has also resigned. Mr. Josselyn's resignation came as a [illegible] one which offers many opportunities, and he felt that he should accept it. The Portland Company is controlled principally by E. W. Clark & Company, of Philadelphia; J. W. Seligman and Pratt & Company, of New [illegible] 000,000. The gross earnings of the properties are in excess of $5,000,000 a year. The company owns all the street railway lines in Portland, controls the light, power and steam-heating field, furnishes hydraulic water power in Portland and nearby towns, including Salem, the capital of the state, [illegible] mette and Columbia Rivers. The various enterprises of the company represent over 100,000 horse-power. Mr. Josselyn will succeed Mr. H. W. Good, who died last April. Mr. Josselyn went to Baltimore about two years ago from the West to become assistant to the president of the Maryland Telephone Company, and two months later was elected vice-president. [illegible] in the management of steam and electric railways, electric light and telephone enterprises.

Trade Publications.

[illegible] Street, Philadelphia, Pa., has recently issued a bulletin on centrifugal pumps. Pumps of various sizes, designed for direct connection to electric motors are illustrated. These pumps are made in two types—volute and turbine.

TRUMBULL EXPANSION.—The Trumbull Electric Manufacturing Company, Plainville, Conn., has just issued a unique folder, circular in shape, representing its trademark. Inside are shown illustrations of the company's factory of 1901 and that of to-day. The comparison tells a story of large and rapid expansion.

Business Notes.

A. L. IDE & SONS.—The New York office of A. L. Ide & Sons, the "Ideal" engine, formerly at 11 Broadway, is now located at 90 West Street.

THE E. H. FREEMAN ELECTRIC COMPANY, of Trenton, N. J., is making arrangements to add a third plant to the two already operated by the company. The concern manufactures all kinds of fittings for electric wiring and lighting. The company has just commenced the manufacture of a new socket for electric lamps on electric signs. This socket has just been put on the market.

THE WESTERN WIRE SALES COMPANY, of Chicago, Ill., announces that it has been made general Western agent of the Bay State Insulated Wire & Cable Company, Hyde Park, Mass. This company has recently been organized with Andrew J. Conlin as general superintendent, and J. H. H. McNamee is treasurer and general manager. Outside of the regular lines of the rubber and lead covered insulated wires and cables, this company is making a specialty of railroad signal wire to meet any specifications 30 per cent pure Para rubber insulated wires and cables, mining cables, flame-proof wires, telephone wires, etc.

BILLET CONVEYING.—One of the oldest and most prominent firms identified with the steel industry in America, is the Alan Wood Iron & Steel Company, whose establishment at Conshohocken, Pa., about a dozen miles from Philadelphia, dates back eighty-odd years. During all these years this firm has witnessed the introduction of many improvements in manufacturing and seen many mechanical devices for the facilitating of production and handling put into operation. The electrically-operated conveying equipment for expediting the movement of hot and cold billets at its Ivy Rock Mill, indicates that even if the firm is old as years are counted, it is not lacking in up-to-date equipment for increasing facilities. When the ingot is of equal heat from centre to corners, it is brought to a transfer table by crane. The movement of the table is controlled by an operator shielded from, but in plain view of, a tri-section roughing roll. The table takes the ingot to the roll, through which it passes forward and backward several times. The lengthened ingot is then passed to the second section and again rolled; the proper length and thickness being finally obtained by a few passes through the third section of the roll. The cutting of the cold steel bars is done on the opposite side of the mill; the long bars being brought to the cutter by transfer table controlled, as in the rolling, by a man in plain view of the cutter. When the current is turned on, a certain length of the bar passes under the cutter, the part remaining on the table being automatically clamped to hold the bar securely while being cut. The cutter comes down with a pressure of 500 lbs. in the cylinder and the severed portion of steel drops onto a Link-Belt inclined apron-conveyor which delivers the billets to cars running on a narrow gauge track.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first [illegible]*)*

American Electro-Therapeutical Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. [illegible] York. Meetings, fourth Friday of each month.

American Street and Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Detroit, Mich., third Wednesday, September, 1907.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, Atlantic City, N. J., October 14-18, 1907.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Montreal, Que., June 26, 27 and 28, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Montreal, September, 1907.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulhol- [illegible]

Colorado Electric Light, Power & Railway Association. Secre- [illegible]

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 1537 Old Colony Building, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November [illegible]

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting, October, 1907.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, Dr. Arthur H. Elliot, [illegible] each month.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

[illegible] Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

International Independent Telephone Association. Secretary, Charles West.

Iowa Electrical Association. Secretary, L. B. Spinney, Iowa State [illegible]

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., Oct. 16, 1907.

KENTUCKY INDEPENDENT ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Battle Creek, Mich., August 21-23, 1907.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting, New York City, July 17, 18 and 19, 1907.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, August 20 and 22, 1907.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Charles W. Ford, Oklahoma City, Okla.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., [illegible]

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

PUBLIC UTILITIES ASSOCIATION OF INDIANA. Secretary J. A. Shunk, Peru, Ind. Regular meetings second Thursday in May and December.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 25, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Atty's, [illegible] New York, N. Y.]

857,569. ELECTRIC CURLING IRON; Isabel Allen, Kansas City, Mo., and George Hanlon, Shawneetown, Ill. App. filed Oct. 16, 1906. Construction of curling iron having a tubular member with a resistance element spirally contained therein, and a slideable switch or controller in the handle by which a greater or less resistance may be included in the circuit.

857,591. TROLLEY HARP; Arlington D. Brittain, Youngstown, Ohio. App. filed April 18, 1906. The trolley harp has a pair of arms bolted thereto and projecting rigidly upwardly therefrom and adapted to guide the wheel on the wire. A specially constructed wheel having removable flanges is employed.

857,606. BATTERY; Frank A. Decker, Philadelphia, Pa. App. filed March 30, 1904. In a battery, a compartment having imperforate walls of porous material, a fragmental electrode in said compartment, and means in said compartment for permitting the free circulation of fluid and contact thereof with said electrode, substantially as specified.

857,607. ELECTROCHEMICAL APPARATUS; Frank A. Decker, Philadelphia, Pa. App. filed Jan. 16, 1906. In an apparatus of the class described, a plurality of envelopes, and a rubber conduit conforming and vulcanized to the bottoms and communicating with the interiors thereof.

857,612. TROLLEY STAND; Edgar L. Fixler, Delta, Ohio. App. filed July 12, 1906. Mechanical features of a trolley stand from which the pole is quickly detachable. The object is to provide for the change in the quickest possible time, and [illegible] to the operator.

857,621. SWITCHING DEVICE; Alexander M. Haubrich, Chicago, Ill. App. filed Sept. 28, 1904. Construction of switch for telephone systems where separate lines are operated in conjunction with single subscriber lines. Has a two-way key and a plurality of depressible buttons.

857,643. TROLLEY GUARD; George L. Matheney, Bridgeport, Ohio. App. filed July 12, 1906. A pair of vertically depressible cheeks are slidable in spring impelled relation at each side of the trolley wheel so as to yield downwardly in passing guy wires, etc.

857,664. ELECTROMEDICAL APPLIANCE; David R. Overman, St. Louis, Mo. App. filed Jan. 10, 1907. A pad or bandage comprising a cushion of soft leather prepared with wool thereon and having a pocket with a battery therein, the terminals of which extend into the wool of said cushion.

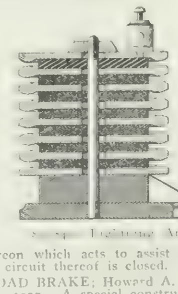
857,686. ELECTRICALLY PROPELLED VEHICLE. Russell Thayer, Philadelphia, Pa. App. filed April 4, 1907. An electric truck of the type adapted to run on a car track and receive current through a trolley pole when this is possible, but having storage batteries by which it may proceed independently of the trolley when desired.

857,707. DEVICE FOR PERMITTING THE AUTOMATIC OPERATION OF FIRE ALARM BOXES; Leonidas G. Woolley, Lima, Ohio. App. filed Aug. 31, 1906. Has a revoluble arm rotarily impelled by a spiral spring and resisted in its movements by a fusible element.

857,708. CIRCUIT OPERATING DEVICE; Leonidas G. Woolley, Lima, Ohio. App. filed Aug. 31, 1906. Relates to modifications of the above.

857,735. FUSED PLUG AND RECEPTACLE; John C. Hatzel and Edgar L. Morley, New York, N. Y. App. filed Jan. 5, 1906. Features of construction of a plug adapted to receive a standard fuse and having all the metallic parts covered so as to avoid all possibility of accident by short circuit.

857,752. MECHANICAL POWER BRAKE; Louis Pfingst, Boston, Mass. App. filed March 6, 1903. The usual hand brake has a motor armature thereon which acts to assist the application of the brake whenever the circuit thereof is closed.



[illegible] Lightning Arrester.

857,792. RAILROAD BRAKE; Howard A. Coleman, Sanborn, Ia. App. filed March 4, 1907. A special construction of motor for the application of a brake, both the armature and the fields having spaced polar projections.

857,797. MOTOR CONTROL APPARATUS; George W. Euker, Pittsfield, Mass. App. filed Aug. 31, 1905. A flexible cord is connected to the usual arm of the starting rheostat and this flexible cord terminates in a push button switch. By pulling the cord and operating the switch, an operator of a printing press may control the entire action from any desired location.

857,849. LIGHTNING-ARRESTER; Joseph V. E. Titus, Keokuk, Ia. App. filed Oct. 20, 1904. Construction of lightning-arrester having a plurality of plates arranged with spark gaps formed between the same, and having a layer of resistance material arranged between each of said plates and out of the path formed by said gaps.

857,866. INDUCTION COIL; Morris W. Brinkmann, New York, N. Y. App. filed March 14, 1905. Construction of induction coil provided

electrolyte from said body upwardly through the cells and then down-

1902. An automatic safety stop device for brake mechanism com-

ated by said device for opening the air brake valve in case the motorman is incapacitated.

857,909. ELECTROLYTIC CELL; Alfred O. Tate, New York, N. Y. App. filed Sept. 28, 1904. An electrode for an electrolytic cell having positive and negative conductors of relatively good conductivity located adjacent to each other and separated by an insulating medium, the lateral edges only being exposed to the electrolyte.

ALLY; Alfred O. Tate, New York, N. Y. App. filed Sept. 28, 1904.

857,926. PROCESS OF PRODUCING STEEL DIES; George F. Diez, New York, N. Y. App. filed Feb. 5, 1907. The method of depositing iron upon a conducting surface which consists in subjecting the surface to be coated to the action of an electric current in an electrolyte containing iron sulphate and sodium bicarbonate.

857,927. PROCESS OF RECOVERING THE NICKEL CONTAINED IN BASIC NICKEL PRECIPITATES; Herbert H. Dow and Walter S. Gates, Midland, Mich., and Arthur E. Schaefer, Cleveland, Ohio. App. filed April 18, 1906. In the process of rendering soluble the nickel contained in basic nickel precipitates, the step which consists in treating such a precipitate with free halogen.

857,929. STORAGE BATTERY ELECTRODE; Thomas A. Edison, Orange, N. J. App. filed March 30, 1905. An electrode mass for storage batteries employing alkaline electrolytes, comprising an intimate mixture of a suitable active material and metallic flakes, scales or films formed wholly or in part of metallic cobalt, substantially as set forth.

857,953. ALTERNATING CURRENT MACHINE; Ralph D. Mershon, New York, N. Y. App. filed July 5, 1904. In an alternating current machine, adapted for variation in the number of its poles, the combination with the primary element, of a secondary element, resistances in the secondary element, and permanent connections for said resistances with the secondary winding or windings at such points that said resistances become successively more effective in their action as the number of poles is increased, as set forth.

857,959. AUTOMATIC TELEPHONE EXCHANGE; N. E. Norstrom, Junction City, Kan. App. filed May 31, 1900. The combination with a switching mechanism and magnets for operating it, of a generator and connections for sending electrical impulses for controlling said magnets, a crank for operating said generator, an adjustable indicator for controlling the impulses sent by said generator, and means for operating said indicator by the movement of said generator.

857,966. AUTOMATIC TELEPHONE SWITCH; C. M. Thompson, Chicago, Ill. App. filed Jan. 25, 1907. In an automatic telephone switch, the combination of a motor magnet having two windings and an electromagnetic device combined with means for closing the circuit through both of said windings one after the other by a single operation of

858,002. SPEED GOVERNOR FOR DYNAMOS; Edward B. Jacobson, Pittsfield, Mass. App. filed Jan. 18, 1904. A fly wheel driven dynamo having an electromagnet varying the contact of the pulley with the fly wheel in accordance with the intensity of the current

858,011. METER; William J. Mowbray, New York, N. Y. App. filed April 30, 1906. Electric meters of the type adapted for use in testing service meters installed on the premises of consumers of electric energy.

858,016. ARMATURE TESTING APPARATUS; Victor Patton, Hastings, Col. App. filed May 24, 1906. An apparatus for testing armature windings by which "shorts," grounds, "cross" and similar defects may be located.

858,050. ELECTROPLATING APPARATUS; David F. Broderick, New Britain, Conn. App. filed Aug. 10, 1906. Provides means whereby work to be plated can be started from a given point or station and made to return thereto, the work being deposited successively into various baths during its travel.

858,064. SIGNAL; Harold W. Eden, Detroit, Mich. App. filed Feb. 5, 1906. Construction of housing for ordinary magneto having a cover with a grooved edge to permit the insertion of a dust excluding sustance.

858,117. MEDICAL BATTERY; Charles W. Taylor, New York, N. Y. App. filed Dec. 22, 1905. Construction of medical battery having an induction coil and a movable sleeve therefor, and means connected

ALTERNATING CURRENTS; Louis H. Thullen, Edgewood Park, Pa. App. filed March 2, 1906. Relates to block signaling on railroads where alternating currents are employed to actuate the signals. Provides an inductive bond between the track sections which will be opaque to alternating currents, but give a free path for the passage of the propulsion current from block to block.

858,135. ELECTRIC TANK SWITCH; Jacob T. Anderson, New York,

858,160. ANODE; Alexander J. Deloye, Torrington, Conn. App. filed An anode for electroplating, of downwardly tapering form and h a series of integral outwardly projecting spurs or project

858,196

858,211. ELECTROMAGNETIC LOCOMOTIVE; Joseph L. Potter, Indianapolis, Ind. App. filed Dec. 11, 1905. A toy electric carriage connection therefrom for driving the wheels of the vehicle.

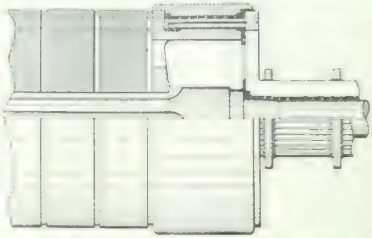
in the present apparatus with respect to false signals are corrected.

ally breaking the circuit through mechanism operated by a motor,

858,238. TROLLEY FINDER; Frederick G. Weber, Ashland, Ky. App.

wheel is being positioned on the wire.

858,246. DIRECT-CURRENT DYNAMO-ELECTRIC MACHINE; Edwin C. Wright, Newport, Ky. App. filed Nov. 30, 1906. Provides



858,255. TROLLEY FOR ELECTRIC RAILWAYS; Harry Bennett, Newark, N. J. App. filed April 17, 1906. The upper end of the trolley pole is formed in a separate section which telescopes into the main portion and is spring impelled outward therefrom.

858,288. BRANCH BOX; Albert F. Hills, Syracuse, N. Y. App. filed Oct. 10, 1905. A branch box for electric wires which is particularly applicable for exposed conduit circuit. Relates to features of construction by which the connections are made water-tight.

858,317. CORN POPPER; George B. and Joseph H. Young, El Paso, Tex. App. filed Nov. 30, 1906. A cylindrical drum or hopper is rotated on a vertical axis and has a resistance element sinuously embedded in its lower face.

858,325. PROCESS OF PRODUCING VANADIUM AND ITS ALLOYS; Frederick M. Becket, Niagara Falls, N. Y. App. filed June 19, 1906. The process of producing vanadium which consists in reacting on a vanadium compound reducible with silicon and carbon.

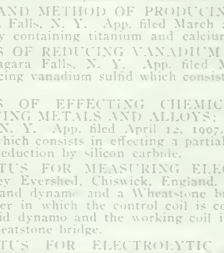
858,327. ALLOY AND METHOD OF PRODUCING IT; Frederick M. Becket, Niagara Falls, N. Y. App. filed March 20, 1907. Method of making an alloy containing titanium and calcium.

858,328. PROCESS OF REDUCING VANADIUM SULFID; Frederick M. Becket, Niagara Falls, N. Y. App. filed March 5, 1907. The process of reducing vanadium sulfid which consists in reacting thereon with silicon.

858,329. PROCESS OF EFFECTING CHEMICAL REDUCTIONS AND PRODUCING METALS AND ALLOYS; Frederick M. Becket, Niagara Falls, N. Y. App. filed April 12, 1907. The process of reducing oxides which consists in effecting a partial reduction by carbon and a further reduction by silicon carbide.

858,335. APPARATUS FOR MEASURING ELECTRICAL RESISTANCES; Sydney Evershed, Chiswick, England. App. filed Feb. 28, 1906. Has a hand dynamo and a Wheatstone bridge and a coil control galvanometer in which the control coil is connected between the two poles of said dynamo and the working coil is connected to either end of said Wheatstone bridge.

858,341. APPARATUS FOR ELECTROLYTIC DEPOSITION OF



fluid is being drawn through the tank.

case the trolley leaves the wire. Relates to mechanical features of construction.

telegraphy or lines having very high capacity.

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NEW YORK, SATURDAY, JULY 13, 1907.

CONTENTS

Electrical Exports.

The electrical export trade has continued throughout the past year to exhibit many signs of healthy progress, and the returns now available for May indicate that the whole twelve-months will reach a high level. During May the exports of heavy electrical machinery were $800,566 as compared with $681,955 last year. For the 11 months, the total is $7,924,806 as compared with a previous $7,229,576 and $6,661,676 in 1905. In like manner the export of electrical instruments has shown a gratifying increase for the whole period, although May itself fell off somewhat. The exports of this class last May reached $619,393, while in 1906 they were $709,875. But for the 11 months they were $7,508,364 as compared with $6,115,254 and $4,490,818 in the periods corresponding, of 1906 and 1905.

For the 11 months therefore the total export of electrical apparatus has attained the respectable figure of not less than $15,433,170, and it bids fair for the whole fiscal year to reach about $17,000,000. Large as this may seem, it is, however, below 10 per cent of the total production in this country of electrical goods, and from this point of view a good deal of effort can be put, and ought to be put, in the development of fuller trade relations with countries that are still in the list of "prospects." The United Kingdom, Mexico, British North America and Japan are our best customers for heavy machinery, and with them again, Brazil is a good patron of our electrical instruments. Under present tariff conditions there does not appear to be much to expect from growth of relationships with Continental Europe, but South America, the West Indies, Asia and the Far East are as open to us as to the rest of the manufacturing world; and there are huge, unsatisfied wants in all of them. Many of these countries without cheap fuel have fine water powers, and Mexico has shown how large a demand may be created by the latter. Recent years have seen also the production of large classes of detail apparatus for industrial and domestic use, which, serviceable in temperate climes, will eventually become indispensable in tropic and sub-tropic regions.

The Heating of Copper Wires by Electric Currents.

Perhaps the simplest and most familiar fact connected with the flow of electric current through a wire is that the watt rate of generation of heat within any length of it is equal to the square of the amperes multiplied by the resistance of that length. This is a consequence of Ohm's law. When, however, we try to deduce from this fact the temperature elevation attained by the wire under the conditions of heat liberation, we encounter numerous difficulties, and the problem of either measuring or computing the increase of temperature becomes difficult. It is known that the temperature elevation of a concealed wire, cooled by conduction, follows a law similar to Ohm's law; that is, the temperature elevation of the wire corresponds [illegible], the flow of heat corresponds to the flow of electric current and the [illegible] is represented by a

thermal resistance, depending upon the dimensions of the insulating cover or covers, as well as on the thermal resistivity of the materials.

An interesting paper on the subject of concealed wires heated by electric currents, was presented by Dr. A. E. Kennelly and Mr. E. R. Shepard before the recent convention of the American Institute of Electrical Engineers. It was shown that the final temperature elevation of the wires increased faster than the square of the current in all cases. The measurements showed, in fact, that the temperature elevation for very small currents increased as the square of the current; but that at elevations near 50 deg. C. they increased at an exponent of about 2.2, or faster than the square, while at elevations near 100 deg. C. they increased at an exponent of about 2.3. The reason for this is that the hotter the wire becomes, the greater its resistance, and the greater the heat produced by a given current in that resistance. If the resistivity of copper did not increase with temperature, the final temperature elevation of the wire might be expected to increase in direct proportion to the square of the current strength. Within the range of 100 deg. C. temperature elevation, the plotting of final temperature against steady current followed nearly straight lines on logarithm paper. A large number of measurements were made on the heating of wires in sand, soil and gravel, from which a number of data on thermal resistivity of such substances have been tabulated for reference.

The Properties of Electrons.

It is a significant indication of the close connection between physical science and its applications, that President Samuel Sheldon's recent address before the American Institute of Electrical Engineers was devoted entirely to a subject of recent physical investigation—the properties of electrons. The paper is useful to the electrical engineer, because it forms a compilation of the most essential facts at present possessed concerning electrons, expressed in electrotechnical terms rather than in the language of physicists. The paper refers to the fact that the mass of an electron appears to be entirely electromagnetic. In other words, the only kind of inertia possessed by the ultimate particles of matter is their electromagnetic inertia, or the inertia of the self-induction of virtual electric currents, due to the motion of the electric charges which constitute electrons. When an electron is stationary with respect to its surrounding ether, the electric flux from its charge radiates uniformly in all directions and there is no magnetic flux developed. The stresses due to the radiating electric flux balance in all directions, or produce no resultant force upon the electron. When, however, the electron moves, the cutting of ether by the electric flux generates magnetic forces and these forces pull upon the electron. The distribution of electric flux emerging from the electron is also disturbed. It weakens ahead of the electron and intensifies in its wake. This causes a resultant electromagnetic force to pull back on the electron during acceleration, with an intensity proportional thereto, or in accordance with the Newtonian law of inertia. Work of an electromagnetic kind has, therefore, to be done upon any and every electron during acceleration, owing to its self-induction.

[illegible] inertia of the pound weight, when moved suddenly, is supposed to be the total eletromagnetic force of inertia of that horde of electrons. The only difference between the electromagnetic inertia theory of matter based on electrons and the mechanical inertia theory of Newton, is that the mechanical theory takes it for granted that inertia is constant at all velocities, or is independent of velocity, so that a projectile should resist acceleration to the same extent, whether at rest, or already moving at a speed of half a mile per second; whereas the electromagnetic theory requires that the inertia of the projectile should increase with the speed, and become infinite at the speed of light. Practically, there is no discrepancy between these two theories within the limits of artificially producible speeds so far as experiment is likely to discover. In other words, the increase of inertia in a projectile fired from a large cannon would be quite insignificant, because its velocity is so small compared with that of light. The great potential importance of the electronic theory is not merely that it can explain inertia and the unity of all matter, but that it may in time lead to the comprehension of all chemical action. At present we know, for instance, that carbon and oxygen can combine with a disengagement of thermal energy, but we have no idea of why a carbon atom attracts oxygen atoms, how the combination occurs, or how heat is liberated in the process. Chemistry is mainly the name of a very long list of observed facts concerning the relative behavior of different substances, the ultimate nature of the substances and of their reactions being unknown. If, however, the electron theory can be highly developed, and if atoms of all kinds are mere groupings of electrons, we ought to get to understand how these different atoms must behave towards each other, and so, perhaps, predict chemical phenomena. Another great untility that may exist in the electron theory is in the working of metals in such a manner as to increase the number of free electrons, or the degree of freedom of such free electrons as ordinarily exist therein. By this means, we should expect to increase the electric conductivity of the metals, or diminish the size of wire that would be necessary for carrying a given power to a given distance with a given loss. Of course, it may be said that metallurgical experiments are more likely to be practically useful in this direction than electronic theory; but, on the other hand, it is readily conceivable that the electronic theory, if sufficiently developed, might suggest experiments that would otherwise never be thought of.

The Waste of Energy in Cables and Condensers.

In a cable carrying direct current, the loss of power which is wasted in heat occurs entirely in the conductor according to $I^2 R$, so far as concerns practical operation, because unless the cable is seriously defective, the power wasted by current leaking through the dielectric is insignificant. With alternating-current transmission, however, the waste of power is not limited to the $I^2 R$ loss in the conductor, just as in direct-current cables, but includes also a loss in the insulator of the type $E^2 G$, where G is an equivalent conductance of hysteresis, increasing with the length of the cable and with the frequency, but depending, as well, upon the nature and form of the dielectric. The virtual hysteretic conductance G of the cable is also affected by the wave shape of the impressed voltage. The extra loss of power in dielectric hysteresis is not only objectionable as waste of money at so much per kw-hour, but also

because it raises the temperature of the cable, and causes the safe carrying capacity of the cable to be reduced.

Our Viennese contemporary, "*Elektrotechnik und Maschinebau*," has recently printed two articles of Dr. Bruno Monasch on the subject of this hysteretic loss of energy. A number of measurements were made of this loss in condensers and in short lengths of underground cable. The selected method employed a Wheatstone bridge balance, with resistance in the bridge arms, an optical telephone in the bridge wire, and a condenser with resistance in series to balance the test condenser. The bridge was supplied with alternating current of measured voltage. The observations recorded show that when the various samples of alternating-current power-transmission cables were tested at about 1200 volts and 50 cycles-per-second, the charging current had a phase of about 1 degree short of quadrature. This represents a distinct power-consumption component of current. The angle of quadrature defect did not vary much with voltage, or with frequency. The waste power which accompanies this one-degree phase-difference from quadrature may attain considerable proportions. For example, it is indicated in the article that a particular three-phase cable operating at 11 kilovolts and 50 cycles-per-second, might be expected to consume 580 watts per kilometer, or 930 watts per mile. In round numbers, this might be called a kilowatt per mile. In the course of a year, the total energy expended in an underground network of 60 miles in length of such high-tension cable, would be upwards of 500,000 kw-hours. It is evident that the economic importance of such dielectric losses in an extensive high-tension system may be serious, and call for careful study from engineers. Unlike I^2R losses, which increase with the load, and are relatively small during hours of light load, these E^2G losses are substantially the same all the year round.

The Suspension Insulator.

The Niagara papers of Messrs. Hewlett and Buck, the latter of which is printed elsewhere in abstract, present a most interesting and promising method of high-tension line construction. As Mr. Hewlett very properly intimates, the necessity of large dimensions has forced the ordinary pin form of insulator to a size that is both mechanically and electrically objectionable. It is mechanically bad in that the lateral strains are so severe that proper support is very difficult; and it is electrically bad because the large masses of porcelain required, even when the insulator is made in several parts, are difficult and expensive to construct of good quality. Moreover, by carrying the wires in suspension the strains on the long cross-arms needed in high-tension construction are greatly reduced. So long as wires were spaced only two or two and a half feet, the cross-arm gave little trouble, but the present practice of spacing five or six feet is quite another matter. The form of suspension insulators described is a very simple and workable one, being built up of units each of which is of a size easily made in a high grade porcelain. As is well known, the limit of voltage on insulators is due not to their capacity to resist puncture, but to their external sparking distance. By using several units in series this distance can be greatly increased and the puncture strength will always remain ample.

The advantages of such a construction are many and it ought thereby to be possible so to increase the sparking distance as very greatly to increase the working factor of safety. Even with the best pin insulators now obtainable the factor of safety is considerably less than prudence would dictate. Using four or five of these suspension elements in series, one should easily reach a factor of safety of four or five at all voltages now in use, and voltages now beyond the range of practice should become entirely feasible. That this construction is being tried on several important lines is most encouraging and it looks very much as though a safe basis had been secured for very considerable increases in working voltage. For the last few years transmission voltages have remained almost stationary. There has been a tendency upwards, shown by a moderate increase in the maximum used and by an increased number of plants working at from 50,000 to 60,000 volts, but the limitations imposed by the insulators have been very keenly felt. Now a new line of work is open and we shall be much surprised if it does not lead to a really considerable advance in voltage. The new insulators seem to be especially well suited to use with tower construction, since it is of course desirable to decrease the number of groups when each is somewhat large and costly, and the necessary length of a considerable series makes a high support especially desirable. The tower constructions shown by Mr. Buck are admirably adapted to their purpose and his promise of a 100,000-volt line is one that indicates a great advance in electrical power transmission.

There are still some structural considerations to be settled. The permissible length of span is determined by the weights to be carried, the proper securing of the lines against damage by swaying, and the most suitable frequency of anchorages, are things that must be worked out by experience. We note that in the 100,000-volt line described by Mr. Buck the spans are to be from 500 ft. to 1000 ft. This is a large difference and a comparison of costs and factors of safety for the two spacings would be most interesting. The question of proper spacing is particularly important in the case of aluminum cables with their very low elastic limit and relatively large catenary droop. The matter of anchorages is almost as important, since there must be no tendency for considerable lengths of line to work over. Fortunately mooring by these unit strain insulators is comparatively a simple matter, but it somewhat complicates the construction at the mooring towers. The very high present cost of conductors, however, fully justifies going to considerable expense to increase the working pressure, so that the suspension insulators come at a most opportune time. It is perhaps not to be expected that the new construction will disclose no difficulties. Considerable ingenuity may have to be exercised to protect the unit insulators against damage by the constant working of their wire connections, and the design of suitable fixtures may require considerable experimentation. Yet the broad principle is certainly an excellent one that promises much for the future of power transmission. The ability to work at 100,000 volts with a factor of safety greater than is now usual at 50,000 or 60,000 volts, implies a very large saving in conductors in all large transmission projects. For short-distance work at moderate pressures the suspension plan will hardly supersede the somewhat simpler pin construction save where heavy cables have to be carried. We shall await with the keenest interest the operation of lines insulated in the new way, and with considerable confidence in a successful outcome.

The Municipal Ownership Inquiry.

[illegible] Commission of the National Civic Federation are beginning to make their appearance, through the newspapers, and the complete volumes are expected soon. The first two reports to come out deal with the relation between labor conditions and municipal ownership. One is written by Prof. John R. Commons, of the University of Wisconsin, and the other by J. W. Sullivan, editor of the *Clothing Trades Bulletin*, a union organ.

The views of Prof. Commons are in many ways favorable to public ownership, but he finds that the matter of dealing with employees is a serious problem. He favors the recognition of organized labor as a means of doing away with political pressure. Prof. Commons finds that in this country unskilled labor is better paid by municipalities than by private companies. In Great Britain, he says that, with municipal ownership hanging over them, private companies have been led to better the condition of their employees.

Mr. Sullivan goes extensively into the subject of municipal corruption in this country, and says that municipal ownership restricts men in their activities in a way foreign to American ideas, and has failed to promote the interests of employees under it. Mr. Sullivan says that only in the most poorly paid forms of labor has municipal ownership raised wages, and points out that it is antagonistic to organized labor. [illegible]

"Unionism and officeholding, even of the pettiest grade, do not fuse. Another source of undermining the union movement lies in such municipal benefit and pension schemes as have forestalled the unionization of both the Glasgow and Liverpool tramway forces. Inevitably purely trade-union organization will be discouraged with the progress of political trade-union organization. The national labor movement of Great Britain was perhaps necessarily changed in character for a time through the Taff Vale decision; a political demonstration was unavoidable, but the ensuing political events, despite voices of warning, carried the unions to a point difficult to distinguish from Socialism. And similarly, the steps beyond a union campaign for municipalization in this country and a stage of municipalization itself, should this come, cannot be foreseen by American unionists. There might indeed come a glimpse of the wonders of collectivism, but erected on the ruins of unionism.

"Appointments must be possible to all citizens. Union rules and orders must give way in the shop to the law and official decisions. The Miller case of the Government Printing Office at Washington set at rest reasonable doubt on these points, one result recently being the refusal of 70 members of the typographical union in that office to pay the union eight-hour assessment. In the municipal enterprises investigated at Richmond, South Norwalk, Syracuse, Allegheny, Wheeling, Detroit, Cleveland, and Chicago, the laborers are not organized, while in the mechanical trades both union and non-union men without discrimination hold positions. Through the activity of business agents union men may at some municipal plants obtain a larger proportion of situations than non-union, but rarely can the agent compel the municipal employee, if firmly unwilling, to pay his union dues."

Discussing the same subject, Prof. Commons, who is a well-known municipal ownership advocate, says with regard to conditions observed in England:

"The natural tendency of municipal employees to better their own condition by use of their political strength is seen in the growth of the Municipal Employees' Association. This is a spurious form of trade unionism which has sprung up with the growth of municipalization, and nothing of its kind has been found among American unions. It has gained affiliation with other unions in the Trades Union Congress and in local trades councils. Its platform is simple enough—to prohibit strikes, to oppose councillors at the polls if they stand in the [illegible] help in the elections. Its demands are in excess of anything that other unions have been able to secure from private employers or even from municipal corporations.

"It invites into membership all employees of municipalities, and since they are nearly all eligible to other unions, evidently the aim of this organization is to separate a privileged class of workmen, and to do this through the political power of those whom they abandon. It weakens other unions while building on their support. With even a minimum of intelligence in the other unions, such a parasitic union would be repudiated. Such has been the fate of the Municipal Employees' Association. As long as its membership was small the consequences of its policy were not observed and its demands received the uncritical assent of others in the general approval of all efforts to raise wages. But with its rapid growth during the last two years the unions of unskilled workmen, who suffered first from its competition for members, brought their protest to the Trades Union Congress in 1906, and that body, after careful deliberation, repudiated the Municipal Employees' Association and all similar organizations of public employees by the practically unanimous vote of 1,196,000 to 42,000.

"It is thus promptly settled, before this organization has reached 15,000 members throughout Great Britain, that the trade union world is clearly opposed, both in sentiment and self-interest, to the creation of a privileged class of municipal employees. As far as the regular trade unions are concerned the principle of trade union wages rising and falling in municipal employment is accepted in its full significance. Without the support of the regular unions the strength of the Municipal Employees' Association has disappeared. It was a temporary phase of the rapid increase of municipal ownership.

"The increase in municipal ownership in Great Britain has, of course, brought an increase in the number of municipal employees, and this has caused apprehension in certain quarters. Generally the chief officers of the municipal enterprise take the ground that they and other employees should not vote in municipal elections, and they openly set that example to their subordinates. Some of them go even so far as to advocate the disfranchisement of municipal employees in municipal elections. This has also been advocated by some of the councillors. However, such a proposition is no longer seriously considered. If the vote of municipal employees is a menace, the remedy must be looked for in directions other than disfranchisement. It goes without proof that such a remedy is needed, for municipal employees sooner or later cast their votes for candidates who promise or have secured a betterment of their condition, regardless of its effect on the enterprise as a whole. Omitting disfranchisement, there are two directions in which such a remedy can be found—first, a limit to be set beyond which municipalization shall not go, and, second, the attitude of the public, and especially of the workmen in private employment."

Mr. Sullivan, also, in support of his contention that municipal ownership has not bettered the condition of its employees, says: "Any advantages in wages or hours to be figured out for the municipal enterprises investigated in America over the private ones compared with them look like State illustrations of the soft berths to be found in public employment. To what extent the jobs are political for the employees, single or collectively, or a bid for the labor vote, is constantly a question.

"Public employees, frequently against their will, under duress from officials who may injure them, promote by election contributions the fortunes of certain men and parties, though at heart they may be opposed to both. The executive, mayor, councilman, or department head, not only in appointing, but in promoting or dismissing employees, is exposed to partisan, social, personal, or other pressure. Even if the reformer in office is genuine, even if the scheme he has promises well for the working masses, there arises the question of the duration of his official powers and those of his successors with similar aims, together with the assiduous attention of the public to its own protection."

Mr. Sullivan adds with regard to American conditions: "In America the municipalized enterprises visited by our labor in-

vestigators have been rich mines for significant facts relating to politics rather than to labor. These facts are not usually among those heretofore emphasized by the American advocates of municipal ownership. The testimony as to political rottenness, root and branch, in Syracuse, Allegheny and Wheeling is conclusive. The municipal plants examined in these cities, it is to be remembered, were selected as models by representative municipalizers of the commission. Nor is the political labor situation in Detroit, Cleveland, Chicago or Richmond at all settled as well as it might be. In Cleveland the present mayor in the beginning increased his reform forces in the public water department so as to strengthen his vote in the primaries—an act possible at all times also under the next and succeeding administrations, which may be bad where the present is good. The degree of purity attained by the present administration is attributable to the officials and the public sentiment aroused and not to municipalization. In Chicago, where civil service is ironclad, the appointment by the mayor of department heads and even of the Civil Service Commission itself has more than once proved a vulnerable point in the civic armor, with sad results. In Detroit, Cleveland or Chicago the stability of the municipally operated enterprises rests largely on the mayor, who, however personally estimable and statesmanlike, necessarily becomes as a candidate a relatively good or bad politician, representing for a brief term a policy that may change with his successor. It is plain that in this political situation the resultant labor problem is most difficult. An employee can only hold office in uncertainty, with its consequent evils. This form of disquiet is not usual in private employment. As at Richmond, its exclusion of black men suggests a burning race question indeed, North and South, were municipalization generally adopted and Richmond's example in that respect followed.

"Any advantage in wages or hours to be figured out for the municipal enterprises investigated in America over the private ones compared with them looks much like state illustrations of the soft berths to be found in public employment. To what extent the jobs are political for the employees, single or collectively, or a bid for a labor vote is constantly a question. A correct view takes in these points: Syracuse, the wages situation politically debauched; Wheeling, the same; Allegheny, the same, to an extent that when a difference of 50 to 100 per cent in favor of municipalization is soberly computed by one man it makes another laugh; Detroit, private and municipal plants but a shade difference; Cleveland, nine hours municipal against ten in the general labor market, wages the same; Chicago firemen in the fire department do not receive union rates; New Haven—no municipal undertaking—hours, eight, public departments, as against nine, water works; Philadelphia, United Gas Improvement Company, better wages and hours than any city department and a reduction from twelve hour shifts under municipal operation to eight under the company, with higher wages."

Electrical Display for Boston Old Home Week.

The electrical display during Boston's Old Home Week will be one of the chief features of the entertainment in the seven days between July 28 and August 3. An electrical parade at night which will be featured with a large number of specially decorated trolley car floats is planned by the committee which is headed by Mr. John Campbell, president of the Electrical Auditing Company. An electric fountain will be erected in the historic Frog Pond on Boston Common, and an electrical pyramid and electrical arch are also planned. Hundreds of strings of incandescent lamps will be looped through the public garden and common, and a special display will be made at the mall near the Charles Street entrance of these grounds. A floral electrical arch will probably be erected opposite the entrance of the South Terminal Station at the junction of Federal and Summer Streets. An electrical pyramid is also considered among the decorative schemes. C. Howard Walker, a landscape architect of wide reputation, has the artistic side of the decorations in hand, and Lt. Gen. Nelson A. Miles, U. S. A., retired, is in charge of all military features. Gen. Wm. A. Bancroft, president of the Boston Elevated Railway Company, is expected to serve as chief marshal of the civic parade, which has already booked over 10,000 participants.

Engineering Education.

The fifteenth annual meeting held last weeek in Cleveland by the Society for the Promotion of Engineering Education was well attended, more than 80 of the 415 members being present. During the meeting the council recommended 80 applicants for membership, thus bringing the total to 495. A large number of papers was presented dealing with every aspect of engineering education. Much credit for the success of the Cleveland meeting is due to Prof. W. T. Magruder, secretary, who also carried on the campaign which so largely increased the membership.

The new officers chosen are as follows: Charles S. Howe, president Case School of Applied Science, Cleveland; vice-presidents, Clarence A. Waldo, head professor of mathematics, Purdue University, Lafayette, Ind., and William G. Raymond, dean of College of Applied Science and professor of civil engineering, University of Iowa, Iowa City; secretary, Arthur L. Williston, director Department of Science and Technology, Pratt Institute, Brooklyn; treasurer, William O. Wiley, publisher scientific books, New York City.

A resolution was adopted asking the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Society for Chemical Industry each to appoint two members to act with three members of the Society for the Promotion of Engineering Education, as a committee on engineering education. The duties of this committee, as expressed in the resolution, will be to examine into all the branches of engineering education, including engineering research, graduate professional courses, undergraduate engineering instruction, and the proper relation of engineering schools to secondary industrial schools or workmen's schools, and to formulate a report or reports upon the appropriate scope of engineering educations and the degree of co-operation and unity that may be advantageously arranged between the various engineering schools. This joint committee is requested to make a report of progress to the society within a year and a final report within two years. Several of the other societies have expressed a willingness to take this action and it is believed that all of them will co-operate in the purposes for which the committee is appointed.

The address of President Dugald C. Jackson was on "The Relation of the Engineering Schools to the Secondary Industrial Schools," and very clearly represented his idea that the country needs more trade training schools in order to prepare its young men for the best work there is in them. There is need for more schools that turn out corporals and sergeants of industry, he said, and commended the farmers for their agricultural schools, but, at the same time, criticized them for their unwillingness to spend more money in that direction.

Secondary schools are inadequate in number and extent to meet the problem in secondary education. Those for training foremen and superintendents are almost unknown and little attention has yet been paid to making skilled artisans through schools of this kind. The speaker said that the organization of such schools lies with the teachers and faculties of the engineering schools and that they should make every effort to see that secondary schools are established and use their influence to foster them. The country needs trained artisans, men who are able to do their work intelligently and with a thorough knowledge of the process through which the material they are handling goes. Information in their line of work will lend interest to the operations of the shop and factory and make better men of the workmen.

Prof. H. H. Norris, of Cornell, presented a paper on "Meth-

interesting and led to considerable discussion. Profs. Harold B. Smith and Arthur W. French, of Worcester Polytechnic Institute, furnished a paper descriptive of the new electrical engineering building of that institution, while J. Walter Esterline, professor of electrical engineering, Purdue University, described the electrical engineering laboratory of Villanova College. Dayton C. Miller, professor of physics in Case School, followed with a paper on the Rockefeller Physical Laboratory of that institution. On the subject of "Organization and Conduct of an Electrical Engineering Laboratory," John W. Shuster, assistant professor of electrical engineering in the University of Wisconsin, furnished a paper in which he discussed the possibilities of an engineering school in laying broad foundations for future practice and the relation of practicing engineers to the school. A paper of Albert A. Radtke, professor of electrical engineering at Armour Institute of Technology, discussed plans of teaching central station work and making plans for plants. He said that students should be taught as far as possible from actual practice and observation of plants in operation.

A paper by Prof. Fred A. Fish devoted to the changes that have been made in the first two years of the electrical engineering course at Iowa City College led to a discussion on a five or six-year course of study in engineering schools instead of four, as most of them now have, and it was stated by some of the speakers that students would be much better prepared for their work, with more time spent in school. On the other hand, some of the instructors believed that but few would take such a course because of the time and the extra expenditure of money it would require. Again, it was argued that with the intensive study that is practiced in the German schools, American boys could do vastly more work than they do. The time should not be lengthened, one of the speakers said, but the students should be held to account for the work assigned to them. The German students work harder and the results are better. The answer to this was that boys could not be made into men instantly and that they would have to be borne with until they realize the purpose of an engineering education. It was brought out that a number of schools now have longer courses for those who desire them, and that a post-graduate degree is given to those who complete them. It was also suggested that a general engineering education be given in the four years, and that those who wished to spend more time specialize on what they wish to follow in the extra years they take.

Prof. Herman Schneider, of the University of Cincinnati, read a paper on the co-operative engineering course of that institution, described some time ago in these columns. Arrangements have been made with the Allis-Chalmers Company and some others of the large plants and factories in that city, through which students are employed every alternate week of the school year and given practical work, just the same as any of the other men. The classes are divided, so that when half the members are in the shops, the other half are taking the classroom work. While working, the men also take problems for the spare hours of the evening. In this way the men follow the work from the time the raw material is taken into the shops until the finished product is turned out. The course requires six years and the admission requirements are the same as for the four-year course. The plan has been in operation one year and good results are promised. Electrical, chemical and mechanical students are taking this practical work. They receive pay ranging a little higher than that of the ordinary apprentice and in all this amounts to something like $2,000 during the course. The members of the society were greatly interested in this paper and many questions were asked regarding the work, all of which the speaker endeavored to answer.

Mr. Charles S. Gingrich, of the Cincinnati Milling Machine Company, spoke on the same topic from the standpoint of the engineer or owner. He said that the factories must look to the engineering schools for their trained young men, but at the same time these men to be immediately valuable must be practical. In no other way can they gain a practical knowledge of actual manufacturing so well as working in the shop under shop conditions. They learn how to deal with the men and how to treat them, as well as gain an intimate knowledge of the work they will superintend later on. This plan takes the school into the shop instead of trying to take the shop into the school and that is the proper thing to do. The attitude of Cincinnati manufacturers is favorable to the plan.

A discussion of this paper brought out the fact that some of the railroads are establishing training schools for their men. The one at Altoona, established by the Pennsylvania Railroad, was mentioned, and the plan of large concerns doing this was discussed in a favorable way. As to trouble in Cincinnati from the labor unions, it was pointed out that the arrangements are with open shops, but that unions would not oppose the plan, since the men are not apprentices in the same sense that boys who expect to follow those vocations regularly are.

The report of the committee on industrial education, read by C. M. Woodward, Washington University, St. Louis, considered two kinds of industrial training—one that fits the boy mentally and morally for the work he is to do, and the other, that which the shop-school gives. The report stated that the difference between industrial training in Europe and this country is that the European method is to begin at the bottom, while in America the idea is to begin at the top. However, few industrially trained men in Europe ever rise to the dignity of engineers. They are trained to do their work, but little attention is paid to their mental training. Manual training schools in America are great feeders of the engineering schools, and should, therefore, be encouraged in every way possible. This country has comparatively few such schools in proportion to its population, and until more interest is taken in the matter, the European method will have to be considered the best. It can be used to good advantage in America in a modified form. The report outlined the work of a model school for manual training, in which a portion of the time is given to mental training, so that when a man is fitted for the work he expects to follow, he will also have a mental training that will fit him to be something besides a hand in the factory. Manufacturers and railroad men prefer boys trained at these schools and they stand higher than others from the beginning, with an opportunity to advance. They are prepared for co-operation of brain and hand, are skilled in the matter of learning and are, therefore, in position to acquire a knowledge of anything more readily than without the training. There is a great opportunity for men of wealth to use their money in establishing such schools and for the public schools to put in such departments to fit their boys for lives of usefulness.

Prof. Williston, another member of the committee, spoke of the organization of the National Society for Industrial Education, formed last November in Boston. Many different types of schools, he said, will be needed to meet the demands in the many different localities and conditions.

Mr. Albert G. Wessling, assistant engineer of the Allis-Chalmers Company, spoke of the student apprenticeship from the manufacturers' standpoint, a topic similar to that discussed by Mr. Gingrich. He first gave a description of a model factory, and then how necessary it is that the engineer understand every step in the course from where the raw material is secured to the accounting and publicity departments. Demands are made upon him from all departments. The man who has received the practical training to be had in the shops is well armed for the questions that will come to him later on, and for originating new devices and planning improvements that will meet the product of competitors. Opportunities are always open in that direction and the trained man may make himself more valuable in proportion to the skill he has in seeing and meeting these questions.

The speaker described the instruction given students in the electrical department, where they begin in the commutator department, then go to the winding department, and so on, each time going to work that is more difficult than that just left until finally they are drilled in the business offices. Lectures on various subjects are delivered and they are given every op-

portunity to learn the practical end of the business thoroughly. No college can turn out full-fledged engineers, he said, and the only way that thoroughly trained engineers can be secured is by putting them into the shops while they are in college that they may learn all together.

Charles E. Downton, foreman of apprentices, Westinghouse Electric & Manufacturing Company, spoke of the department that has been organized by that concern especially for training young men in the work. There are two classes of apprentices that come to the department, technical and non-technical. Mr. Downton said that the schedule of work laid down for these men did not cover the entire range of the factory, but, on the other hand, they are taught to do certain portions of the work well. In the engineering course, the men are taken up where they leave their work at college and given the practical side of the work, and taught how to handle men. This is one of the important features of the engineer's training. The men are assigned to work with others and trained so that they will be able to fill vacancies whenever they occur. Should they fail at first, they are given another trial. Some of those who failed at first have afterward made very excellent men and are holding good positions. A club has been organized for the engineers and officers, which has proved beneficial in a social and economic way.

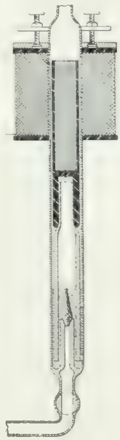
Apprentices are expected to remain until able to take a place in the plant, and 50 per cent of them are now with the company. The course requires two years, but this is not held to rigidly, conditions sometimes governing the disposition of the men.

The paper by Mr. Charles F. Scott, consulting engineer of the Westinghouse Electric & Manufacturing Company, dealt with many of the problems covered by preceding papers and especially urged that engineers should be able to handle men well. In this work they must come in contact with them and know them. Nothing will give them this advantage so well as to work in the shops with them. Mr. Scott also said that an engineer should be able to think out and execute new things. He deals with nature's materials and forces and must not allow precedent to bother him, but if possible step on ahead with ideas that will be valuable to his company. Education will train men to think, but they must use good, common sense when they begin their work in a manufacturing plant. The future engineer must be a larger man than those who have been able to take care of the work in the past.

The discussion following this paper was as to whether the colleges are able to prepare engineers so that they may take places without special training in the shops afterward. While all realized the value of such training, at the same time they felt that the schools are not so deficient in practical training that their men must take an apprentice course before they are able to take positions of any kind. In a general way the members indicated their belief that the schools are a very important factor in training engineers for all kinds of work, and that to a very large extent they are able to take up and succeed with work after leaving their colleges.

Valve for Vacuum-Tube Lamp.

A patent issued June 4 to Mr. D. McFarlan Moore, gives considerable information concerning the type of valve employed for admitting gas in limited quantities to a Moore vacuum-tube lamp. This automatic feeder valve, which was mentioned briefly on page 865 of our issue for May 4, 1907, is shown in vertical section in the accompanying illustration. The essential elements of the valve consist of a porous pencil of arc lamp carbon and a seal of mercury, which covers the tip of the pencil when the valve is "closed" and allows the tip to be exposed when the valve is "open." The vacuum-tube lamp, to which minute quantities of a certain gas are fed as desired, is connected to the lower extremity of the valve, while the receptacle from which the gas is obtained is joined to the upper extremity. The influx of gas to the vacuum tube is regulated by an electro-magnet, whose plunger serves for moving a displacer into or out from the mercury according to whether the valve is to be "closed" or "opened." With the displacer in its lower position the mercury completely covers the tip of the carbon, but when



VALVE FOR VACUUM-TUBE LAMP.

the displacer is raised the mercury surface becomes lowered and the carbon tip is exposed. The gas percolates through the mass of the carbon, so that there is no sudden influx of gas and no sudden fluctuation of the gaseous tension within the tube lamp.

Invention of the Telephone.

The recent death in Paris of Charles Bourseul, a retired employee of the French post-office service, recalls the days of polemic discussion over the invention of the telephone, in which the names of Bourseul and Reis occupied such leading places. The claims made for Bourseul rest upon the following passage from a paper which he published in 1854:

"Suppose that a man speaks near a movable disk, sufficiently pliable to lose none of the vibrations of the voice, and that this disk alternately makes and breaks the current from a battery; you may have at a distance another disk which will simultaneously execute the same variations. * * * It is certain that in a more or less distant future, speech will be transmitted by electricity. I have made experiments in this direction; they are delicate, and demand time and patience, but the approximation obtained promises a favorable result."

This was published some years before Philip Reis began his investigations. Writing in 1868, Reis said: "Incited thereto by my lessons in physics in the year 1860, I attacked a work begun much earlier concerning the organs of hearing, and soon had the joy to see my pains rewarded with success, since I succeeded in inventing an apparatus by which it is possible to make clear and evident the functions of the organs of hearing, but in which also one can produce tones of all kinds at any desired distance by means of the galvanic current. I named the instrument 'Telephon.'"

In the great suits involving priority in the invention of the telephone, the claims for Reis, based upon this publication, upon an article in the *Gartenlaube* and an illustration of his apparatus in the catalogue of an instrument dealer, were strongly pressed, the charge being specifically made that Bell had derived the idea of his telephone from one or more of these sources. On the other hand, other suits were based upon the allegation that an application for a patent filed by the late Elisha Gray was revealed to Bell by one Wilbur, an employee of the United States Patent Office. Neither of the above

charges were substantiated to the satisfaction of the courts.

The following note relating to Bourseul appeared after his death in the Paris edition of the London *Mail:*

"Some years ago M. Bourseul, who was living in retirement on his postoffice pension, asked for an audience of the Postmaster General. On being asked his name, he gave it as 'Bourseul, inventor of the telephone.'

"It was supposed that he was a harmless lunatic, but when he proved that he was a retired member of the postoffice staff, M. Mougeot caused an inquiry to be made into his antecedents, and was astonished to discover from the documents filed in the postoffice archives that the old fellow had spoken the truth, and that in 1854 Bourseul, after vainly offering his invention to the French postoffice, had published a full description of his invention in several technical periodicals. This detailed description is of far too technical a character for publication in the *Daily Mail,* but it will suffice to say that the principle of Bourseul's instrument—which he did not call the telephone—was absolutely identical with the telephone, the letters patent of which were applied for by Graham Bell at Washington on Feb. 14, 1876—or 22 years later.

"Bourseul, as is shown by the correspondence in the postoffice archives, spent five years in endeavoring to induce the French postoffice to take up his invention, but the authorities refused to take his invention seriously.

"On learning these details, M. Mougeot sent for the old gentleman, and asked him what he wanted. Bourseul complained that he found it difficult to make both ends meet with the small pension he was in receipt of. M. Mougeot, with the approval of the French Government, thereupon increased the old man's pension by £120 per annum, whereupon Bourseul returned in great delight to the country place to which he had retired.

"The president of the French Telephone Subscribers Association says that his death would probably have passed unnoticed but for the fact that Prof. Hodge, in a recent lecture on the telephone at Pittsburg, declared that the original inventor of the telephone was the Frenchman Bourseul. There is some question of raising a monument to Bourseul as the inventor of the telephone."

CURRENT NEWS AND NOTES.

OPERATORS WANTED.—[illegible] thousand young men who are willing to prepare themselves can have an opportunity in the next few months of entering the railway service in a branch which has produced the greatest number of higher officials. The railroads of the country are face to face with the task of securing at least 6000 telegraph operators, and possibly double that number in the next nine months. This number of new telegraphers is necessitated by the new law which limits the hours of labor in this branch of the railway service. There is not a railway management in the United States that knows where or how it is going to get the large additional force needed. The fact is that there are not enough telegraph operators in the country at the present time to supply this enormous demand, and the problem is to create a supply as quickly as possible.

THE TELEGRAPH STRIKE.—Advices from Chicago state that the Commercial Telegraphers' Union decided on July 7 to postpone for one week its vote on the question of declaring a strike against the Postal and Western Union companies. Meantime the strike situation at San Francisco remains apparently unchanged. Two hundred union telegraphers at St. Louis, in executive session last Sunday, expressed confidence in the central executive and their readiness to obey strike orders immediately. U. S. Commissioner Neill has gone to the Pacific Coast to deal directly with the situation there. Later information is to the effect that the prospects for peace are not so bright. It is stated that Western Union Superintendent Miller at San [illegible] strikers because they are not company employees. The general situation is rather confusing.

ANTHRACITE DIMINISHING.—In some of our cities, like Greater New York, central station and traction companies are forbidden to use soft coal. But Mr. Edward T. Parker, the coal expert of the United States Geological Survey, predicts that at the present rate of consumption the anthracite deposits of the United States will be practically exhausted in 75 years. He urges manufacturers to use bituminous coal and declares that the smoke nuisance will soon be abated as a result of experiments now being conducted. Commenting on these figures, Dwight T. Randall, engineer in charge of smoke abatement, Geological Survey, said: "There is evidently not enough anthracite coal in the country for power purposes in the large cities of the East. In 1905 New York city burned 9,000,000 tons of anthracite coal and 3,500,000 tons of bituminous. This ratio has already changed and will continue until bituminous coal is in the ascendancy. It is estimated that New York and Philadelphia are now using one-fifth of the total yearly production of anthracite. Thus it is seen that we must conserve the hard coal if we wish it to last any length of time. We have found it entirely feasible to abate smoke in power plants, great and small," continued Mr. Randall, "but it is next to impossible to prevent smoke issuing from the chimneys of residences burning soft coal. Therefore it would seem that the logical thing would be to utilize the rapidly waning supply of hard coal for the homes and use the soft coal in the factories and power plants. The real problem before the East is the abatement of smoke from soft coal. New York is now showing that this can be done in the experiments that are being conducted by the New York Edison Company."

[illegible] torney-General Jackson, of the State of New York. On his application this week, Supreme Court Justice Platzek made an order appointing R. Burnham Moffat a referee to hear evidence before the beginning of an action against the Western Union and Postal Telegraph Companies, which the Attorney-General proposes to bring to set aside certain contracts which, he declares, the two companies have entered into for the fixing of message rates. These agreements, he declares, are in restraint of trade and in violation of the anti-trust laws of the State of New York. The order requires all of the officers and directors of both companies to appear before the referee, and each officer is named separately. In addition, the proprietors of the big hotels in New York City are commanded to appear before the referee and produce before him all agreements, contracts, letters or other papers concerning the contracts which they have with either company for sending or receiving telegraphic messages in their hotels. The date for the first hearing is set for July 16, in the office of the referee, 63 Wall Street. The petition of the Attorney-General sets forth that the two corporations, the Western Union and the Postal Telegraph & Cable Company, are supposed to be rival corporations, organized for the purpose of transmitting telegraphic messages. About Jan. 1, of this year, he declares, the two companies entered into an agreement that hereafter they should mutually agree upon and enforce a tariff for messages, and that this tariff should be binding on both companies. The Attorney-General goes on to show by comparative tables the rates charged by both companies before the alleged agreement was entered into and afterward, and declares that the rates were increased, in many cases more than 20 per cent. He further alleges that when this contract was entered into the two companies agreed to establish offices to be used by them in common and for a division between them on a basis to be agreed on of the profits and receipts of such common offices. He adds that thereby a monopoly in the business of transmitting telegraphic messages was created and is now being maintained by the two companies. His action to restrain the carrying out of this monopoly, he says, will be brought in New York County, for the reason that the offices of [illegible]

WIRELESS IN JAPAN.—A wireless station has been established at Choshiu, Japan, to communicate with American liners at sea over a maximum distance of 100 miles.

CONSOLIDATION IN JAPAN.—The Tokyo Electric Light Company and the Tokyo Electric Power Company have been amalgamated. A movement is on foot to include the Tokyo Electric Railway Company in the consolidation.

JAPANESE WIRELESS TELEPHONE.—Mr. Taka Shojiro, of Tokyo, has, according to a Japanese journal, invented a wireless telephone which is claimed to give results superior to any of the forms which have been invented abroad.

ELECTRICAL INDUSTRY IN JAPAN.—According to a consular report, there were organized in Japan during March, new electric railway companies with a total capitalization of $650,000, and new electric power companies with a capitalization of $100,000.

LABOR TROUBLES IN JAPAN.—The Japanese government has recently met with much difficulty in dealing with labor troubles. A recent incident was a conflict between two bands of workmen employed in the construction of the works of the Hakone Water-Power Electric Company, one of which attacked their opponents with dynamite bombs, killing and wounding a number of them.

NEW EDISON PRIMARY BATTERY.—A patent issued July 2 to Thomas A. Edison describes an improvement of the Lalande-Chaperon primary battery, known in this country as the Edison-Lalande battery. In this battery the electrodes are zinc and copper oxide in an electrolyte of potassium hydrate. The improvement consists in adding to the electrolyte about 15 per cent of silicate of potash, whereby, it is stated, the capacity of the solution for zinc or its solvent power is more than doubled, thus enabling a cell of a given ampere-hour capacity to be made much smaller. Instead of copper oxide, nickel hydroxide may be used. The superior results attained are ascribed to the formation of a double salt of zinc, silicon and potassium, which is much more soluble in the alkaline solution than the single salt of zinc and potassium and zinc.

THE BUSINESS OUTLOOK.—Judge Gary, chairman of the board of directors of the U. S. Steel Corporation, in an interesting interview this week said with regard to the present industrial activity: "It would be surprising if, with the prevailing conditions, there should not be some diminution in the volume of business during the remainder of this year. The business of our own company during the last six months has exceeded that of the first six months of last year, and we know that in 1906 there was a great deal of business done. I had all the presidents of our constituent companies here last week for a general talk over the situation before my departure. Every one of them was exceedingly optimistic. They could see nothing ahead but sound conditions and enormous continued business. Next year is a Presidential election year. This has always had the effect of causing a curtailment of orders during the latter part of the preceding year and the first part of the election year. Business men do not care to undertake new enterprises or order quite so heavily in the face of uncertain political conditions. The second point is that we have been doing too much business for the amount of money that has been available to finance our needs. It is well enough known that various corporations, among them many railroads, have had difficulty in securing capital requisite to their continued growth on the scale that has prevailed. We, fortunately, have not experienced this difficulty. The increase in the volume of money in the world has not kept pace with the increase in the volume of business. Companies [illegible] funds to make the purchases they would like. This necessarily leads to a cutting down of orders to some extent. But the railroads and other corporations have been forced to continue to purchase large quantities of current supplies, even though they have been forced to pay very high rates for the money required." Judge Gary alluded also to the lesser activity in building and the effect of radical, socialistic agitation.

THE PUBLIC UTILITIES BOARD of Greater New York, in which so general an interest is felt, has taken hold of its new duties in a vigorous manner. Beginning its second week of existence with its first open session, it has passed several important resolutions. In effect the board has called upon all traction and gas corporations within the district to submit to it copies of their accounts and records; requested, within two weeks, copies of all traction operating and equipment schedules; started the work of the inspection of gas meters upon a systematic basis, and arranged for the appointment of committees to take up what are possibly the two most important traction "problems" in the city, the bridge crush and the construction of the Fourth Avenue (Brooklyn) subway. The governor has sent to the State Senate for confirmation the names of the men he appointed on the Public Service Corporations. In his message he announced for the first time the terms they were to serve. The members of the New York City Commission will serve as follows: Chairman W. R. Willcox, 1913; William McCarroll, 1912; Edward Bassett, 1911; Milo Roy Maltbie, 1910; John E. Eustis, 1909. The terms of the up-state commissioners will be: Chairman Frank W. Stevens, 1913; Charles Hallan Keep, 1912; Thomas Mott Osborne, 1911; Martin S. Decker, 1910; James E. Sague, 1909.

NATIONAL ELECTRICAL CONTRACTORS.—The National Electrical Contractors' Association will hold its seventh annual convention in New York on July 17, 18 and 19, when a very large attendance is expected. Headquarters will be at the Imperial Hotel, and the business meetings will be held at the Engineering Societies Building. The first session, which will be open to everyone interested in the electrical business, will be called to order at 10 a. m., July 17, by Mr. J. C. Hatzel, chairman of the National committee, who will introduce Mr. James Hilton, president of the Electrical Contractors' Association of New York State. Mr. Hilton will welcome the members and guests on behalf of the State Association, and turn the convention over to Mr. James R. Strong, president of the National Association. Professor George F. Sever, consulting engineer of the City of New York, will address the convention on the relations between the municipality and the electrical contractor. Mr. Arthur Williams, past president of the National Electric Light Association, will speak on the relations of the lighting company and the contractor, and will be followed by Mr. J. Robt. Crouse, who will explain the work of the Co-operative Electrical Development Association during the past year. This will terminate the morning session, and in the afternoon there will be a business meeting. At 10 a. m. on July 18, there will be another open meeting, and addresses will be made as follows: Mr. T. C. Martin, of the Electrical World, on the relations between the press and the electrical contractor. Mr. C. M. Goddard, secretary of the Underwriters' National Electrical Association, will speak on the relations between the underwriter and the contractor. Mr. C. L. Eidlitz, first president of the National Association, will speak on the subject of that body. The remaining sessions will be occupied with executive business. On Wednesday, July 17, there will be a river trip for the ladies in the afternoon, and in the evening there will be a dinner at the Waldorf, followed by an amateur vaudeville by members. On Thursday, there will be an automobile ride for ladies in the afternoon to Coney Island, and in the evening, for members, a smoker at Shanley's, after the business session. On Friday there will be a trip up Long Island Sound by boat, with clam bake and baseball game, East against West, by members.

THE MICHIGAN ELECTRICAL ASSOCIATION.—The Michigan Electrical Association will hold its convention this year at Battle Creek, Mich., August 21, 22 and 23. The Post Tavern will be the general headquarters, and the sessions of the convention will be held in the Business Men's Association Rooms in the Post Building, directly across the street from the Tavern.

SMELTING IRON ELECTRICALLY.—A dispatch from San Francisco, dated July 4, states that the electric process smelter at Heroult, on the Pitt River, 18 miles from Redding, Cal., started up on that day. The smelter cost $70,000 and is the first of its kind to be established on a commercial basis. The success of the smelter, which is still somewhat experimental, means a great deal to California. There are mountains of iron ore along the Pitt River which could never be smelted in [illegible]

ENGLISH TELEGRAPHY.—The latest financial statement of the British post-office telegraphs shows that for the third year in succession the loss sustained on the service has amounted to more than a million pounds, although the receipts for the year were the largest ever known, reaching a total of £4,151,376. A review covering 37 years is included in the return, and shows that the total loss on the service during that period has amounted to £14,271,827. About eight millions of this loss is accounted for by capital expenditure, but the remaining six and a half millions is dead loss on the working of the system.

A LONG DISTANCE SIGN.—It is stated that a very striking "sign" or lighting fixture will crown the office building of the Columbia Gas & Electric Company, in Cleveland, Ohio. The building will be 60 ft. x 100 ft. and will have 16 stories below the tower, the tower being equal to four stories more. From the dome of the tower will rise a statue of liberty, with a crown studded with electric lamps. The statue will hold a torch from which a flame of gas will burn constantly, and at the exact hour every hour in the day and night a flame of gas will rise 25 feet and remain burning one minute. The time will be observatory time, telegraphed from Washington and the time machinery entirely automatic. The flame will be visible for about twenty miles.

TESLA'S INVENTIONS.—In a further letter, of July 2, to the *New York Times*, Mr. Nikola Tesla says: "I am receiving so many notices and inquiries on the subject of Martian signaling that I shall be much obliged to you if you will kindly refer those who have taken occasion to comment upon this feature of my letter in the *Times* of Sunday, June 23, to the March number of *The Harvard Illustrated Magazine*, in which I wrote a short article in response to repeated requests of the editor. What I have stated in that publication and others mentioned therein is all I care to say now, despite tauntings and temptations. A full technical report descriptive of my apparatus and results of observations I have particular reasons to reserve for two old institutions—academies of science—of both of which I am an honorary member."

RADIUM SUBSTITUTE.—With respect to recent advices from Paris as to a cheap radium substitute, a special cable dispatch from that city, of July 6, says: "In regard to the discovery of a new radio-active compound, molybdate of uranium, by André l'Ancien, a medical student of Rochefort, concerning which I cabled you yesterday, Prof. Le Chatelier, of the College of France, states that it is of little importance, as the substance contains an infinitesimal quantity of radium—one gram in 40,000. L'Ancien, he says, merely hit upon a new compound such as is frequently discovered in chemistry. The latest estimate, made this week, of the present stock of pure radium-bromide is about 17 decigrams, of which one-third is on the market and the remainder in the hands of Mme. Curie and various scientists. The price quoted by dealers is $80,000 a gram, the output having ceased."

THE ELECTRIC RAILWAY IN JAPAN.—The project for electric railways which since the late war have been put forward in Japan aggregate an estimated expenditure of $390,000,000. The Tokyo Tramway Company recently started work on extensions to cost $1,000,000, and comprising 36 miles of track. The Buso Central Railway, which has started to build a railway from Sendagawa to Odawar, a distance of 53 miles, has decided to equip for electric traction instead of steam traction as first intended. An electric railway 15 miles long is to be constructed on Amaji Island. Work is under way to equip the present steam road between Yokohama and Kodzu for electric cars in addition to steam trains. The Yokohama Railway Company has been granted authority to extend its lines to Kamakwra and Kanazawa. For this purpose the capital of the company will be increased to $1,000,000, making a total capitalization of $1,500,000.

MACHINERY CLUB.—The Machinery Club has been organized for the purpose of providing a pleasant place of common resort for entertainment in the heart of the business section of New York, conveniently located to most of the offices of the concerns interested in the various branches of the machinery and metal trades. Quarters have been engaged on the 20th and 21st floors and provisionally on the 19th floor of the Fulton Terminal Building on Church Street. The space reserved, from 36,000 to 54,000 sq. ft., is ample for lunch and grill rooms, library, assembly rooms and possibly a few bed rooms for the use of out of town members. The club will primarily be a luncheon club, but it is also expected to be a general rendezvous for the machinery trade in New York City. The resident members are limited to 750, suburban members to 500 and non-resident members to 1000. The House Committee consists of Messrs. T. N. Motley, P. A. Ware, E. H. Benners, C. A. Schieren, Jr., and G. A. Howells. Messrs. J. R. Vandyck, G. L. Gillon and C. E. Crook form the membership committee, the present address of which is 26 Cortlandt Street.

OWNERSHIP IN INDIANA.—A special dispatch from Indianapolis, of June 30, discusses the ill-luck of some 12 Indiana municipal plants. After pointing out the main causes, it says: "The constitution of Indiana fixes a limit of 2 per cent to the indebtedness of municipal corporations, and beyond this they cannot go. When the rush for municipal plants began nearly all the cities were dangerously near this limit and some having passed it, purchased plants on the instalment plan and levied taxes to meet the indebtedness as it came due. As a rule these plants were run down and from the first repairs had to be made, as at Washington and Peru. Then, again, those economic devices that private capital is always quick to take advantage of were out of reach of these cities because of the scarcity of money, and the service by comparison was poor and the patrons constantly becoming more dissatisfied. Some of the developments in connection with municipal ownership in Indiana would be very amusing were it not for the serious consequences that flow from them to that already overburdened individual—the taxpayer. For instance, when the new administration was installed at another city the discovery was made that the city was carrying $124,000 insurance on the electric light, waterworks and filtration plants. On an immense water tank, made of cement and assumed to be full of water all the time, there was an insurance of $20,000. It couldn't have burned if the whole city had turned out with firebrands and thus attempted to destroy it. The city waterworks was insured for $32,000, with all the probabilities of fire against it. There was $60,000 insurance on the electric light plant, though employees were always present and such a loss by no means probable. The new board reduced the insurance and saved $4,000 in premiums. The secret of this heavy insurance lay in the fact that a member of one of the city boards was the agent for the insurance company that was carrying the 'risks.'"

The New Building of the Boston Edison Company.

WITH a second-hand boiler and engine in an abandoned stable at the end of a dark alley, the Edison Electric Illuminating Company of Boston began its career in February, 1886. The first lighting service was given at the Bijou Theater, and the work was personally supervised by Mr. Thomas A. Edison. To-day the company serves 30 cities and towns in the Boston metropolitan and suburban district, covering a territory of 450 square miles and supplying a population of 1,000,000. At the beginning the company supplied the energy for 627 incandescent lamps, or less than what is now used on a single floor of a modern department store, and in many residences in the district. The company now has an alternating current connected load of 17,300 kw and a direct current connected load of 62,700 kw. The underground service has been increased until at present the company has $5,000,000 invested in distributing circuits and conduits out of sight beneath the pavements. The sale of power became an appreciable feature of the company's business in 1887. In June, 1901, the Boston Electric Light Company's plant and business were purchased by the Edison Company, and this consolidation was followed by many improvements in the service and extension of the supply into the suburban districts. Since the original station of the company at Head Place was shut down for about 20 hours in 1888, there has not been a complete cessation of the service at any time.

The growth of the company's business has necessitated the erection of a new ten-story modern office building at 33-39 Boylston Street, Boston, and this structure is practically finished at the present writing. The new home of the company is unique in style of architecture, convenient arrangement of offices, electric installation and elevator service. Fig. 1 gives a perspective view of the building, and Fig. 2 a view of the show window. The architects were Messrs. Winslow and Bigelow, of Boston, and the consulting electrical, heating and ventilating engineers were Messrs. Densmore and Le Clear of the same city. Whidden & Company of Boston were the general contractors, the electrical installation being carried out by Herbert S. Potter, Boston. The arrangements for general interior illumination and the design of the fixtures were in the hands of a special lighting committee, composed of Dr. Louis Bell, Boston; Mr. W. D'A. Ryan, Lynn, Mass., and Mr. L. B. Marks, New York.

The building has a frontage of 45 ft. and rises to a height of 125 ft. Indiana limestone was used for the solid portion of the front, although this is but little more than an outline, an unusual design having been followed in the glass installation

FIG. 1.—GENERAL VIEW OF BOSTON EDISON BUILDING.

FIG. 2.—SHOW WINDOW, BOSTON EDISON BUILDING.

The front of the building faces south, and the effect is largely that of a single sectionalized window 22 ft. wide, rising from the street level to the tenth floor. The individual panes are held in a bronze framework, the front of each story being separated by heavy bronze casements into five sections of six panes each. Three sections in each set can be opened, on vertical axes. Unusual delicacy of outline is the result. At the level of the third floor a stone balcony of ornamental design, with a pedestal at either corner supporting a large bronze lamp, forms the only important decorative relief on the front of the building. The top is finished with a modeled copper cheneau above the cornice. The soffit panels of the cornice will be illuminated in the evening and the cheneau will also be silhouetted with lamps. The design of the façade is especially adapted to elaborate electrical display. On the top of the roof is a steel

[illegible] Light," is mounted, the letters being 4 ft. high and the sign visible legibly for more than three-quarters of a mile.

The building is provided with two entrances, one at either side of the large plate glass window of the exhibition room, which is on the street level. One entrance leads directly into the exhibition department; the other into a marble vestibule and corridor flanked on one side by the elevators leading to the offices and on the other by a glass partition which forms the west wall of the exhibition room. This partition is provided with doors, also leading directly into the exhibition department. The general arrangement of the first floor is shown in Fig. 3. Immediately beyond the elevators are the cashier's desk and the general inquiry desk. These were placed on the first floor for the convenience of customers and inquirers who have not the time or the inclination to take the elevator to the offices above.

The second floor is arranged in one large room conforming in general design to the first floor. This room is given up to

FIG. 3.—FIRST FLOOR PLAN.

the city sales division and is provided with desks for the company's agents. The third floor is intended for a library and meeting hall. It is a high-studded room finished in white and has been fitted with the General Electric Company's "linotype" system of lighting, in which the lamp cylinders are concealed and continuous in a row around the wall of the room near the ceiling. The cornice is curved to render the lamps invisible, the rays being reflected from the curving surface in an even illumination throughout the room. Besides being intended for a library, this room will also be used as a lecture room and for the purpose of entertainment by the employees of the company. At one end a stage has been provided which will be equipped in a modest way with small set pieces and a drop curtain. The stage will be provided with 100 footlights mounted on swivels and controlled from a small dimmer switchboard located out of sight of the audience in a passageway at the side of the stage. A general wall cabinet for this room is located at the side of the switchboard, but the graded control of the lighting is effected from the concealed switchboard. The chairs for this auditorium are packed beneath the stage through trap [illegible]

stereopticon whenever lectures are given for the instruction of agents. The balcony on the exterior of this room will be fitted with 40 lamps to serve as a welcome when the hall is open in the evening.

The fourth floor is devoted to divisions of the general agent's department. Besides a large open space in which will be the desks of a number of the special agents, office rooms have been provided for those who feel it necessary to be free from interruption. These include an office for the general agent, a large room for the members of the division of statistics, another for the division of claims and adjustments, and one each for the special agent in charge of new buildings and the suburban district manager.

The fifth and sixth floors are devoted to the auditor's division, and are arranged in a most convenient manner, with ample desks and complete lighting facilities for such a department. The seventh floor is given up to the private offices of the superintendent of the operating bureau. The main office of the information division is also on this floor, together with an assembly hall, which is illustrated in Fig. 4. This room is to be used for gatherings of department heads, special guests, etc., and it is handsomely furnished with Mission style chairs, tables, divans, etc. Large portraits of President C. L. Edgar and Mr. Thos. A. Edison adorn the walls, with other photographs of interest. In one corner of the room is a kitchenette equipped with a Simplex electric cooking outfit large enough to take care of 50 persons. The eighth floor is given up to the purchasing department, the ninth to the installation and construction department, and the tenth to the drafting department. This latter

FIG. 4.—ASSEMBLY HALL.

floor is specially suited for this class of work, being at the top of the building.

The office employees at present number about 400. The company's old building at Head Place is connected with the new Boylston Street office building by a covered passageway at about the sixth story. At Head Place are the offices of the electrical engineering department, the laboratory, photometer room, transforming station, stock room, superintendent of underground lines, meter and arc lamp stock, stenographic, mailing and filing divisions. The company's private branch telephone exchange is also located here. This is a department store or relay type of switchboard, and it consists at present of two sections, each accommodating two operators. The full capacity of the board when extended will be six sections or twelve operators. The board is of the common battery type and there are at present 60 trunk lines connected with the Oxford Exchange of the New England Telephone & Telegraph Company's Boston district. The switchboard is operated continuously day and night.

Two electric elevators of the new Otis traction type have been [illegible]

ployees of the company. Each elevator has a lifting capacity of 2500 lbs., at a speed of 500 ft. per minute, and the winding drums are located directly on the ends of the motor shafts, which gives a more rapid acceleration than has heretofore been practicable with electrically-driven elevators. The elevator motors are located in a special compartment on the roof of the building and each machine is driven by a 150-ampere, 220-volt, direct-current motor making 625 r. p. m.

The exhibition department is undoubtedly the most interesting feature of the new building from the central-station standpoint. For several years the company had maintained attractive display rooms at its Head Place offices, and when it was decided to erect the new building it was settled that the space assigned for the education of the public in the uses of electricity should be the most prominent in the whole plan. The crowds of onlookers at the front window of the department and the

nation is increased by eight arc lamps set in concentric diffusing shades recessed in the ceiling. To enable the effects of incandescent illumination to be studied, the capitals of the columns are outlined with frosted incandescents mounted in special outlet boxes as close together as possible. At the rear of the exhibition room is a balcony landing with stairways leading both to the basement and the second floor.

Efforts are being made by the company to have at least a sample of every practical electrical appliance in the exhibition department, and manufacturers interested in this line of work have been given an opportunity to place their products here. In the electrical installation in the new building no peculiar or extravagant schemes were followed, but the aim has been to show clearly just how any modern office building can be equipped for the convenient and economical use of electric light and power. Thus, the ventilating system was designed to per-

FIG. 5.—EXHIBITION DEPARTMENT, BOSTON EDISON BUILDING.

large number of visitors who have already inspected the new quarters indicate that a wise selection of location was made in putting this department on the street level. Fig. 5 is a general view of the exhibition room as it appears from the Boylston Street window, excluding the apparatus in the window itself.

The exhibition room is one of the most carefully arranged for its uses in the country. It is about 54 ft. long and 30 ft wide, the height being nearly 20 ft. Both the first floor and the basement are to be used for exhibition purposes. In the basement provision has been made for the display of such heavy apparatus as large individual motors, ice crushers, coffee mills, bread mixers, large fans, vacuum cleaning apparatus, arc lamps, large signs and other bulky appliances which perhaps do not interest the casual visitor or the purchaser of ordinary electric convenience as much as the heavy power customer. The first or main floor of the exhibition department is finished in Greek design with eight large columns of [illegible] marble with [illegible] capitals. A cornice extends around the ceiling supported upon these large columns, and giving a [illegible] substantial appearance to the room. Everything except the columns is finished in white, while the brilliant [illegible]

mit easy inspection by the public, different styles of distributing cabinets were installed in the exhibition room for purposes of comparison, the elevator machinery can be seen by any one who is interested, and in the basement are also shown a motor-driven vacuum cleaning system and a sump pump of the automatic electrically operated kind. In the ordinary office building this apparatus is almost always installed out of sight of the public. The heating system is the direct radiation type, regulation being by automatic temperature control. Fresh air is drawn into the basement, screened and delivered to the rooms at approximately normal room temperature. The 140-in. suction fan in the basement is direct driven by a slow-speed General Electric motor which is mounted in the exhibition section. At the top of the building is a plenum chamber containing a 60-in. disk fan driven by direct connection on a vertical shaft by a 3.5-hp, 220-volt, 150-200 r. p. m., direct-current General Electric motor. The vitiated air from the building is drawn out of the various room ducts into this plenum chamber and forced into the external atmosphere through louvres.

The general wiring diagram of the building is shown in Fig. 6. The requirements of lighting and power service in the ex-

hibition department greatly modified the wiring installation for [illegible] ing electricity to future apparatus whose consumption is more or less indeterminate were essential. The general switchboard for the building is located in the exhibition room basement, and part of the connections to this board at the sub-base have been left exposed for the purpose of showing visitors the details of such construction. The switchboard is 25 ft. long and it is composed of eight panels of pink marble. At one end of the board, recessed in the wall behind, is the direct-current street-service panel and main cut-out cabinet for direct-current service. The alternating-current service board is at the opposite end, occupying panels 7 and 8. Proceeding from left to right as in Fig. 7, which shows the main switchboard in elevation, the service of the various panels is:

1. Power, basement and roof fans, elevator motors.
2. Meters, internal lighting and power, demand indicators.
3. Internal lighting, arcs, incandescents, illuminating.
4. Exterior lighting, balconies, marquise, riser, bull's-eyes, lanterns, cornice, tower, cartouche.
5. Meters, exterior lighting and exhibition apparatus, demand indicators.
6. Exhibition appliances, main cut-out switches.
7. Junction board exhibition apparatus. Tenth floor, alternating current lighting riser.
8. Alternate-current meters and demand indicators.

This grouping enables the company to learn for its own information or for demonstration the current and energy consumption of the various services in both temporary and integrated loads, and it shows in operation how much energy is consumed in the various advertising departments, both exterior and interior. Both indicating and recording instruments are liberally used on the switchboard. It was not considered necessary to install double-throw switches and duplicate bus-bars, so the wiring scheme from the purely electrical standpoint is simply one of subdivision along orthodox lines. The amount of energy liable to be demanded, however, together with the varied voltages and services needed, called for skillful engineering in the mechanical disposition of the various circuits.

From the main direct-current cut-out cabinet three 220-110-volt 1,000,000 circ. mil cables feed the second panel of the switchboard by conduit run beneath the floor, supplying the energy for general illumination and power in the building as an office structure. The direct-current service for the exhibition department is likewise fed at the fifth panel by nine 1,000,000 circ. mil cables, 220-110 volts leading from the main direct-current cut-out cabinet. Four 700,000-circ. mil cables carry 220-110-volt alternating-current power from the alternating service board to panel 8. All wiring is carried in armored conduit.

The general distribution scheme is well illustrated in Fig. 6. [illegible] pair of 400,000-circ. mil risers which are run as an independent circuit from the switchboard. The plenum chamber fan motor on the roof is also served by a separate pair of No. 8 risers. The general lighting of the floors from the second upward, including the second, is handled by a three-riser set diminishing in section from 400,000 circ. mil to No. 4-0 beyond the fourth

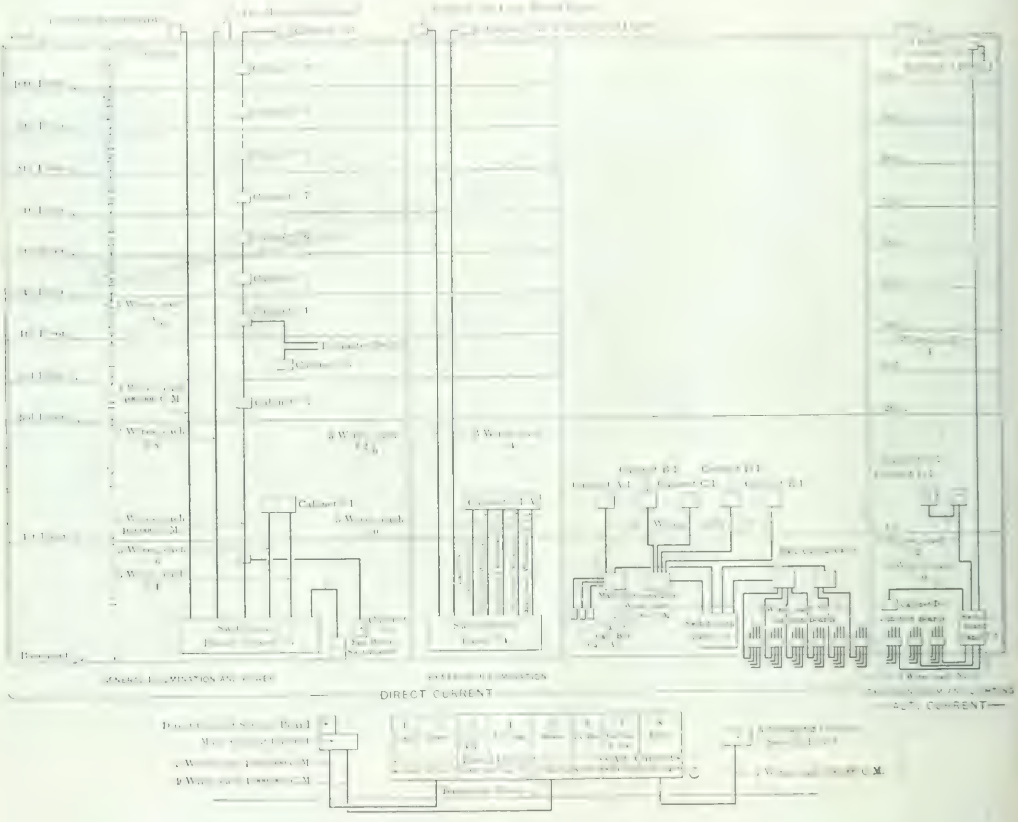


FIG. 6—WIRING DIAGRAM OF MAIN SWITCHBOARD, SHOWING SERVICE CONNECTIONS

floor. The general lighting of the exhibition department is supplied from the office building side of the switchboard, the company having decided that this illumination ought to be included as regular consumption and not as advertising lighting. The exhibition room lighting cabinet is served by three No. 6 wires and by three No. 4 leads, incandescents and arcs being separately controlled. The basement is supplied by a branch from the illuminating riser, and the basement fan motor by three No. 0 wires leading from the switchboard.

Separate sets of three-wire risers are run from the main switchboard to the roof to cabinets controlling the tower and the cornice lamps. The tower circuit consists of three No. 2-0 wires and the cornice feed is No. 4 section. The lanterns, balconies, cartouche, bull's-eye and marquise lighting are all controlled from a cabinet in the exhibition department, three-wire risers varying in section from No. 6 to No. 10 being run to this cabinet from the switchboard.

The exhibition department is provided with a large number of floor outlets, wall and column receptacles for alternating and continuous current at voltages of 110 and 220. Fig. 3 illustrates the arrangement of these in the exhibition room at the street level. All receptacles differing in current characteristics are so designed that the wrong plugs cannot be inserted in them, and are provided with metal plates numbered and lettered according to the current and voltage. The columns in the main exhibition room are liberally provided with wall outlets arranged radially for the different classes of service. All outlets are designed to carry a much larger current than any single piece of machinery in the room is likely to demand for some time to come. The floor receptacles are supplied through conduits run in the floor, and these outlets are of a special design, which enables additional circuits or extensions to be made on the ceiling beneath, without obstructing the main floor above. In general, the exhibition room is supplied from one panel of the switchboard through four three-wire 1,000,000-circ. mil circuits which terminate in four main cut-out cabinets located in the wall behind the main board. A clearance of 4 ft. separates the main switchboard from the wall. From the main cut-out cabinets five three-wire No. 0 circuits lead to the street floor cabinets, three circuits of the same size lead to cabinets in the basement, and six circuits lead to junction boards in the basement walls, whence feeds are run upward to the first floor and longitudinally to the outlets in the basement floor. The same general plan was followed with the alternating-current service, working from the seventh switchboard panel. Two No. 4 wires are run as a riser pair to the drafting room, so that if desired the company can use alternating current lamps in this department. Outlets are in general supplied from cabinets by independent branches. Behind the switchboard a spring was unexpectedly struck in excavating, and it was necessary to install a sump and automatic pump at this point to take care of the drainage. This outfit is one of the exhibits, and its operation by a 1-hp. 230-volt motor is frequent enough to be of interest to the visitor who is concerned with such details. One of the devices installed is a large gas meter, with connections so that the superiority of electric illumination over gas can be demonstrated. At one side of the basement are two rooms which will probably soon be equipped for color examinations and comparisons of different styles of shades and lamps. The main exhibit floor already contains a large variety of apparatus, including a General Electric kitchenette, Simplex kitchenette, heating appliances, small motors, electric signs, flashers, washing machine, electric light bath, hair-drier, refrigerating equipment, meters, photographs of the company's property, coffee mill, etc. Free copies of the company's monthly publication, *Edison Light*, are also distributed here.

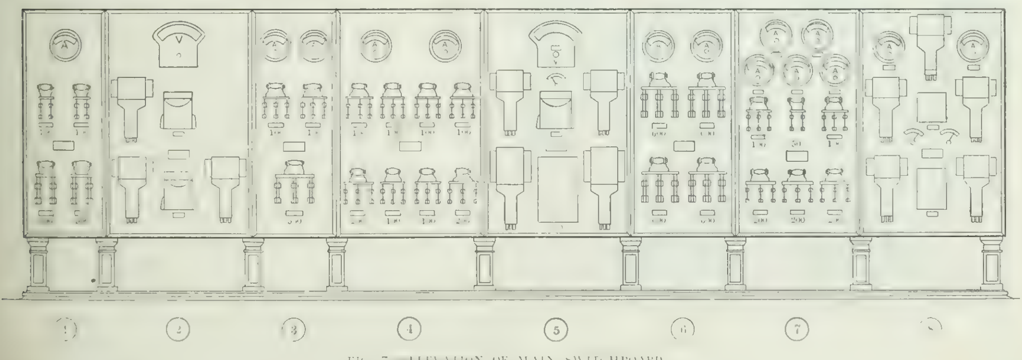


FIG. 7.—ELEVATION OF MAIN SWITCHBOARD.

Arc Lamps for Railway Car Illumination; Their Distribution and Characteristics.

By ALFRED L. EUSTICE.

The use of electric lamps for illuminating railway cars has been on the increase for some years, and at the present, owing to the luxury of trains in general, the electrical engineer is heeding the constant demands of the public and concentrates his efforts along the lines of more efficient illumination. The American engineer has possibly given less attention to car illumination than some foreign countries, but one must bear in mind the different conditions which exist that brought about electrical car illumination for general use. The roads in foreign countries are very short, as compared with many of our great railway systems, thus enabling the use of a battery equipment with little difficulty, and small cars permit the use of fewer units.

For several years the incandescent lamp has held the field of electric car lighting, but its sphere of general usefulness has recently been entered by the electric arc which promises to be an aggressive factor in this class of work in the future. Although the electric arc was the first form of electric lamp known, it is only the recent developments of the enclosed arc that have placed it where it can be used under exacting indoor requirements. The long life of the carbons; the development of the smaller units of the enclosed type, the good regulation secured, and the good diffusion of light secured by the aid of modern glassware, all add to the value of the enclosed arc for car illumination.

A system of arc lights has recently been installed in a car on the Chicago & Northwestern Railway running between Chicago and Waukegan, which has many features and characteristics that receive more than passing attention and form a subject of general interest in railway circles. The test for distribution, etc., the results of which are discussed farther on, was performed by the writer, the test being instigated by the Universal Electric Storage Battery Company.

The car, an interior view of which is herewith given, is of the

Pullman standard 55-ft. type, mahogany finished with red plush seats, light wooden blinds and the regular olive decorated top. The interior equipment consists of three small enclosed arc lamps, rigidly fixed in position upon the ceiling as shown, the customary protective devices and controlling switch being placed in the saloon in the end of the car well concealed from the public. The lamps are an adaptation of a regular type of lamp and are fitted with a somewhat special type of an opal shade. The entire lamp is mounted and braced so as to prevent vibration with respect to the car. Experience has shown that the vibration of the car itself has no effect upon the operation of the lamp, which is equally as good at standstill, low, or high speed.

The lamps are operated in parallel from a straight storage battery system, the rated capacity of which is 120 ampere-hours, placed in a compartment under the car. The compartment is 15 ins. high, 20 ins. deep and 65 ins. long, and contains 50 cells arranged in 5 trays of 10 cells each. The weight of battery equipment complete is 1350 lbs.

Since weight and space occupied are two points of great consideration in car work, a comparison between the arc system and others may be of interest. The average battery for incandescent lighting with an axle dynamo system occupies a space 24 ins. deep, 18 ins. high and 96 ins. long, and consists of 16

FIG. 1.—VIEW OF INTERIOR OF CAR.

cells. Such a standard equipment would be 32 cells, normally 60 volts rated at 336 ampere-hours. This is the largest size in ordinary use. Each cell in this class of installation will weigh, complete with containing tray, about 165 lbs.

An incandescent light system which would give approximately the same light and distribution as the Pintsch gas light, would require a minimum of 20 16-cp lamps or would give a total wattage, per car, of about 1000. This number of incandescents would, of course, give only about one-third the light of the three arcs, but the illumination secured would be fairly satisfactory. However, the incandescents would require a battery weighing from 5000 to 6000 lbs., which is entirely too much weight to place on any car of average construction.

The life of the carbons in the small enclosed arcs used on the car will approximate 40 hours for positive and 40 hours for negative, or one new carbon every 40 hours. The cost of maintenance can be readily seen to be less than for incandescents where [illegible] per lamp per year and incandescents numbering 20 to 40 per car [illegible]

The arc lamps approximate 200 cp each with globes complete, and have a consumption of 300 watts, giving about 1½ watts per candle. These three lamps replaced the former installation of five Pintsch gas units of approximately 36 cp each, or a total of 180 cp in the car.

The arc-light system is on trial service on a suburban run between Chicago and Waukegan for various reasons. In this class of work the lighting period is a great percentage of the total time the car is on the road. The passengers on these runs are very apt critics and from their actions the feasibility of the adaptation of the arcs can be determined. A point well in favor of the arcs is the fact that the passengers, 90 per cent of whom read their paper on the journey, will first fill the arc lighted car in the train, which is made up of several cars.

Suburban service requires many stops with consequent slow speed throughout much of the distance; hence, the axle-driven system of lighting would not be an ideal installation for incandescent light; and since the cars are in actual service about five hours per day, the straight storage battery would not be economical for incandescent lamps. The head end system requires that every baggage car be equipped with a turbine and generator and must be coupled up at all times. This condition cannot be filled when the train is standing in the shed. The car must be provided with adequate steam fittings and be placed next to engine. This system has the great disadvantage of using steam at the times it is most needed by the locomotive when on the road.

If the service were equipped with arcs throughout, the cars could run over two nights per charge so that they could be regularly located on a siding and have their exhausted battery replaced with a fresh charge, which would be at hand. A large station could be maintained so that a certain percentage of the batteries would be on charge at all times, holding a day's supply in reserve upon suitable trucks. The light weight and small size of the arc batteries would enable the refilling of the car compartment with great rapidity. In fact, on the car here described, the actual work of shifting is done in from three to four minutes and the car is always ready for the road in less than five minutes' time. Contrasted with the storage and axle-driven systems, the inspection of apparatus is of no importance, whereas the delicate controlling devices on the axle drive require expert attention after every trip.

The tests of the distribution of illumination in this car show well the features of the system and from a study of the curves one is enabled to judge the results that could be secured by making slight changes in the installation.

The results herewith given were secured while the car lay in the Waukegan yards with all conditions exactly as when the car is on the road. In fact, two things were detrimental to the best showing of results, namely, the lamps had not been trimmed for some time, the glassware was noticeably dirty and the battery was operated upon its last run before charge. A duplicate test was carried on in a car of the same type fitted with five Pintsch gas units, which were operating exactly in the same manner as when on the road and with glassware clean. The test in the car with the Pintsch gas system, however, was carried on solely for results that would be found in practice, no manometer or meter being placed in the system, for the object was merely to study the difference between the commercial results obtained by the two systems for the same car.

The intensity of illumination in foot-candles was secured by means of a "Weber" photometer which had been thoroughly calibrated in the laboratory before the trip. However, to insure that the standard, which is a miniature tantalum lamp operated on 3.8 volts, did not change, the accuracy of the calibration was checked in the laboratory after the return and the results then interpolated from the calibration curve of the instrument.

On account of the characteristic floating of the arc, the results varied to a slight extent for the same photometer setting. The floating spot, although quite apparent upon the globe, was not large enough to cast a noticeable shadow on the plane of the seats. A succession of readings was taken by the observer [illegible]

traveled completely around the globe. These readings were taken at seat No. 8, with only lamp No. 2 in operation, showing a difference of only .5 foot-candle intensity between maximum brilliancy and when the spot was directly in the plane of the photometer screen and the arc. This is a difference in intensity of about 21 per cent.

The photometer setting was maintained and the three lamps were put in operation and readings taken when the spot was such as to give maximum and minimum illumination on the screen. From these results, no record being kept of the position of spots of arcs No. 1 and No. 3, a difference of intensity of .32 foot-candle was secured, or only 14 per cent variation between maximum and minimum. From observations we are led to assume that only very infrequently will the spot from more than one lamp give a diminution of intensity in a definite direction. This difference shows the maximum effect, since it is the nearest position to the arc, and even 20 per cent in over 2 foot-candles is barely noticeable to even an experienced person.

The distribution of illumination throughout the car was assumed to be symmetrical with respect to the center line of the car, so that readings were taken on one side of the car only. The working plane was chosen in line with the center of the seats 30 ins. from the center line of the car and in the plane of the seat top which is 40 inches above the floor. This is about the height at which a person in a car will hold a paper when reading.

One arc is located in the center of the car at seat No. 8 and the two end arcs are 18 ft. from the center and 9 ft. 6 ins. from either end at seats No. 2 and No. 14 respectively. Instruments were in the line throughout the test, which gave an average e. m. f. over each lamp terminal of 96 volts and a total line current varying from 8.3 to 8.5 amperes, or about 1.35 watts per candle.

A photometer setting was taken at each seat throughout the length of the car with the diffusing screen in the above-named plane. In order to secure a fair average value of intensity of illumination, six readings were taken at each seat after a short interval of time, so that the arcs had ample time to travel and give an average value. The average value at the various seats can be seen in a glance at the accompanying curve.

An investigation of this curve will show that, while it is very good, yet it can be improved in general character. The average intrinsic value of the illumination is what may be termed brilliant in this class of work, which shows that units with lower candle-power would serve the purpose equally well. Midway between the arcs will be seen a break in the general form of the curve which would be materially helped by the addition of another unit.

A mirror is located near seat No. 15 in the end of the car,

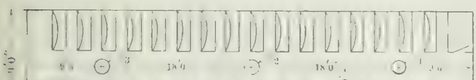


FIG. 2.—DIAGRAM OF CAR SHOWING LOCATION OF LAMPS, ETC.

the effect of which is noticed in the sudden increase in the intensity as that seat is reached.

Experience has shown that the curve of distribution depends much upon the nature of the glassware, so that, considering that this curve represents the performance of the arcs with only a single glass bowl-shaped enclosing globe, the distribution could be much improved by the addition of a suitable reflector.

A set of readings was taken directly under lamp No. 2, which gives an idea of the maximum intensity in the aisle of the car. However, it was thought to be of little value to secure a curve down the aisle, so that was omitted.

Turning our attention now to the curve representing the performance of the Pintsch gas system under commercial conditions in a standard type mahogany car, we see that the distribution is remarkable for uniformity. The specific readings were easily obtained and were very uniform, so that only average values are given as shown by the curve; but, as before stated concerning the arcs, these values are the average of six readings.

The general average illumination for the Pintsch gas system with units approximating 180 cp in a car was found to be about .75 foot-candle, while that of the arc is about 2½ times greater for approximately 600 cp of units.

A very interesting feature of this investigation was found in the effect of the color of the car upon the intensity. A third car—combination smoker-baggage, lighted with a standard

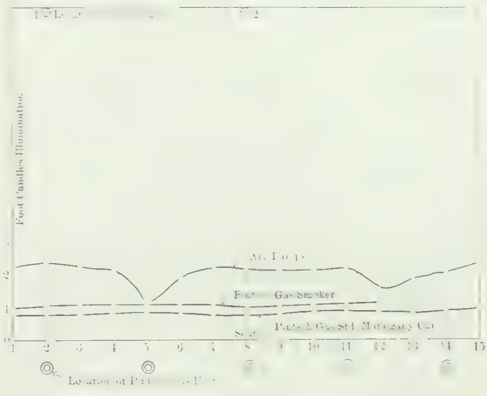


FIG. 3.—AVERAGE DISTRIBUTION OF ILLUMINATION.

equipment of Pintsch gas under the same conditions as the previous car, was tested in the same manner. The car was painted a very light gray and had cane seats. Readings directly under a Pintsch unit in the mahogany car gave an average of .98 foot-candle as compared with a reading of 1.12 foot-candles in the light-colored car.

The general character of the distribution curves is much the same, the light-colored car showing about 25 per cent greater effective illumination for an equal expenditure of energy than did the standard mahogany car.

A mail car is at present being equipped with the arc light system for combined axle dynamo and storage on a severe run out of Chicago and will be placed under rigid tests within the next 30 days. This run requires the car to be in use at least four hours per day in the terminal yards, and with the present gas system is has been the custom to gas the car once for the yard duty, and again before it starts on the trip.

Electrostatic Telephone.

In an article in *Comptes Rendus* for May 27, Mr. H. Abraham describes a modification of the "speaking condenser" of Argyopoulos and Deprez, and calls it an electrostatic telephone. The receiver is a piece of aluminum foil mounted on a sheet of gauze. An insulated metallic disk is brought as near to the aluminum foil as possible, and this "condenser" is charged to a difference of potential of 1000 volts. Under these circumstances the instrument is very sensitive to changes of voltage, and gives a sound when an ordinary telephone ear-flange is attached to it. An alternating potential difference of 0.003 volt is about the smallest that will produce an audible note, but the sensitiveness may be increased by transforming the incoming current or by resonance. This, however, is limited by the circumstance that the primary must be shunted on the line, and the square root of the ratio of capacities governs the limit. In any case, it is certain that in its present form the electrostatic telephone cannot aspire to a rivalry with the electromagnetic telephone.

Niagara Meeting of the A. I. E. E.

Following are further abstracts of papers read at the recent annual convention of the American Institute of Electrical Engineers held at Niagara Falls.

COMMUTATING-POLE RAILWAY MOTORS.

A paper by Mr. E. H. Anderson discussed the various possibilities that reside in the use of commutating poles with direct-current railway motors. Since, when commutating poles are used, the commutation is automatically taken care of for variations in speed in current, it is possible to change the voltage impressed on the motor through quite a range without sparking. The only limitations in raising the voltage are, first, the armature speed and the strength of the binding wire; second, the voltage between bars, and third, the insulation of the turns. According to present practice, before being connected to the armature winding, the commutators of railway motors are tested from bar to bar with about 500 volts so that the actual jumping of current from bar to bar on a clean commutator would not occur at less than 500 volts per segment. An ordinary commutator of 111 segments and four poles would, under these conditions, be suitable for 1300 volts between brushes. It is noteworthy, however, that the actual jumping of the current across the side of the micas of a clean commutator is not the limiting condition. The real limiting condition is the voltage per bar which will maintain an arc already established. If the average volts between segments in commutating-pole motors be assumed as 24, and the number of commutator bars per inch of circumference be taken as 5, it is possible to construct a 40-hp motor for 850 volts by using a 9-in. commutator, or a 250-hp motor for 1700 volts by using an 18-in. commutator. These values relate to four-pole motors. On 1200 volts a commutating-pole motor commutates decidedly better than an ordinary design of motor on 600 volts. The 1200-volt motor requires proportionately more insulation than the present 600-volt motor. This extra insulation requires more diameter and greater external dimensions.

There are several ways of making use of voltages higher than are now employed. The most prominent of these are the following: Combination city and interurban service, the former at 600 volts and the latter at 1200 volts. The motors would be wound and insulated for 1200 volts. Two motors would be connected in multiple and the two groups of a four-motor equipment would be handled in series and in parallel. A second way would be a combined city, suburban and interurban service, the two former being at 600 volts and the latter at 1200 volts. In this case the motors would be wound for 600 volts with a relatively low armature speed, but should be insulated for 1200 volts. On a 600-volt trolley two motors would be connected in multiple and the two groups would be handled in series and in parallel. On a 1200-volt trolley the two motors would be connected in series and the two groups of a four-motor equipment would be handled in series in parallel. The armature speed and the commutating features should be so designed that if one pair of wheels slips and a motor has 1200 volts across its terminals, its armature speed will be reasonable and the commutation good.

[illegible]

As an introduction to the discussion of single-phase and three-phase generation for single-phase railways, a paper was read by Mr. A. H. Armstrong presenting the advantages and disadvantages of each. From the viewpoint of simplicity the single-phase generation possesses considerable advantage, but it entails certain greater cost and lower efficiency. Advantages result from the use of a secondary single-phase distribution obtained from a three-phase source. The author discussed the following combinations of three-phase to single-phase com[illegible] distribution to motor-generator sets feeding into the single-phase secondary distribution. (2) Three-phase generators operating on alternating-current railway load on one leg, thus calling for both primary and secondary single-phase distribution. (3) Three-phase generation and primary distribution to sub-station, feeding successive trolley sections with separate phases. (4) Two-phase generation, the generating station being located in the center of the system and feeding one phase each way. (5) Three-phase generation and primary distribution to transformer sub-stations connected three-phase to two-phase and feeding the secondary distribution circuits in such a manner that adjacent sub-stations feed like phases into a common trolley section.

The matter of the proper selection of the generating apparatus for single-phase roads seems to be closely connected with problems of a commercial character relating to a possible future load requiring a three-phase input. From a purely engineering standpoint, and considered from the point of view of the railway load only, the single-phase system of generation and distribution is to be recommended. The possible installation of generators having a frequency lower than 25 cycles would help this decision, owing to the unfitness of such a low frequency for general power distribution work.

Of the several methods of single-phase combinations proposed, the motor-generator set best protects the three-phase distribution system where energy is purchased from foreign distributing systems, and such a method presents many advantages which may outweigh its increased first cost. Where the railway company finds it expedient to generate and distribute energy from its own three-phase generators, the use of a single leg for the railway load (3) or the installation of three-phase-two-phase transformer sub-stations (5)—both seem to offer advantages justifying their recommendation and the choice between the two may perhaps be left to the needs of local requirements.

[illegible]

A paper by Mr. A. H. Armstrong discussed the relative advantages and disadvantages of the present standard frequency of 25 cycles and the proposed lower frequency of 15 cycles. In comparing the weight of direct-current and alternating-current motors for various frequencies, he stated that a 25-cycle motor weighs 50 per cent more than a 15-cycle motor, 30 per cent more than a direct-current motor on a one-hour rating, while, on the continuous capacity rating, a 25-cycle motor weighs 25 per cent more and a 15-cycle motor 20 per cent more than a direct-current motor. For railway work, the less weight of a 15-cycle motor in comparison with a 25-cycle machine is partly offset by an increase of 30 per cent in the weight of the step-down transformer on the car. Thus, there is no material reduction in the weight of the complete alternating-current motor and control equipment. A 15-cycle series motor commutaties much better than a 25-cycle motor of the same type, but not so well as a direct-current motor. It is noteworthy, however, that recent improvements in alternating-current motor design have resulted in the production of a single-phase motor which compares very favorably in commutation with any of the standard direct-current railway motors now in operation, although inferior in this respect to the commutating-pole type of direct-current railway motor. In fact, the commutation of the single-phase motor has been so improved and the commutation losses so reduced even with a frequency of 25 cycles as to make it unnecessary to adopt any additional expedients to eliminate commutator troubles. While certain capacities of 15-cycle turbo-generator units may be constructed fairly comparable with 25-cycle units, it is very probable that the adoption of 15 cycles or less would seriously handicap the standardization of a complete line of such units. Both step-up and step-down transformers are handicapped at 15 cycles by an approximate increase in cost 30 per cent over that of 25-cycle design. The great field for alternating-current motors of 150 horse-power capacity and smaller is on interurban lines acting as feeders to the surface, elevated and subway lines of large cities. The ability of such motors to run from the same generating and distributing systems without re-

quiring the introduction of frequency changer sets constitutes a strong argument in favor of continuing the present practice of using 25 cycles on such lines. Mr. Armstrong expressed the opinion that the problem of standardizing the frequency might well be left in abeyance until the coming of fuller knowledge of the operation of electric locomotives equipped with motors of different types, and that much stronger claims for recognition must be brought forth before the adoption of 15 cycles can be seriously considered.

The subject of 25 and 15 cycles for heavy railways was also discussed in a paper by Mr. N. W. Storer, who stated that railway electrification, if developed as every electrical engineer hopes it will be, will mean an undertaking of such magnitude as to make it practically independent of other electrical interests, so that if a frequency different from the standard now in use will be advantageous, it should be adopted. The output from a motor of a certain size will be increased by from 30 to 40 per cent by the use of 15 instead of 25 cycles. Thus, a certain 100-hp, 25-cycle motor operated at 113 horse-power at 15 cycles with a considerable decrease in temperature rise. This same motor with a larger number of turns in the field coil and run on 15 cycles carried a load of 135 horse-power with a rise in the temperature less than at a load of 100 horse-power at 25 cycles. A larger motor which carried a load of 255 horse-power with a certain temperature rise, was found capable of carrying 300 horse-power at 15 cycles at about the same temperature rise, and with new field coils having more turns the motor could be made to carry at least 325 horse-power and probably 340 horse-power without an excessive temperature rise.

The greatest gain from the use of 15 cycles is to be found in heavy railroading where locomotives are employed. It has been found that in virtually all cases the weight of useful apparatus on the drivers, even with 15 cycles, is sufficient to give the necessary adhesion without adding dead weight. Moreover, the use of 15 cycles means that in practically all cases for the locomotive a smaller number of motors can be used than is possible with 25 cycles. An outline description was given of a locomotive which has been built to haul a 400-ton train both on heavy grades and at high speeds on level track. The locomotive is designed for 15 cycles, weighs approximately 140 tons and has four motors, each with a nominal rating of 500 horse-power. With a 400-ton train behind it, this locomotive would thus have to handle a total of 540 tons. A 25-cycle locomotive built to handle a 400-ton train at the same speed and on the same grades would require six motors of approximately the same dimensions, and the extra two motors, together with the extra weight of mechanical parts would bring the total weight of the locomotive up to approximately 185 tons. The total weight of train would thus be 585 tons, or an increase of about 8 per cent. The capacity of these motors would be in the neighborhood of 375 horse-power, which would be just about sufficient to handle the extra weight. It must be seen at once that the motors for this locomotive would cost 50 per cent more and the mechanical parts also considerably more. The only parts of the equipment which would cost less would be the transformer and preventive coils, and the control equipment would be enough more expensive to counterbalance this.

The locomotive is of the articulated type, each half of which has two pairs of drivers and a four-wheel truck similar to the standard American type of steam locomotive, the two halves being coupled back to back. The drivers are 72 in. in diameter with 7 ft. 6 in. between centers of axles. On each axle is mounted a gearless motor having a nominal rating of 500 horse-power and a continuous capacity with forced ventilation of about 375 horse-power. The motors, weighing approximately 19,500 lbs., are spring-supported, mounted, and connected to the drivers in exactly the same way as the motors on the single-phase locomotive for the New York, New Haven & Hartford Railroad. The frame of the locomotive is of the standard steam-locomotive type placed outside of the wheels. It is of cast-steel connected at the front and rear and at three places between the ends by heavy cast-steel girders. The truck, which is of the standard steam-locomotive pattern, has 36-in. wheels, with a wheel-base of 6 ft. 2 in.

The electrical and other equipment in the cab is mounted on a raised platform which is about 2 ft. above the floor-line and occupies the middle of the cab, allowing for a passageway on either side. There are numerous windows along the sides of the cab which afford excellent light for the inspection of the apparatus. The equipment is extremely simple and accessible. The main transformer, which is designed for 11,000 volts, is mounted above the trucks with the top just below the platform in the cab. Directly above the transformer is located the electropneumatic switch-group to which the various taps in the transformer are carried. Back of the switch-group are the preventive coils used in passing from step to step on the transformer, and from these preventive coils runs a single lead to the reverser switch-group, which is placed directly above the main motor. On this raised platform are also placed the motor-driven air-compressor, the motor-driven blower for furnishing air for ventilation of the motors and transformer, and the high-pressure air reservoirs. Suspended from the structural work between the platform and the Z-bars in the roof of the cab are the oil circuit breaker in the high-tension circuit leading to the transformer, the small switches used in connection with the auxiliary motors, and the 20-volt battery, which is used for operating the valve-magnets in the controller. The high-tension current is collected from the overhead wire by the standard type of pantagraph trolley. It will be noted that on account of the large drivers and the comparatively high position of the apparatus in the cab the center of gravity of the locomotive is higher than usual in electric locomotives. The riding qualities of the locomotive are exceptionally good. The weight of the locomotive, as stated, is 140 tons, there being 50,000 lbs. on each driving axle and 40,000 lbs. on each truck.

From 15 to 20 roads have been put in commercial operation with single-phase current at 25 cycles, and it has been proved beyond doubt that the single-phase motor is a thoroughly practical and commercial machine. At the same time, as was anticipated, experience goes to show that there are certain advantages to be gained by the use of a lower frequency.

Electrical engineers have an enormous responsibility in deciding upon matters of detail, such as frequency, which will have an effect that will far outlast any one who has a voice in the matter; and it certainly behooves electrical engineers to consider carefully before recommending the continuance of the present standard frequency of 25 cycles, where it imposes such a handicap on the capacity of the transportation systems.

WINDINGS FOR INDUCTION MOTORS.

An article by Prof. Comfort A. Adams and Messrs. W. K. Cabot and G. Irving, Jr., discussed the advantageous features of fractional pitch windings for induction motors. From both theoretical and experimental observations the authors conclude that the fractional pitch winding in comparison with the winding having 100 per cent pitch is advantageous in that it allows a reduction of the several components of the leakage reactance; a reduction of the over-all length of the motor and in some cases a considerable gain in the convenience of winding as well as a saving in space. It represents, however, a decrease in the exciting reactance, that is, a higher density in all parts of the magnetic circuit and a higher exciting current for the same voltage. It is to be noted that except for the reduction in endwise length over the windings, the effect of using a fractional pitch is the same as that produced by reducing the number of active conductors. Although the latter method is in many cases the more efficient from the standpoint of operation, the former is frequently more convenient from the standpoint of the manufacturer, even when the saving in endwise length is not a controlling factor.

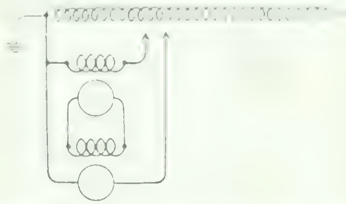
REGENERATION WITH SINGLE-PHASE RAILWAY MOTORS.

A paper by Mr. William Cooper described a method of using single-phase railway motors to restore energy to the generating

[illegible] exciter for the others. By providing the auto-transformer with suitable voltage outputs the value of the field current of the exciter is varied through a wide range. In this respect the conditions are very much more favorable than in the case of the direct-current motor, in which the only variations that can possibly be made are in the series parallel combinations of the motors which are being used as generators. The arrangement [illegible] accompanying diagram.

Assume a car or locomotive upon which the motors are mounted to be in motion, the armatures turning at a corresponding speed. If the field circuit of the first machine be connected to the transformer, an alternating electromotive force will be generated by its armature, the value of which will be directly proportional to the speed. If the field circuit of the other motor be connected to the exciter armature, an alternating current will pass through it, and the second armature will in turn generate an alternating electromotive force the value of which varies about as the square of the speed—the excitation of the first machine remaining constant.

The electromotive force generated by the second armature will bear a very close time-phase relation with the electromotive force of the transformer, for the reason that the current in the field circuit connected to the transformer lags approximately 90 time-degrees behind the e. m. f., as does the current



REGENERATION WITH SINGLE-PHASE RAILWAY MOTORS.

in the field-circuit of the second machine. This combination throws the generated electromotive force of the second machine approximately 180 time-degrees back of the transformer electromotive force, or by reversing the connections in the same time-phase relation.

One other point that is worthy of note in connection with the operation of this system is the absolute safety and stability of the combination. While the machines being operated as generators are normally series machines, it will be noted that no one of the armatures is connected in series with its own field coils, and under no condition can there be any surging or building up of load. In case of momentary interruption of the supply circuit, the circuit again being restored, the system will again operate exactly as before the interruption, there being no surging or violent action of the machines.

The system of regenerating has been used in testing locomotives to give a dead-load condition under a wide range of speed. Numerous stand-tests have also been made, so that the operation of the motors under the conditions is well established and there is no doubt about the scheme doing all that is claimed for it.

HIGH TENSION LINE CONSTRUCTION.

In a paper read by Mr. Harold W. Buck, the author gave an account of some new methods in high-tension line construction, some of which were applied in the construction of the Canadian Niagara Power Company's transmission line described in our issue of June 29, Mr. Buck being electrical engineer of this company. The method of line construction described in the paper is stated to have been developed by the writer and Mr. E. M. Hewlett

According to this method, each span is dead-ended at each support through a series of insulating units which may be plain disks connected together with steel links. The various spans are then electrically connected by jumpers hung below the [illegible] cross-arms, eliminating all pins. The number of disks linked together in series depends upon the line voltage, the disks themselves being identical for all voltages.

Fig. 1 illustrates a design for a 100,000-volt two-circuit line which is soon to be constructed for transmitting 50,000 horsepower 165 miles. The spans in this case will range from 500 to 1000 ft. in length. Here the line is suspended below the cross-arm on most of the towers. The lines will be dead-ended with jumper connection as shown only at angles and on tangents at about every fifth tower. This dead-ending will be for the purpose of stopping any creeping of conductors on the line as a whole, to check the transmission of longitudinal waves along the conductors due to wind, and on curves to take the

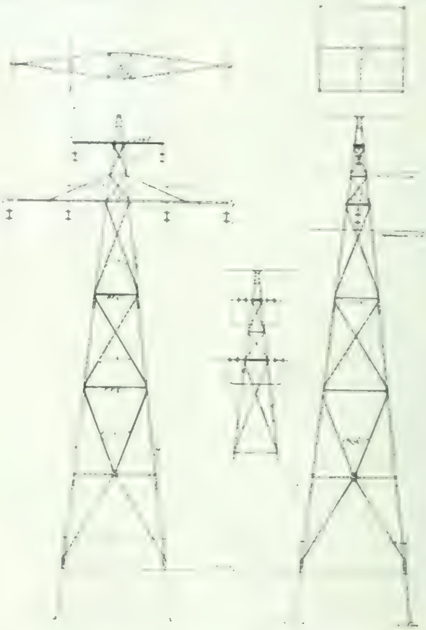


FIG. 1.—100,000-VOLT TWO-CIRCUIT TRANSMISSION LINE.

side stress of the conductor due to change in direction. In this installation the lines will not be triangulated, but at suitable intervals along the lines the conductors will be transposed so as to balance up effects of mutual, static and magnetic induction. Special cross-arms will be installed at transposition towers.

Fig. 2 illustrates another design for a two-circuit line which is to be built for 80,000-volt operation. The spans in this case will range from 300 to 400 ft. and the conductors will have an approximate triangular relation. The conductors will be suspended by a series of insulators from the cross-arms as in Fig. 2 with occasional rigid attachment, for the reasons given above.

Fig. 3 shows a method of assembly of the insulators for suspension under a cross-arm. Fig. 4 illustrates a method of assembly where the spans are dead-ended at the cross-arm with jumper connection.

The advantages of this construction, which might be termed "series unit insulation," over the pin and petticoat type are summarized as follows:

1. With the standard type of pin insulator now used the difficulties of construction increase very rapidly at the higher [illegible] increases for voltages above 60,000 nearly as the cube of the increase in voltage. Either large petticoat diameters must be used, or very high insulators with many petticoats. In either case the manufacture of the porcelain parts is a difficult and expensive matter, and with the long pin necessary the mechanic-

al stresses from the line on insulator, pin and cross-arm are objectionable. With the series unit system proposed, the cost of insulator progresses only in direct proportion to the increase of voltage, the only change being in the number of units in series. There is practically no limit to the degree of insulation obtainable.

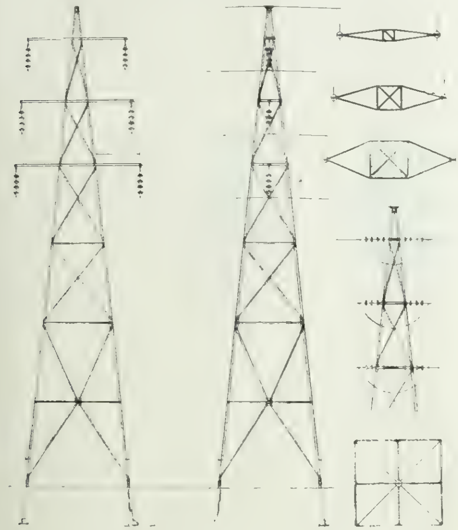


FIG. 2.—80,000-VOLT TWO-CIRCUIT TRANSMISSION LINE.

2. One of the most difficult elements of design in a transmission tower where long pins and petticoat insulators are used is to obtain a cross-arm which will resist the torsional stresses due to the leverage of the pin. With the pin entirely eliminated, the stresses are directly applied to the cross-arm, which cheapens the construction of the tower.

FIG. 3.—METHOD OF ASSEMBLING INSULATORS.

3. In the arrangements where the insulating units are attached on either side of the cross-arm, taking the full tension in the line with jumper connection between spans, the insulation can be increased indefinitely by adding disks in series without increasing the space occupied on the tower.

4. Where each span is dead-ended, all faces of the insulating units are exposed to the cleansing action of the rain, so that dirt cannot accumulate thereon. This arrangement also prevents the dripping water from forming electrical communication between units as occurs from one petticoat to another in the pin type of insulator.

5. A standard insulating unit can be adopted for all voltages, the only variation being in the number linked in series. This simplifies the manufacturing problem.

6. If any insulating unit becomes damaged or completely shattered the insulation of the remainder is not affected. The damaged unit can be replaced without the necessity of renewing the whole.

7. If a tower is directly struck by lightning the cross-arms will be likely to take the discharge, since they are above the lines, whereas in the pin type of insulator the line is usually the highest point.

8. In long-span installations where the conductor at each end of the span is tied fast to an insulator mounted on a pin, experience has shown that crystallization is apt to take place in the conductor at the tie, due to its rigidity at that point and the vibrations in the span. This frequently results in breakage of the conductor. The flexible connection between conductor and cross-arm afforded by the series of insulators should reduce this tendency to crystallization, and should therefore permit spans of any length to be used without further precautions against this action.

Fears may be expressed that with the conductor suspended under the cross-arm serious swinging to and fro might take place. From numerous observations it is believed that no such swinging will occur. Long aerial spans under wind pressure take a permanent and steady deflection throughout the span proportional to the average wind velocity along the span, and no indications have been observed of long spans responding to so-called gusts. The towers illustrated are designed so that the conductor can safely be deflected by the wind about 60 deg. on either side of the neutral position.

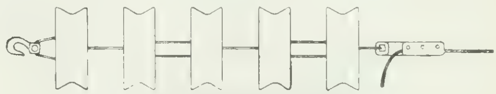


FIG. 4.—DEAD-END INSULATOR ARRANGEMENT.

Insulators of a great many forms have been built and tested, but the one which gives the best results electrically and mechanically is the "link-type" developed by Mr. Hewlett and having the grooved or fish-tail periphery. Four of these in series are sufficient for 100,000-volt operation with a liberal factor of safety.

A very important element in this construction is of course the methods of fastening the insulating units together and attaching them to the line and cross-arms. This can be accomplished in many ways and several methods have already been worked out, but these details are beyond the scope of this paper. Further experience in practical line construction and operation under this system will demonstrate the best methods of installation and attachment.

The Use of Special Instruments in Telephone Service.

At the recent convention of the Association of Railway Telegraph Superintendents at Atlantic City, N. J., Mr. Robert E. Chetwood, Jr., of the American Telephone & Telegraph Company, read an interesting and instructive paper under the above-named title.

Mr. Chetwood stated that he believed the range of commercial telephony will be extended mostly through improvements in the line circuits themselves rather than by the use of more powerful transmitters or more sensitive receivers. In the case of a circuit several hundred miles long only a small percentage of the current placed upon the circuit by the transmitter reaches the receiver, the difference representing the transmission losses in the line and in the apparatus associated with the line.

There are four factors which determine the transmission efficiency, or attenuation in a circuit, namely resistance, inductance, mutual electrostatic capacity; shunt resistance, the shunt resistance being the mutual, or the wire-to-wire insulation resistance of the circuit. A definite relation exists between these factors which can be expressed mathematically. The attenuation can be increased by decreasing the resistance, that

[illegible] most expensive method of improving transmission. The second method is to increase the inductance. Improving transmission in this way is known as loading a circuit and consists of installing in a circuit, at certain definite intervals, coils of low ohmic resistance and high inductance, the coils themselves being known as loading coils. But loading has also its limitations. In the first place, a loaded circuit requires a much higher insulation resistance than a non-loaded circuit and also the circuit must be of a certain minimum length before the value of the loading becomes apparent in increased transmission. It is a fairly expensive method of improving line transmission, as the coils are expensive to make and on open wire circuits must of course be protected from lightning. The greatest success in loading so far obtained has been in connection with cable circuits, where the insulation can easily be maintained at a high figure, and on open wire circuits of a gauge of wire smaller than No. 8. The possibilities of improving transmission by loading are extremely promising; in fact, much has been accomplished already in loading No. 12 wire circuits and also in loading cable circuits. The loading of open wire circuits larger than No. 12 has not, however, been entirely successful, but promises to be so in the near future.

A third method of bettering transmission is to decrease the mutual electrostatic capacity of the circuit—that is, make the current as small as is possible. The capacity of a circuit depends on the diameter of the wires composing the circuits and on the separation between the wires. The larger the diameter of the wires the greater the capacity, and the greater the separation between the wires the less the mutual electrostatic capacity. This is one of the reasons why part of the gain in transmission which should result from the use of wires of low resistance is lost, due to the increase in capacity, the capacity increasing as the line wires increase in size. As the capacity decreases as the separation between the wires increases, it is obvious that transmission can be improved by placing the wires further apart. This of course means a fewer number of circuits per pole line and consequently means a large increase in the cost of circuits to handle a given volume of business. Again, the improvement in transmission due to a separation between the wires of a circuit of 24 inches instead of 12 inches is so slight as to make it a method not to be seriously considered.

The fourth and last method of improving transmission is by increasing the shunt resistance of a circuit, or, in other words, increasing the insulation resistance. Inefficient line maintenance is the cause of poor transmission more often and to a greater extent than is realized. Every slight leak on a circuit provides a shunt path to keep the transmitter current from reaching the receiver at the distant end of the circuit. If the points of low insulation on the wires of a circuit do not coincide and are not of approximately the same resistance, then the circuit becomes unbalanced and noisy, which, of course, means unsatisfactory transmission. Of two circuits composed of the same size line wires, the one which is perfectly quiet will give better and more satisfactory transmission, than the one that is slightly noisy due to leakage caused by broken insulators, trees, etc., even though a more powerful transmitter is used on the second circuit than on the first.

In commercial telephone work, he said, any wire that does not show an insulation of at least 10 megohms per mile, on a clear day, is considered a faulty wire.

In concluding, the author stated that he could conceive of but one or two situations that will allow of the use of powerful transmitters, and the peculiar conditions which theoretically will allow of the use of such instruments have not been met with in practice. In each case where it at first seemed as though the situation demanded more powerful transmitters than the standard transmitters, it has been found that by improving line maintenance and operating conditions, by increasing slightly the amount of current furnished to standard transmitters [illegible] powerful [illegible]

New Telephone Patents.

[illegible]

The telephone is continually becoming more useful as a means of enabling persons to hear who are afflicted with certain kinds of deafness. Of course, one of the serious problems is the production of a portable apparatus of sufficient range and sensitiveness. Two recent patents represent attempts at solutions. One describes the microphone transmitter shown at the right in Fig. 1. The carbon granules are held against the

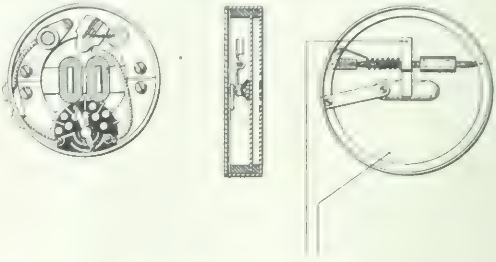


FIG. 1.—HOLLAND MICROPHONE.

diaphragm by a cup of metal upon a pivoted support. The motion of the cup is limited so that the granules cannot be spilled out. The cup support carries a counter-balance adjusted so that the normal contact of the granules is light and sensitive. This is the invention of N. H. Holland, of Chicago.

The second patent covers an adjustable receiver invented by K. M. Turner, of New York City, and assigned to the General Acoustic Company. A number of points of the receiver winding are brought out to points of a switch, so that at will any number of turns of the coils may be used. The instrument is of course adjusted for the particular use at any moment.

SWITCHBOARD CIRCUITS.

H. G. Webster, of Chicago, has patented two circuit systems for common-battery switchboards, the patents being assigned to W. J. Kellogg. One is a three-point jack system in which the control of the line signal lies in a cut-off relay differentially wound. In making a call the line relay current traverses the line and both windings of the cut-off relay. This latter is not energized. When a plug is inserted in a jack, however, the balance is destroyed, as current is led from one of its contacts through the jack to a point of the cut-off relay connected between the windings. A further feature is that a two-part plug and cord serve to make proper connection with the three-point jack.

The second patent describes a two-wire scheme designed to avoid annoying clicks. The circuit is so arranged that the connection between the line and battery is never severed. A shunt is arranged across the cut-off contacts so as not to interfere with the operation and yet to maintain a battery circuit.

MULTIPLEX SYSTEM.

The use of superimposed alternating currents has long been suggested as a means to multiplex telephony. The system depends upon the use of frequencies above the range of the human ear, and the superimposing upon these of transmitter currents. Maurice Leblanc, of Paris, France, one of the joint inventors of earlier patents for such a system, has obtained a recent patent. In the system now described, there are provided two main line wires. For each simultaneous transmission there must be a pair of branches, one at each end, and a generator branch near the middle. All of these branches are tuned to resonate at the frequency of the generator of the middle branch. The end branches contain receivers, transmitters and coils. The transmitter superimposes its current upon the alternating current. This alternating current is excluded from all branches except those tuned to receive it, and [illegible]

THERMAL LINE RELAY.

Relays for controlling the auxiliary circuits of common-battery switchboard circuits have almost always been patterned in some degree after the telegraph relay. The early relays were almost copies of the telegraph relay, while later relays have progressed far from the prototype. An entirely different sort of relay is used by Messrs. F. B. Cook and J. G. Nolen, of Chicago, in their telephone exchange system recently patented. Their relay is shown in Fig. 2. The line current, passing

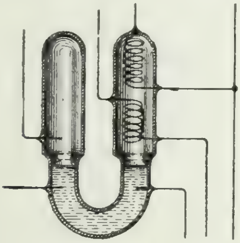


FIG. 2.—COOK AND NOLEN THERMAL RELAY.

through the two practically non-inductive windings, produces sufficient heat to expand the gas in the chamber. This by its unbalanced pressure displaces the conducting liquid sufficiently to close or open, according to arrangement, the auxiliary circuits.

JACK STRIP.

When the metal plate jack strip superseded the all-rubber strip, the metal, as was natural, took on as near as practical the general form of the rubber. This probably accounts for the solid metal lugs usually riveted upon the ends of the metal plate. H. P. Hibbard, of Chicago, has departed from this arrangement, and forms up his lugs out of the ends of the plate. A long tongue is left upon the stamping, which, after being bent first at right angles to the plate, by say a left-hand bend, is then formed into a hollow tube by a series of three right-hand right-angle bends equally spaced along the length of the tongue. The result is a square section hollow lug integral with and meeting the foundation plate at one of its edges, and extending beyond the main body of the base plate. Mr. Hibbard's patent is assigned to the Western Electric Company.

SENDER FOR AUTOMATICS.

Another patent assigned to this company covers a sender switch for automatic switchboards, with which, after a call is once set and started, it is impossible to mix up the selection by tampering with the lever. The lever is secured to its shaft through a ratchet which is so arranged as to release the instant the mechanism starts backward in the process of sending in a call, and it cannot be recaught until all parts reach zero position. When it is desired to set a call, the lever is swung to the desired number. The lever is at this time locked, and carries with it its shaft. The first movement forward breaks one connection in the sending circuit and makes a second. The first is controlled by a cam moving with the lever, and the second by a lug moving with the escape wheel and carried forward with the shaft. As soon as the lever is released, the cam and shaft return to normal and close the break in the circuit. The ratchet then begins to step back home, where it stops, due to the operating circuit of its magnet being broken by the lug.

WALL SET.

Mr. W. Kaisling, of Chicago, has obtained a patent for a wall set, this being assigned to the Stromberg-Carlson Company. All parts save the bell are mounted upon the back-board and the shelf and box swing down to uncover them. Part of the box side is secured to the back-board, this being cut away from the box through the line of the switch hook. When the box swings out, this piece of course is left behind, the hook switch not being disturbed. Another feature is a long bolt for securing the box in the closed position. This screw passes through the box front and through guides within the box, in a manner such that it always registers automatically with its nut set in the back-board.

WIRELESS APPARATUS.

The requirements of wireless telephony are so much more exacting than for wireless telegraphy that at first view the proposition looks hopeless. However, apparently a step has been made in the right direction by F. J. McCarty in his apparatus shown in Fig. 3. At the left of the sound channel is a telephone transmitter, while at the right is the primary side vibrator of the induction coil. This vibrator consists of a sensitive diaphragm arranged to vibrate under influences of the voice, to make and break the primary circuit. It will be seen that the frequency of the sparks will correspond to that of the voice currents sent out from the transmitter and superimposed upon the spark coil currents by a tertiary winding. This ter-

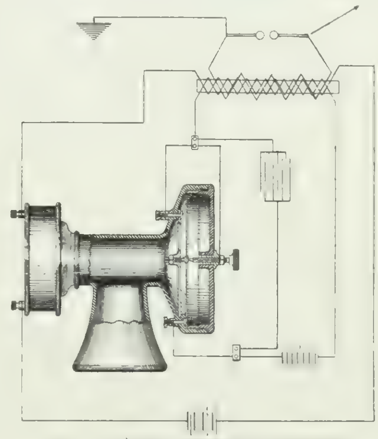


FIG. 3.—McCARTY WIRELESS TELEPHONE.

tiary is wound in a layer between the primary and secondary and has a blanketing effect increasing as its resistance lowers. It is the inventor's idea that the transmitter effect is introduced in this manner.

RING-OFF SYSTEM.

With grounded lines and a bridged clearing-out drop there is found, at times, difficulty in operating the drop. To overcome the difficulty L. B. Nieman, of Staplehurst, Neb., has proposed an auxiliary low-resistance drop bridged off to ground. Each station has a key to ground one terminal of its generator when desired, so that the drop may be thrown.

Letter to the Editors.

Wireless Transmission of Energy.

To the Editors of Electrical World:

SIRS:—The writer has read with a good deal of interest the reprint in your issue of June 29, 1907, of Mr. Nikola Tesla's recent letter to the *New York Times*.

In this letter it is to be observed that Mr. Tesla is still harping on his system for the "wireless transmission of energy" and proclaiming it as a discovery deserving to rank with that of Copernicus. It occurs to the writer, however, that we have been hearing about this system (mostly from Mr. Tesla himself) for a number of years, but apparently the "system" has never progressed beyond the *paper* stage.

At the exposition in St. Louis in 1904, a very substantial purse was offered to anyone who would succeed in transmitting even one-tenth of a horse-power a few hundred feet without

[illegible] why Mr. Tesla did not wade in boldly and carry off the prize? And if he will enlighten us as to how *many* air ships he has *in operation*, deriving their power from water-falls, it will be greatly appreciated.

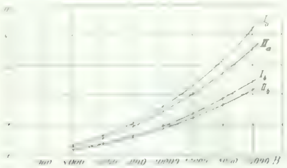
No one appreciates Mr. Tesla's achievements in the electrical field more than the writer, but it certainly seems that it is incumbent upon the inventor to show why his "system" of wireless transmission has failed to materialize, practically.

[illegible]

DIGEST OF CURRENT ELECTRICAL LITERATURE

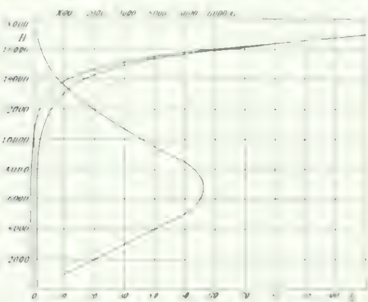
Dynamos, Motors and Transformers.

Alloy Steel Sheets for Transformers.—R. POHL.—An article on the use of special alloy-steel sheets for transformer construction. The characteristic features of this alloy—which is composed, according to Kapp, of 96.2 per cent iron, 3.4 silicon, 0.32 manganese, 0.03 carbon, 0.04 sulphur and 0.01 phosphorus, so that it is a silicon steel very low in carbon, sulphur and phosphorus—are an extraordinarily high resistivity (so that the eddy current losses are reduced) and a low coefficient of hysteresis. The total losses at 50 periods are about half the losses in ordinary dynamo-iron sheets at the same saturation. The permeability is considerably increased up to saturation of



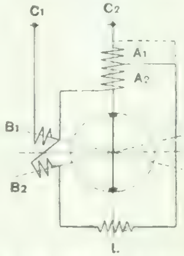
[illegible]

about 10,000, but then decreases rapidly. The only disadvantage of these alloy-steel sheets is their high price, which is two and a half times that of ordinary dynamo-iron sheets. The author shows in detail that, nevertheless, this alloy may find useful application in the construction of transformers. The author predetermines the design of a 50-kw, single-phase transformer for a frequency of 50. First for ordinary transformer iron sheets and second for special alloy-steel sheets. The characteristic curves are given in Figs. 1 and 2. Fig. 1 gives the total loss for one kg., that is, the sum of hysteresis and eddy current losses in watts per kg., while Fig. 2 gives the magnetiza- [illegible]



[illegible]

[illegible] periods, curve I_b to a thickness of 0.5 mm and 50 periods, curve II_a [illegible] thickness of 0.35 mm and 50 periods. The author shows that by the use of these special alloy-steel sheets for transformers it is possible not only to increase the efficiency, but in spite of the high [illegible] transformer may be reduced if the special properties of the alloy are properly taken into account in the design. The chief change in the design is the reduction of the ratio of iron weight to cop- [illegible] crease of the thickness of the sheets of the flux density whereby the dimensions and the weights are essentially reduced. The use of alloy sheets is especially profitable for small transformers operating below the temperature limit, but the profit disappears for large and magnetically highly-saturated types. There is no profit either in the case of revolving dynamo-electric machinery. In order to make the alloy sheets applicable to the



[illegible]

latter the cost of the alloy sheets should be further reduced.—*Elek. Zeit.*, June 13.

[illegible] notes on tests of a compensated single-phase motor without exciting brushes. The machine was a 75-hp. 50 cycle (or 60-hp. 25-cycle) traction motor. As shown in Fig. 3, the rotor has a bar winding with one turn per commutator section, while the stator winding, also of bars lying in half-closed slots, is divided into four branches A_1, A_2, B_1 and B_2. Of these, A_1 and A_2 occupy eight slots per pole, while B_1 and B_2 occupy two slots per pole, and are arranged side by side at equal angles on either side of the normal to the brush axis. The compensating circuit is shown as including B_2 and A_2, but might equally well have been connected, as shown by the dotted line, so as to include A_1, A_2 and B_2. The turns in B_1 and B_2 have to be chosen so as to give the necessary displacement of the compensating and exciting circuits relatively to the brush axis. In the present motor A_1 was made equal to A_2 and B_1 to B_2. L is an adjustable inductance. The tests were carried out at the lower frequency of 25, so as to reduce the compensating action of the short-circuit currents under the brushes to a minimum. The influence of the ohmic losses is also greater at the lower frequency, so that, as regards both compensation and efficiency, the conditions are more severe at 25 cycles than at 50 cycles. The results of the tests are given in diagrams and it is shown that the automatic compensation was complete between 300 and 400 r. p. m.; i. e., without in any way adjusting the inductance L, the power factor remained unity between these speeds. The motor, in fact, shows complete compensation at speeds well below synchronism, a result which is not attainable with the ordinary compensated repulsion motor having series exciting brushes as well as short-circuited brushes. With a constant supply current of 50 amperes, the power factor is unity between 280 and 400 revolutions, while with 100 amperes the zone of complete compensation is more limited and does not continue above 330 r. p. m. This is owing to the fact that, with the higher current, voltages of 450-500 volts are required for 330 to 400 revolutions, and this involves saturating the iron and the consequent increase in leakage. To overcome this diffi-

culty, it would, however, only be necessary to reduce the inductance L, and so increase the compensating current I_2 at the higher speeds. With a view to deciding how variations in the amount of the compensating current affect the power factor and the efficiency, a second similar motor was arranged as shown diagrammatically in Fig. 4. This arrangement possesses some advantages over Fig. 3 in that the whole stator winding is permanently connected to the supply circuit whether compensation is taking place or not. There were ten slots per pole of which 4 x 2 were occupied by A_1 and A_2 and by B. The axis of A_1 and A_2 were separated by four slots, so that there were two slots on either side of the brush axis. The short circuit and open-circuit characteristics of this motor were

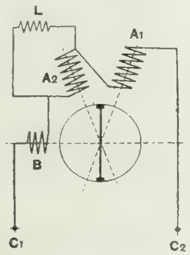


FIG. 4.—DIAGRAM OF ARRANGEMENT.

practically as in the other case. The maximum efficiency occurs at a little below synchronous speed and it falls to 75 per cent at half synchronism. Large air-gaps are quite permissible in these motors without detriment to their electrical qualities.—Lond. *Elec. Rev.*, June 14.

Commutation.—A. Lienard.—The commutation of a direct-current dynamo is satisfactory only if the condition is fulfilled that RT is larger than L, where T is the duration of commutation, L the self-induction of the short-circuited coil and R the contact resistance of the commutator segment with the brush in the position where the contact is the most extended one. To establish the above relation it is generally supposed that a brush has just the size of the collector segment and that consequently there is always one coil in the stage of commutation under each brush. The present author discusses the more general case where a brush covers several segments and gives the mathematical theory of this case.—*L'Eclairage Elec.*, June 15.

Separation of Iron Losses.—T. F. Wall.—In a former article the author had shown how to separate the iron losses in non-synchronous machines by the use of retardation curves. He now shows how to separate the losses without such curves and gives the results of experiments on a 5-hp motor. A method is then given whereby the momentum of inertia of the rotating parts may be found by means of the circle diagram. From this and a retardation curve, the friction loss is found for the same motor as was used in the first part, and a comparison of results is made.—Lond. *Elec.*, June 21.

Determination of Losses in Motors.—C. F. Smith.—A paper read before the Manchester Section of the (British) Institution of Electrical Engineers summing up the various methods for the experimental determination of the losses in both direct-current and alternating-current motors.—Lond. *Elec. Rev.*, [illegible]

Lamps and Lighting.

Two-Filament Lamp.—An illustrated description of an incandescent lamp made by a British company. As shown in Fig. 5, it contains two filaments of high and low candle-power respectively, which can be used separately, or the two in parallel; therefore the lamp will give three distinct candle-powers, and the current used is approximately in proportion to the light given. A 5/16-cp lamp will give 5, 16, or 21 candle-power at will, by simple rotation of the lamp. Any combination of candle-power can be made above 2½ candle-power. The lamp is made to fit any standard lamp-holder. There are three contacts at the top of the lamp, one being common to the two filaments, while the other two are connected to each of the two filaments respectively. The lamp can be twisted so that a connection is made to both the filaments at once, or the filaments can be used separately, thus giving a choice of three

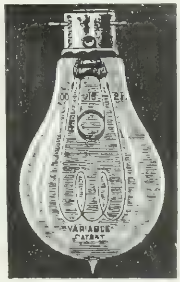


FIG. 5.—TWO-FILAMENT LAMP.

candle-powers. This will at times be found of advantage, and will tend to economy in current consumption.—Lond. *Elec.*, June 14.

Arc Lamps for Photographic Work.—An illustrated note on arc lamps made by a British company for photographic, copying and process work. In one type enclosed arcs are used, the lamps being of the non-focusing type, and an extra long arc is used as its light has a higher actinic value. With open-type arc lamps a parabolic reflector is employed so as to concentrate the light to a small surface.—Lond. *Elec. Eng'ing*, June 13.

Quartz Amalgam Lamp.—L. Arons.—An article on improvements of his amalgam lamp whereby he has succeeded in obtaining a very rich line spectrum. He admits that the old cadmium-amalgam lamp has great disadvantages in comparison with the mercury lamp. Even when artificially cooled, the glass cracks after a short use. Since, however, Heraeus has succeeded in constructing vacuum tubes of quartz, we have at our disposal a material quite capable of withstanding the heat necessary for maintaining the mercury or amalgam arc in full strength. The best amalgam to use is one of lead and bismuth, corresponding to the formula Hg_5PbBi. On gradually increasing the current, the lines of mercury appear first and then those of lead and bismuth, but these frequently alternate and fluctuate. Küch has proposed to add zinc and cadmium in order to increase the ultra-violet spectrum. In this manner a very rich spectrum is obtained, in which the ultra-violet portion may contain as many as 18 mercury lines, as well as 8 due to lead, 8 to bismuth, 5 to cadmium, and 3 to zinc. The lamp will burn for hours at a stretch. Whether it can be turned to industrial use is not certain as yet, but quartz lamps containing pure mercury are already being manufactured for public lighting.—*Ann. der Physik*, No. 6; Lond. *Elec. Eng'ing*, June 20.

Mercury Arc.—J. Polak.—The first part of an illustrated article on the mercury arc lamp and its technical applications. The author first discusses the physics of the mercury arc, dealing with the distribution of the energy in the arc, and the mechanism of electric conduction through the column. The two characteristic features of the mercury arc are, according to the author, ionization due to high temperature, especially at the cathode; and transmission of electricity, especially by means of "molions." The latter are neutral mercury molecules combined with an electron. The author then discusses in detail the drop of potential at different points of the column of the lamp. The paper is to be continued.—*Elek. Zeit.*, June 13.

Enclosed Arc Lamps.—W. Wedding.—A translation in abstract of his recent German paper on the development and present status of enclosed arc lamps.—Lond. *Elec.*, June 21.

Searchlights.—J. I. Hall.—A second article illustrated by diagrams on improvements in the design of projectors.—Lond. *Elec. Rev.*, June 14.

Theatre Lighting—An illustrated description of the electric lighting plant of the Palace Theatre in London.—Lond. *Elec. Eng'ing*, June 13.

Fuse Pillars.—An illustrated description of the construction

[illegible] *Elec. Eng'ing*, June 20.

Power.

[illegible]—[illegible] scription of an electromagnetic device for varying the speed of a power shaft driven by a constant-speed prime mover. The arrangement will be understood from Fig. 6. The armature *a* is similar to the armature of an ordinary direct-current ma-

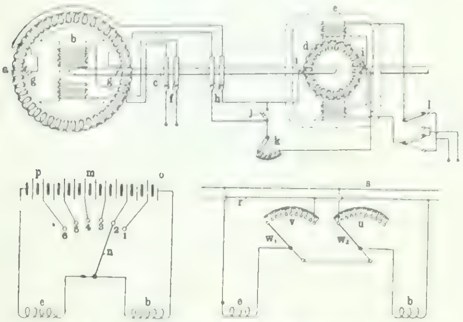


FIG. 6.—ELECTROMAGNETIC VARIABLE SPEED GEAR.

chine, and is mounted on the shaft of the prime mover. In electromagnetic relation to this armature is placed a field magnet, *b*, of any desired number of poles, this field magnet being fixed to the driving power shaft, *c*, and rotating with it. The power shaft also carries a second armature, *d*, which is fastened to it in any suitable manner, and rotates in electromagnetic relation to a second field magnet, *e*, which is not rotatable. The rotating field magnet, *b*, is provided with slip-rings, *f*, *f*, by which the exciting current is introduced, and the brushes, *g*, *g*, carried by the rotating magnet *b* and bearing on the commutator of the first-mentioned armature *a*, are also connected through slip-rings *h*, *h*, to the brushes, *i*, *i*, of the second armature *d*. In order to vary the speed at which the power shaft is driven in this arrangement, it is only necessary to vary the excitation of the fields *b* and *e*. According to one method shown in the lefthand lower diagram of Fig. 6 the fields *b* and *e* are excited by means of a battery, *m*, having a number of cells in series, and positive and negative plates being connected to an arc of separate terminals 1, 2, 3, 4, 5 and 6, adapted to make contact in turn with a key, *n*, connected between a pair of terminals one from each of the field magnets, *b* and *e*; the other terminals of the two field magnets are connected to positive and negative plates, *o*, *p*, at the two ends of the battery. It will be seen that by this arrangement by moving the key, *n*, over the arc of terminals the excitation of the field magnets may be varied simultaneously, the excitation of one of the field magnets being increased while that of the other is decreased and vice versa. In the arrangement shown in the righthand lower diagram of Fig. 6 the energy for excitation of the fields is taken from mains, *r*, *s*, and in this case connected switches w_1, w_2, are used. These switches are adapted to pass over arcs of contacts, *v*, *u*, respectively, and the two fields are connected to these switches and to the mains, *r*, *s*. This arrangement, therefore, serves to control the excitation in the two fields simultaneously by means of a pair of connected rheostats formed by the switches, w_1, w_2, with their arcs of contacts, *r*, *u*, and their resistances. In order to start the power shaft, the field of the field magnet *b*, should be very weak, as the e. m. f. generated at the brushes of the armature, *a*, should be small, and only sufficient to circulate the necessary current in the armature, *d*, as there is no counter e. m. f. at starting. The torque exerted between the first magnet *b*, and the armature, *a*, and which is directly transmitted to the power shaft, *c*, is thus very small. In order to increase the total effective torque on the power shaft by starting, therefore, it is convenient to insert resistances, and this is done by means of the variable resistances, *k*, in series with the armature, *d*. It is thus possible to obtain a higher voltage between the brushes, *g*, *g*, of the first armature without exceeding a safe value of current. A useful torque is thus obtained between the armature, *a*, and field magnet *b*, on account of the increased strength of the field. The resistances, *k*, will be cut out when the speed comes up.—Lond. *Elec. Eng'ing.*, June 13.

Traction.

Electric Traction in Great Britain.—The annual list of British electric tramways giving statistical data on the equipment, etc., of 179 tramway systems of the United Kingdom. A second table gives statistical data on 16 electric railways and the third table gives data on 21 electric power companies.—*Supplement* to Lond. *Elec. Rev.*, June 21.

London Underground Railway.—An illustrated description of the Charing Cross, Euston & Hampstead Railway, which is the last link in the system of underground railways, forming the scheme originated by the late C. T. Yerkes. The equipment of the line is of the same general character as that of the previous tube railways. The third-rail system is used. The power is supplied by 11,000-volt, 33-period, three-phase currents and is changed to direct current in four rotary converter sub-stations. —Lond. *Elec. Eng'ing*, June 20.

Automobiles.—A. A. C. SWINTON.—A paper read at the Engineering Conference of the (British) Institution of Civil Engineers in which the author reviews various systems of electrical transmission gear on motor vehicles.—Lond. *Eng'ing*. June 21.

Installations, Systems and Appliances.

Static Balancers.—C. C. GARRARD.—The first part of an article on the use of static balancers on three-wire direct-current systems in order to balance the voltage between the outers and the neutrals. The static balancer really consists of a choke coil, the terminals of which are connected to two or more brushes bearing on slip rings connected to equally-spaced points round the armature of the dynamo. Between the slip rings, of course, an alternating e. m. f. is generated, but the strong choking action of the balancer prevents any large flow of alternating current out from the slip-rings. At a point midway between the terminals of the balancer the connection to the midwire of the direct-current network is made. A diagram illustrating the system is given in Fig. 7. *D* is the dynamo, shown dia-

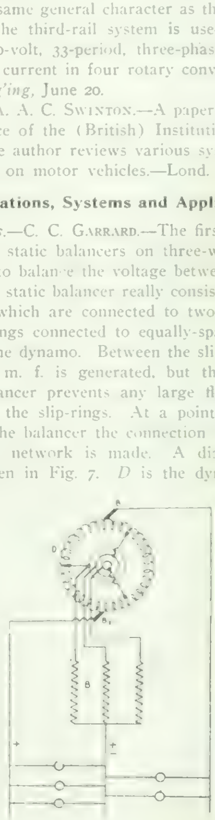


FIG. 7.—[illegible] BALANCER SYSTEM.

grammatically as a two-pole one. In addition to the commutator, the armature is provided with slip-rings. The balancer is shown as of three-phase construction, having three legs connected in star. The author then discusses the regulation of voltage of the dynamo with the static balancer and begins to discuss the design of such balancers.—Lond. *Elec. Rev.*, June 14.

[illegible] of the (British) Institution of Civil Engineers on the up-keep charges of large electric generating sets. The charges for the electric generators, steam engines and gas engines are separately

considered. The cost of maintenance is divided under two heads. The first section comprises charges which may vary with the capacity of the plant: *a* capital charges, including repair shops, tools, *b* wages and supervision, *c* painting and cleaning of engines, *d* insurance. The second class are the charges which may vary with the hours run or units generated and are materials and wages for renewal of parts (piston rings, packing, dynamo brushes, etc.).—Lond. *Eng'ing,* June 21.

Wires, Wiring and Conduits.

Corrosion of Lead-Covered Cables. F. FERNIE.—An article in which the author discusses various causes of the corrosion and pitting of the lead sheathing of underground cables. The corrosion may be caused by purely chemical means. Thus soft water in the presence of air has a corrosive action on lead. The corrosion may also be due to electrolytic action. Some notes are given on the chemistry and electrochemistry of the subject.—Lond. *Elec. Eng'ing,* June 20.

Electrophysics and Magnetism.

Alpha Rays and the Periodic System of Elements. A. VAN DER BROEK.—According to Rutherford's latest determination the ratio of the electric charge to the mass of alpha particles is just about half that for the hydrogen atom. This fact may be interpreted by various hypotheses. It may mean that the positive elementary charge is attached to two hydrogen atoms, or that two of them are attached to one helium atom or that one of them is attached to half a helium atom, if this is possible. The present author gives a new and rather daring interpretation as follows: The alpha particles are atoms of an elementary substance, not isolated as yet, from which all other elements, except hydrogen, are made up. He calls it "alphon," and supposes that each atom of alphon is endowed with an elementary positive charge, and goes to constitute alpha-rays and canal rays. "Alphadas" are molecular weights which are multiples of two. He recasts the periodic system, making it consist of 15 horizontal rows instead of 11, and assigns to each element its nearest "alphad" weight. The greatest discrepancies are in silver 118 (really 108), and vanadium 46 (really 51.2). But taken over the whole series the discrepancies disappear. The sum of all the alphads is 7728, and the sum of all observed weights 7723.65, a difference of less than one-tenth per cent.—*Ann. der Physik.,* No. 6; Lond. *Elec. Eng'ing,* June 20.

Electrochemistry and Batteries.

Gas Cell and Carbon Cell.—A. BERTHIER.—The first part of an article in which the author emphasizes the importance of further studying the gas cell and the carbon cell, and gives a review of the whole subject. In the present installment the author deals with gas cells.—*L'Eclairage Elec.,* June 22.

Units, Measurements and Instruments.

Loading Stationary Induction Apparatus for Heat Tests.—G. C. SHAAD.—In determining the heating of transformers and regulators in almost all cases some modifications of the "loading-back" methods, as employed in the testing of motors and generators, may be used with the result that the apparatus is run under very nearly operating conditions and the power supplied is only equal to that of the losses of the apparatus to be tested plus the losses taking place in a few small auxiliary transformers. The simplest loading-back method of testing two transformers of the same voltage and reading is indicated in Fig. 8. The arrangement is self-explanatory. The generator *G* supplies the core losses of the transformers. The primaries are connected in series with their potentials opposing, as indicated by the relative signs, and into this primary circuit is introduced, by means of the transformers shown, a potential equal to the sum of the impedance voltages of the units under test. When a single unit is to be tested it is often possible to form a combination of step transformers, or transformers of a different voltage and rating, in such a way that a large part of the power represented by the full load of the transformer is returned to the source of supply. An example of such a combination is shown in Fig. 9. Here a 300-kw., 13,200/370-volt unit is loaded by means of two 200-kw., 6000/370-volt transformers. The potential strain on the 6000-volt unit is, of course, increased over normal when their primaries are connected in series. Assuming that the load impedance voltage of the 300-kw unit is 400 volts at full-load, then a transformer combination, giving 800 volts in opposition to the 1200 volts difference between 13,200 and 12,000 volts, should be connected as shown in the diagram and this would limit the current flow

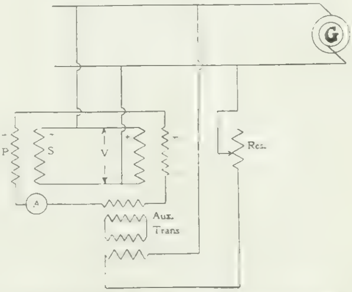


FIG. 8.—METHOD OF TESTING TRANSFORMERS.

to normal value when full potential is applied to the secondaries. If three one-phase transformers of the same type are to be tested and a three-phase source of power is at hand the method is as follows: The secondaries are connected in three-phase delta and normal voltage fed to them from a three-phase source. The primaries are also connected in delta, but at one corner of the delta there is inserted a transformer combination such as will give the combined impedance volts of the three units and the desired current is caused to circulate in the wind-

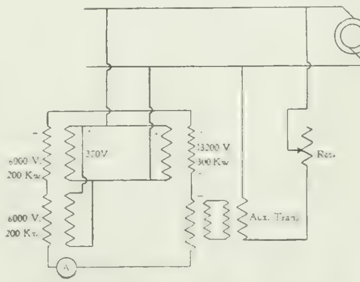


FIG. 9.—METHOD OF TESTING TRANSFORMERS.

ings. The auxiliary transformers may be fed from one of the three phases or from a separate source through the intermediary of a regulating resistance. The regulating resistance may be replaced by a potential regulator. In Fig. 10 is shown an example of the connections for three 200-kw, 60-cycle, 6600-2200 volt, air-blast transformers. The secondaries are connected in three-phase delta and fed from a 100-kw, three-phase machine normally giving 2300 volts, but reduced to 2200 volts by means of the field rheostat. The voltage necessary to force 30.3

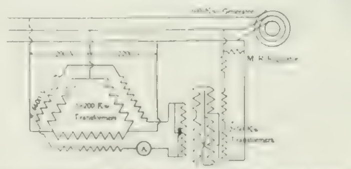


FIG. 10.—CONNECTIONS FOR AIR-BLAST TRANSFORMERS.

amperes full-load current through the high tension winding of one transformer with the low-tension coil short-circuited is 190. The total voltage required to be furnished by the auxiliary transformers is 560 for full-load and about 700 for 25 per cent. overload. The auxiliary transformers used in the

load on the transformers in test they are connected step-down, step-up to give a ratio of four to one or furnishing 550 volts with 2200 volts impressed. The magnetic potential regulator is connected in the 2200-volt circuit and the potential raised until full-load current flows in the transformers under test. For the overload the connections of the low-tension windings of the auxiliary transformers would be changed to three coils in the first transformer in series feeding two coils of the second unit in series, thus giving 733 volts with 2200 volts impressed. The impressed voltage, in this case, would be cut down by means of the regulator, until the desired current flowed in the transformers being tested. Finally some notes are given on tests of feeder regulators and induction regulators.

Telegraphy, Telephony and Signals.

High-Frequency Oscillations by Means of the Electric Arc.—W. L. Upsom.—An account of a (British) Physical Society paper in which the author gives a record of the appearance of arcs formed between electrodes of carbon, copper, iron and aluminum, taken in all possible pairs, and struck in air, hydrogen and coal gas. In many of the experiments one of the metal electrodes was cooled by water circulation after the manner of the Poulsen arc. The paper also contains the results of measurements of the voltage and current of various arcs of fixed length, and these measurements plotted to a current base yield curves of considerable interest in view of Poulsen's success with the cooled copper carbon arc in hydrogen. The author shows, in fact, that for such an arc in particular the slope of its characteristic curve is very steep, and, like the solid carbon-carbon arc in air, is negative. These properties are two very necessary ones for an arc that is to be used like the Duddell musical arc, for converting continuous current into high-frequency alternating current. A principal feature of these characteristic curves of the various arcs between the metals (including carbon) experimented with is that whenever aluminum forms one electrode the characteristic curve is remarkably steep. This is a point that may be found of value in the development of Poulsen's method. After the reading of this paper, Dr. Fleming gave an exhibition of the effects produced by oscillations generated by the Poulsen arc, and described how he had made a rough estimate of the efficiency of the arc method, and had found that the proportional energy radiated was of much the same order as in the spark method, namely, about 40 per cent.—Lond. *Elec. Eng'ing*, June 20.

Telegraph Perforator.—An illustrated description of the Creed receiving telegraph perforator which has recently been introduced into the service of the British Post Office and several cable companies. This perforating receiver reproduces at a rate of about 150 words per minute as a maximum, an exact replica of the Wheatstone perforated tape prepared at the sending end of a circuit.—Lond. *Elec. Rev.*, June 14.

Railway Points and Signals.—Ferreira.—A paper read at the Engineering Conference at the (British) Institution of Civil Engineers on the application of electricity to the working of railway points and signals. The general requirements are pointed out and it is said that the maintenance of an electric system should not cost more than that of the manual system, as the money spent in cleaning, oiling, painting and renewing rods and wires is saved and will be found to cover the cost of the electricity used, if an economical system is adopted.—Lond. *Eng'ing*, June 21.

Self-Starting Single-Phase Motor.

An interesting form of self-starting single-phase motor has recently been placed on the market by the Advance Electric Company, of St. Louis, Mo. The machine possesses the mechanical starting characteristics of a series motor and the operating characteristics of a shunt motor. Electrically it is constructed ... induction motor, without mechanical devices for converting it from one machine to the other.

The machine is provided with a single primary winding of the usual construction, placed in slots in the stator core. There are two secondary windings on the rotor, one is of the squirrel-cage type similar to the secondary of an induction motor, the other is of the commutator type similar to the secondary of a repulsion motor. The latter winding is completely insulated from the core, and is short circuited on itself in a certain electrical plane at a desired angle from the primary winding by means of brushes on the commutator connected together. The former winding is placed in circular slots placed below the main

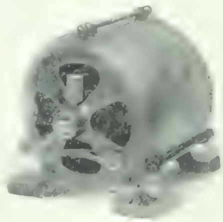


FIG. 1.—SINGLE-PHASE MOTOR.

slots and separated some distance from them, the bars of the winding being soldered to two end flanges. Thus considering this squirrel-cage winding in connection with the primary winding, the machine is a single-phase induction motor with large magnetic leakage; it has a good operating torque when the speed is near synchronism, but has no starting torque whatsoever. Considering the commutator winding in combination with the primary winding, the machine is a plain repulsion motor exerting a torque which is largest at starting but does not decrease to zero at synchronous speed. In the actual machine the repulsion motor characteristics predominate at starting, while the induction motor characteristics predominate under running conditions.

Performance curve of a ¼-hp, 110-volt, 60-cycle motor under service conditions are given in Fig. 2. It is noteworthy that when operating without load, the rotor runs slightly above synchronism; as load is applied the current decreases until the

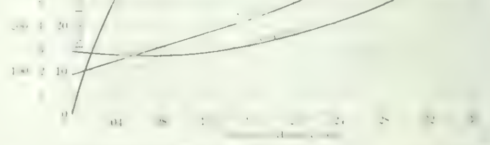


FIG. 2.—PERFORMANCE CHARACTERISTICS OF ¼-HP. SINGLE-PHASE MOTOR.

speed drops to synchronism, below which the current increases with the load. Moreover, the internal losses of the machine decrease slightly as the load is first applied, and subsequently increase with increase of load. The full load torque of the above machine is 6 lb-ft; the starting torque is 14 lb-ft or 233 per cent of the full load torque. In a recent starting test the motor took 10.3 amperes at 108 volts and consumed 600 watts.

The performance characteristics can be varied to a large extent by changing the relative position of the brushes and the stationary primary windings. The brush holders are rigidly

attached to the end plate and remain in a fixed position, but the stator core may readily be revolved to any position desired when the clamping studs are loosened; the position of the stator determines not only the operating characteristics but the direction of rotation. It is claimed that the motor may be operated at speeds much below synchronism by reducing the supply voltage, the tendency to burn and spark at the brushes being eliminated by the damping action of the squirrel-cage winding.

Dial Decade Testing Set.

The instrument illustrated herewith is a new form of dial decade testing set brought out by Leeds & Northrup, of Philadelphia. It is arranged for the measurement of conductor and insulation resistances, the location of faults, crosses and grounds by the Murray and Varley loop methods, and the location of open circuits.

The arrangement of the bridge arms is a departure from the usual type of dial set, in which it is customary to have a switch for each bridge arm and consequently any resistances due to poor contacts enter directly to affect the accuracy of the ratio coils. In this improved form any resistances due to the switch contact cannot affect the accuracy of the ratio coils, since the contact of the switch *S* is in the battery circuit. The resistances *a*, *b*, *c*, *d*, *e*, and *f*, which form the bridge arms, are

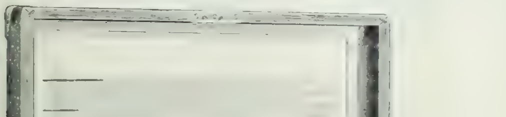


FIG. 1.—DIAL DECADE TESTING SET.

adjusted to a high degree of accuracy and are soldered to the contact studs as shown. Their values are such that when the switch *S* is placed at .01, .1, 1, 10, 100, the ratio *A*/*B* will be that indicated for any particular setting. The switch *S*, therefore, serves as the junction point of the arms *A* and *B* of the bridge.

This method of connecting the coils in the bridge arms also simplifies the manipulation of the bridge, since it is only necessary to multiply the rheostat setting for a particular balance by the setting of the bridge arm switch used in the same measurement. If the bridge arm switch is on the contact marked .1, then the unknown resistance is 1/10 of the rheostat setting; if the ratio 1 is used, then the unknown resistance is read in direct terms of the rheostat, or, if the ratio is 10, then the unknown resistance is 10 times the rheostat setting and so on. It will thus be noted that the [illegible] of memorizing certain plug settings in order to produce the ratios *A*/*B* or *B*/*A* as is the case in plug bridges employing a commutator in the bridge arm, is avoided.

The rheostat coils consist of 10 units, 9 tens, 9 hundreds and 9 thousands, making a total of 10,000 ohms. Each dial has its switch made up of six brushes making independent contact and with the ends of the brushes bent so that they do not lie tangent to the circle in which they travel and consequently do not wear grooves or rings in the surfaces of the contact studs. The switches may be rotated continuously in either direction, thus moving from the highest point in any particular group of coils to the lowest without the necessity of turning back through all the other coils. This arrangement is very desirable when locating swinging crosses, since the bridge can be balanced with rapidity. The inner ring of each switch provides a continuous bearing surface so that any dependence upon friction in the central bushing for contact is avoided.

The parts have been grouped so as to provide for maximum convenience of manipulation. The switch heads stamped 1, 10, 100 and 1000 form the rheostat and the switch in the upper left-hand corner is the bridge arm switch. The small single-pole double-throw switches serve to arrange the bridge connections for resistance or loop testing and can be set for a particular

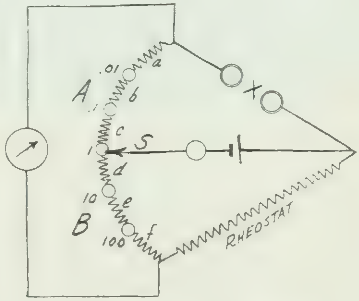


FIG. 2.—DIAGRAM BRIDGE OF CIRCUITS.

test by reference to the stamping on the switch ends without the necessity of referring to a diagram of connections.

The galvanometer is of the D'Arsonval type, and is not influenced by surrounding magnetic fields. It has been designed to withstand the rough usage to which portable testing sets are at times subjected. An Ayrton shunt is provided so that the galvanometer deflections may be reduced in proportions of .1 and .01.

The battery and galvanometer keys are of the lock-down type, which permits these circuits to be permanently closed when locating open circuits. The operator thus has the free use of his two hands for manipulating the set. A sensitive reflecting galvanometer or more battery may be used when locating high resistance faults, but for all ordinary purposes, the contained galvanometer is amply sensitive and the contained battery has sufficient e. m. f. The resistances are wound with manganin. By a special method of adjusting, which the manufacturers have employed, it is possible for the user of the bridge to replace a burnt-out coil without altering the accuracy of adjustment of the other resistances in the instrument.

Exhibits at the Jamestown Exposition.

Among the principal exhibits of machinery at the Jamestown Exposition is that made by Allis-Chalmers Company, of Milwaukee, occupying Section 8, Machinery and Transportation Building, as shown in part by the accompanying illustration.

The character of this exhibit is not marked by the display of any unusual or special apparatus, nor does it include specimens of all Allis-Chalmers Company's extremely large and varied line of products, but only a few of the standard machines whose

[illegible] sands of installations the country over, and are doing efficient, economical, every-day service.

The electrical machinery shown includes a belted alternator and a Reliance engine, the latter of which is hidden in the background of the picture. There is also shown a complete line of apparatus for electric drive, including standard Allis-Chalmers induction motors and direct-current motors, whose liberal design and uniformly excellent service have distinguished them above the machines of all competitors.

In the photographs, model and parts of Allis-Chalmers steam turbines shown in this exhibit may be observed three of the special features, viz., channel-shaped shrouds protecting the ends of the blading from injury, machine cut slots in the foundation

ALLIS-CHALMERS EXHIBIT AT [illegible] EXPOSITION.

rings insuring absolutely accurate spacing of the blades, and improved arrangement of balance pistons reducing the diameter of the cylinder and preventing distortion under varying temperatures.

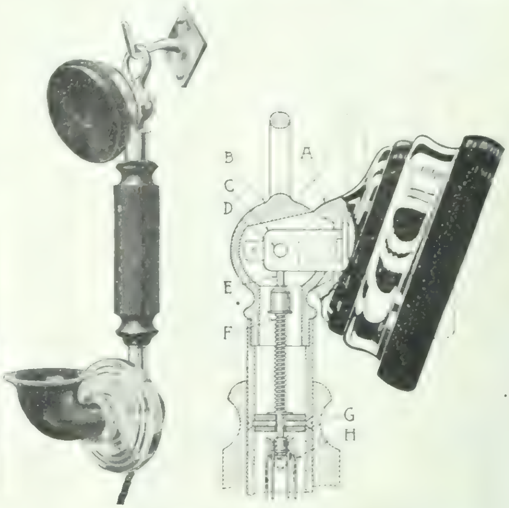
The greatly extended use of compressed air for driving drills pneumatic riveters, hammers, cleaners, clipping and calking tools, etc., has created a strong demand for small air compressor plants which may be placed conveniently to the work in hand. A portable compressor outfit mounted on a truck, comprising a Christensen air compressor, built solely by the Allis-Chalmers Company, driven by a motor, may be seen here with all its accessories.

At either corner of the space are placed large swinging racks of frames containing protographs and illustrated summaries of bulletins of the principal products of the company.

Combination Telephone.

The instrument shown in the accompanying illustrations, while similar in some respects to most combination telephones of the type, differs decidedly in some details. A marked feature embodied in its design is the arrangement of the contact springs and plunger, or the switch-hook, in the handle without enlarging the size of the telephone. No triplet or hookswitch box is required, thereby providing a most convenient and compact telephone that can be placed anywhere and yet be ready for use. The illustration of the instrument hanging on a dummy hook shows the receiver in its normal position, but when placed to the ear it takes the position as shown in dotted lines in Fig. 2. The simple operation of placing the instrument to the ear signals the operator, and removing the receiver from the ear opens the contacts and gives the disconnect signal in the regular way.

Referring to Fig. 2, the lever *C* is rigidly fastened from the inside of the back plate *A*, and moves on the fulcrum pin *D*, which is driven through the socket *B* casing containing all the lever parts. When the receiver is moved upwards the foremost end of the lever *C*, in which is fastened the link *E*, is forced down, actuating the plunger rod *F*. This forces the rubber plunger *G* down, letting the operating contact springs *H* snap over the plunger and bringing them together. As the telephone is taken from the ear, the receiver is aided to drop to its normal position by the music wire helix, drawing the plunger up and opening the contacts as shown. The line can be held by placing the thumb against the receiver, and a signal



FIGS. 1 AND 2.—COMBINATION TELEPHONE.

for a new connection is given by moving the receiver backward and forward.

The Stromberg-Carlson Telephone Manufacturing Company has furnished these instruments for a variety of purposes, mostly for bank people and busy men who want something convenient but not cumbersome.

Marshall Field & Company Adopt Nernst Lamps.

Marshall Field & Company, of Chicago, have just awarded the largest contract ever placed for lamps for store lighting, calling for 12,000 Nernst glower units for immediate delivery. The store will be equipped a section at a time and on account of the vastness of the undertaking, the complete installation will perhaps not be in operation until well along into the Fall.

The store contains over 38 acres of floor space, and the average number of employees is 9000. While it is not a regular department store, it handles a great variety of the better classes of goods, such as dry goods, millinery, men's and women's clothing and furnishing goods, carpets, furniture, wall hangings, leather goods, pottery, glassware, jewelry, bric-à-brac, books, shoes, toys, sporting goods, etc. There is thus scarcely a problem in store illumination that this vast establishment does not exemplify, and at great expense, various modern systems of store illumination were installed in different sections and put to an exhaustive test before a decision was reached.

The 13 floors to be lighted vary in ceiling height from 14 ft. to 19½ ft. Two and three-glower lamps suspended on specially designed chain pendants hanging from three to five feet from the ceiling—according to height—will be used. The fixtures are particularly appropriate in design and the lighting units will add materially to the appearance of the store. Incandescent lamps to the number of more than 40,000, in low hanging fixtures, were formerly used. The energy is supplied by the Chicago Edison Company. Messrs. D. H. Burnam & Company are the architects in charge of the new building construction, now practically completed. The new lighting system will be installed under the direction of Mr. F. J. Pearson, electrical engineer for Marshall Field & Company.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—A vast amount of business was transacted notwithstanding the interruption of a holiday and the usual inventories and midsummer stoppage of machinery for repairs. Settled warm weather has reduced stocks of summer fabrics at many points where congestion was threatened, and in some cases supplementary orders from wholesalers replenish depleted stocks that it was feared would be carried over to 1908. Crop news is encouraging, on the whole, although grain rose sharply in response to aggressive manipulation, and cotton was affected by an official report of condition that fell below expectations. One of the most favorable developments of the week was the improvement noted in collections at many markets, a sure sign that retail stocks are moving, though the number of cities reporting reduction sales of slow trade is sufficiently large to show that trade in summer wear has not in all cases been satisfactory, and the usual measures of business, such as clearings and failures, point to irregular conditions. Thus the clearings of the entire country have fallen behind 1906, due entirely to New York's loss, which is assigned to speculative dullness, as outside of the metropolis clearings gained over the first half of 1906. All of the railways reporting for the month of May showed good gains in gross earnings, but small increases in net. In failures it is to be noted that the number is down to the lowest minimum of the last 25 years, but the liabilities are the largest, with one exception, for ten years past. There were 4792 failures reported to *Bradstreet's* for the first six months of 1907, involving liabilities of $76,529,059 and assets of $42,018,143. This is a decrease in number of 1.6 per cent from 1906, of 8.5 per cent from 1905, of 10.2 per cent from 1904, and almost identical with the number reported in the first half of 1903. With this exception the number of failures is the smallest reported in the first half of the year since 1882. As regards liabilities, however, the showing is different, owing to a number of relatively large suspensions this year. Thus the liabilities in 1907 are 30 per cent larger than in 1906, 22 per cent larger than in 1905, but 8 per cent smaller than in 1904. Compared with 1903 liabilities are 27 per cent larger, and, with the exception of 1904, liabilities this year so far are the largest since 1897. Copper is quoted at $23\frac{5}{8}$c. for lake; $22\frac{1}{8}$c. for electrolytic, and $21\frac{1}{8}$c. for casting stock. The exports last month were 16,193 tons, an increase of 7183 tons over May, a decrease of 1070 tons compared with April, and a decrease of 2441 tons compared with June a year ago. In the six months from Jan. 1, copper exports were 81,583 tons, comparing with 101,765 tons in the corresponding period last year.

THE MEXICAN LIGHT & POWER COMPANY, which has contracted with the Street Railway Company, of Mexico, to supply 5000 horse-power for operating the tramways, has recently ordered 8000 horse-power capacity transformers to come from the works of the Westinghouse Electric & Manufacturing Company through G. & O. Braniff & Company, the representatives for the Republic. These transformers will be divided into six units of 1000 kilowatts each, the transformer being single-phase. The energy is transmitted to Mexico City from Necaxa at 60,000 volts, which passing through transformers is reduced to 20,000 volts at the Power Company's Nonoalco sub-station. At this voltage the energy is distributed to five different sub-stations located at different parts of the city, Churubusco, Alameda, Inlianilla, etc. These new transformers will reduce the voltage received at 20,000 to approximately 3000 volts for the motor generator sets in these respective sub-stations, the motor generator sets being used to change the alternating current to direct current for the trolley circuits at approximately 600 volts. A part of this additional transformer capacity will be also used by the power company for lighting and power service in the vicinity of the districts where they are installed.

MUNICIPAL PLANT FOR FRANKLIN, LA.—Contract has just been let to Muralt & Company, engineers, of 114 Liberty Street, New York, for a complete modern municipal electric light plant for the town of Franklin, La. This town is one of the oldest settlements in that part of the country. As a matter of fact it is the locality made famous by Longfellow's "Arcadia." At the same time it is progressing along modern industrial lines and in addition to having lately installed an extensive central market building it has now just passed the above-mentioned contract for an electric light plant. The latter will be of sufficient capacity to furnish electric light to the 4000 or more inhabitants and electric power to several sawmills and sugar refineries. In addition, there will be a street lighting system of 25 arc lights and 40 incandescents. The power house will contain Heine safety boilers, Harrisburg engines and Fort Wayne electric apparatus. The contract calls for getting out the machinery in three months and the complete plant is expected to be in operation early the coming fall. Mayor J. C. Lewis, of Franklin, was the moving spirit in getting this plant and he was unanimously supported by the Franklin Council. The plans and specifications were prepared by Warren B. Reed, consulting engineer, of New Orleans.

ALASKAN POWER.—The largest grant ever made for water in the Yukon has just been issued by the Minister of the Interior, Frank Oliver, to the Yukon Milling, Dredging & Power Company. The grant is for 50,000 ins. of water from the Klondike River for 20 years. The diversion is to be made from the river at a point three-quarters of a mile above Rock Creek, which is 15 miles from the mouth of the Klondike. The company receiving the grant receives also authority to use the water for generating power and to transmit and sell it. The power is to be developed by Pelton wheels. The grantees get the right to 50,000 ins. at all times of the year. The flow of the Klondike at low water is only 54,000 ins. At ordinary states of water it is 100,000 ins. At high water it is 305,000 ins. The Twelve Mile carries 8000 to 20,000 ins., varying according to the season.

ELECTRIC VENTILATION.—The approach of warm weather is rapidly increasing the sales of electric propeller fans by the B. F. Sturtevant Company, of Boston, Mass. Among recent orders are the following: Bausch & Lomb Optical Company, Rochester, N. Y.; Washington Water Power Company, Spokane, Wash.; Sewer Pumping Station, Washington, D. C.; J. T. Stanley, New York City; American Lithographing Company, New York City; Brace Brothers, Wilkinsburg, Pa.; G. W. Miller, Toronto, Ont.; Klots Throwing Co., Scranton, Pa.; Hotel Touraine, Boston, Mass.; St. Augustin's R. C. Church, Newark, N. J.; Victor Talking Machine Company, Camden, N. J.; Stecher Lithographic Company, Rochester, N. Y.; Lewis & Kitchen, Kansas City, Mo.; Hermit Club, Cleveland, Ohio, and Why Lunch Company, New York City.

PROTECTING HYDROELECTRIC PLANTS.—In order that it may not have any trouble in the future through ice clogging its turbines, the York Haven (Pa.) Water & Power Company is having a spillway erected in its dam in the Susquehanna River at a cost of about $50,000. The spillway is practically an extension of the wall of the dam and reaches from the big wall to the western shore of Duffey's Island. It has a width of 18 ft. and has a slope of sufficient depth to allow anything that happens to be in the water to pass over it easily. The improvement is being made under the supervision of E. F. Baker, superintendent of the company. Steps are also being taken to enlarge the capacity of the plant.

RUBBER MANUFACTURE IN JAPAN.—A company with a capital of $1,000,000 has been formed for the manufacture of rubber products. The greater part of the capital has, it is stated, been subscribed by foreigners. The factory will be located at Osaka.

GENERAL ELECTRIC COPPER.—Advices from Boston state that the General Electric Company is expending about $1,000,000 in developing and placing its Bully Hill copper property in California upon a producing basis. For a year and a half development work has been progressing without net returns of any moment. It is understood that it has been deter-

ly decided to double the capacity of the Bully Hill smelter and instead of two furnaces there will be four with reduction capacity of 1200 to 1500 tons per day. President Riordan says that the whole plant will be reconstructed at a cost of between $300,000 and $400,000. The Bully Hill Company is expending at least $500,000 in the building of 18 miles of railroad connecting its smelting plant at DeLamar with the Southern Pacific about two miles above Kennet. It is estimated that this road will effect a saving to the Bully Hill Company of $4 per ton in coke supplies and a pro rata saving on all freight. The Bully Hill should be able to supply 25,000,000 lbs. of copper per annum to the General Electric Company at a cost of about 10 cents per pound. On 15-cent copper this would mean an annual saving to the General Electric Company of $1,250,000 and on 20-cent copper $2,500,000. The company's total investment, including the purchase of the property, will probably be in the neighborhood of $2,500,000, so that the General Electric Company may get its total investment back in between one and two years. The copper requirements of the company amount to about 1,500,000 lbs. per week, which is at the rate of 75,000,000 lbs. per annum.

BREAK IN COPPER.—On Tuesday of this week the deadlock between producers and consumers of copper, which has lasted for several months, was broken and a reduction of 3c. or more was made from the price of the last previous sale. Though rumors were heard of selling at considerably reduced prices by both the United Metals Selling Company, which handles all the product of Amalgamated, and by the Calumet and Hecla, the only reduction which was officially confirmed was in the case of Phelps, Dodge & Company, who deal in electrolytic copper entirely. They reduced their price from 25 cents to 22 cents a pound. It was reported that Calumet and Hecla had sold some of its product at 23, a reduction of 3½ cents from the former price, and that the United Metals Company was quoting certain grades of lake copper at 22⅛. That the reduction of the price was the outcome of a conference between the large consumers and producers was the common belief.

ORDERS FOR GENERATORS.—Among recent sales of electric generating sets the B. F. Sturtevant Company, of Boston, Mass., report the following: Electric Construction Company, Richmond, Va.; McCann Ice Plant, Philadelphia, Pa.; Bethlehem Brewing Company, New Bethlehem, Pa.; Smith & Hammond lumber steamers; Eberhard Faber Pencil Company, Brooklyn, N. Y.; Metric Metal Works, Erie, Pa.; Hanover National Bank Building, New York City; Sedalia Ice, Light & Fuel Company, Sedalia, Mo.; H. J. Kunzig, Philadelphia, Pa., [illegible]

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market showed considerable strength throughout the week and quotations advanced on moderate buying in spite of the high rates for money. Call loans touched 15 per cent on Monday, but eased off later. At the close of the week the market was strong and very active. The whole list showed good gains with prompt advances in such stocks as St. Paul, Amalgamated Copper, New York Central and Union Pacific. Most of the active shares on Saturday touched the highest level of the week, and although the market was professional, there was some outside support. Of the electric stocks General Electric and Westinghouse are the only ones which show declines in face of the generally strong market. The curb market developed greater activity during the week, with the volume of transactions nearly twice as large as the previous week. Gains of 1 and 2 points were scored for many stocks, the mining issues being the features. The table shows the closing quotations of July 9.

NEW YORK.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

BOSTON.

	July 2	July 9		July 2	July 9
American Tel. & Tel....	109	109	Mass. Elec. Ry. pfd.....	—	*58
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Elec. Co. of America...	9¾	[illegible]	[illegible]	[illegible]	[illegible]
Elec. Storage Battery...	51	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

BUCKET SHOPS.—Notwithstanding the general complaint among commission houses of the lack of public interest in the stock market, it is stated that the bucket shop interests, driven under cover by the recent laws in Massachusetts and Pennsylvania, are making strenuous efforts to establish connections with the stock market in New York. The officers of the Stock Exchange, through their detective bureau, are said to have scented danger of some of the bucket shops connecting with firms on the Exchange. Secretary Ely has issued circulars to the Stock Exchange firms calling attention to the provisions of the constitution that all wire connections with offices or persons not members of the Exchange, engaged in the banking or brokerage business, whether by telephone or telegraph, must be registered with and approved by the committee of arrangements. Circulars have also been sent out calling attention to the necessity of receiving the approval of the committee on commissions for all branch offices in New York or elsewhere, which must also be registered. These two circulars ask the members to comply with the regulations.

MESSENGER SERVICE.—The United Electric Service Company has applied to the Board of Estimate for a franchise in Manhattan. This company wishes to establish a messenger call box system. "Big Tim" Sullivan, Tammany leader, is supposed to be behind the company. The concern applied for a franchise under the name of the United District Messenger Company, as the corporation counsel advised its officials to organize under the transportation corporations law instead of under the business corporations law. The company operates chiefly in the financial section and on the upper West Side. He says the company contends that "it has been impossible to install boxes profitably because of the exorbitant rates charged by telephone companies for the use of their wires. The rate charged is $108 a mile for each pair of wires, but since the application of the company for a franchise the rate has been cut in half. But the telephone companies have refused to lease any additional wires."

WESTINGHOUSE NOTES.—Kuhn, Loeb & Co. have taken an issue of $6,000,000 Westinghouse Electric notes dated as of Aug. 1 next which will bear 6 per cent interest and will run for three years. They will be used to pay off the $6,000,000 of notes which mature on that day. The new notes will be secured by $6,000,000 Lackawanna & Wyoming Valley Rapid Transit 5 per cent first lien bonds, $3,000,000 Westinghouse Electric assenting stock, and $3,000,000 (market value) of British Westinghouse Electric debentures. The notes have been taken by Kuhn, Loeb & Co. They were being offered to investors last week at 97½.

AMERICAN RAILWAYS BONDS.—A syndicate composed of Bioren & Co., Newburger, Henderson & Loeb, and E. C. Miller & Company, all prominent Philadelphia banking houses, is offering a block of $600,000 of 10-year collateral trust 5 per cent gold bonds of the American Railways Company for public subscription. These bonds are offered at 92 and interest. They are due on April 1, 1917, and will yield more than 5½ per cent. This is a recent issue of the American Railways Company, for the purpose of supplying the funds needed in the expansion of business.

TEXAS TELEPHONES.—The local independent telephone exchanges in 20 of the principal towns of Texas and several long distance telephone lines have been purchased by the Cen- [illegible] system and under one management.

DIVIDENDS.—The Little Rock Railway & Electric Light Company has declared semi-annual dividends of 3 per cent on preferred stock and 2 per cent on common.

GENERAL NEWS

Construction News.

MOBILE, ALA.—Sanderson & Porter, of New York, N. Y., have been engaged as consulting engineers in connection with the enlargement of the power plant of the Mobile Light & Railroad Company. The company has placed contracts with the Babcock & Wilcox Company for two 512-hp boilers and has purchased Rodney stokers; one central condenser, and is preparing to install coal-handling apparatus. In addition to the above there will be installed stacks, pumps and heaters, for which the company is now receiving bids. J. H. Wilson is president.

BERKELEY, CAL.—The Oakland Traction Company has been granted franchises by the Town Trustees to construct lines on several cross-town streets.

FRESNO, CAL.—It is said that H. E. Huntington is planning to build an electric railway between Fresno and the Yosemite. Surveys by the way of Crane Valley, a distance of 96 miles, have been completed. The road will cost $3,000,000 and electricity for operating the line will be furnished by the San Joaquin Power Company, which is controlled by the Huntington syndicate.

ST. HELENA, CAL.—H. M. Pittman has purchased the property of the St. Helena Fruit Drying & Packing Company, at Barre Station, from A. D. Butler and proposes to establish an electric plant there for the purpose of furnishing electricity for lighting and power purposes in St. Helena and Calistoga.

SAN BERNARDINO, CAL.—The Arrowhead Reservoir & Power Company, which recently took over the Arrowhead Reservoir Company, has increased its capital stock from $6,000,000 to $6,500,000 and is now preparing to float a bond issue equal in amount to its capital stock. The money will be used to complete the large irrigation and power projects of the company north of the city.

SAN DIEGO, CAL.—The City Council has passed an ordinance granting the Point Loma Electric Railroad Company a franchise to construct and operate a street railway in the city.

SAN MATEO, CAL.—Peter Thorsen and J. Johns, of the San Mateo Construction & Contracting Company, have applied to the Board of Trustees for a franchise to construct and operate an electric railway system in this town and to Burlingame. The name of the company is to be the People's Railway Company and it contemplates using the underground conduit system.

SANTA CRUZ, CAL.—The Big Creek Power Company is now erecting a new steam plant in this city having a capacity of 1800 horse-power. The water power plant of the company, located 18 miles from Santa Cruz, is to be entirely rebuilt during the year, and the capacity of the plant increased from 800 to 2500 kw. The improvements will involve an expenditure of $500,000. The work is being carried on under the supervision of F. E. Fitzpatrick, general manager of the Coast Counties Light & Power Company and S. W. Coleman, general manager of the Union Traction Company.

YREKA, CAL.—The Siskiyou Electric Light Company is increasing the capacity of the Fall Creek plant on the Klamath River by the installation of new machinery. The entire system is now being operated by the Shasta River plant, while repairs are being made to the Fall Creek plant.

DENVER, COL.—Announcement has been made that the controlling interest of the Denver City Tramway Company has been transferred to a syndicate of New York and Providence capitalists, the members of which are Marsden J. Perry, Benjamin A. Jackson and Col. Samuel P. Colt, of Providence, R. I., [illegible] and W. L. [illegible], of New York, N. Y.

DENVER, COL.—The Central Colorado Power Company has filed a mortgage of $20,000,000 in the clerks' offices of Larimer, Grand, Summit, Lake, Eagle, Pitkin, Garfield and Denver counties. The property covered includes the De Remer water power location at Shoshone Falls [illegible] Glenwood Springs, [illegible] Gore Canon plant, and the third plant, which will be located on Roaring Fork near Aspen. The three plants of the company will have a combined capacity of [illegible] horse-power. In addition the company will have [illegible] storage reservoirs, [illegible] on upper R[illegible] on Grand River.

BRIDGEPORT, CONN.—The Eaton, Cole & Burnham Company is [illegible]

BRISTOL, CONN.—[illegible] and the Bristol & Plainville Tramway Company for electric lighting ex[illegible]

[illegible]

now making arrangements to construct a plant and expects to have its system in operation before next winter.

HARTFORD, CONN.—A resolution incorporating the Bridgeport & Danbury Electric Railway Company has been passed by the Legislature over the Governor's veto. The company is capitalized at $1,500,000.

HARTFORD, CONN.—The House of Representatives on June 28 rejected the Senate amendment to the bill of the Glastonbury Power Company. The amendment prohibited the company from doing business in the territory of the Hartford Electric Light Company without contract with that company.

NORWICH, CONN.—The City Council has authorized the Gas and Electric Commissioners to make the necessary improvements and additions to the municipal electric lighting plant, the cost not to exceed $30,000. The money will be expended to furnish a site for the Uncas Power Company's sub-station and other electrical apparatus as provided in its contract with the city, and to provide for the rapidly increasing demands for both gas and electricity, which will require additional primary lines from the station to central points of distribution in the city, also to furnish new transformers and meters for new customers.

TORRINGTON, CONN.—The office and storehouse of the E. A. Perkins Electric Company were recently destroyed by fire, causing a loss of $15,000.

WILMINGTON, DEL.—J. Ernest Smith, representing the Commercial Light, Heat & Power Company, on June 29 paid to the city treasurer $6,250, which was the second installment due the city on the amount promised in return for the franchise granted the company by the Street and Sewer Department to lay gas mains in the streets of the city. The company has agreed to pay the city $50,000, half of which is to be paid by the Delaware Electric Transmission Company.

WASHINGTON, D. C.—Bids will be received until July 20 by Elliott Woods, superintendent U. S. capitol buildings and grounds, for weatherproof and rubber covered electric wires for House of Representatives office building, material to be delivered on reels at the building.

DE KALB, ILL.—The De Kalb, Sycamore & Interurban Traction Company has filed a certificate with the Secretary of State showing an increase of capital stock from $100,000 to $1,500,000.

FORT WAYNE, IND.—Contracts for the construction of the municipal electric lighting plant were awarded on June 26 as follows: To Fort Wayne Electric Works, Fort Wayne, for section 3, steam turbine generators and exciters; section 4, condenser equipment; section 7, arc-lamp transformers, switchboard, appliances and station electrical work; section 8, arc lamps, and section 10, transformers and connecting public buildings, for a total of $73,899. To McBride Electric Company, of St. Paul, Minn., for section 9, pole line and wiring system and underground (distributing system), and section 11, power plant and coal storage, for a total of $56,002. To the O. K. Engineering Company, of St. Louis, Mo., section 1, boilers and equipments and stack connections, and section 5, feed-water heater, boiler, feed pumps, separators, pipe work and connections, for a total of $19,220. To Alphons Custodis Chimney Construction Company of Chicago, Ill., for section 2, stack, for $4,300, and to the Moellering Construction Company, of Fort Wayne, section 12, dam in Spy Run, for $1,238.

FRANKLIN, IND.—J. B. Rogers, manager of the Franklin Water, Light & Power Company, writes that the company expects to get its new franchise early in July, when the plant will be remodeled and the following new equipment installed: A new engine direct connected to a 250-kw, three-phase alternator, a new 125-kw, three-phase alternator to take the place of the present machine and belted to the engine already installed. One 75-light transformer to take the place of the direct-current arc machine, when all arc lamps will be changed to alternating-current series enclosed lamps. When the improvements are completed a 24-hour service will be established and electricity will be furnished for power purposes.

[illegible] IND.—The City Council has authorized the Board of Public Works to proceed with the erection of a new brick building at the municipal electric light plant, to cost $6,000.

RED FORK, I. T.—The Sequoyah Park Company has been organized for the purpose of constructing an electric railway and improving Sequoyah Park. The company contemplates an expenditure of $100,000 for improvements and construction of the line, which will be 11 miles in length.

CRESTON, IA.—[illegible] the equipment and system of the Creston Mutual Telephone Company, which [illegible]

[illegible] The Western Electric Telephone Company is contemplating making improvements to the local systems, which will [illegible]

[illegible]

KENSLEY, KAN. [illegible] Power Company [illegible] Moe, of Albuquerque, N. M.

PENOBSCOT, ME. [illegible] Electric Company have been filed with the Secretary of State. The company [illegible] generating electricity for light and power purposes, which will be distributed in the towns of Bucksport, Orland, Penobscot, Castine, Bluehill, Winterport, Frankfort, Stockton Springs and Verona. The capital stock of the company is $200,000, and the officers are: William M. Shaw, of Greenville, president, and Albert H. Shaw, of Bath, treasurer.

BALTIMORE, MD.—The Baltimore, Halethorpe & Elkridge Railway Company has secured the right of way for an electric railway between Baltimore and Halethorpe, work on which will commence within a short time.

BALTIMORE, MD.—At the annual meeting of the Consolidated Gas, Electric Light & Power Company, held July 1, plans were announced for erecting an addition to the Westport electric power plant, which provides for a structure large enough to provide for 72,000 horse-power. One-third of the structure will be erected this year, and a turbo-generator set of 7500 horsepower has been ordered, with boilers and necessary equipment.

BALTIMORE, MD.—As it is costing the city nearly twice as much to light the City Hall and court house by its own plant as it is paying the local electric companies for lighting the other public buildings and places, the Mayor has instructed Superintendent of Lamps and Lighting, McCuen, to prepare proposals for lighting the city hall and court house. The city plant in the court house costs the city 12 cents per kw-hour, while the other buildings are lighted at the rate of 6¾ cents per kw-hour. If it is decided to light the two buildings by competition the city plant will be abolished.

AMESBURY, MASS.—A new Rice & Sargent engine of 300 horsepower has been installed in the plant of the Amesbury Electric Light Company. The engine is direct connected to a 200-kw generator.

ARLINGTON, MASS.—The Board of Selectmen has recently closed a 20-year contract with the Edison Electric Illuminating Company, Boston, Mass., for street lighting and lighting the municipal buildings. The long term contract secures a reduction of 20 per cent from the rates on [illegible]

BOSTON, MASS.—Bids will be received until July 16 by the Trustees of the Boston City Hospital for electric wiring the East Boston Relief Station on Porter Street, East Boston. George H. M. Rowe is superintendent.

BOSTON, MASS.—The board of arbitrators, consisting of Samuel H. Hudson, Dugald C. Jackson and Herbert A. Wagner, who were appointed some time ago to consider the matter of the city's contract with the Edison Electric Illuminating Company, with a view to securing a reduction for the cost of electric lighting, have succeeded in bringing about better terms between the company and the city. At the present rate of consumption a saving of $17,300 a year has been secured by the board, or a total of $43,250 for the two and one-half years preceding Feb. 20, 1909, when the present contract expires.

BROOKLINE, MASS.—Bids will be received by the Board of Selectmen until July 15, for street lighting for a term of six years on specifications to be drawn up by the superintendent of wires and lights.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has asked for permission to erect poles for a high-tension power line across Rocky Mountain and the town from the river electric plant of the Turners Falls Company.

MARLBOROUGH, MASS.—The Marlborough Electric Light Company has petitioned the Board of Electric Light and Gas Commissioners for permission to issue additional capital stock to the amount of $170,000, the proceeds to be used for paying the funded and floating debt of the company and the cost of permanent improvements to the plant.

MILLERS FALLS, MASS.—The committee appointed on the lighting investigation has recommended that the offer of the Franklin Electric Light Company, of Turners Falls, be accepted. At a special meeting of the fire district, held July 1, the commissioners and the investigation committee were authorized to enter into negotiations with the company to furnish electricity to operate the municipal electric lighting system. The company offers to furnish electric energy to the Millers Falls district at the following rates: 3½ cents per kw-hour up to 40,000 kw-hours per year; 3¼ cents per kw-hour from 40,000 to 50,000, and 3 cents per kw-hour for all over 50,000 kw-hours, unless the amount should be so great as to warrant a special contract.

PETERSHAM, MASS.—The plan of establishing an electric lighting system in this town is now under consideration. It is intended to erect a plant to supply electricity for street and residential lighting.

SPRINGFIELD, MASS.—The United Electric Company has awarded a contract to W. H. Falvey, of this city, for the construction of a one-sto[illegible]

TAUNTON, MASS.—The City Council is considering the proposition of increasing the capacity of the municipal electric lighting plant. It is stated that a large number of additional street lamps have been called for which cannot be installed unless an additional engine is placed in the plant. The demand for electricity for power purposes is increasing rapidly, which call for increased facilities at the power house.

WEBSTER, MASS.—The Board of Electric Light and Gas Commissioners has authorized the Webster Electric Company to issue 650 shares additional capital stock to enable it to purchase the Southbridge Gas & Electric Company. The commissioners have also approved the issue of an additional 100 shares to pay for the extension of lines, par value $100.

WINCHESTER, MASS.—The town of Winchester has decided to abandon the moonlight schedule for its street lighting, and will have the lamps lighted every night until midnight. This will not involve a new contract and only a slight additional expense. The electric lighting service is furnished by the Edison Electric Illuminating Company, of Boston.

CHARLOTTE, MICH.—The Commonwealth Power Company, of Jackson, has notified this city that its power is contracted to the capacity of its plants and that it will be unable to take the contract to light the city for a year and perhaps for a longer period.

HOLLAND, MICH. [illegible] entering into negotiations with the Grand Rapids-Muskegon Power Company to supply electricity for operating the municipal electric lighting plant during the coming winter.

KALAMAZOO, MICH.—Frank W. Armstrong, of Chicago, Ill., is reported interested in the establishment of a heating and power plant in this city for the purpose of furnishing power to the manufacturing industries of Kalamazoo.

MANCELONA, MICH.—The Stover dam, which supplied power for the lighting system at Mancelona, is being rebuilt and the city will be in darkness until the dam is completed.

MIDLAND, MICH.—Surveys of the Chippewa River are being made by H. von Schon, of Detroit, for the purpose of planning several power developments.

STANDISH, MICH.—The Citizens' Manufacturing Company is increasing the capacity of its plant and is installing generators, etc.

WINONA, MINN.—The La Crosse Water Power Company on July 1 closed its option for the purchase of the plant of the Winona Railway & Light Company, and will operate the system by electricity transmitted from its hydroelectric plant, now under construction at Hatfield, Wis. The Winona Railway & Light Company is planning to double track its street car lines and also build an extension at the West End to the new ball park.

MERIDIAN, MISS.—The Meridian Light & Railway Company has petitioned for an amendment to its charter, authorizing an increase of its capital stock to $2,000,000.

HOLDEN, MO.—The City Council has ordered a complete overhauling of the municipal lighting plant at a cost of about $6,000.

MAITLAND, MO.—The power plant of the Maitland Electric Light & Power Company has been destroyed by fire, entailing a loss of about $10,000.

WARRENSBURG, MO.—The Gas & Electric Development Company, of Philadelphia, has consummated a sale of the Magnolia Light, Heat & Power Company to Philadelphia parties. The new company will be known as the Warrensburg Light & Power Company and will be operated by the Gas & Electric Development Company. Extensive improvements are planned.

NEWARK, N. J.—Bids will be received until July 16 by the committee on repairs, heating and sanitation of the Board of Education, for furnishing material and installing an electric lighting apparatus in the South Eighth Street School. R. D. Argue is secretary of the board.

CHAMPLAIN, N. Y.—The application of the Champlain Electric Company for permission to increase its capital stock from $15,000 to $30,000 was denied by the State Commission of Gas and Electricity.

COEYMANS, N. Y.—The Town Board of Coeymans has awarded the contract for lighting the villages of Ravena and Coeymans to the Atlantic Light & Power Company for a term of five years. The company offers to furnish 30-cp incandescent lamps for $20 per lamp per year, and promises to furnish 50 lamps in Coeymans and 80 lamps in Ravena by Oct. 1. An action has been brought against the Town Board of Coeymans and the Atlantic Light & Power Company to enjoin them from executing the contract. The Upper Hudson Electric Company submitted a bid for $13 for each lamp. The Atlantic Company has no plant at the present time.

ELMIRA, N. Y.—The Elmira, Corning & Waverly Railway Company has secured franchises for the right of way through the towns of Chenango, Southport and Corning.

HEMPSTEAD, N. Y.—The State Railroad Commission has granted the Sea Shore Municipal Railway Company authority to construct a street railway from Hempstead through Rockville Center to East Rockaway, a distance of five miles.

NEW YORK, N. Y.—Announcement has been made that the New York City Railway Company is planning to electrify the old Belt Line car system [illegible]

NEW YORK, N. Y.—Bids will be received until July 15 (readvertisement) at the office of George B. McClellan, mayor, chairman Armory Board, for furnishing and installing electric lighting fixtures, etc., in the Twelfth Regiment Armory, Borough of Manhattan. Robinson & Knust, 164 Fifth Avenue, Manhattan, are the architects.

ONEIDA, N. Y.—The City Council has refused to grant a franchise [illegible]

tricity and gas in Oneida. The company offered to furnish electricity for 10 cents per kw-hour.

ONEIDA, N. Y.—The application of the Oriskany Hydro-Electric Company, which proposes to operate in the counties of Oneida, Madison and Chenango, for a certificate of authority to transact business, and for consent to issue first morgtage bonds to the amount of $400,000 was denied by the State Commission of Gas and Electricity.

OSWEGO, N. Y.—At an election held June 27 the citizens voted to purchase the property of the Country Club upon which to erect a power house in connection with the relocation of the high dam. The new power house will cost about $75,000.

PORT JEFFERSON, N. Y.—The State Railroad Commission has granted the Suffolk Traction Company permission to issue a mortgage of $1,200,000.

PORT WASHINGTON, N. Y.—The Mineola, Roslyn & Port Washington Traction Company has been authorized by the State Railroad Commission to change its name to the New York & North Shore Traction Company, and to increase its capital stock from $150,000 to $1,250,000 and to issue a mortgage of $1,000,000.

ROCHESTER, N. Y.—The State Railroad Commissioners have authorized the Rochester, Scottsville & Caledonia Electric Railroad Company to increase its capital stock from $500,000 to $2,500,000.

ROCHESTER, N. Y.—The Rochester Railway Company is making arrangements to transform the old car barn of the Rochester Electric Railway Company in Charlotte into an auxiliary power house. It will be equipped with a 500-kw rotary converter, electricity for which will be supplied by the Rochester Railway & Light Company from its station at the lower falls.

UTICA, N. Y.—The State Commission of Gas and Electricity has granted the Utica Gas & Electric Company permission to issue $2,000,000 in bonds to pay for betterments heretofore incurred and in process of making upon the plant of the Utica company and its subsidiary companies.

CLEVELAND, OHIO.—The directors of the Cleveland, Southwestern & Columbus Railway Company have approved the proposal to purchase a controlling interest in the Mansfield Railway, Light & Power Company, of Mansfield. The two properties will not be merged, but will be operated as one system. A new power house will probably be built in Mansfield capable of furnishing power for both the city lines and the new interurban line now being built from Ashland.

COLUMBUS, OHIO.—Bids will be received until July 30 by the Board of Trustees of the Columbus State Hospital for furnishing and installing complete an engine, dynamo, switchboard and feed wires in the power house.

GROVE CITY, OHIO.—Proposals will be received until July 15 for lighting the streets of the city for the term of one year. William C. Merritt is city clerk.

TOLEDO, OHIO.—The County Commissioners have rejected all bids received on June 26 for the construction of the power house at the County Infirmary, as all were in excess of the engineers' estimate, which is $27,000.

OKLAHOMA CITY, OKLA.—The Oklahoma City Street Railway Company has decided to erect its own power house at a cost of about $175,000. The equipment will consist of four 400-hp boilers and two 1600-hp engines. The engines will be direct connected to generators of 21,200-kw capacity. Provision will be made to double the capacity of the power house at any time, and with the additional installation provided for it is designed to handle the Oklahoma City & Guthrie street railways in connection with the interurban line.

HILLSBORO, ORE.—The City Council has granted a franchise to the Oregon Electric Railway Company to pass through the city on Base Line Street, and has also granted the United Railways Company a franchise by the way of Main Street, with the right to use either First, Second or Third streets for connection with the southern limit of the city.

MOSQUITE, ORE.—The board of directors of the Snake River Irrigation District has authorized an issue of bonds for $325,000 to build a complete pumping plant for irrigation of the district. Bids are now being asked for for both bonds and the plant. Bids on the plant will be opened July 30.

PORTLAND, ORE.—The Government Forestry Service has granted a permit to the Southern Pacific Company, of Kentucky, to construct a dam, conduit and power house in the Cascade forest reserve, for the purpose of generating electric power for general commercial use.

ALLENTOWN, PA.—The officers of the Allentown & Reading Trac- [illegible] power in the power house at Griesemersville.

CHESTER, PA.—The Philadelphia Rapid Transit Company is making [illegible]ngements to construct a double track system from Cardington to [illegible]indale. It is also said that the company is contemplating extending [illegible]

[illegible] in Williamsburg and Martinsburg and the intervening country.

SCRANTON, PA.—It is reported that the Central Railroad of New [illegible] on its line between Scranton and Mountain Park for the purpose of handling its large summer excursion traffic.

SHARON, PA.—The New Castle & New Wilmington Electric Railway is contemplating extending its line to Mercer and Grove City.

WASHINGTON, PA.—The County Commissioners have decided to abandon for the next five years at least, the heating and lighting plant in the new county jail. The commissioners have awarded the contract for furnishing light, heat and power for the court house and county jail to the Washington Electric Light & Power Company. The contract is for a term of five years to date from Aug. 1, at $6,600 per year. In addition to this the county will have to pay an additional $1,000 this year for the installation of a large motor, which will be used to run the ventilating apparatus instead of the steam engine now in use. It is stated that it has cost the county more than $9,000 a year to maintain and operate the plant in the jail building.

PROVIDENCE, R. I.—The Board of Aldermen on July 1 passed over the mayor's veto the ordinance granting the Providence Telephone Company an exclusive franchise for six years.

ANDERSON, S. C.—Hugh McRae, of Hugh McRae & Company, of Wilmington, N. C., has recently been in the city to complete arrangements for the development of the Cherokee Falls, four miles below Greggs Shoals, on the Savannah River. Work will commence at once on the construction of the dam, which, when completed, will furnish 10,000 horse-power. The company will be known as the Calhoun Falls Power Company and will be capitalized at $8,500,000.

NEWBERRY, S. C.—The City Council has granted a franchise to the South Carolina Public Service Corporation to construct and operate an electric street railway on several streets of this city.

SIOUX FALLS, S. D.—H. M. Byllesby & Co., of Chicago, Ill., have been retained as consulting engineers to make plans for the reconstruction and extension of the existing hydraulic plants of the Sioux Falls Light & Power Company. About $15,000 will be expended in rebuilding the present dams and in adding new equipment.

BRISTOL, TENN.—The Bristol Street Railway Company has been granted a 30-year franchise to build and operate a street railway system in Bristol.

CHATTANOOGA, TENN.—The Chattanooga Electric Company is now furnishing the Chattanooga Railways Company with electricity for operating its system. The Ridgedale power plant of the railway company will be closed down and hereafter will only be used in case of emergencies. The present equipment of the plant of the electric company consists of three 500-kw and one 1000-kw steam turbines. In addition the company has received a 500-kw turbine which will soon be placed and has also ordered a new 1000-kw machine to be installed in the plant. The company will also install boilers of 1640 horse-power to furnish power for the new 500 and 1000-kw turbines.

LAWRENCEBURG, TENN.—Plans are being prepared by Walter G. Kirkpatrick, of Jackson, Miss., for a municipal power plant consisting of concrete dam, turbines, transmission and distribution lines, arc lamps, dynamos, electric pumping, steel towers, tank and water mains.

SPARTA, TENN.—At the municipal election held June 27 the proposition to issue $40,000 in bonds to construct an electric light and water works plant was defeated by a vote of 95 to 18.

AMARILLO, TEX.—At an election held recently the citizens voted to grant a telephone franchise to H. H. Davenport & Co., of Hillsboro. The new franchise runs for 30 years and binds the company to install a system at a cost of $100,000.

BROWNSVILLE, TEX.—An election will soon be held to vote on the proposition of issuing $70 000 in bonds for the construction of waterworks and electric light plant. W. P. Bullock, of Kansas City, Mo., is engineer.

DALLAS, TEX.—It is stated that the contract for the construction of the power house of the Sherman-Dallas Interurban Railway at McKinney will soon be awarded.

WACO, TEX.—The City Council has granted Joseph Henry, of Denver, Col., a franchise to construct and operate an electric light and power plant in this city.

OGDEN, UTAH.—The City Council has passed an ordinance providing that the committee on electric lighting be given authority to make arrangements to secure water power site and rights.

PETERSBURG, VA.—At a meeting of the City Council held July 2, the gas and light committee's report, recommending a three-year contract with the Virginia Passenger & Power Company, for street lamps, at the prevailing rate of $57 for each lamp per year, was adopted. The proposed contract provides for a two-year extension, but the company has been authorized by the court to make a five-year contract, and the receivers will have to secure its authority to make a new contract.

BELLINGHAM, WASH.—Engineers of the Cascade Valley Railway Company are working on the final location of its line through the Cascade Pass. W. A. C. Rouse, president of the company, states that work will commence on construction of the road within 60 or 90 days.

CHEHALIS, WASH.—Application has been made to the City Council by J. B. Weeks, of Tacoma, for a 50-year franchise for the Centralia-Chehalis Electric Railway & Power Company.

SPOKANE, WASH.—The Panhandle Railway & Power Company is making surveys for the new electric railway which it proposes to build to Priest Lake.

[illegible] on Stave River, 35 miles from Vancouver, capable of developing 300,000 horse-power. Besides supplying electricity for operating the trains of the Great Northern Railroad the promoters expect to furnish electricity for commercial purposes in the Puget Sound cities.

STRATHCONA, ALB.—The City Council has practically decided to grant a long-term franchise to the Strathcona Radial Company to build an electric railway in this city and to adjoining places. The company has made arrangements to make connections with the Edmonton municipal system now being built.

KAMLOOPS, B. C.—The city clerk writes that the city expects to enlarge the electric light plant and is making inquiries in regard to producer gas plants.

HAMILTON, ONT.—The lighting committee of the Board of Works has decided to receive bids until about Aug. 1 for street lighting.

INGERSOLL, ONT.—The new owners of the Woodstock, Thames Valley & Ingersoll Electric Railway Company are contemplating the con- [illegible]

DESCHENES, QUE.—G. Gordon, superintendent of motive power, of the Hull Electric Company, writes that the company is installing an additional generator and making other improvements to its plant.

New Industrial Companies.

THE AMERICAN ELECTRICAL DEVELOPING COMPANY, of Amsterdam, N. Y., has been incorporated with a capital stock of $100,000 to manufacture electrical apparatus. The directors are: R. T. Ford, of Rochester; T. J. Murphy, of New York, and Richard Murphy, of Amsterdam.

THE COOLEY ELECTRICAL CONSTRUCTION & SUPPLY COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $2,000. The directors are L. H. Cooley, H. H. Cooley, of Rochelle Park, N. J., and J. H. Hendrick, of New York, N. Y.

THE DANNER ELECTRICAL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000. The directors are Paul de K. Chesnaye, of New York; H. C. Hepburn and E. M. Post, of Babylon, L. I.

THE DECATUR HOME TELEPHONE COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $300,000. The purposes of the company are to make, license, lease, etc., telephonic and telegraphic appliances and apparatus of all kind. The incorporators are C. N. King, G. H. [illegible] and J. E. [illegible]

New Incorporations.

HUNTSVILLE, ALA.—The Central Texas Telephone Company has been organized with a capital stock of $50,000 by A. B. Foster and others.

LOS ANGELES, CAL.—The Washington Electric Water Heater Company, of Los Angeles, Cal., has been incorporated with a capital stock of $200,000 by J. N. Winger, G. N. Turner and W. A. Sewright.

PUEBLO, COL.—Articles of incorporation have been filed for the Canon City, Pueblo & La Junta Railway & Power Company, with a capital stock of $200,000, by Francis James, Andrew J. Behymer and others.

WILLOWS, CAL.—The Snow Mountain Electric Power Company has filed articles of incorporation, with a capital stock of $500,000. The directors are: Charles H. Glenn, C. R. Wickes, A. S. Lindstrom, of Willows; B. H. Burton, T. Harrington, M. J. Boggs and H. C. Stovall, of Colusa. The company has been organized to develop a hydroelectric power plant on the Middle Fork of Stony Creek. Willows will be the principal place of business.

CAIRO, ILL.—The Cairo Terminal Traction Company has been chartered to build a railway from Cairo to the north line in Pulaski County. The incorporators and the first board of directors are L. E. Fischer, of Danville; D. Hogan, Mound City; W. S. Dewey, D. H. Sawyer, and H. F. Vogel, of Cairo.

CHICAGO, ILL.—The Homer Roberts Telephone Company has been incorporated with a capital stock of $500,000 by Joseph C. Belden and others.

CHICAGO, ILL.—Articles of incorporation have been filed for the Midland Telegraph Company, with a capital stock of $15,000. The incorporators are Nathan S. Smyson, John A. McKeown and F. W. Raymond.

LAWRENCEVILLE, ILL.—The Farmers' Telephone Company has [illegible] F. Breen and M. G. Couch.

QUINCY, ILL.—The Quincy Interurban Company has been incorporated, with a capital stock of $25,000. The directors are: Henry F. Dayton, J. Henry Bastert, Ezra Best, John J. Fisher, W. T. Duker, [illegible]

ROCK ISLAND, ILL.—[illegible] corporators are Lewis E. Rote, William Fisher and Martin Probst.

GERMANY, [illegible] Fulton County, has been organized to construct and operate telephone lines and exchanges in Germany and Fulton County. The officers of the company are: Isaac L. Babcock, president; George Beeler, vice-president, and Frank Leiter, secretary.

[illegible] been incorporated to construct a telephone system with an exchange in this town.

TULSA, I. T.—The Tulsa Electric Light Company has been incorporated with a capital stock of $15,000 by R. D. Campbell, D. M. Martindale, of Tulsa, and H. F. Burt, of Oklahoma City, Okla.

DALLAS, IA.—The Dallas Mutual Telephone Company has been incorporated with a capital stock of $1,000 by H. E. Willis and others.

MENLO, IA.—The Jefferson Mutual Telephone Company has been incorporated, with a capital stock of $10,000, by M. R. Cline, L. E. Smith and C. Wilson.

OAKLAND, IA.—Articles of incorporation have been filed for the Betna Valley Farmers' & Merchants' Mutual Telephone Company, with a capital stock of $15,000. Joshua H. Spalti is president.

PERSIA, IA.—The Persia Mutual Telephone Company has been formed with a capital stock of $10,000.

FRANKFORT, KY.—The Barren River Telephone Company, of Barron County, has been incorporated with a capital stock of $300 by Emmet G. Logan, Frank P. Hayes and G. W. White.

HOPKINSVILLE, KY.—Articles of incorporation have been filed for the Pembroke Home Telephone Company, with a capital stock of $40,000, by R. E. Cooper and others.

MOUNTAIN GROVE, MO.—The St. Louis, Mountain Grove & Southern Railway Company has been chartered, with a capital stock of $300,000 to build a railway from Mountain Grove to Bryant Creek, a distance of 30 miles. The directors are: J. J. Hedges, J. H. Jarrett, E. L. Richardson, of Springfield; J. Allhands, of St. Louis, and P. M. Johnston, of Elmo, Ill.

RENO, NEV.—Articles of incorporation have been filed for the Interurban Electric Railroad Company with a capital stock of $100,000 by Walter Wright, Louis Berrum, J. L. Robinson, O. M. Clifford, George W. Perkins, John Guilding and W. F. Webster.

[illegible] the Secretary of State for the Empire & Keystone Telephone Company. The company is capitalized at $10,000 and the incorporators are: Alonzo A. Calkin, Monticello; William H. Wilson, Eldred; Fred F. Freeman, Berryville, and others.

EARLVILLE, N. Y.—The Earlville Electric Light Company has been incorporated, with a capital stock of $10,000, by Guy H. Clark and others.

LONG EDDY, N. Y.—The Delaware & Sullivan Telephone Company has been incorporated with a capital stock of $10,000 by J. T. Male and others.

BERLIN CENTER, OHIO.—The Berlin Center Telephone Company has been incorporated with a capital stock of $10,000 by W. K. Hughes and others.

DEFIANCE, OHIO.—The Defiance, Hicksville & Fort Wayne Railway Company has been incorporated, with a capital stock of $10,000, by W. E. Golding, H. C. Eflert, M. O. Topliff, E. A. Murphy and M. I. Brown. The road will be operated by electricity.

SYLVANIA, OHIO.—The Citizens' Telephone Company, with a capital stock of $10,000, has been incorporated by F. J. Maisen and others.

Legal.

[illegible] City of Redlands and its trustees against the city treasurer, A. E. Brock, the California Supreme Court rendered a decision affirming the validity of a bond issue of $50,000, the proceeds to be applied to the electric lighting of the city during the year of 1907. The treasurer alleged that the bonds were illegal, for the reason that the bonds that were to be used was not among those for which municipal corporations were authorized to borrow the money. The court holds otherwise and commands the city treasurer to sign bonds.

LIABILITY OF OWNER OF ELECTRIC WIRE TO POLICE OF- [illegible] BUILDING, WHILE IN THE DISCHARGE OF HIS OFFICIAL DUTY.—A police officer of the city of Greenville, Tex., went to the top of a building in the night time for the purpose of discovering who, if any one, was engaged in a room in an adjoining building in the offense of gaming. While thus in pursuit of the functions of his office he came in contact with a primary wire belonging to the defendant and was injured. The wire in question carried a current of 1000 volts or more and the insulation had been allowed to rot and wear off. The defendant contended that its act in maintaining the wire in a defective condition at the place described could not be regarded as actionable negligence, because an injury to the plaintiff at the time and in the manner set forth could not have been anticipated or foreseen. But this was held not to be an available defence. The plaintiff was on the building in the discharge of an official duty and for the purpose of apprehending suspected violators of [illegible]

[illegible] the lower court in the case of the Vulcan Detinning Company against the

American Can Company, the Court of Errors and Appeals of New Jersey has carried the principle of the responsibility of an employee to keep inviolate the secrets of his employer one step further than it has ever gone before in the eyes of the law, making the responsibility involuntarily to extend to whoever hires away the possessors of the private knowledge. The litigation arose out of the use by the American Can Company of a process of separating and recovering tin and steel from tin cans and waste scrap which the Vulcan Detinning Company claimed to own. The New Jersey Court in its finding holds that the former employees of the Vulcan Company who received knowledge of the secret process in confidence became its trustees, with all the duties and obligations of such a position. By employing these men with the knowledge that they possessed the Vulcan Company's secret, the court contends that the American Can Company also became responsible and put itself in the peculiar position of trustee for its rival. The American Can Company is not only permanently enjoined from proceeding with its detinning operations, but it is ordered to account to its rival for all of the profits it has made out of the detinning plants up to date.

RIGHT TO USE PATENT TROLLEY SWITCHING DEVICE IN CONNECTION WITH ELECTRIC LOCOMOTIVES NOT FURNISHED BY PATENTEE.—The General Electric Company, to whose rights the plaintiff company succeeded, sold to the Illinois Telephone Construction Company, in 1903, twenty-two electric locomotives. Upon the delivery of one of the locomotives the discovery was made that there was no practical overhead switch for the trolleys and that one was required in order to operate the locomotives automatically. The Illinois Company was engaged in operating trains in tunnels under the streets of the city of Chicago, and to be required to switch the trolley from one line to another by hand would have been a serious impediment to the running of trains. After many experiments a system was hit upon by which the trolley could be automatically switched from one line to another, correspondingly with the switching of the car. A patent on this device was secured and the present suit was brought to restrain the tunnel company from using certain other electric locomotives, previously purchased from another manufacturer, in connection with the device. It was held that, as there was no restriction in the contract of sale, the tunnel company could use the switching device, not only with the locomotives bought of the General Electric Company, but as well with others bought from other makers, and that the seller could not claim that such use amounted to an infringement of his patent rights. Thomson Houston Electric Company vs. Illinois Telephone Construction Company, United States Circuit Court of Appeals, 152 Fed. Rep. 630.

NEGLIGENCE OF ELECTRIC LIGHT COMPANY IN PLACING HIGH-TENSION WIRES TOO CLOSE TOGETHER AND IN NOT PROPERLY INSULATING A QUESTION FOR THE JURY.—D. L. Brooks, an experienced lineman in the employ of the Western Union Telegraph Company, wos ordered to string some wires for the company on a pole at the corner of Main and Calhoun streets in the city of Memphis, Tenn. On the same pole were two wires belonging to the Memphis Consolidated Gas & Electric Company, the pole standing between the two wires, which were about eighteen inches apart. One of the wires was spliced at a point near the pole and the insulating tape had worn away. The lineman, while at work, received a shock of electricity, which threw him from the pole and resulted in his death. No one witnessed the accident, but there was evidence tending to show that the shoulder of the deceased touched the exposed wire of the Memphis company while his foot was resting upon a grounded telephone wire attached to the pole about five feet lower down. In an action against the Memphis company the negligence charged against the defendant was in placing the high-tension electric light wires too close together on the pole, in not properly insulating them, and in failing to inspect them so as to keep them in a reasonably safe condition. In the lower court the question of negligence was left for the determination of the jury and a verdict against the company was brought in. Upon appeal to the United States Circuit Court of Appeals it was held that the question was a proper one for the jury and the judgment against the defendant company was affirmed. The defendant claimed that the lack of insulation at the point where the wire was spliced was immaterial because it is impossible to effectually insulate a high-tension wire of the kind in question and the deceased had been instructed [illegible] all such wires as live wires, and as if no attempt had been made to insulate. But in view of the fact that such wires are required to be insulated, and that in this case an attempt to insulate had been made, the court was of the opinion that it was for the jury to say whether or not [illegible] care. [illegible] Company, [illegible] Fed. Rep. [illegible]

Obituary.

[illegible]

MR. L. J. MAGEE.—We record with profound regret the sudden death in New York City from apoplexy, on July 2, of Mr. Louis Jones Magee, a distinguished electrical engineer. He was born in Malden, Mass., in September, 1862, and was graduated from Wesleyan University in 1883. He entered the shops of the Thomson-Houston Company at Lynn and then went to Lima, Peru, where he installed several electrical illuminating plants. When he returned he became more closely associated with the Thomson-Houston Company as its representative to Europe, where he constructed its first electric tramway on the Continent. In Berlin he organized and became the resident manager of the Union Elektricitats-Gesellschaft. Three years ago he returned to this country, and he has since represented the consolidated Allgemeine Elektricitats-Gesellschaft as resident director here. Meantime he has been a frequent contributor to the engineering press. In 1894 he married Miss Virginia P. Kent, of Berlin, who survives him. His mother, Mrs. Mary Magee, 86 years old, is living at Malden. Mr. Magee was a member of the American Institute of Electrical Engineers and of the Engineers' and Lawyers' clubs.

Personal.

MR. GILBERT ROSENBUSCH, of the Underground Electric Railways Company of London, Ltd., sailed from Liverpool for New York on the *Adriatic*, July 3, to study the latest developments in electric traction work.

MR. P. G. WATMOUGH, JR., consulting electrical engineer, New York, advises us that he has lately been occupied in straightening out various matters in the Elberon plant of the New Jersey Consolidated Water & Light Company.

COMMISSIONER SAGUE, of the Public Utilities Commission of New York, has been made chairman of the committee on instructions for the expert attachés, and Mr. C. D. Barnes, electrical expert of the old Railroad Commission, has been retained.

MR. T. N. VAIL.—At a meeting of the board of directors of the New York Telephone Company last week Mr. Theodore N. Vail was elected president to succeed Charles F. Cutler, deceased. Mr. Vail is president of the American Telephone & Telegraph Company.

MR. HENRY C. HIGGINS, manager of the Sterling, Dixon & Eastern Electric Railway, of Dixon, Ill., and also manager of the Lee County Lighting Company, has resigned both positions. He will be succeeded by Mr. Edward B. Kirk, of Oshkosh, Wis., vice-president and general manager of the Winnebago Traction Company.

MR. CHARLES S. POWELL has resigned as general agent of the Westinghouse Electric & Manufacturing Company, with headquarters in New York City, and with his resignation the position has been abolished. Mr. Powell has made no definite plans for the future, but expects to be in New York for the next two or three months.

MR. GEORGE B. FOSTER has taken the management of the Power Improvement Company, which on July 1 opened an office at 2018 Fisher Building, Chicago, to handle De Laval steam turbines, generating units and centrifugal pumps, and the Wilkinson mechanical stoker. Mr. Foster is well known in Chicago through his many years' connection with the Bullock and Wagner companies.

MR. C. W. HUMPHREY, formerly engineer and manager of the Northern Colorado Power Company, has opened an office for consulting practice in all branches of electrical engineering work in The Rookery, Chicago. Mr. Humphrey was also formerly engineer for the Denver Gas & Electric Company, and has had considerable experience in electric power plant work in Denver and vicinity.

MR. J. E. LYONS, chief engineer of the Cleveland, Painesville & Eastern power plant at Willoughby, Ohio, has been promoted to the position of superintendent of power and cars, to take effect July 1. Mr. Lyons was master mechanic of the East Cleveland Railway Company for five years, and was with the Cleveland City Railway Company for one year in the same capacity. He has been with the C. P. & E. R. R. Company [illegible] years.

MR. A. C. WILLARD, consulting mechanical engineer, advises us of the opening in the National Metropolitan Bank Building, Washington, of a firm of associate engineers, of which he is a member. Mr. Philander Betts is the member for electrical engineering and Mr. S. H. Woodbridge for heating and ventilation in the Southern states exclusively. The chief purpose is the equipment of buildings, but general consultation work in mechanical and electrical engineering will be undertaken.

MR. HIRAM PERCY MAXIM will resign his position as chief engineer of the Electric Vehicle Company on August 1, having held that important position for many years. He does this to take up some new developments which cannot be made public at the present time, but regarding which full details will be announced in the fall. His headquarters will remain at Hartford, Conn., where he will open an office. Since 1895 Mr. Maxim has played a very prominent part in the develop[illegible] types, both gasoline and electric. He has been chairman and member [illegible] technical committees on automobile improvement.

MR. RALPH D. [illegible] *Caronia* for England on his way to South Africa in connection with the [illegible] this country about 100 day[illegible] will meet in South Africa a number of the directors and officials of the Victoria Falls [illegible] Company, [illegible] ible for the

[illegible]
tion of the steam stations and as to the local distribution circuits. He will go from Johannesburg to Victoria Falls, passing on the way through the country in which will be located the transmission line from Victoria [illegible]

MR. C. D. McKELVEY.—Mr Charles D. McKelvey, of Paterson, has been appointed inspector of railroads by Joseph W. Congdon, president of the Board of Railroad Commissioners of New Jersey. Mr. McKelvey [illegible] larly well equipped for his duties. He began as a telegraph operator in a country station. Then he was successively brakeman, conductor, train dispatcher and station agent on the Erie, after which he became general superintendent of the New Jersey Midland, serving as such until 1889, when he went to the New York Central to take charge of the Grand Central Station. About a year later he resigned to build the Edgewater tunnel. Subsequently he had charge of the construction of the Wilkes-Barre & Eastern Railroad. He next served with the New York, Susquehanna & Western Railroad, being its general superintendent for nine years. He served last year on the Finance Commission of Paterson and as president of the Board of Public Works of that city.

Trade Publications.

SPARKING COILS.—The Autocoil Company, 136 Seventh Street, Jersey City, N. J., has issued a sheet containing illustrations of its "08" hard-rubber unit autocoils.

ELECTRICAL INSTRUMENTS.—Queen & Company, Philadelphia, have issued a large sheet hanger in colors illustrating a number of testing sets, which together cover the entire field of electrical testing.

THERMIT STEEL FOR WELDING.—This is the title of a recent publication of the Goldschmidt Thermit Company, of New York, N. Y., issued to give more specific information regarding the use of thermit in making repairs. Prices are also included of thermit and accessories.

PORTABLE ELECTRICITY.—With this title, Harvey Hubbell, Inc., Bridgeport, Conn., has issued a well illustrated catalogue describing the various types of Hubbell attachment plugs and showing some of their applications in household use. One cap fits all the Hubbell attachment bases, which are made for cord suspensions, chandeliers, wall brackets, floors, walls, etc.

STEAM POWER PLANT ECONOMY.—Chas. C. Moore & Co., of San Francisco, have issued for free circulation a pamphlet entitled "A Method of Calculating Steam Power Economy," containing a comparison of economies with steam and electrically driven auxiliaries, initial cost of plant under Pacific Coast conditions, and total cost of power with special reference to the use of oil fuel.

FUSES, BASES, ETC.—The Chase-Shawmut Company has just issued to the trade a very attractive 58-page booklet, pocket size, covering its complete line of fuses, bases and fittings. In addition to its regular line, this catalogue presents a number of specialties which have recently been placed upon the market. Containing over one hundred illustrations and considerable valuable data, this catalogue will be eagerly sought by all interested in this class of material.

WARREN ALTERNATORS.—The Warren Electric Manufacturing Company, Sandusky, Ohio, in Bulletin No. 30, illustrates and describes the Warren revolving-field alternator, which is made for generating single-phase, two-phase, or three-phase currents. Owing to the spacing of the coil slots, a customer who purchases, for example, a single-phase, 85-kw alternator can at any time convert it into a 100-kw, 2 or 3-phase machine, by merely changing the armature coils. Machines of 100-kw, 200-kw, and 300-kw, 60-cycles, are illustrated, one of the latter being shown in the Bay City, Mich., municipal electric light station.

OERLIKON PUBLICATIONS.—Among recent publications of the Maschinenfabrik Oerlikon, Zurich, Switzerland, which are always excellent in matter and execution are the following quarto pamphlets: A 54-page pamphlet describing and illustrating the Caffaro-Brescia generating and transmission plant; one of 34 pages devoted to an elaborate account of an electrolytic method for the production of hydrogen and oxygen from water; and a 26-page pamphlet giving in detail the methods and results of tests of the electrical machinery built for a 50,000-volt Italian transmission line. Recent Oerlikon bulletins describe the steam turbine supplied to the Central Electric Company of London, and a new railway motor. A bulletin gives the results of operation of a Swiss electric railway and another relates to the details of tests for high-voltage apparatus.

[illegible] are described in a booklet recently published by the Green Fuel Economizer Company, of Matteawan, N. Y. A pair of fans supplied to the East St. Louis & Suburban Railway are said to be the largest ever built with overhung wheels, the wheels measuring 19 ft. 6 in. in diameter, by [illegible] drawings and lay-outs of a number of large and interesting installations, including the new Hoboken terminal of the Lackawanna Railroad. A portion of the book is devoted to the Green Fuel Economizer, which is often put in with mechanical draft fans because they both are beneficial under similar conditions and complementary in promoting fuel economy.

LIGHTNING ARRESTERS.—[illegible] ning arresters has been developed during the last year by the General Electric Company, and is described in Bulletin 4511 just issued. These lightning arresters are designed to First, discharge potentials moderately higher than the potential of the circuit protected. Second, restrain the flow of the dynamic current across the gaps and extinguish the arc when normal potential is restored. Third, discharge high potentials covering a wide range of frequency. Fourth, prevent excessive rises of potentials between lines as well as between lines and ground. These, like previous lightning arresters made by this company, are an elaboration of Prof. Elihu Thomson's fundamental patents; and investigations and experiments of the past year have suggested certain improvements which are described in the bulletin. The lightning arrester consists in general of a number of spark gaps, some of which are shunted by resistance rods. In this way, selective paths are formed and these are so designed as to give the arresters a uniform voltage breakdown regardless of the frequency or quantity of discharge. Diagrams of connections are shown, and different styles of disconnecting switches, choke coils, etc., are illustrated.

NATIONAL ELECTRIC LAMP ASSOCIATION BULLETINS.—The National Electric Lamp Association has issued a series of eight bulletins for circulation among architects, building contractors, illuminating engineers, electrical engineers, college professors, students, mechanical engineers and civil engineers, members of electrical associations, members of electrical societies, etc. Two of these give a brief description of the National Electric Lamp Association and its engineering department, where the lamps from all companies composing the Association are sent to be subjected to every conceivable test. Two bulletins treat of the "Gem" metallized filament lamp, and include a general description of the lamps, characteristics of the lamp as to operation, power consumption, quality of light, adaptability, simplicity of operation, etc. Cuts of the lamps with various Holophane reflectors are given, together with the vertical distribution curves of the lamps in units. Tables show the actual cost of operating the various types of lamps for 1000 hours on various costs of power. The tantalum lamp is described in another bulletin. Vertical distribution curves are given and also tables of the comparative cost of operating carbon "Gem" metallized and tantalum filament lamps showing the advisability of substituting tantalum lamps for the less efficient type where the cost of power is high. Two bulletins are devoted to the tungsten filament lamp. These lamps are at present on the market only in the 40 and 60 cp street series form but may be soon manufactured for multiple service. "Data on Illumination" is the title given to Bulletin No. 7, which gives a number of points to be considered in designing illumination, on methods of illumination and measurement of light. Tables are given showing the intensity of light sources in candle-power per square inch, color of common illuminants, effect of colored lights on various colors, required illumination for various classes of service and increase of illuminations for various colored walls. Cuts of several of the lamps are given in connection with their vertical distribution curves, and a table gives the intensity of illumination in foot candles produced at various points in horizontal planes by a light source of one candle-power, and also the angle made by the light ray and a line perpendicular to the horizontal plane. As an aid to those computing lighting circuits a table is given showing the current taken by various lamps, together with wiring tables and proper formulæ for computation. The Engineering Department of the National Lamp Association, 4411 Hough Avenue, Cleveland, Ohio, will place anyone interested on the permanent mailing list for bulletins on incandescent lamps and illumination.

Business Notes.

THE FORD ELECTRIC COMPANY [illegible] where it has improved facilities for transaction of business.

VAN DORN [illegible] which will be devoted to the manufacture of tools, particularly electric [illegible]

EDISON BATTERIES [illegible] ceived a letter from Mr. James Craig, the owner of the winning motor boat, "Ailsa Craig," in the recent race from New York to Bermuda, for the James Gordon Bennett cup, stating that the "Ailsa Craig" was equipped [illegible]

CROCKER-WHEELER (Columbus, Ohio) OFFICE.—In order to handle the mass of business in electric generators and motors in southern Ohio, the Cleveland office of Crocker-Wheeler Company, of Ampere, N. J., has found it advisable to open a sub-office in the Columbus Saving & Trust Company Building, Columbus, Ohio. The sub-office will be in charge of Chas. W. Cross, formerly of the Cleveland office of Crocker-Wheeler Company.

SUBWAY CONTROLLING APPARATUS.—Mr. John C. Terry, sales engineer of the J. L. Schureman Company, Chicago, who is in charge of the New York branch of this company at 92 Chambers Street, New York City, has recently secured the contract for furnishing the controlling apparatus for the new tunnel of the Interborough Rapid Transit Company. The conditions to be met with in this installation are somewhat difficult and the contract was awarded after a most thorough investigation into [illegible]

Weekly Record of Electrical Patents.

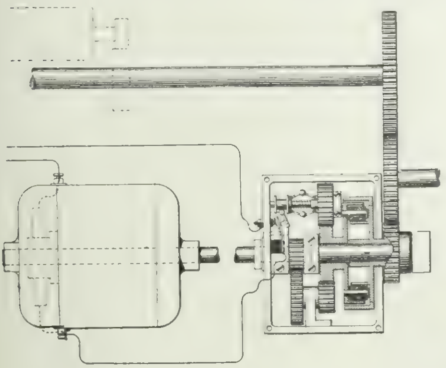
UNITED STATES PATENTS ISSUED JULY 2, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 45 Park Row, N. Y.]

858,353. TELEPHONE EXCHANGE, Clarence A. Anderson, Lindsborg, Kan. App. filed May 18, 1903. The combination with step by step mechanism, a propelling device therefor, and a holding pawl, of a magnet for releasing said mechanism from its holding pawl, and a normally open electrical connection for said magnet arranged to be closed by the forward movement of said mechanism and to be held during two or more steps thereof.

858,385. METHOD OF MAKING INSULATING TUBES; Emil Haefely, Basel, Switzerland. App. filed Sept. 26, 1904. Relates to method of manufacturing insulating tubes, and provides a machine having a roller with protuberances which contact with the tube in succession and compress its material into compact and durable form.

858,391. PRIMARY BATTERY; Charles E. Hite, Burlington, N. J. App. filed Dec. 23, 1905. Provides a battery or cell of compact form adapted to give a greater potential difference between its terminals than is now obtainable, and consists in bringing the elements close together and maintaining the electrolyte in such manner that it will be replaced by further electrolyte as fast as exhausted.



858,687—Ignition System for Explosion Engines.

[illegible] PRIMARY BATTERY; Charles E. Hite, Burlington, N. J. App. filed Dec. 28, 1905. Relates to modifications of the above.

858,399. CONTROLLER; Michael Kelly, Hammond, Ind. App. filed Sept. 22, 1906. Provides an improved form of controller for dental motors adapted to rest upon the floor and be operated by the foot of the operator while the same foot is resting upon the floor.

[illegible] ELECTRIC FURNACE PROCESS; Franz von Kügelgen and George O. Seward, Holcombs Rock, Va. App. filed [illegible] A furnace designed especially for the production of low carbons and carbon free metals, such as chromium, tungsten and molybdenum.

858,425. METHOD OF CONTROL FOR ELECTRIC MOTORS; Norman W. Storer, Pittsburg, Pa. App. filed July 24, 1905. Relates to the series parallel control of electric motors and is designed to limit the fluctuations in the amount of current required to the minimum which will permit the fulfillment of the required service conditions.

[illegible] TELEPHONE SYSTEM; L. B. [illegible], Omaha, Neb. App. filed Dec. 31, [illegible] In a telephone system, the combination with a central station and a subscriber's station, [illegible] circuit, a line circuit, a plug and jack for connecting the circuits, a signal controlling relay bridging the line circuit, a cut-off relay for controlling the said relay circuit, and a resistance and impedance circuit bridging the springs of the jack and inductively related to the cut-off relay.

[illegible]468. CONTROLLING APPARATUS; Walter J. Richards, Milwaukee, Wis. App. filed April 11, 1904. [illegible] regulating the operation of fluid pumps, especially in conjunction with [illegible]

[illegible] FLUID-PRESSURE SYSTEM; Walter J. Richards, Milwaukee, Wis. App. filed Oct. 6, 1904. Relates to electrically driven fluid pumps, and particularly to the use of alternating currents for the [illegible]

[illegible] CONTROLLING APPARATUS FOR PRESSURE SYSTEMS; Walter J. Richards, Milwaukee, Wis. App. filed [illegible] Relates to modifications of the above.

858,474. ATTACHMENT FOR ELECTRIC METERS; William L. Saunders, Denver, Col. App. filed June 27, 1905. Relates to an attachment for electric meters and is designed to frustrate and detect [illegible] to the electric meter.

858,476. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Otto S. [illegible] Pittsburg, Pa. App. filed Aug. [illegible] Relates to systems [illegible] for limiting [illegible] current that may be supplied to [illegible] while accelerating in speed.

[illegible] CONTROLLER FOR STORAGE BATTERIES AND SIMILAR PURPOSES; Frank L. Sessions, Columbus, Ohio. App. filed Oct. 29, [illegible] of devices by which storage batteries are on one hand connected to the charging lines and on the other hand are subsequently connected [illegible]

858,481. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Norman W. Storer, Pittsburg, Pa. App. filed July 24, 1905. Relates to systems of control for electric motors and particularly to such systems as operate to change the motors from series to parallel relation during acceleration.

858,507. PROCESS OF ELECTRIC WELDING; Weston M. Fulton and John S. Brown, Knoxville, Tenn. App. filed June 23, 1904. Relates to the electric welding of thin sheet metal. Consists in effecting an approximately uniform resistance to the electric current between the electrodes by continuously removing the scale from the surface of the electrodes and dressing or polishing said surfaces to evenness so as [illegible] uniformity [illegible] with the metal to be [illegible]

858,554. WIRELESS TRANSMISSION; Harold A. Yarnell, Los Angeles, Cal. App. filed Apr. 23, 1906. Relates to wireless transmission and provides means for eliminating the losses due to the ground connection heretofore employed and thus increase the efficiency of the system.

858,563. GALVANIC BATTERY; Benjamin J. Blameuser, Chicago, Ill. App. filed Jan. 20, 1906. Relates to improvements in galvanic batteries and more particularly to batteries in which depolarizing compounds are provided for combination with the nascent hydrogen evolved during chemical action.

858,569. SPACE TELEGRAPHY; Sewall Cabot, Brookline, Mass. App. filed Nov. 5, 1906. Provides a receiving system in which a plurality of oscillation detectors are associated with an elevated receiving conductor and in which by means of suitable apparatus and connections each one of a plurality of signaling devices may be associated with different oscillation detectors.

858,574. ALTERNATING-CURRENT RECTIFIER; William B. Churcher, Cincinnati, Ohio. App. filed Aug. 4, 1905. Provides mechanism for producing direct current of low voltage from a source of alternating current. Employs an electrolyte cell having lead electrodes in dilute sulphuric acid.

858,591. CIRCUIT-CONTROLLING MEANS; Ellsworth E. Flora, Chicago, Ill. App. filed Oct. 11, 1906. Relates particularly to means for controlling an electric circuit for any desired purpose as for instance the operation of a signal through the medium of said circuit.

858,606. INDICATOR; Earle L. Kelzer, Catella, District of Alaska, and Wesley P. Rodgers, Seattle, Wash. App. filed March 1, 1907. Relates to improvements in indicators for elevators and provides means by which the passengers of a car can make known to the operator or conductor the floors to which they desire to be conveyed without calling out the number as now practiced. Has a single signal lamp in the car and means for controlling it.

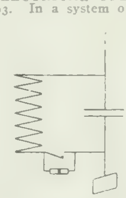
858,611. ELECTRICAL SIGNALLING APPARATUS; William W. Lovett, Los Angeles, Cal. App. filed Nov. 12, 1906. Relates to a complete portable telephone outfit for soldiers in which a cable is unwound from a reel at the back of the soldier as he advances.

858,621. PROCESS OF ELECTRICALLY REDUCING OXIDE ORES; Albert J. Petersson, Alby, Sweden. App. filed Oct. 30, 1906. Relates to a process of electrically reducing oxide ores or other oxides or combinations of oxides while using as a reducing agent carbon or carbonic acid obtained from the carbon of the charge.

858,622. METHOD OF CARRYING OUT METALLURGICAL REDUCTION AND MELTING PROCESSES; Albert J. Petersson, Alby, Sweden. App. filed Oct. 30, 1906. Relates to a method of reducing and smelting ores and the like in an electric furnace.

858,623. PROCESS OF CONTINUOUSLY PRODUCING CARBID FROM LIME AND CARBON; Albert J. Petersson, Alby, Sweden. App. filed Oct. 30, 1906. Relates to modifications of the above.

858,632. SYSTEM OF ELECTRICAL OPERATION; J. C. Slaughter. App. filed May 3, 1903. In a system of electrical operation, means



858,668—Receiver for Electrical Oscillations.

for varying the field strength of an alternating current generator adapted to operate in unison with means for maintaining a predetermined voltage supply.

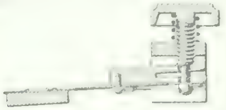
858,637. TELEPHONE ATTACHMENT; Wm. H. Stinson, De Funiak Springs, Fla. App. filed March 13, 1905. A device intended to be applied to a telephone call bell and having balls which are released [illegible]

858,668. RECEIVER FOR ELECTRICAL OSCILLATIONS; Peder O. Pedersen, Copenhagen, Denmark. App. filed June 28, 1906. A re[illegible] tion having inductance and capacity therein, said circuit having a contact device adapted to close the circuit of vibration directly at one position of its throw, and a divided circuit including a wave indicator and adapted to be included in the circuit at the other position of throw of said contact device.

858,676. SYSTEM OF ELECTRICAL OPERATION; Joel C. Slaughter, Dallas, Tex. App. filed March 12, 1903. Provides means whereby a saving will be effected in the power required to operate a generator during reduced loads thereby reducing the fuel consumption below that which would be required to operate the systems in use at present.

858,687. IGNITION SYSTEM FOR EXPLOSION-ENGINES; Richard [illegible] App. filed [illegible] An arrangement for driving a dynamo from an engine for ignition purposes and including [illegible] maintained. There is also provided a safety device which opens the circuit in case the centrifugal slipping device fails to act.

duction coil and which is automatically locked in any position to which it is set. Includes a provided member having a pair of resilient leaves and longitudinally adjustable means having shoulders em-



858,698—Vibrator Adjustment for Induction Coils

Feb. 10, 1906. Relates to features of construction of an outlet or junction box designed to meet the need for a shallow box for use in making connections from both sides of a partition for electric or gas lights.

858,700. OUTLET-BOX; Leon W. Bossert, Utica, N. Y. App. filed Apr. 25, 1906. Relates to modifications of the above.

858,718. ELECTRIC FURNACE; Paul L. T. Heroult, LaPraz, France. App. filed Apr. 18, 1906. Provides certain improvements in electric furnaces whereby the power factor (when an alternating current is used) is increased and whereby the resistance to the passage of the current is lessened.

858,720. SYSTEM OF ELECTRICAL DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. App. filed Feb. 21, 1903. Relates to improvements in systems of distribution, and particularly to a generating, storing or distributing system involving the use of a storage battery and booster.

858,732. TROLLEY-POLE-CONTROLLING DEVICE; William Lile, Venice, Ill. App. filed June 28, 1906. Provides mechanism which will permit the trolley pole to drop away from the trolley wire when the trolley jumps the wire instead of permitting the pole to swing or fly upward under the tension of the spring which keeps it in contact with the wire under general conditions.

armature formed of a plurality of independently wound comparatively short magnet sections placed side by side longitudinally of the axis of rotation and coupled either in series or in parallel, whereby the ... endered substantially equal throughout the length of the sectional magnet.

INSTRUMENT; F. W. Medhurst, Tasmania, Australia. App. filed March 8, 1907. In a combined portable telephone and telegraph instrument, in combination, a high tension coil, an extra pole piece in said coil, and a reed, and means for altering the note of such reed.

858,767. SYSTEM FOR PARTY-LINES IN TELEPHONE EXCHANGES; J. M. Storkerson, La Crosse, Wis. App. filed Apr. 25, 1906. In a telephone system, a telephone line; a plurality of series of multiple jacks; a relay; a second relay; and signal receiving means; said first relay having contacts adapted to connect said line alternately to one of said series of multiple jacks or to said second relay, and said second relay having contacts adapted to connect said line alternatively to another of said series of multiple jacks or to said signal receiving means, substantially as described.

858,775. NIGHT-SERVICE ATTACHMENT FOR TELEPHONE-LINES; C. E. Ackerman, Vernon Township, Mich. App. filed Sept. 27, 1905. Details of circuits for party lines including doctor's station which may be signaled without disturbing the others.

858,780. ELECTRIC-FURNACE PROCESS OF MAKING LOW-CARBON METALS OR ALLOYS; Frederick M. Becket, Niagara Falls, N. Y. App. filed Jan. 30, 1906. A means for manufacturing low-carbon metals in electric furnaces in which the current is conducted to and from the charge by carbon or graphite electrodes. Provides electrodes of very small sectional area in proportion to the current which they carry, as compared to those generally employed.

858,793. RAILWAY-TRAFFIC-CONTROLLING APPARATUS; Clyde J. Coleman, Rockaway, N. J. App. filed Nov. 7, 1904. Relates to detail features of construction of a signaling system employing liquid or compressed carbonic acid gas to actuate the signals.

858,797. SYSTEM OF ELECTRIC CONTROL; Wolfgang E. Ebert, St. Louis, Mo. App. filed Dec. 1, 1905. Relates to a system of controlling electrical devices whereby a comparatively large number of such devices may be controlled from a distant point by a comparatively small number of mains.

858,846. HOUSE-WIRING CONDUIT SYSTEM; Harry Alexander, New York, N. Y. App. filed Mch. 22, 1906. Designed to provide a system of wiring a building which permits a wide range of flexibility, and which contemplates changes in the location of the circuits and devices, and which provides for an intercommunicating system throughout the various compartments in a building.

858,862. PRIMARY AND SECONDARY BATTERY; Thomas A. Edison, Orange, N. J. App. filed Jan. 10, 1906. An alkaline battery electrolyte containing an alkaline silicate, as set forth.

858,822. TELEPHONE STAND; William B. Oliver, Collingswood, N. J. App. filed Jan. 15, 1907. In a telephone support, the combination with a self-balancing standard, having an overhanging portion, of a spring actuated receiver hook mounted in said standard below said overhanging portion; and a transmitter casing pendulently connected to

... may be secured without

electromagnets for use in lifting or pulling iron pipes and rods. Has ... of alternating polarity.

electrically heated tools and especially a tool which is intended to carry a pen, electric contact or analogous metallic instrument in a convenient way so that the same may be quickly and highly heated and can be easily placed in or removed from the tool.

858,984. TELEPHONE TRANSMITTER; N. H. Holland, et al., Chicago, Ill. App. filed July 28, 1906. A transmitter comprising a diaphragm supported at its edges, a ring-shaped member bearing loosely upon the diaphragm inward of its support and adapted to receive vibrations from the diaphragm, a spring holding said member in position against said diaphragm and serving to stretch the portion of the diaphragm spanned by said member, and a microphone operated by said member.

filed Aug. 24, 1905. Relates to electrical therapeutic apparatus having an electrode which is held in one hand and which may be moved from point to point as may be desirable.

859,018. TRANSPORTATION SYSTEM; Franklin S. Smith, Philadelphia, Pa. App. filed Nov. 21, 1906. Relates to railway or transportation systems in which electrical apparatus is placed along a roadway or track so as to be operative through other apparatus fixed to or carried by a car or vehicle to move the same along the track.

859,019. ELECTRIC TRANSPORTATION SYSTEM; Franklin S. Smith, Philadelphia, Pa. App. filed March 11, 1907. Relates to modifications of the above.

859,029. ELECTRICAL APPARATUS; Joseph C. Vetter, Coney Island, N. Y. App. filed Aug. 24, 1905. Provides an induction apparatus particularly adapted for use with a cell to which it may be readily attached.

Oct. 23, 1906. Consists in providing a rail-bond which shall be securely held in place in a protected position but which may be readily applied and removed when desired.

York, Pa. App. filed April 9, 1907. The process of making phosphorus which consists in reducing a compound in which phosphorus ... substantially the same size, and finally acting on the material by an ...

859,091. BATTERY-CELL; Arthur H. Marks, Akron, Ohio. App. filed Sept. 12, 1906. Relates to battery cells or boxes, and particularly to the covers of the same. Provides a cover the retaining flange of which is so constructed that it will not crack or break while in use. The top plate has a soft rubber flange around its edge extending over the sides of the box.

859,092. SPARK-GAP APPARATUS; Walter W. Massie, Providence, ... transmitter have openings therein for the passage of a cooling medium and perforations leading from the openings for the escape of said cooling medium, in proximity to the gap between the rods.

859,132. SMELTING PROCESS; Frederick T. Snyder, Oak Park, Ill. App. filed June 11, 1906. The process of smelting ores containing zinc which consists in mixing the ore with reducing materials, heating the mixture to reduce and volatilize the zinc, condensing the gaseous zinc on the earthy portions of the ore, then smelting said earthy portions to form a slag, thereby revolatilizing the zinc, and condensing the revolatilized zinc.

App. filed June 18, 1906. Relates to a furnace for carrying out the above-described process.

App. filed June 25, 1906. Relates to an additional process of treating ore.

859,135. METALLURGICAL PROCESS; Frederick T. Snyder, Oak Park, Ill. App. filed June 30, 1906. A still further process of treating zinc sulfid ore.

859,136. ELECTRIC FURNACE; Frederick T. Snyder, Oak Park, Ill. App. filed June 30, 1906. Relates to an electric furnace for carrying out the foregoing processes.

ores, particularly zinc ore.

filed Jan. 20, 1904. Details of construction of three-phase generator.

859,147. AUTOMATIC ALARM DEVICE; Louis Strodtbeck, Middle- ... automatic alarm devices and more particularly to one for use in gas

movement of the elevator when it reaches the upper or lower limits of travel and means for automatically arresting the movement of the elevator on the occurrence of a slack cable due to the car or cage sticking in the shaft.

859,178. PROCESS OF TREATING LIQUORS BY ELECTRICITY; ... through the said liquor without having anything other than the barrel or cask in contact with the liquor.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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During 1906 ELECTRICAL WORLD *printed and circulated* 970,000 *copies, an average of* 18,827 *copies per week. Of this issue* 16,000 *copies are printed.*

NEW YORK, SATURDAY, JULY 20, 1907.

CONTENTS.

ENORMOUS TROLLEY EARNINGS.

At the beginning of the present year we made for 1906 our usual estimate of output and earnings in the various departments of electrical activity, the data appearing in the issue of Jan. 5. At that time we gave the probable street railway earnings as not less than $360,000,000, a sum that looked very large and was criticized by some as being excessive and inaccurate. It is interesting, therefore, to note the figures given in the "Red Book," a standard annual compilation of data on street railway properties issued by the McGraw Publishing Company in connection with the *Street Railway Journal*. The "Red Book" makes a classification of earnings in five large classes, including 481 systems, and embracing practically every earner of any capacity, although all told there are not far short of 1000 such roads or systems in the country. It appears that 63 systems reported earnings of $275,245,206, and that the whole 481 reported $358,043,073. This is, as will be noted, barely two million short of our estimate or "guess"; and allowing for some duplication offset by the roads not reporting, the figure of $360,000,000 may safely be accepted, as confirmed in an extraordinary manner by these official reports summarized six months later.

We are glad to note the accuracy of our forecast, and gratified also with this splendid evidence of the ability of electricity to create great industries and solve the problems of urban transportation. In 1890, when the street railways were still very largely under a régime of horse and cable, their total income from all sources was $91,721,845. In 1902, when a considerable proportion had been converted to electrical methods, the gross income was $250,504,627, or just about $100,000,000 less than it was four years later. Thus the earnings have been growing at a compound rate of almost exactly 10 per cent yearly. To maintain such a growth would seem difficult, but there is no reason to believe that the year 1907 will show any falling away under the régime of complete electrification.

A LITTLE LESSON FROM ITALY.

We Americans were in bygone years accustomed to lead the vanguard of improvement, and used to show the way to the world in many a line of technical advance. It is therefore something of a shock to the consistent Chauvinist to find the technical progress now in no small measure in the hands of others. Has Yankee ingenuity lost its grip and Yankee hustle its motive power? We think not, but yet the situation is not gratifying to natural pride. It is not easy to analyze its causes, but the fact seems to be that many an improvement is neglected here long after it is put to good use abroad, even though it be actually of American origin. Whatever the explanation, it is a bit annoying to the patriotic engineer to see the Italian Government pushing ahead with the electrification of its State Rail-

ways, while here each trunk line waits for another to move first. We believe that one of the stock arguments against governmental ownership of railways is the difficulty of getting improvements made when competition is abolished! Italy, however, has been singularly wide awake in electrical matters ever since the days of Alessandro Volta, and it is perhaps fitting that Italy should show us the way in this.

It is not a large program from the standpoint of our merger kings, this electrification of about 200 miles of line in a dozen sections, but it shows a willingness to go ahead and a faith in the future of electric traction that are most commendable. Italy is not a rich kingdom and $10,000,000 looks larger there than here. It has been appropriated, though, while we here have been thinking the subject over and the work will go ahead. The work is to be mainly on the three-phase system as used in the Simplon tunnel and on the Valtellina line. In cases where a direct current line is already running the extensions are naturally on the same system. By and large, however, three-phase traction seems to be successful on the other side of the water, while here the only recognition it has thus far received is in the plans for the electrification of the Great Northern Cascade tunnel. The Italians in particular are showing enterprise that quite puts us to shame. They have met sufficient success to justify them in going ahead without waiting for an ideal system to become standardized. Considering the mileage of railroads in Italy, about four per cent only of our own, a very good beginning has been made. American progress in electric railroading has been great in independent lines, without having gone much into the electrification of ordinary railroads. We would not in the least belittle what has been done here in electric traction. Its weak point is that it has of late, with a few notable exceptions, fallen into growth along conventional lines, while foreign engineers have pushed ahead with some very valuable and suggestive pioneering which we seem slow to follow. Even in high-voltage direct current working, of which some competent engineers think very highly, the advances have been wholly abroad, and in alternating-current traction we can as yet show comparatively few results. It is time to wake up.

Track Resistance with Alternating Current.

In an interesting paper noted in the Digest, Herr Lichtenstein takes up rather exhaustively the increase in track resistance found with alternating current, a subject just now of growing importance. The subject has been studied to some extent by others, but we know of nothing so exhaustive or carried out under more nearly practical conditions than this. Of course the increase in virtual resistance is due to a combination of causes, the saving factor being the low value of μ found at the current densities used. Herr Lichtenstein pays especial attention to the computation of this from the experimental data and finds values of μ ranging from 8 to 20 under the various circumstances of use. The impedance factors found, for the Zorsen Marienfelde track, by the way, varied from 2.65 at about 18 cycles and about 36 amperes in the rail, to 6.3 at, nearly, 50 cycles and 150 amperes. It is perfectly clear that low current density and periodicity are necessary if this factor is to be kept within any reasonable limits. Even so the results would be bad were it not for the very bad (for general purposes) magnetic properties of modern rail steel. If the rails were at all comparable magnetically to ordinary steels the permeability would be several times that observed and the inductive effects correspondingly worse. Evidently in using alternating current for railway purposes it is going to be advisable to keep the voltage as high as may be to decrease the current density in the track, as well as for the usual reasons. One must be prepared, clearly, for impedance factors at three or thereabouts even under fairly favorable conditions. As to periodicity from this point of view, the lower the better. We hope that when the New York, New Haven & Hartford electric system goes into service the same interesting question may be worked out on its tracks with the perhaps even less magnetizable American steels.

Balancers versus Three-Wire Dynamos.

The paper by Mr. Budd Frankenfeld on this topic discussed at the Washington convention of the National Electric Light Association, and printed elsewhere in abstract, presents a good contrast and comparison between the balancer and the three-wire dynamo. It also gives a good condensed history of the development of three-wire dynamos, which are very rare in large central stations, although they are common enough in isolated plants. The argument is made that balancer sets should be rated on the basis of neutral current supplied, and of half the main outside voltage. This is tantamount to rating a balancer as a motor-generator, and according to the output of the generator element. Thus, a balancer which worked across 220-volt outside mains and delivered 500 amperes at rated load would be a 110 x 500 or 55,000 watt machine. The summing up is powerfully in favor of the balancer for central station three-wire distribution. The advantages of the balancer over the double-unit generator system are indeed remarkable, and it is strange that the balancer has not come more generally into use in this country. In Europe, the balancer is more generally used in three-wire central-station distribution than it is with us. The only marked advantage of the double-unit generator over the single unit and balancer system is in the voltage to which the arrangement can be advantageously carried; but since the United States central station Edison voltage is nearly always limited to 250 volts between outers, this consideration is of no consequence.

The Purity of Vibration Frequencies in the Lines of the Visible Spectrum.

In the last number of the *Bulletin of the Bureau of Standards*, a paper appears on the purity and intensity of monochromatic light sources. Among other subjects considered are questions as to the sharpness of the spectrum lines—or what corresponds to the same idea—the purity of the frequencies of vibration which such lines represent. In a well adjusted spectrometer, the lines in the visible spectrum appear marvellously sharp and thin, representing what appears to be a high degree of purity and precision in the corresponding atomic vibration. A single rate of vibration would be represented by an indefinitely thin line in the spectrum of a perfectly adjusted spectroscope. The lines possess, however, a small but appreciable breadth. The

optical apparatus. The remainder is, however, a real want of purity in the vibrations examined. It may mean that different electrons are oscillating slightly out of synchronism in different atomic systems under examination. Possibly the mutual jostling of colliding atoms tends to accelerate some electrons temporarily, while at the same time retarding others. Consequently the rates of oscillation deviate slightly on both sides of the normal or mean frequency. In estimating the purity of a spectrum line, the article proposes to use in the case of a pure doublet the ratio of the distance between the two components to the length of the wave. It is shown that the degree of purity of the spectrum lines varies between about one part in a thousand for the broadest lines, to about one part in four million for the narrowest lines. The subatomic alternators in the latter case maintain synchronism within such a degree of precision. It is pointed out, moreover, that some of the fainter satellite lines in the immediate vicinity of main lines have a yet higher sharpness and degree of purity.

THE POWER FACTOR OF RUBBER-COVERED WIRES.

There is hardly any subject on which electrical engineers dispute so readily, and differ so radically, as rubber-covered cables. Experiences have been very varied with rubber cables, and the subject is very complex, both from the chemical and the physical point of view. Some declare that all that is needed to make a high-tension rubber-insulated cable successful is to have 30 per cent pure Para gum in the insulator and allow the manufacturer to satisfy his own bent on the remaining 70 per cent. Others declare that provided only there is 30 per cent of rubber in the insulation, it does not matter whether it is 20 per cent or 10 per cent pure gum; second-hand redigested rubber will do as well. Each advocate cites actual experience in support of his views. A paper read by Mr. Henry W. Fisher recently, before the American Institute of Electrical Engineers, described a number of tests on different samples of rubber-covered No. 10 wire. The break-down voltages of 17 samples of different manufacture varied between 12.8 kilovolts and 23.1 kilovolts with an average of 18.5, the latter representing a maximum electric stress near the wire of 21.3 alternating kilovolts per millimeter. Comparing the observed breakdown stresses with the chemical analysis of the different samples, there seems to be very little interconnection, except that the samples containing most rubber usually had higher electric strength. The percentage of rubber by analysis is indicated as having varied between 15 per cent and 28 per cent. Taken as a whole, the conclusions that the paper leads to, seem to be that nothing can be predicted about the electrical behavior of rubber-covered wires on the market from chemical analysis, within the range of samples in commercial use. High-grade samples and low-grade samples often seem to test much alike.

The method employed in testing the power-factor was of comparatively recent development, and deserves to be more generally known. It depends upon the use of a "vibration-galvanometer." This consists essentially of a fine wire set in a magnetic field and carrying the testing current. The period of oscillation of the wire is adjusted mechanically, so as to be in resonance with the fundamental frequency of the testing alternating current. The galvanometer is then placed in a Wheatstone bridge arrangement for measuring the capacity of the cable under test. Until recently, it had been customary to attempt a Wheatstone bridge balance in a capacity test of this kind, with a telephone in place of a galvanometer. Owing to the various harmonics present, the telephone never could be brought to silence, and a minimum of sound was almost impossible of determination. With the vibration-galvanometer, however, adjusted to vibrate powerfully at the single fundamental frequency, and only very feebly at other frequencies, this difficulty is overcome, and the paper describes the sensitiveness of the arrangement as such that capacities of suitable magnitude can be measured to one part in 5000. The frequency of the alternator must, however, be carefully controlled, and in the cases reported was governed by an electrically vibrated tuning fork, the most uniform source of controlled frequency known.

The observed power-factors of the various samples reported varied between 2 per cent and 9 per cent. This represents a very marked difference between the different samples. The power-factor of a cable is the ratio of the watts, expended mainly in the dielectric, to the volt-amperes of the charging current. The power-factor is usually regarded as fairly constant at different voltages. It is a very important quantity, from an engineering standpoint, because it represents waste of power, like that in the iron cores of transformers, going on day and night, if the alternating-current cables are kept charged. In the case of the tests reported, the power wasted was only from 1 to 10 watts per 50 miles of wire, at 53.5 cycles per second. If, however, the testing voltage had been 7500 volts, instead of 75 volts, or 100 times higher, the power wasted would probably have increased as the square, or would have been 10 to 100 kilowatts per 50 miles of wire, with an average of, perhaps, one kilowatt per mile. In the case of direct-current systems of distribution, practically all the power wasted in transmission is by I^2R in heating the wire. The same is substantially true for low-tension alternating-current distributing cable systems, or for high-tension alternating-current distributing overhead bare-ware systems; but with alternating-current cables, operating at from six to ten kilovolts, or more, the waste of power is partly in the conductor and partly in the insulator. The tests reported in the paper seem to indicate that the larger the proportion of rubber in the insulator, the lower the power-factor, and, therefore, the lower the waste of power. This rule, however, does not apply to all of the results. In particular cases, a lesser rubber content was accompanied by a lesser power factor. The importance of the power-factor of a cable is not only in the loss of power in the dielectric. It is also important because the greater the power wasted in the dielectric, the higher its temperature, and the greater the depreciation of insulation and dielectric strength. That is, a large power-factor not only costs power and eats into the coal pile when a large system of high-tension underground cables has to be fed; but it also heats the cables unduly, and tends thereby to lower their dielectric strength. The tests indicate that the whole subject is most complex, but that from a practical standpoint the power-factor of a cable is nearly as important to the purchaser as the dielectric strength. These two quantities do not appear to be very closely connected, except that in a general way the samples that were weakest in rubber were weakest in strength and largest in power-factor, with puzzling exceptions to both these rules.

Boston Street Lighting Report.

Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, Mr. Samuel H. Hudson, of Boston, and Mr. Herbert A. Wagner, consulting engineer, of New York, have submitted to the city of Boston and the Edison Electric Illuminating Company of that city a report upon the cost of street lighting in Boston in their capacity as an arbitration board between the city and the Boston Edison Company. The work of these experts as arbitrators was to determine:

1. The proportion of the actual output of electricity generated at the Edison Company's stations for the public lamps provided for in the street lighting contract as compared with the company's entire output in kw-hours.

2. The total investment of the company in land, buildings, plant, poles, lines, conduits, cables, meters, machinery, apparatus and other equipment used in the manufacture and distribution of electricity.

3. The investment of the company on account of its public business obtained by taking the proportion of the total investment that the output on behalf of the public lamps bears to the total output, unless the arbitrators unanimously select a better method.

4. The total operating expenses of the company, meaning the annual outlay for fuel, water, supplies, wages, salaries, insurance, accidents, rents, taxes and all other expenses except depreciation in excess of ordinary repairs.

5. The operating expenses of the company on behalf of public lamps, computed by taking the proportion of the total operating expenses of the company that the electrical output for street lamps bears to the total output.

6. The undivided or surplus earnings of the company, being its gross annual income derived from the sale of electricity less operating expenses, dividends and interest; and the percentage which the company's annual surplus bears to the total investment, exclusive of land.

7. An allowance for depreciation in excess of ordinary repairs of the company's investment in plant and property used in its public business, computed by taking the same percentage of the value of the company's investment on account of its public business as in (3), but excluding the land, as the total amount of the undivided earnings of the company (6) is of the company's total investment (2) exclusive of land; such allowance not to exceed 7 per cent of the company's investment on account of public business exclusive of land.

8. An allowance for interest or profits computed at 6 per cent per annum on the company's investment on account of its public business (3); but in case the cost of any part of the company's investment shall have been met by the issue of bonds bearing interest at less than 6 per cent, and any of such bonds are still outstanding, the amount thereof shall be apportioned between the company's total investment and its investment on account of public business in proportion of the electrical output as in (1); and the allowance provided for in this clause shall be computed on so much of the company's investment on account of public business as is represented by such bonds at the rate actually paid upon them, and on the remainder of its investment at 6 per cent per annum.

The contract finally provides that in case the cost of manufacturing and distributing the energy for public lighting and the allowances for depreciation and profit (5), (7) and (8) amount in the aggregate to a sum less than the price then being paid by the city, the price of lighting shall be reduced for the remainder of the term of the contract, or until again reduced by arbitration to a sum equal to the cost of manufacture and distribution, plus the foregoing allowances for depreciation and profit.

The arbitrators compared the operations of the company for the fiscal years ending June 30, 1904, 1905 and 1906. The returns for 1906 were found to give the lowest cost to the city and as this year immediately precedes that upon which the arbitration takes effect, it was agreed upon as a fair basis for award. The methods of procedure prescribed and applied to the 1906 returns gave a cost to the city which exceeded the amount paid by the city to the company during the same period by $45,700. The arbitrators unanimously agreed that the maximum demand method used by the company in its commercial rates would be more fair and equitable under present conditions to determine the proportional investment on account of public business than the kw-hour pro-rating method. Therefore a new determination of the investment on account of public lighting was made by applying to the total investment of the company the ratio which the maximum demand upon all the stations of the company by the public lighting bore to the total demand upon the company at the peak load in December, 1905. This reduced the figures obtained by the straight kw-hour method by $63,000, making a saving to the city of $17,300 per year compared with what it paid in 1906, or a total saving to the city in 2.5 years, of $43,250. About 1,850,000 kw-hours was used to operate apparatus directly in the company's main generating station upon which the generation of energy for both public and commercial lighting is dependent, and it was considered that this portion of the energy generated was not properly nor actually a part of the output. The arbitrators found it difficult to determine the exact or fair amount of this energy to be deducted, and unanimously agreed not to make the deduction, which decision results in an advantage to the city of $5,000, which is included in the $17,300 reduction previously referred to.

The price to be paid by the city for the last 2.5 years of the contract is therefore to be reduced in the proportion that $17,300 bears to the $377,075 paid by the city for the fiscal year ending June 30,1906, or at the rate of 4.6 per cent on all bills rendered at the contract rates for service after Aug. 20, 1906 to the end of the contract. The company is to refund to the city 4.6 per cent of all amounts so far paid to it by the city for public lighting service rendered from Aug. 20, 1906 to July 1, 1907, with interest at the rate of 6 per cent per annum on such refunds.

The arbitrators visited the company's power plants and found the great proportion of its equipment representative of the highest economy in steam and electrical engineering.

Convention of the National Electrical Contractors' Association.

The National Electrical Contractors' Association began its seventh annual convention at the Engineering Societies Building, New York City, on July 17, and the meeting was in progress at the time of our going to press.

The programme as arranged is as follows: The first session, which was open to everyone interested in the electrical business, was called to order at 10 a. m., July 17, by Mr. J. C. Hatzel, chairman of the National committee, who introduced Mr. James Hilton, president of the Electrical Contractors' Association of New York State. Mr. Hilton welcomed the members and guests on behalf of the State Association, and turned the convention over to Mr. James R. Strong, president of the National Association. Mrs. J. B. Olson, on behalf of the ladies' auxiliary of the Association presented Mr Strong with a handsome bouquet of roses. The work for the rest of the morning is as follows: Professor George F. Sever, consulting engineer of the City of New York, will address the convention on the relations between the municipality and the electrical contractor. Mr. Arthur Williams, past president of the National Electric Light Association, will speak on the relations of the lighting company and the contractor, and will be followed by Mr. J. Robt. Crouse, who will explain the work of the Cooperative Electrical Development Association during the past year. This will terminate the morning session, and in the afternoon there will be a business meeting.

At 10 a. m. on July 18, there will be another open meeting, and addresses will be made as follows: Mr. Hugh T. Wreaks,

secretary of the Wire Inspection Bureau, will discuss the "Standardization of Wire." Mr. T. C. Martin, of the Electrical World, on the relations between the press and the electrical contractor. Mr. C. M. Goddard, secretary of the Underwriters' National Electrical Association, will speak on the relations between the underwriter and the contractor. Mr. C. L. Eidlitz, first president of the National Association, will speak on the subject of that body. Mr. Oscar T. Crosby will describe the Cahill telharmonium, and the convention in a body will visit the plant at the close of the morning session. The remaining sessions will be occupied with executive business. On Wednesday, July 17, there will be a river trip for the ladies in the afternoon, and in the evening there will be a dinner at the Waldorf, followed by an amateur vaudeville by members. On Thursday, there will be an automobile ride for ladies in the afternoon to Coney Island, and in the evening, for members, a smoker at Shanley's, after the business session. On Friday there will be a trip up Long Island Sound by boat, with clam bake and baseball game, East against West, by members.

In the Early Days.

A "Retired Manager" becomes reminiscent as follows in *Stone & Webster Public Service Journal,* the occasion being a visit to his former headquarters, where he reports that a resolution aimed at the company had been introduced in the council the evening before:

"The Billville Electric Company don't seem buried under popularity of late, Jim. And you think the company is giving better service than ever?—Well, as to the latter, I agree with you. Yes, sir; I agree with you. Why, in my day it was an even bet that the lights went out three times between soup and nuts. In those days we ran the Opera House lights off the railway circuit, and every car that came up Sixth street grade produced Stygian blackness in the Opera House. We had a flagman to hold the cars at critical points in the play, but even at that, Eliza often crossed the Ohio without a glimpse of the ice. Well, I suppose I can't better describe the kind of lighting service we used to furnish than by saying that the gas people actually pitied us. While our lights were some bad, our railway work was certainly the limit. The principal duty of the superintendent was to see that every man returned his car before he went home, and to take care of the money that was crowded on him. Nobody rode in the cars except careless people who set no value on their time. I remember that we once tried an innovation and washed the windows of a car. Old Dr. Griswold was misled by the result and ruined his new silk hat by forcing it through the window under the impression that it was open. We had to buy him a new hat, and that stopped any further improvements.

"Yes, Jim; you do give better service; in fact, you are doing an entirely different business. Your business has now developed until it is a science, that is, the administrative department has, but I can't see that there has been much of a change in the 'diplomatic' department so to speak. This end of the business has stopped right where it was years ago in your case, and you have got more company than a flea on a dog. Did you ever think of the natural advantages we had in those days when we desired to swat a patron who thought he knew how to run our business? To begin, John Swazy and I owned most of the stock; I was president and manager and John was treasurer. John knew more folks in this country than any other living man, excepting, possibly, myself, and he knew 'em well enough to eat in the kitchen with the family, and have everybody call him by his Christian name. As to our men, 'employees' you call them, why they were our neighbors. That's the kind of a line-up we had in those days. There were no rules, and they wouldn't have been obeyed had there been any—and a passenger who got 'flossy' with a conductor settled it with the conductor. A man who complained about his lights was told that he knew what he could do about it by a man who rented him his house, or to whom he owed poker money. As to the city officials, they most all owed John money, and those who didn't thought an electric franchise was a joke on the fellow that got it. Then again, society in this town had not reached that stage where it began to think in large chunks. So far as its relations with our company were concerned, its reflections were individual or personal. If one of our men 'sassed' anybody the franchise of the company was not hit in the solar plexus; simply the schedule was interfered with during the adjournment behind some neighboring barn to arbitrate the matter."

Fifteen-Cycle, Single-Phase, Demonstration Locomotive for the Pennsylvania Railroad.

On page 91 of our issue for July 13 appeared abstract of a paper by Mr. N. W. Storer containing a brief description of an 11,000-volt, 15-cycle, single-phase locomotive built by the Westinghouse Electric & Manufacturing Company for the Pennsylvania Railroad. We are now able to report the results of tests of this locomotive and to explain more fully the service for which it was designed.

The locomotive has been developed by the Westinghouse interests in conjunction with the Pennsylvania Railroad, under Mr. George Gibbs, chief engineer of electric traction, according to the programme laid out by the late President Cassatt, and is the third locomotive built under that arrangement. The first locomotive, which was designated as No. 10,001, was of the geared, direct-current type. The second, known as 10,002, was of the gearless, direct-current type. Both of these locomotives were placed in service on the Atlantic Avenue improvement of the Long Island Railroad; each is driven by four 350-hp motors and weighs about 100 tons. The mechanical parts of these two locomotives were constructed at the Altoona shops of the Pennsylvania Railroad, but the electrical equipment was supplied by the Westinghouse Company.

SINGLE PHASE, 10,000 VOLT, 15 CYCLE, LOCOMOTIVE

Locomotive No. 10,003, which is illustrated herewith, has been produced as a result of a systematic investigation involving elaborate tests that have been prosecuted for several years. On account of the limited time available, and the necessity for the elimination of all possible delays, both the mechanical and the electrical parts were supplied by the Westinghouse interests. Its design is such as to render it especially suited for the severe service in connection with the New York terminal operation of the Pennsylvania Railroad. The duty required will be appreciated when it is known that grades of 2 per cent are encountered, and yet high speeds must be attained. On the test tracks at Pittsburg, which are about five miles long, and in reality a succession of curves, locomotive No. 10,003 recently reached a speed of 73 m. p. h., and it is claimed that a speed of 90 m. p. h. can easily be reached on a straight track.

The complete locomotive is to consist of two separate halves, only one of which has yet been constructed; the half locomotive

[illegible] lbs., indicating a tractive effort for the whole locomotive of 48,000 lbs. The former locomotives were built for third-rail, direct-current operation, while the latter locomotive will use single-phase current from an overhead trolley wire. Before the construction for the electrification of the Pennsylvania terminal in New York is undertaken, it is the purpose of the Pennsylvania Railroad thoroughly to test out the merits of these two systems. The decision will probably not be reached before Jan. 1, 1908.

The most striking features of locomotive No. 10,003 are its entire simplicity and the accessibility of the parts that may require attention. All of the main control equipment is placed on a raised platform in the middle of the cab on each side of which there is a wide passageway. The voltage regulating switches are arranged immediately above the main 11,000-volt auto-transformer, while the blower equipment and reverse switches are placed immediately over the propelling motors. Ample space is left on all sides of the main motors for inspection and repair.

The motors are of the gearless type, the method of mounting being identical with that used on the New Haven locomotives, as described in our issue for April 14, 1906.

It is interesting in this connection to note that the Westinghouse Company has already built, or has under construction, 60 single-phase locomotives and more than 2000 single-phase compensated series railway motors, and that at the present time at least 1000 miles of track have been arranged for single-phase operation.

80,000-Station German Telephone Exchange.

[illegible] signed for service to 80,000 subscribers. The operating room for local connections is 433 ft. long, 65.6 ft. wide and 32.8 ft. high, with double skylights. Below is the apparatus room with the distributing frames, relays, motors, etc., 433 ft. long, 65.6 ft. wide and 10.5 ft. high. The cable shaft from the street, which terminates in this room, is 46 ft. wide and 8.2 ft. high. In an adjacent room of the same floor the battery is located and below it is the operating room for trunk connections, 131.2 ft. long, 65.6 ft. wide and 26.2 ft. high. The exchange has an ultimate capacity for 80,000 subscribers, but at present will be fitted up for 40,000 subscribers.

The system used is the so-called "Verteiter" (distributing) system, by means of which through subdivision into a "distributing" and "connection" exchange not only quicker connections are possible, but there is a considerable saving in operators, cables, jacks, etc.

The exchange consists of three groups. In the "distributing exchange" the incoming cells are distributed to the operators of the "calling exchange" who forward the desired connection to the non-occupied operators of the "connection exchange," where the multiple jacks are divided in groups of 10,000. For the 40,000 lines there are 1,000,000 jacks, 66,000 lamps, 98,000 relays, 12,500 plugs, 22,000 keys and 279.5 miles inside cables.

The advantages of this "distributing system" are even distribution of all incoming calls to the operators, avoiding a crowding of calls to operators already busy, and by means of this a more rapid connection between two subscribers. The trunk exchange has 500 trunk lines. At present there will be installed 70 switchboard sections, each with two operators, 24 distributing tables and four information desks. When a subscriber asks for information the operator writes a note on a slip of paper which is sent by a pneumatic tube to an information desk. Any desired information is given by the information desks. For night connections special trunk boards are provided.

[illegible] 15 cells, one as a reserve, and the necessary charging machinery. All protective devices for relays, lamp circuits, etc., are placed in one room.

Expert Investigations in Municipal Ownership.—I.

A general review has been issued of the examinations made in the United States of municipal and private plants by the Municipal Ownership Commission of the National Civic Federation. This review is by a committee of four appointed by the commission. Two of the writers, Messrs. Walton Clark, vice-president of the United Gas Improvement Company, of Philadelphia, and Charles L. Edgar, president of the Edison Electric & Illuminating Company of Boston, criticize severely the municipal plants examined, while two other writers, Prof. Frank Parsons, of Boston, president of the National Public Ownership League, and Edward W. Bemis, superintendent of the Cleveland (Ohio) water works, find much to favor in municipal plants which were investigated. Several reviews of British municipalization will be made public later. Messrs. Clark and Edgar concur in the statement that the inquiry of the committee, both from the standpoint of British and American experience, more especially the latter, has shown that "where municipal ownership has been removed from the realm of philosophic discussion and put to the test of actual experience it has failed ingloriously." The belief is expressed by these gentlemen that the "few enthusiasts" who still advocate municipal ownership "will soon be convinced by the logic of events, and turning their energies to other things will through them realize their ambitions of usefulness to their fellows." Prof. Parsons and Mr. Bemis, on the other hand, take a most hopeful view as to municipalization, declaring that the failures of municipal ownership are insignificant compared to the failures of private ownership, either in number or importance. "It is not public ownership, but private ownership," Prof. Parsons says, "that is responsible for our periodic crises and the ruin of our industries." As to the fitness of American cities to manage business affairs, many of them, he says, have clearly proved their fitness, and the rest can be made fit. "It is not impossible," he adds, "that the elimination of the public service corporations through public ownership is one of the things that would do more to help along the process of making our cities fit." Mr. Bemis believes that the greatest reason for the strength of the municipal ownership movement lies in the relations of the public service corporations with the state and local governments, which relations he declares are destructive of political purity, democracy and free institutions. In this same connection Mr. Edgar and Mr. Clark take the view that the evil of building up political machines with city employees as a basis exists now to a degree in American municipalities and that the disastrous effects would be much greater if the many gas, electrical and street railway employees were added to the present number of city officeholders.

The reports reviewed by Messrs. Clark and Edgar, on the one side, and Messrs. Parsons and Bemis, on the other, aggregate almost one million words and were made to the Public Ownership Commission of the National Civic Federation by technical experts, engineers, accountants and statisticians who visited a large number of public and private enterprises in the United States and Great Britain.

Mr. Edgar and Mr. Clark agree in setting forth numerous objections to municipalization, a very important one being that in several British cities which have tried public ownership, it has been found that the organization of municipal workmen constitutes a serious threat against the municipality itself and as a result the disfranchisement of city employees is being seriously considered in England. Were municipal employees in [illegible] utilities, the writers declare the remaining voters would find [illegible] galling to the individual oppressed and no less detrimental to [illegible] remedy proposed in England, disfranchisement, is declared to be "unthinkable" in the United States. Under public owner- [illegible]

government are submitted to continuous temptations; first through the opportunity to build up a political machine, with the city employee as a basis, and second, through the opportunity to unduly favor contractors, with the expectation of either financial or political benefit to themselves.

"There is little about municipal trading to attract men of the first class." Mr. Edgar and Mr. Clark unite in saying: "We have not found evidence in the United States that the personnel of the city government of Chicago (referring to Mayor Dunne's administration) or Wheeling is superior to that of Atlanta or Norfolk, or that the introduction of municipal water and electric plants in Detroit has brought a higher type of citizenship into the governing body than we find in New Haven, which has neither."

Three American gas plants were examined by the Investigating Committee and experts. These were at Wheeling, where the plant is operated by the city, and Atlanta and Norfolk, where there is private ownership and operation. In addition the committee visited the Philadelphia gas works and the labor investigators visited the Richmond, Va., gas works. As to the price charged the consumers, it was found to be 75 cents per thousand cu. ft. net at Wheeling, $1 net at Atlanta and $1 net at Norfolk, the municipal plant thus selling at the lowest price. To offset this, however, Messrs. Edgar and Clark point out that in Atlanta there is free installation of service, at Norfolk partially free installation, while at Wheeling charge is made for the service pipe from the curb to the meter and for the setting of the meter.

In comparing the public and private gas service, the reviewers say: "If we consider together the price the Wheeling consumer pays for gas and the character of the service rendered, we may not doubt that he gets less of net results per dollar expended than does the gas consumer in Atlanta or Norfolk. Low and varying pressure, uncertain candle-power, influenced at times by a dash of natural gas (at Wheeling) will bring troubles to studying children, that, while not factors in financial calculations, have a proper place in this inquiry. Wheeling's gas plant is not an important factor in the well-being of Wheeling's citizens. What with fast meters, charges for service and meter setting, absence of any gratuitous work, the admixture of 15-cent, 8-cp natural gas, insufficient and irregular pressure, and general inefficiency in the complaint department, Wheeling gas is a dear commodity at any price. Our experts found nothing to praise in Wheeling's service and little to criticize in the service of the companies at Norfolk and Atlanta. In general, it may be said, so far as condition of plant and operating efficiency is concerned, there could not well be a worse condition of affairs than the engineers report as existing at Wheeling. In the other two cities the record regarding condition of plant, and regarding the various points of practice mentioned above in the case of Wheeling, while it contains a few points of criticism, is on the whole satisfactory. In both cases the plant is pronounced to be modern and kept in an orderly condition."

The labor situation at the plants examined is compared to the advantage of the private plants. "The general impression made at Wheeling," says Messrs. Edgar and Clark, "was that no one about the works took any more interest in his duties than was absolutely necessary to enable him to hold his job, and no one, either at the works or on the street, was at all interested in getting work done in an efficient manner. The power of appointment at Wheeling did not rest with the superintendent, and therefore the employees did not have the fear of discharge by him in case they did not perform their work properly. At Norfolk and Atlanta the certainty of prompt discharge in case they did not satisfy their immediate superiors in the operation of the plant acted to make the men work better and more efficiently than was the case at Wheeling."

Referring to the Philadelphia gas works as an instructive comparison of the results of municipal and private operation, the reviewers quote Dr. L. S. Rowe as authority for the statement that the quality of the gas supplied has been improved by the company now operating the service, and that through the rental paid the city has received for eight years an average profit of $491,674 annually, while for the last few years under city operation there was a loss of $245,398 per year. The private company, however, charges no more than did the city, but supplies better gas. "The commission's records," say Mr. Edgar and Mr. Clark, "indicate a high degree of efficiency in the company operation of the Philadelphia gas works, and kindly and liberal treatment of employees. On these latter points Dr. Rowe speaks as follows: 'As has been shown (under municipal management), there were abuses in almost every branch of the operation. The purchase of coal and the residual products were each under the control of favored individuals; the wages account was padded with incompetents, the friends of men prominent in city politics. It is unquestioned that there were leaks in the management of the gas works at other points than the distributing system; it is true that the labor account was debauched, and it is certain that in the purchase and sales departments there were influences at work which worked harm to the city's interest. But the loss through such sources was inconsiderable when compared with those inflicted by councils by the senseless blocking of the way to improvement in cutting off the appropriations for modernizing the plant. During the entire period of municipal operation the officers in charge were engaged in a losing fight to preserve the works from ruin. There never was a time during the entire period of responsible control when it could truly be said that the works were in an efficient condition.'"

Four of the best known American municipal electric plants, those of Chicago, Detroit, South Norwalk, Conn., and Allegheny, Pa., were examined by the commission and the experts. Of these South Norwalk is the only one that does commercial lighting. As to the cost of operation of these plants, the Chicago plant is cited to show that including items of depreciation, interest, taxes, proportion of salary, insurance and water, there is a loss to the city, based on simple interest on the amount paid, of $6.70 per lamp per year, or a total of $284,202 annually, compared with what the cost would be if service were taken from a private company. Computed with compound interest on the amount paid, the loss is $11.07 per lamp, or $469,217 per year. These figures are based on statements submitted by the commission's expert accountants and do not agree with the estimates of the City Electric Department, which show a saving to the city. As to the character of the plants, that in South Norwalk is criticized for its use of a direct-current, 220-volt two-wire system, a type never generally adopted in this country. This equipment, say Mr. Edgar and Mr. Clark, compels the consumer in South Norwalk to pay 20 per cent more for the light produced than would be necessary under a better system. The Detroit electric undertaking is found to be of a type of about 15 years ago and the capacity can hardly be expanded within the present building unless the type of operating units is changed to those of a more modern class. The Allegheny plant is described as "poorly designed, inefficient and expensive to operate." Appropriations for technical equipment have been neglected to such an extent, say the reviewers, "that the electrician had to build his own switchboard out of such junk as he could collect from machine shop yards." Of Chicago's four municipal electric plants, three are declared to be of obsolete type, while the fourth is not properly constructed for economical operation. The stations are scattered through the city without system and are very poorly located. The plants use 1,400,000,000 gals. of city water (minimum) for which no charge is made. Of the 6700 lamps in use, 4180 are of a type which has been generally discarded throughout the country. On the subject of operating efficiency, it is set forth that economical operation at Allegheny is much hindered by the unnecessary number of employees. Six or eight of the force could be dismissed, reducing the payroll 15 to 18 per cent, and "the half dozen extra laborers often put on for political purposes at election time could be dispensed with, changes which would add to the efficiency of the service as well as lowering its cost." In Chicago, the civil service rules are declared to be a source of inefficiency. Men who have become inefficient are

held in responsible [illegible] and the best men are often prevented from being advanced in rank or chosen from the outside because of lack of special knowledge required by the civil service examiners.

Under the heading "Financial," an exhaustive review of the economic operations of municipal and private undertakings both in Great Britain and the United States is given by the reviewers, who find that it is admitted by the advocates of municipalization that the debts of British cities have been enormously increased by its operations. "We venture to believe," they say, "that the loss to the communities whose municipal industries we have investigated from bad management and lack of enterprise, resulting in restricted service of modern utilities, is many times the profit these cities claim to have realized from their Rip Van Winkle methods of serving the public. It is not worth while to discuss the effect on the finances of American cities of the municipal operations of the industries that we have here investigated. Properly audited they have, with one or two exceptions, lost money, and their plants are all inadequate to good service and have, with the exception of the water plants, little more than a scrap value in view of the present state of the arts. What effect could such poor efforts as we have witnessed have on public wealth or public comfort? It cannot fail to be bad."

Mr. Edgar and Mr. Clark conclude their present review as follows: "Whatever the subjective relation of municipalizers to their reform their objective relations, as we have seen, is far from what it once was regarding the commodities and services to be municipalized. They have been obliged by the logic of events to cut away from much that seemed precious to themselves and to many who trained with them. Their opponents, taking cognizance of the projects abandoned, hoped that now municipalizers might be pinned down to the consideration of ascertained facts relating to undertakings which their representatives have had an opportunity to visit and to developments obvious to all who are interested in the progress of the debate on the question. The voluntary movement of the municipalizers to this not easily shiftable point would, we submit, in itself have been a contribution to the cause of truth and a source of gratification to their adversaries. But the radical British municipalizer has exhibited the resources of hope and fancy, if not of logic and consistency. While his American comrade is still shouting for municipal ownership, he is today, in his latest frame of mind, looking expectantly to 'municipalization by provinces'—that is, for gas, water, tramways and electricity he now wants national government, appropriation, ownership and operation. He has dropped municipalism and comes out for what he all the time had in the background of his thought—socialism.

"Thus the familiar old song of state socialism is paraphrased. The principle was accepted by leading municipalizers of Great Britain, who appeared before our commission in London, and it is the logical outcome of municipalization. When ex-Mayor Dunne, of Chicago, came out last summer for 20-year franchises for the street car corporations of his city he demolished his platform, ignored his campaign principles and returned to the system of private ownership in the one industry whose reform through municipalization was the loudest cry that gave him his office."

Composite Arc Light Electrodes.

Among the patents issued July 9, are six on composite arc light electrodes, all of which are assigned to the General Electric Company.

A patent issued to Johannes Harden relates to a lower electrode composed essentially of a titanium compound, the upper electrode being either of carbon alone or containing small quantities of titanium carbide, ammonium chloride or magnesium sulphate. The lower electrode may contain 90 parts of the titanium carbide to 10 parts of carbon; or it may consist of 75 parts of titanium chloride, 10 parts of carbon, 3 parts of ammonium chloride, 2 parts of magnesia sulphate and 2 parts of tar to act as a liquid binder. It is stated that while light-producing salts, such as lime and magnesia, are used in some forms of electrode to color the arc, such salts are merely evaporated into the arc by the heat produced, whereas the titanium carbide in the electrode described is ionized by the current, the ionized vapor thus formed serving as the principal gaseous medium through which current between the electrodes passes.

Five of the patents above noted were issued to Robert H. Read. One of these contains five claims on an arc light electrode containing magnesium carbide. With this material may be mixed powdered carbon or refractory oxides to form solid electrodes, or it may be employed with or without these ingredients as a core.

A second patent has four claims on an arc light electrode containing a conducting carbide insensitive to moisture, which may consist of carbide of aluminum. It is stated that this substance gives excellent results either when employed pure or when mixed with a carbonized binder, or it may also be used as a core for a cored carbon; and that a good arc from ¼ in. to ⅜ in. in length may be maintained by one ampere with a drop across the arc of 50 volts.

A third patent contains 11 claims relating to an arc light electrode formed of carbide of titanium or containing a predominating amount of titanic material, which latter may have its pores filled with carbon. It is stated that such an electrode gives a light of extraordinary efficiency, the arc obtained being of the luminous type and of a very good white color.

A fourth patent contains 22 claims for the general case of an electrode containing a carbide decomposable from the action of moisture, and the process whereby such electrodes are provided with a superficial coating impervious to water.

The fifth patent contains a single claim on an arc electrode consisting of zirconium carbide mixed with a suitable carbonizable binding material.

CURRENT NEWS AND NOTES.

ROYAL BIRTHDAY HONORS.—Mr. John Gavey, engineer-in-chief until recently of the British Postal Telegraphs, has been promoted as Companion of the Bath, to knighthood in that order. This recognition will give great pleasure to a host of friends of "Sir John" in this country. Dr. J. A. Ewing has also been made a C. B. Before being appointed Director of Naval Education in 1905, he was for many years professor of engineering and applied mechanics in the University of Cambridge, and there carried on his celebrated investigations and researches in magnetism. We note also that Sir James Kitson, Baronet, well known in engineering and steel industries on both sides of the Atlantic, and a staunch friend of electrical development, has been raised to the peerage, while Sir W. Holland, who has had much to do with cables and wireless has been made a baronet.

RAILROAD SIGNALS.—A special cable dispatch from Berlin, Germany, of July 12, says: "The Prussian railway authorities have been making experiments on the line between Berlin and Stettin to find a method for insuring the efficiency of signals and thus preventing accidents. In the effort to secure a preliminary signal to give warning of a stop signal many devices were tested. These included flashlights by the side of the track when nearing a signal and other visible signs. Electric wave transmission to the locomotives also was experimented with. The method finally selected consists of fastening two or three horns with a rubber bulb, similar to those used on automobiles, to the telegraph poles at intervals of about 100 yards. These are electrically operated, and have been found very trustworthy in warning engineers. The railway authorities have decided to introduce these preliminary signals on a number of roads."

ELECTRIC RESISTANCE MATERIAL.—A patent was granted July 9 to A. L. Marsh on a resistance material composed of 88 parts nickel, 8 parts chromium and 4 parts aluminum. It is stated that the addition of the aluminum doubles the resistance and gives an oxide coating which protects the core against further oxidation. The specific resistance of the oxide is about 50 times that of copper.

METERS AND MORALS.—The Citizens' Gas & Electric Company, of Waterloo, Ia., is, according to the *Progressive Age*, in a novel predicament. The temperance people of the town got an order from the courts compelling all saloons to have their cellar doors nailed up tight and it was done. Now the meter readers cannot get at the meters and the saloon keepers refuse to interfere with the doors.

TRACTION IN GERMANY.—U. S. Consul J. I. Brittain, of Kehl, Germany, advises that a new electric railway has just been opened for traffic from the Alsatian town of Munster to the Schlucht, the summit of the mountains dividing Germany and France. This 6.7 miles line was built at a cost of $285,000, and connects the Schlucht with a similar line extending to Gerardmer, France. The electric omnibus is killing the livery business in many of the towns of Alsace-Lorraine and Baden.

A FOE OF THE FAN.—The following is a serious item from the *New York Sun*: "There is one thing I want to warn you about," said the wigmaker to the man who was buying his first wig, "and that is the electric fan. Whenever you see an electric fan in motion, give it a wide berth. If you don't it is apt to embarrass you. Electric fans and wigs are deadly enemies. Nothing outside of an Indian and a tomahawk will lift a wig from a wearer's head quicker than an electric fan in motion."

NOT FOG BUT KNIVES.—The Springfield, Mass., *Republican* says: "The loss of many English fishing boats is now said to be due to the fact that the helmsman often carries a specially forged fisherman's knife. These knives possess strong magnetic properties and will deflect a compass needle two or three points. This means that the helmsman may be apparently steering a true course, but is in reality much out of the way." In the early days, the seaman who did this kind of thing knowingly was fastened to the mast with his own knife through his hand.

STEAM RAILROAD TROLLEYS.—It is stated that control of the Troy & New England Railway, an electric line running from Troy to Averill Park, has passed to the Delaware & Hudson. The line was purchased, it is understood, for the purpose of rounding out the Delaware & Hudson's holdings of electric lines in and around Troy and Albany. It already owned the United Traction Company of Albany, and with the New York Central controlled the Schenectady Rail way. L. F. Loree, president of the Delaware & Hudson, has been elected president of the Troy & New England Railway.

ROYAL TELEGRAMS.—An English magazine states that all royal telegrams pass through the government telegraph office at St. Martin's-le-Grand, and are manipulated by a special operator, who is reserved for this duty. Unlike public messages, no duplicates are kept, and the original messages, in certain instances, are promptly returned to the palace, after a note has been made of the number of words for the purpose of the account. The cipher codes which are used between the Foreign Office and the embassies abroad are not employed for the personal messages of the King, nor is any system of cryptic writing usual between monarch and monarch.

STANDARD TIME.—In a paper on "Standard Time," prepared for the recent Atlantic City convention of the Railway Telegraph Superintendents, Mr. W. J. Camp, electrical engineer of the Canadian Pacific Railway's telegraphs, gave some interesting facts regarding the method of maintaining uniform time along that company's system. Every day at noon standard time is transmitted from headquarters at Montreal and this time is regularly forwarded by cable to Fanning and other islands in the Pacific Ocean and to Bermuda, Jamaica and the Azores in the Atlantic. The master clock is at McGill Observatory. The company maintains a time service department, which keeps a close record of the clocks and all employees are required to carry standard watches. At Montreal there are 81 clocks on five circuits controlled by one master clock. These circuits obtain current from a small storage battery.

POWER PLANT IN NEVADA.—Further details regarding the recent contract made with J. B. Daniels, a mining man, of Wonder and Fallon, Nev., and the United States Government, are to the effect that the Government has agreed to build an electrical power plant on the Truckee River, where the Truckee empties into the Carson, in Churchill County, and furnish power to Daniels for the mines of Fairview and Wonder and also for an electrical railroad from Wonder to Fallon. He states that the Government intends to erect a power plant that will generate 5000 horse-power, and that a portion of this power will be used to operate the gates along the canals of the Truckee-Carson Irrigation Project in Churchill County, built by the Reclamation Service. At the point where the Truckee empties into the Carson, the water falls a distance of more than 60 feet and a large amount of energy can be generated. The plant when completed will be one of the largest in Nevada. There are 15 mines in the Wonder mining district with ore on the dumps waiting to be shipped. As soon as the electrical railroad is built from Wonder to Fallon, Wonder will be one of the most prosperous mining camps in the state.

TURKISH TELEGRAPHS.—U. S. Consul E. L. Harris, of Smyrna, reports on the telegraph service of Turkey, as follows: "The telegraph was established in Turkey during the Crimean war. The first line began working between Constantinople and Adrianople in August, 1855, and was joined to the Austrian line by way of Roustchouk. During the years which followed the telegraph was established over all the Empire, and at present comprises 22,900 miles of wires. The rate was, until 1884, 40 cents per 20 words within the boundaries of one vilayet and from 60 cents to $2.80 per twenty words between two vilayets, according to the distance. In 1884 this system was modified, the rate becoming 2 cents per word, with a surplus of 6 cents in the interior of a vilayet and 20 cents per word between two vilayets. An additional rate of 2 cents was placed on the use of the cables of the Eastern Telegraph Company. This tariff was reduced in 1897 to 2 cents per word within the limits of a vilayet and 4 cents per word between two vilayets. In 1903 the present rate was introduced, which is as follows: Two cents per word within the limits of one vilayet or between two adjacent vilayets and double this amount between two separate vilayets. The Great Eastern Company has cables only north of Smyrna. Its central offices are in the island of Syra. Certain islands, such as Chios, Tenedos, etc., can be reached by telegram only through this company. The equipments, with the exception of those belonging to the Eastern Telegraph Company, are all provided by a well-known German firm. The material of the private lines of the two railway companies radiating from Smyrna have also been imported from the same German firm. As a natural result of the extension of railways right into the heart of the country, large trading centers will soon be established, necessitating the increased use of the telegraph. This is an opportunity which American manufacturers interested in this line of business should not miss."

COLORADO LIGHT, POWER AND RAILWAY ASSOCIATION.—[illegible] tion will be held at the Savoy Hotel, Denver, Col., Sept. 18-20. Mr. J. F. Dostal, 406 Seventeenth Street, Denver, is secretary

BALANCING FIELD EXCITATION.—A patent granted July 9 to Messrs. E. W. Mix and Paul Bunet, of Paris, describes a method of balancing the field excitation of multipolar dynamos with parallel wound drums. This consists, in the case of a four-pole machine, of providing two windings on each pole, one of which is connected with one pair of brushes and the other with the second pair.

JOHANNESBURG MUNICIPAL PLANT FAILURE.—The Johannesburg Municipal Council has shut down its new gas-engine electric plant, which is stated to be an entire failure. It will claim from the contractors $715,000 paid on account and $525,000 named in the bond for the due performance of the contract. The contractors will have to remove all of the machinery installed. A 1000-kw steam plant is being installed to take up at once part of the tramway and lighting load, to carry all of which satisfactorily demands 5000-kw.

TESTING SAFETY DEVICES.—The Interstate Commerce Commission has appointed a board of experts to supervise and conduct experimental tests of block signal systems and other safety devices, as provided for by the joint resolution of Congress. The members of this board are Prof. Mortimer E. Cooley, Capt. Aziel Ames, Jr., Frank G. Ewald and B. B. Adams. In the appointment of this board of experts the commission has the co-operation of the American Railway Association. A sub-committee of that association went to Washington and conferred with the commission with reference to the proposed tests and the composition of the board of experts. The committee has tendered the commission the use of railway tracks and other facilities for conducting the tests and will co-operate to the fullest extent in securing the best results.

THE TELEPHONE IN RAILWAY SERVICE.—At the recent convention in Atlantic City of the Railway Telegraph Superintendents, Mr. S. Lewis Vanakin, Jr., of Syracuse, N. Y., read a paper in which he gave an account of the method employed by the New York Central Lines in operating the telephone lines along their road. In order to obtain maximum service calls are limited during office hours to three minutes, excepting those made personally by the higher officials, whose communications are not subject to the three-minute rule. The latter class of communications take precedence over all other business, and when such service is called for the line between the points concerned is cleared of all intermediate apparatus in order to obtain clear transmission. When the special business is finished the intermediate offices are notified by Morse wire and the telephone line is restored to its normal operative condition. A call between New York and Chicago can be established in about six minutes and the quality of transmission is reliable, by cutting out the intermediate apparatus.

A JAPANESE DINNER.—A dinner was given last week at the Union League Club to Admiral Yamamoto, of the Japanese navy, who has been visiting New York. The hosts at the dinner were Leigh Best, vice-president American Locomotive Company; Walter L. Clark, vice-president Niles-Bement-Pond Company; Charles A. Coffin, president General Electric Company; Charles L. Cornell, treasurer, Pratt & Whitney Company; Charles G. Curtis, president Curtis Turbine Company; W. D. Dimock, New York Shipbuilding Company; John W. Dunn, president International Steam Pump Company; George Westinghouse, president Westinghouse Companies; John P. Ilsley, Niles-Bement-Pond Company; Edward L. Leeds, Niles-Bement-Pond Company; Charles MacVeagh, United States Steel Corporation; Frederick B. Miles, president University Extension Society; F. C. B. and F. D. McKay, first and second vice [illegible] William Cramp & Sons Ship & Engine Building Company, and Charles M. Schwab, president Bethlehem Steel Company. Informal speeches were made by Mr. Westinghouse, Mr. Coffin, Mr. Miles and Mr. Clark, who acted as toastmaster. Admiral Yamamoto made a brief speech, thanking his hosts for their attention.

FACSIMILE TELEGRAPHS.—U. S. Consul Thomas H. Norton, of Chemnitz, reports as follows concerning the development of telephotography: "Much attention is now paid in Germany to the remarkable measure of success which has attended the installation of Prof. Korn's invention for the transmission by wire of photographic reproductions over long distances. His latest experiments show that nearly as satisfactory results are secured by making use of ordinary telephone wires as on lines specially constructed for the purpose. The only difficulty encountered on telephone wires results from calls on adjoining wires. These cause the formation of zigzag lines on the reproduced picture at the receiving station, which are easily corrected by retouching. Alterations in current intensity by ringing on or ringing off, as well as during conversations over adjoining wires, are without effect. It is further shown that the wire employed for photographic reproduction can simultaneously be utilized for telephonic conversation. The advantages thereby accruing, to journalists more particularly, are self-evident. In these days when so many newspapers have private wires or lease a wire to a distant city for a certain time during the night a correspondent can telephone his dispatches and at the same time transmit the desired illustrative material. The first journal to utilize the new invention is the Copenhagen daily *Politiken*, which has ordered a complete installation for telephonic and telephotographic communication with its Berlin office."

TELEGRAPH COMPETITION.—Mr. Clarence H. Mackay, president of the Postal Telegraph Cable Company, commenting on the proceedings instituted by Attorney-General Jackson, of New York State, against the Postal Telegraph Cable Company and the Western Union Telegraph Company, alleging that the companies had ceased to compete, said in a recent interview: "If two companies ever competed in the United States these two telegraph companies are competing and always have been. At times the competition is even fierce and bitter. Every merchant and manufacturer in the United States, wherever we reach, will bear witness to the truth of this statement. We are litigating with the Western Union all over the country in regard to railroad rights of way. In fact, the tremendous fight between the Pennsylvania Railroad and the Western Union was due solely to the fact that we got that business away from the Western Union. That company is trying to exclude us from all union depots and has just succeeded in excluding us from the Birmingham Union Depot, which is perhaps the finest union depot in this country at present, and we intend to take the matter into the courts to set aside the monopolistic contract between the Birmingham Union Depot and the Western Union. Look at the Cuba cable which we are now laying and which will be in operation by Sept. 30, and which will take a large amount of business away from the Western Union. Look at the Pacific cable, which took business away from the Western Union. Then there are our five cables in the Atlantic and our land line system, which runs into every state in the Union, and is continually taking business away from the Western Union. We are about to construct a new route to the Pacific Coast, passing through the great mining fields, such as Tonopah, Goldfield, etc., all of which will take business away from the Western Union. We are the only company that ever did really compete with the Western Union and succeeded in doing so. Other companies have competed merely to be bought out, and none of them ever paid a dividend in opposition to the Western Union. We are extending our system all the time, and all the time are taking business away from the Western Union. All this talk about the two companies working in harmony is nonsense."

Cleveland Arcade Electrical Plant.

THE Cleveland Arcade Company, Cleveland, Ohio, recently completed a new power plant which contains several features unique in the design of plants for office building purposes. The greatest difficulty to be overcome was encountered in the space limitations, which were found to be rather severe, since the only ground that could be used for the purpose, considering the determination of the company to build the plant outside of the main structure, was a plot 37 ft. x 39 ft. on the east side. The successful operation of the plant shows that even in very small space sufficient power may be developed to take care of large areas.

To understand properly the requirements of a plant of this kind, a brief description of the building it serves will perhaps be necessary. "The Cleveland Arcade" is the largest combined office and store building in Cleveland and one of the largest of the kind in the country, covering 60,000 sq. ft. of area, with a frontage of 135 ft. and height of eight stories on Euclid Avenue, frontage of 185 ft. and nine stories on Superior Avenue and a double frontage of 440 feet and five stories through the length of the arcade. In all, the structure contains 200,000 sq. ft. of rentable floor space, with 530 offices and 60 stores. The radiating surface aggregates 30,000 sq. ft.; the equivalent of 3500 16-cp incandescent lamps are installed and six passenger and two freight elevators are in use. The building is owned by the Cleveland Arcade Company, of which Charles F. Brush, the well-known pioneer in the electric light industry, is the president.

In 1890 the building was completed and the power plant at that time consisted of five 60 ins. x 16 ft. horizontal tubular boilers, hand fired, and three small engines belted to 80-volt Brush incandescent dynamos. Some time later a Russell engine, direct-connected to a 100-kw Elwell-Parker generator, was added. In the winter of [illegible] in order to comply with the requirements of the city respecting the elimination of smoke, Jones under feed stokers were installed under the [illegible] boilers. Three years ago it became evident that a new power plant must be secured, as the old one was well worn and inefficient for the requirements of a modern building. The decision of the owners to locate the plant outside of the building was based upon the following reasons:

1. A large amount of very valuable space in the arcade that could be used for store purposes would be vacated. 2. The noise, dirt and heat, necessary accompaniments of a power plant, would be removed from the building. 3. The possibility of installing a plant of sufficient capacity not only to meet the demands of the arcade itself, but to supply light, heat and power to adjacent buildings, and thus make the plant, in part, at least, self-sustaining.

In addition to the area of the plot of ground available, 37 ft. x 39 ft., there was opportunity to excavate under a private alley and thus add about 10 ft. in one direction to the basement of the power house. The proposition that was thus placed before the engineers included the following points:

1. To design a plant with maximum capacity to be placed on a lot 37 ft. x 39 ft. in area. 2. To provide storage for a week's supply of coal. 3. To select equipment which would give maximum reliability and economy in operation. 4. To provide suitable means for keeping close record of the operation of the plant.

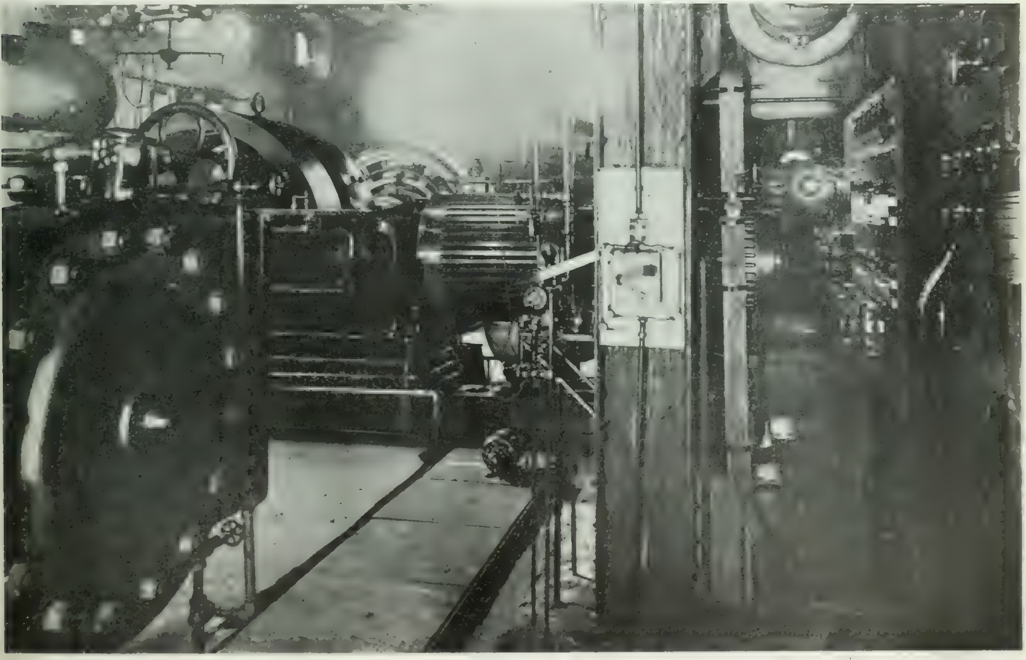


FIG. 1.—GENERATING EQUIPMENT, CLEVELAND ARCADE.

With these limiting conditions before them the engineers decided that a plant of about 1000 hp would be feasible, but to install this a building of practically three stories would be necessary. This plan made it possible to utilize the additional space in the engine room by excavating under the private alley and at the same time made necessary the installation of coal and ash handling machinery.

The floor level of the engine room was made the same as the basement floor of the main building, and the bottom of trenches for piping and cables was kept just above the sewer level. Under all this section of the city lies a bed of clay, sloping generally toward the lake. Above this clay are strata of varying thicknesses of fine, water-bearing sand, often incor-

rectly called quicksand. This wet sand, confined laterally, makes a substantial foundation for spread footings. In this plant the footings and main columns were designed to impose a maximum load of about three and one half tons per square foot on the soil. The column footings and engine foundations were laid about two feet below the water level and may be practically considered as floating in this wet sand, but after more than a year has elapsed they have shown absolutely no signs of settling or moving.

The power building in structure is a simple affair, consisting of an overhead coal bin with a capacity of 200 tons of coal, mounted at the four corners on steel columns; a steel and concrete floor to support the boilers and side walls and roof to enclose the same.

Plate girders 10 ft. in depth form the sides and ends of the coal bin, while the bottom consists of a single sheet rolled in parabolic form, this style of construction affording maximum strength with minimum weight of metal and giving a form of bin easily emptied. The girders extend through the building on one side, forming brackets on the outside, to which the ash bin is attached. The latter is provided with a spout for delivering ashes directly into the wagon.

FIG. 2.—CLEVELAND ARCADE.

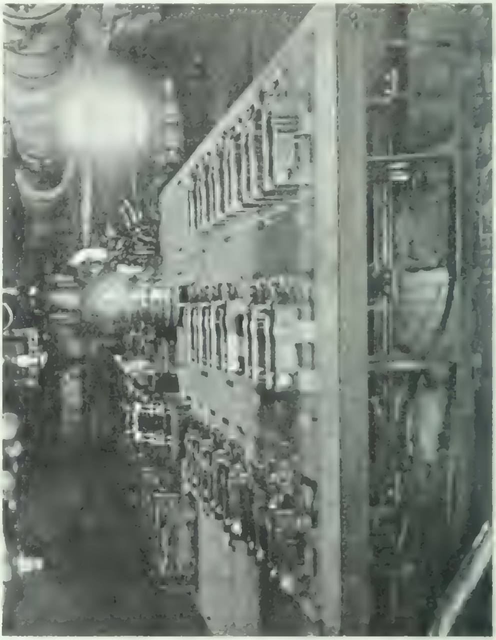


FIG. 3.—SWITCHBOARD.

A Jeffrey bucket conveyor is used for handling the coal and ashes. Space limitations required that this conveyor should be entirely within the power house, with the exception of a loop that extends out under a driveway. Coal holes have been provided in the driveway, so that fuel is unloaded directly from wagons into a weighing hopper of five tons capacity, suspended under the driveway and delivering into the bucket conveyor. This conveyor is driven by a motor belted to a driving pulley. Suspended from the bottom of the coal bin is a track on which is mounted a traveling hopper designed to hold 1000 pounds of coal. The hopper may be filled at any one of the three openings in the bin, moved along the track to the hoppers of the stokers and emptied where desired. A scale beam is furnished with the hopper so that accurate records of the fuel consumed may be kept. Small ash pockets are arranged under the boiler room floor delivering directly into the conveyor, by which the ashes are carried to the overhead ash bin. The main switch and controller of the driving motor, the scale beam of the large weighing hopper, the cables operating the bucket loading gates and the chain controlling the location of the bucket tripper over the coal bin, are all located in one corner of the boiler room, easy of access and under the control of one man. Emergency cutouts for stopping the conveyor are located over the coal bin, in the boiler room and at several points on the engine room level.

Several points entered into the determination of the engineers to select a three-wire system, principal among which were that the Arcade building covers a large area; that the demands for power as well as light, are considerable; that for a portion of the 24 hours, but one of the three units installed is required; that service is to be supplied to adjacent buildings and that the local lighting company has a three-wire, direct-current system in the business district. The generators determined upon are three-wire, 110-220 volt Westinghouse machines with balancing coils, one of 200 kw and two of 250-kw, each running at 200 r. p. m.

One simple and two compound engines were installed. As the space was limited two horizontal tandem-compound engines, right and left, were specified, in order that room might be allowed for the switchboard between the cylinders. But few makers could meet the space requirements and the Ball engine, made at Erie, was finally decided upon. The compound engines are direct connected to the 250-kw generators and the simple engine direct-connected to the 250-kw generator. Owing to the demands of the building for lighting, the 200-kw machine was put into operation before the remainder of the plant was completed. Part of the permanent steam piping was put in to connect with the old boilers, and one of the switchboard panels was put in position temporarily.

The selection of boilers received careful attention on the part of the engineers, and on their advice, it was decided to install water-tube boilers for 160-lb pressure with 100 degrees superheat. In deciding this question a number of other plants were visited and the cost of repairs, time required for cleaning,

reliability of superheater and other points were taken into consideration. In the end the Stirling boiler with rear-pass superheater was purchased. The boilers are set two in a battery and one single. Each has 2618 sq. ft. of evaporating and 1345 sq. ft. of superheating surface. The claim of the makers was accepted that, since most of the evaporation takes place in the first two banks of tubes, a boiler with a rear-pass superheater should be rated on 8½ sq. ft. of evaporating surface per horse-power, making them 308 hp each. Flooding pipes connecting to the superheater drums are provided and they are guaranteed to operate as saturated steam boilers and deliver dry steam under those conditions. Their rating is thus increased to about 400 hp, based on 10 sq. ft. of evaporating surface per horse-power. Operated in practice both as superheater and saturated steam boilers, they have given satisfaction.

Two Jones under-feed stokers were installed under each boiler. They are provided with special hoppers holding 1000 pounds of coal. The stokers are the latest type with Cole automatics, the air supply being furnished by an American blower, driven by an A B C engine. The speed is regulated by a Foster valve which responds readily to change in boiler pressure, regulating both the air and coal supply. An automatic motor drive was also installed, the motor being under the control of a Cutler-Hammer controller operated by change in steam pressure. The boilers are raised high enough from the floor beams to permit placing of air ducts and steam pipes for the stokers in the floor.

The conditions that determined the choice of stokers were that the Jones underfeed, used in the old plant three years, had given satisfaction both from point of economy and smoke prevention; that the new plant has a rated capacity two and a half times that of the old plant and that the old chimney was to be used, so that forced draft would probably be required; and that the boilers being located over the engines, it was necessary that the ash and clinker should be taken out in front of the boilers where the ash holes are located.

Lack of ground space and cost considerations made it necessary to use the old chimney, which is 175 ft. high and 5 ft. inside diameter. The location of the boilers above the ground level reduced the effective height of the stack about 15 ft. and their location increased the horizontal travel of the gases 50 ft., besides adding two right-angle turns. Such conditions made the under-feed type of stoker with forced draft seemingly necessary and the results have shown that the conclusions were well founded.

Necessity for using the feed-water returns from the heating system in the building and space conditions fixed the location of the feed pumps and feed-water heater in the space excavated under the alley-way and on a level with the engine room floor. Two Snider-Hughes monitor duplex plunger pumps for 200-lb. pressure were chosen. The feed-water heater is a Webster open heater for 1000 boiler horse-power.

All high-pressure piping, valves and fittings were specified for 150-lb pressure and 100 deg. superheat. The main headers in the engine room and boiler room and the vertical lines connecting the same are 12-in. pipe. Both boiler room and engine room headers are furnished with gate valves located so that the headers may be separated into sections and a boiler and engine separated from the remainder of the plant for testing. The simple engine and elevator pumps are supplied by a 10-in. branch line. A Keiley reducing valve in this line reduces the steam pressure to 100 pounds. Through a Kieley low-pressure reducing valve, connection is made with the heating system, since live steam is occasionally needed in heating the building. The 16-in. main line of the exhaust piping connects with two 12-in. branches to the heating system, with a 10-in. branch to the feed-water heater and with a 14-in. branch to the exhaust head located near the top of the stack. All exhaust piping is laid under the engine room floor. Both high and low pressure lines are drained and trapped with Squires traps and the exhaust pipes are furnished with Webster oil separators.

Each boiler, in addition to the feed line from the pumps, is provided with a Penberthy injector and also means for filling from city pressure, and each is provided with a Squires feed-water regulator. The feed pumps have each a Squires pump governor. The boilers each have a Foster non-return, automatic, emergency stop valve, with pilot valve in front of the boiler so piped and arranged that any boiler may be cut out of

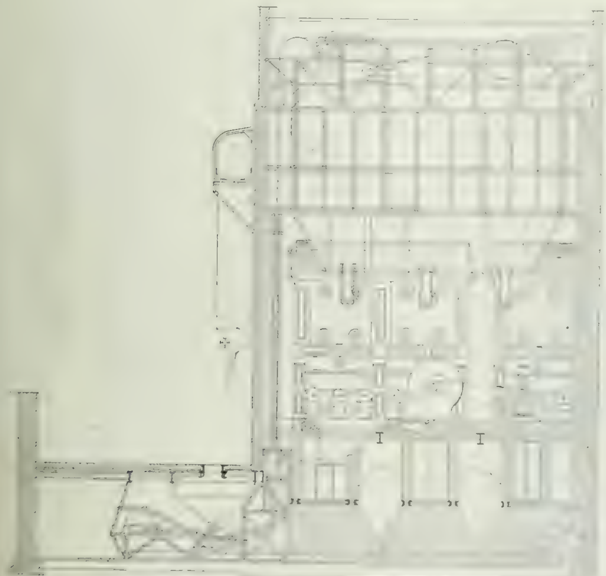


FIG. 4.—ELEVATION OF BOILERS AND COAL HANDLING APPARATUS.

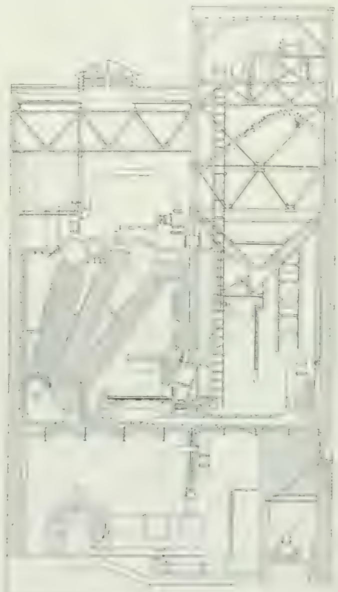


FIG. 5.—SECTION THROUGH COAL BIN, BOILER ROOM AND ENGINE ROOM.

[illegible] be shut down by opening a small valve in the engine room. Each boiler has a Worthington 2-in. hot-water meter in the feed line with by-pass connection and all are equipped with Vulcan soot blowers and flue cleaners.

[illegible] boiler room floor and connection is made to the outside of the building, so that oil can be delivered without unloading the barrels from the wagon. From the tank the oil is piped to the bearings of all the engines and from there flows to a receiving tank under the engine room floor, whence it is raised by a motor-driven centrifugal pump to an oil filter in the boiler room, and from there it flows back to the tank.

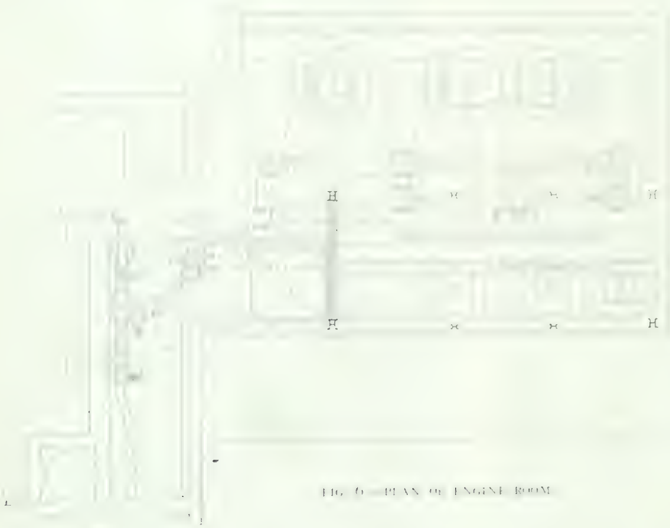


FIG. 6.—PLAN OF ENGINE ROOM.

The Paul vacuum system was installed as part of the heating system. The engineers felt that, in order to remove the back pressure on the engines, insure smoother running of the plant and secure a better circulation throughout the building, a vacuum system was necessary.

[illegible]

The generating panels, containing the usual switches, circuit breakers, ammeters and a Thomson watt-hour meter on each [illegible] designed by the engineers and installed by a local firm. In general appearance it conforms to the generator panels. The station panel contains Bristol recording voltmeters and recording ammeters, showing total station output. An exchange panel provides an emergency or exchange connection with another power plant of similar size in the business section of the city. The exchange panel contains two watt-hour meters, a three-pole, double-throw switch and indicating two-way reading ammeters. Direct telephone connection between the two plants makes it possible for either plant to take the load of the other in cases of emergency. The watt-hour meters are wired so as to record both the energy furnished and the energy received by the plant in the exchange service. Four panels of a similar design make up the feeder board, and on these are mounted switches and fuses for power and lighting circuits both in the Arcade building and for outside service.

In line with the switchboard but separated from it by the main stairway, are two panels of similar design containing steam, vacuum and water gauges, together with a Bristol recording steam pressure gauge and a Bristol recording thermometer connected with the high-pressure lines.

Ducts passing under the trenches for the exhaust lines are provided in the engine foundations for the cables from the generators to the switchboard. As their location is below the water line, lead covered cable is used for these lines, as well as all the main distributing circuits. Distributing cables both for the Arcade and the outside service are laid in a trench back of the switchboard, and the distribution for the Arcade is all underground work of the most modern approved design, with manholes at convenient intervals. The wiring for lamps and motors is all in iron-armored conduit.

One of the most important features of this plant is the complete provision made for tests and records. All coal is weighed and arrangements have been made for regular analyses of the coals, so that contracts may be made on the heat-unit basis. A water meter has been arranged on the cold-water line to determine the amount of water used, and hot-water meters are installed on the feed lines of each of the boilers to keep track of the evaporation. Thermometer wells are placed in the cold-water line, the feed line, at the steam outlet from each boiler, in the main steam header, in the steam header beyond the 100-lb. reducing valve, at the throttle of each engine, at the receiver between the two cylinders on the compound engines and on the exhaust line. Each boiler is piped from the ash pit, from the fire box and from the up-take to a manifold placed conveniently on the wall of the boiler room and connected to a permanently placed draft gauge. A pyrometer for flue gases, recording thermometer on the steam line, recording ammeters and voltmeters on the switchboard, recording pressure gauge on the gauge board, watt-hour meters on each generator panel, watt-hour meters on the circuits for the motor driving the coal conveyor and the motor driving the blower for the stokers, and also on the lines supplying energy to power house, on the circuits supplying the Arcade buildings and those supplying outside circuits, give the engineers in charge the means of keeping the plant at the highest state of efficiency.

The Cleveland Engineering Company made the plans for this plant and overcame the difficulties imposed by small space and [illegible] we are indebted for facilities in preparing this article.

The Selection of Machine Insulation Material.

By William S. Conant.

In these days of prepared insulating fluids, the formulas for which are not printed upon the can labels, and of ready-made insulation cones, strips and bobbins prepared to fit all the best known generators and motors, there is danger of losing what was once the common property of the thoroughly equipped electrical repair shop. I refer to a knowledge of the relative insulating value of the materials used in the rewinding of armatures and field coils and in the designing of electrical apparatus of all kinds required to withstand high tension.

It is not intended to decry the advantages obtained through the purchase of commercial products. Fluid insulators can be made in large quantities with greater care and economy in the preparation and mixture than is possible in any but the largest repair shops. Expensive machinery, too, is often a means of perfecting the quality of a product; it is, of course, a necessity in the manufacture of any of the insulators marketed in solid form.

Nevertheless, the writer believes that a discriminating sense of what "good insulation" means for each particular location is too seldom found among either our builders or repair men. The subject is covered thoroughly by the better class of electrical manufacturers, but repairs are necessary sooner or later and the owner of a burned out machine is always reluctant to lose the time required in shipping it back to the maker. A number of enterprising repair houses in the larger cities have built up a large trade, but intelligent and permanent repairs should be available in every good-sized town. The chief obstacle to this end is the absence of a working knowledge of what constitute the best insulating materials.

The practical electrical shop worker may ignore all discussion of the insulating value of air or of oils and gums in their fluid state. These considerations belong more properly to line construction problems or the design of apparatus for high tension transmission.

Materials intended for the insulation of electric machinery should pass three classes of requirements, involving tests to withstand (1) current leakage, (2) lightning discharge, and (3) heat. These classifications may be made to include as kindred under (1) not only the actual insulation resistance tests, under any set of conditions measured in megohms, but hydroscopic or moisture resisting tests which affect the insulation resistance of many porous materials; under (2) determination on resistance to disruptive discharge from any cause, whether accidental metallic contact with a high-tension transmission line wire, proximity to high-frequency wireless station apparatus or static discharge during a thunder storm; under (3) tests covering the effects due to the presence or absence of heat, such as the mechanical failure of materials with extremes of temperature and with rapid alternation of heat and cold.

It was formerly customary to regard tests showing current leakage as decisive. When, however, it was proven that the results could be made to show wide variations by drying out the materials under test, experimenters have very properly transferred their chief interest to high voltage "break-down" tests. The practical distinction is that the break-down test should show the mechanical condition of a material, while the insulation resistance is only an indication of its hydroscopic condition, and therefore of little practical value. The two classes of tests have no definite connections.

No station leads from an overhead line can be absolutely protected from lightning discharge, and too frequently the high-potential strain from this cause reaches the insulation of electrical machinery. Disruptive discharge, whether from lightning or other source, acts like a fluid in motion with erratic splashings which have been called side flashes. These uncontrolled discharges have been found to strain and break down the insulation at any point, but are most liable to follow surface leakage as in taped windings [illegible] varnish. Discharges will leap over such surfaces and cause short circuits and grounds by the secondary effect of the following dynamo current in burning out the machine insulation. Designers therefore as far as possible avoid the materials which promote these risks and allow large margins of safety in the actual disruptive strength of the insulating layers.

The mechanical design of a machine may allow in many places the use of a thick layer of insulation and thus a greater selection of materials is available. Often, however, the insulation layer must be extremely thin and great care is required in its preparation. In either case tests to determine the disruptive strength of a material should be made on such thicknesses as are designed for practical use. For instance, mica in its natural state is in a class by itself, will withstand approximately ten times the e. m. f. applicable to other sheet insulations, and various samples of mica should be compared in thicknesses measuring either .1 mm or about 5 mils (.005 in.). A suitable thickness for test samples of most other materials is 1 mm or .04 in. This comparison of equal thicknesses of different materials is important as it has been found by trial that the disruptive strength does not increase directly with the thickness of the dielectric. Mica and paraffin seem to be about the only insulating substances of which this is practically true.

At first thought it might seem to be an easy matter to select all the obviously best insulating materials, solid and semi-fluid, to combine them in various proportions and to submit them severally to a series of tests to determine definitely their relative values as insulators. Unfortunately the specific resistance of insulating materials varies widely under changes of external conditions and does not follow the results of similar tests upon electric conductors. A change in the condition of heat or of moisture will often effect a decided change in the relative value of a simple or compound dielectric, and thus it becomes impossible to prepare a graded tabulation of insulating materials to correspond with those compiled for the electric resistance of metals. We are led, therefore, to experiment with the treatment of varying the thicknesses of insulating materials and to select those which do not break down under high-tension tests. Then we must again apply to the materials passing these requirements, working conditions of heat and moisture for definite periods of time and eliminate those samples which are adversely affected.

Some samples may have tested out well for current leakage and disruptive discharge while dry and cold, but, losing such qualities in a damp or hot place, they are proved to be dangerous where such conditions can take place. Thus wood, paper or any textile fabric, unless especially treated, loses its insulating value promptly in the presence of continued moisture in the air.

Similarly, insulating sheets soaked in resinous gums or coal tar, while for a time withstanding high pressures, become "tacky" and break down after a critical temperature is maintained for a few hours. Sometimes the effect of a long application of heat is to cause the insulating material to check, become brittle and finally char. This charring temperature appears to be a determinate figure for each material due to the fact that the moisture (the disturbing element) is necessarily cooked out at such temperatures. Where untreated fabric with necessarily low charring temperature is used as insulation, such as cotton-covered wire for field or armature windings, it is necessary to saturate the insulation in a high temperature varnish. Its charring limit is thus raised above the danger point.

The charring temperatures for the following materials was obtained by immersing samples in a bath of lead, tin and antimony having a melting temperature of 230 deg. F.: Shellacked cambric, 320 deg.; oiled duck, 8 oz., 338 deg.; oiled duck, 10 oz., 347 deg.; drilling, untreated, 347 deg.; cambric, untreated, 355 deg.; leatheroid, 360 deg.; thin silk, oiled, 392 deg.; thin silk, untreated, 428 deg.; surgical brand cotton, 447 deg.; glazed pressboard, thin, 465 deg.; glazed pressboard, thick (.03 in.), 483 deg.; fine linen, 483 deg. The oiling was in each case with linseed and its result was to lower the carbonization point.

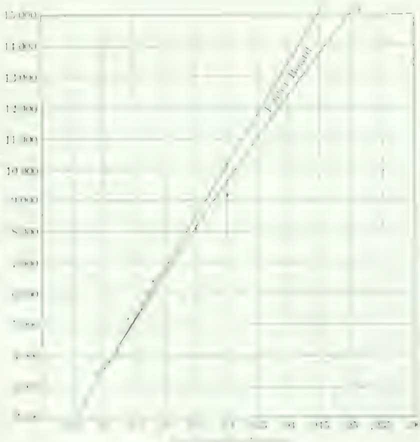
In an article of this scope there is scarcely space for the de-

[illegible] place to refer to some of the causes for the apparent discrepancy of test figures coming from different sources. If the disruptive strength of a material per thousandth of an inch is to be found, it is obviously important to use consistently either direct or alternating current. For convenience in obtaining high pressures alternating current is preferable. Uniformity of results are also only obtainable by using rounded disks for terminals. The proper size for these disks is a matter of dispute, but a fair average might be formed in the size of a silver quarter dollar or shilling. Again, it is absolutely necessary in order to obtain consistent results to compare approximately equal thicknesses of material tested. Lastly, the time conditions must be equalized for each sample—by which is meant that the causes which affect the insulation strength of a material (whether electrical or mechanical pressure, heat or moisture) should be applied under equal conditions for the same length of time to each sample. Fifteen seconds is a suitable period for the application of electric strain. A longer period may heat and consequently weaken a sample unduly. Newly-made samples should not be compared with those which have stood for some time. The "green" sample may not have reached its natural strength, while aged samples have had opportunity to develop intrinsic weaknesses due to internal chemical decomposition.

Some test figures might be added illustrating the points emphasized. Also perhaps some notes upon the characteristics of certain mixtures and the effects of certain ingredients.

Mica.

It can be safely said that no satisfactory substitute has been found for mica in commutator construction. The commutator is the hottest part of a machine and mica will not carbonize. Between segments nothing but amber mica should be used, as it can be turned in a lathe without chipping as deep as other varieties and thus the risk of pitting and subsequent flashing under the brushes is lessened. White mica is harder than amber but much more flexible. A good quality of white mica splits into larger sheets and its flexibility makes it most applicable to repair work, particularly on old surface-wound machines. All variations from white, noticeably greenish or

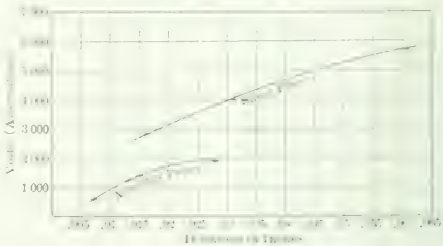


bluish tinge, are harder and more brittle. Metallic veins and chemical impurities are the bane of the mica dealer.

The ultimate disruptive strength of a selected quality of amber mica taken from a number of samples of thickness up to 5 mils, varied from 1980 volts per mil to 4300 volts, the average failing is about 2500 volts. The averages of two assortments of poorer grade mottled samples from different localities were 2200 and 2400 volts per mil respectively. White mica in both large and small sheets averaged 3100 volts per mil. Similar qualities of mica show little difference in strength whether mined in the United States, Canada or India.

Mica Compounds.

The successful building up of thin overlapping sheets and the moulding of finely divided mica into plastic forms has simplified the insulation of many machine parts. The use of hydraulic presses produces a uniform product. These insulations known under several trade names, share to some extent the insulating value of mica. Built up mica, if cemented with a non-hydroscopic varnish, possesses a disruptive strength practically proportional to the thickness. Backed with tough paper or cloth



for mechanical strength, it has advantages over pressboard or other fibrous insulators for core, slot or coil work. Micanite can be made to within .01" of desired thickness and can be milled even closer.

Sheet Insulation.

One of the most widely useful insulations is flexible glazed pressboard. Thicknesses over .03" should be avoided. If space must be filled it is better to use two thinner sheets. The best quality is made of leather findings and comes in yellow and red. Spruce or other wood fibre is unsatisfactory mechanically unless a sulphide process is used, when, on the other hand, its insulating quality is reduced. The unexpected presence of pin holes or non-insulating particles too small for detection by the eye is the chief fault of this material.

In Fig. 1 is plotted a series of readings, each point representing the average of eight breaking voltages on a given thickness of fuller board. The thicknesses tested were from 7 mils to 51 mils and show a uniform increase in disruptive strength rare in sheet insulation. Even on the thickest sample tested the strength was only 14 per cent below the theoretical straight line of strength proportional to thicknesses, while for a thickness of .025" it was but 6 per cent below.

For thicker insulating sheets the whole family of vulcanized or hard fibre preparations is available, including such kindred materials as bone fibre, kartavert, amyloiden, leatheroid, etc. Where flexibility is required the temptation to the maker to use glycerine is often fatal to the electrical properties demanded. Baleen or whale oil is less harmful for this purpose. This is the class of materials, too, where moisture plays havoc and where, after thorough drying out, the insulation resistance may usefully be measured. Pressboard and vulcanized fibre shrink when hot and swell when damp. Drying out adds about 20 per cent to their disruptive strength.

Hard rubber compounds are some of them also used as sheet insulation, especially those vulcanized with asbestos fibre. Flexibility is, of course, impossible and sometimes such material will ignite when brought into contact with a flame. Unless the asbestos fibre is long the sheet will crack when strained. The chief objection to these products is the presence of sulphur, introduced to hasten vulcanization but causing swelling and blisters under heat and subsequent short circuits. 1/32" sheet vulcabeston will break down at about 2600 volts. Asbestos paper and mill board are not insulations but a fire-proofing material. Thin paper (.007") will be punctured under a pressure of 500 volts.

As an illustration of the variable insulating value of one of

these fibrous materials the following list is given. All were made by one company:

Thickness.	Color.	Disruptive Strength.
.019 (1/64″)	Gray	4000 volts
.035 (1/32″)	Red	3000 "
.042	Gray	6000 "
.051	Black	5200 "
.088	Red	8000 "
.101	Black	above 8000 "

Treatments and Composite Insulations.

Varnished cloth and paper are greatly valued necessities, but the day of the simple gum varnish is past. It is now generally recognized that other treatment than that of dipping in a hot bath of melted copal gum or shellac is required if insulation is to stand at a constant value. It was found that these varnishes, which flowed so smoothly and gave such high insulation resistance, soon "checked" when chilled. They are entirely suitable for instrument coils but on a machine coil will crumble away under vibration. Moisture in the air soon finds its way through these minute cracks and then chemical and electrolytic decomposition follow.

Another objection to these simple gum varnishes lies in the fact that they must be dissolved in alcohol, naphtha or some highly volatile fluid. The result is the presence of danger of inflammability during and after application and wastefulness due to evaporation. The expense here involved is applicable to alcohol paints as well as varnishes, while in either when fresh the alcohol actually serves as a conductor. The writer remembers when it was customary to waste between $25 and $50 in "Woodman's black" on the coils of medium sized railway generators.

Asphalt, bitumen and the other mineral pitches have also fallen under just criticism similar to that bearing upon the gum varnishes. Linseed oil, when thoroughly boiled out, has been combined in many successful varnishes. A mixture with copal applied to press board and thoroughly baked practically doubles the disruptive strength of the board. It is only when the test of time is applied that the material breaks down. Linseed oil varnish will in time oxidize and crack. It, like the gum, is acid and must attack both metal and organic material with the usual results.

The attempt has been made to protect copper from corrosion by coating the surface with paraffin treated to withstand heat. Similar materials have also been successfully combined with resin in the preparation of a varnish which has permanent insulating characteristics. The only absolute test in this matter is that of actual service over an extended period of time under aggravating conditions. Often several layers of insulating varnishes for different purposes are desirable, particularly on a refractory machine, which has more than once burned out under the direct effect of trying local conditions. First use a non-corrosive varnish next to the coils and last of all a weather and acid-proof finish.

Insulating fibre in any form is improved by application of varnish but this advantage is lost unless the material remains plastic indefinitely, and this is the object sought by the insulating expert. Another and sometimes independent object, has been to obtain a heat conducting and diffusing quality in the insulating fluid.

In general the purchase of quick driers should be avoided and some form of oven arranged for baking out coils and armatures. The ingredients which cause a paint to dry quickly are apt to decrease its insulating quality. One maker of insulating varnish states as a rule that there should be a disruptive strength in a good varnish of at least 1000 volts per layer of 1 mil in thickness applied 1 minute in an air temperature of 70 deg. F.

In the matter of fabrics it is an advantage to use that commercially prepared by an experienced firm, as the emulsions and processes are presumably the result of expert treatment. So-called "empire cloth" is simply cambric carried through a hot oil bath, but it is difficult to duplicate its electrical strength without the special machinery used in its treatments—preliminary, insulating and drying. If unprepared cloth is bought it should be unbleached to avoid the chemical action of chlorine and smoothly ironed to avoid minute roughness in the finished insulating layers.

Needless to say, many of the insulating paints still sold are unsatisfactory and unserviceable mixtures, but these will sooner drop out of use if the purchaser is able to specify what ingredients and results he knows to be injurious and can state reasons for his demands.

Graphical Method of Determining Power Factor from Wattmeter Readings.

By A. A. RADTKE.

When two wattmeters are connected to indicate the power in a three-phase circuit, the two indications are respectively:

$$W = e\,a\cos\theta$$

$$W_1 = e_1 a_1 \cos\theta_1$$

Now, when the circuit is balanced e and e_1 are equal and likewise a and a_1 are arithmetically equal; hence,

$$\frac{W}{W_1} = \frac{\cos\theta}{\cos\theta_1}$$

and,

$$\theta = \phi - \alpha$$

and

$$\theta_1 = \phi + \alpha$$

The equation then reads:

$$\frac{W}{W_1} = \frac{\cos(\phi - \alpha)}{\cos(\phi + \alpha)}$$

which can be transformed to

$$\frac{1 + \tan\phi\tan\alpha}{1 - \tan\phi\tan\alpha}$$

Since alpha equals 30°, $\tan = \frac{1}{\sqrt{3}}$

Then solving this expression for $\tan\phi$ gives the well known form $\tan\phi = \frac{W - W_1}{.577\,(W + W_1)}$

In order to interpret this expression graphically we resort to a construction shown in Fig. 2. Let the two ordinates of the

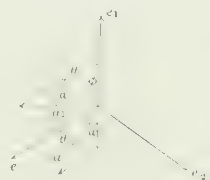


FIG. 1.—VECTOR DIAGRAM.

point D, AD and DC, represent in magnitude the two readings of the meters. Now, with D as a center lay off from the point D, CD on the line AD, locating the point H and the point K on the same line extended. The line AH then represents the numerator of our equation $W - W_1$; and the line AK represents that portion of the denominator within the brackets $W + W_1$. In order now to represent $.577(W + W_1)$, we lay off the line BN and let it represent unit length and on it locate the point M at a distance .577 from B to N. Connect NP and draw the line MF parallel to NP. The line BF then represents in magnitude the denominator of the equation $.577\ (W + W_1)$. Then laying off AH on the vertical axis, locating the point E, and completing the parallelogram $BEGF$, we can now draw the diagonal BGS, which defines the angle of lag, WBS.

The cosine of the angle can now readily be determined. Draw the arc of a circle SWJ with B as its center and consider the radius as unity. Where the line BG extended intersects the arc of the circle, drop the perpendicular ST to the horizontal axis. The line BT then represents the cosine of the

[illegible] readings.

Where it is desirable to read at once the angle of lag, knowing the readings of the wattmeters, a curve XYX can be drawn following the direction before given, by laying off the lengths of the lines BT from the point V vertically and projecting their upper ends horizontally until they meet the diagonals of the parallelograms formed from the individual wattmeter readings; for example, BDR, and drawing through these points a curve.

Fig. 2. [illegible]

as shown. When the curve is once constructed it is only necessary to draw the parallelogram representing the two wattmeter readings and then by extending the diagonal until it intersects the curve XYX, the power factor can be at once read opposite its horizontal projection upon the vertical scale SLV.

From this curve it is at once clear that when the angle of lag is 60 deg., the power factor is 50 and one of the wattmeters reads the total power likewise, when the angle of lag is [illegible] the two wattmeters read equal and the power factor is unity.

Ground Wires and Choke-Coils for Lightning Protection.

By D. S. C[illegible]

The last few years have seen the installation and successful operation of 66,000-volt power systems. Great credit is due the engineers who have been pioneers in this work and who have proved that 66,000 volts can be controlled with ease and safety. So great confidence has been inspired by the success of the 66,000-volt systems that 100,000-volt installations are now proposed. Perhaps the most interesting part of the history of these high-tension systems is their experience with lightning and the devices which they have adopted to protect their systems. High-tension systems are designed to deliver power at great distances from the point where it is generated and so in general are exposed to lightning discharges, especially in countries where severe thunderstorms prevail.

Tests made with high-potential discharges show that the discharge is preceded by brush discharges and pilot sparks which increase in length until the air-gap between the extremities of these arcs gives way under the strain and the spark is established from electrode to electrode.

When a charged cloud appears over a transmission line there is an induced charge on all conductors within the field of influence. The greatest potential difference exists between the cloud and earth, and if the cloud charge should be transferred to any conductor insulated from the earth, there would exist a potential difference between the conductor and the earth; it is thus evident that the ultimate destination of the lightning discharge must be the earth. It follows directly from this reasoning that if the transmission conductors are removed from the direct path of the discharge from cloud to ground, a direct stroke will be avoided.

The most practical and effective manner of accomplishing this result is to install a ground wire directly above the line. The argument has been advanced against the overhead ground wire that it can afford but little protection, due to the fact that it is practically at the same distance from the cloud that the line conductors are, and lightning is thus just as likely to strike the line conductor as the ground wire. Theoretical investigation and practical experience show that this argument is fallacious. From the above description of the manner in which the static spark establishes itself, it is evident that in cases like this where the tension may exist for some time before the discharge takes place, the potential may be just sufficient to establish the arc through this distance, the potential breaking down successive portions of the air-gap intervening between it and the ground, and thus the last portion of the path over which it passes as it reaches earth will be determined by the relative length and impedance of the possible paths it may traverse. It is evident from this view of the lightning discharge that it will surely strike the ground wire rather than the line if it is above the line, as the distance along this path is less, the resistance is less, and the stress in the intervening dielectric is greater.

Prof. Jackson has shown that the ground wire reduces the potential of the transmission line due to the cloud charge so that there is not as great an induced charge on the power line as when it is absent and less energy directly associated with the cloud charge appears in the power system when the cloud discharges.

An overhead ground wire with lightning arresters installed at intervals along the line affords the best possible protection to the line.

The principle of the choke-coil that it serves to reflect waves and surges in whole or part and thus prevents the station apparatus from being subjected to potentials of such magnitude as to endanger their insulation, is admitted to be theoretically correct, and all engineers advise the installation of choke-coils with arresters.

It has been stated that the air choke-coil as ordinarily designed may not protect in the case of a steep wave of very high frequency, as the full potential exists between the first two turns, and the charge passes across the air-gap between the turns. Proceeding thus from turn to turn it passes beyond the choke-coil and the apparatus is subjected to the full stress of the impact. This would also happen in the case of the insulated coil with the result that in the latter case the choke-coil is permanently short-circuited and the coil is put out of commission. It is easily seen that the insulated choke-coil may be destroyed, necessitating a shut-down of the station to remove it for repairs. It must also be tested at regular intervals to determine whether or not it is in perfect condition.

In regard to the use of the outer windings of a transformer as a choke-coil or to placing a choke-coil inside an iron case, the following disadvantages may be noted. When a charge reaches the choke-coil, since the case is a grounded conductor, there will exist a stress between the charge on the wire and the induced charge on the case, tending to cause a discharge to take place over the surface of or through the bushing through which the conductors enter the case; to prevent this in the case of high tension systems such as now contemplated is difficult. It is probable that the air about high-tension transformers is ionized, so that arcs are established much more easily and through much greater distances.

In regard to the contention that the choke-coil may prevent

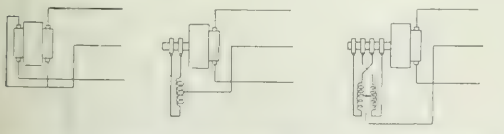
the passage of a charge bound in the remote windings of a transformer, it may be said that the charge when released will first meet the inductance of the nearest turns of the transformer which at the moment of release will act as a choke-coil, and the actual choke-coil will be electrically far from the field of action and will not be a factor in determining whether the insulation will withstand the shock or not.

The manner in which the clouds become charged with electricity indicates that a charge of great magnitude and enormous potential may exist on a cloud. The theory has been advanced that evaporation is attended with electrification each minute particle of water having its minute charge. These particles unite to form larger drops, the potential of which must necessarily be higher. It is also possible and probable that the clouds may assume the potential of the surrounding air, the charge of opposite sign to that of the air readily escaping, and the reactions of these charges upon one another may lead to the concentration of large quantities of electricity on a limited portion of the clouds. These charged cloud masses may unite, causing the resulting cloud mass to have a higher potential. The above processes may be repeated until the potential becomes great enough to cause a discharge to take place from the cloud to earth or to another cloud charged with electricity of opposite sign. It is impossible to prevent oscillations being set up in a system due to lightning discharges in the immediate vicinity of the line. Properly designed protective apparatus will prevent these oscillations from developing high power surges.

Three-Wire Dynamos.

On page 1211 of our issue for June 15 there was given an abstract of a paper on balancers versus three-wire dynamos, which was read by Mr. Budd Frankenfield at the Washington convention of the National Electric Light Association. In addition to the discussion of the relative merits of balancers and three-wire dynamos, the paper contained much interesting information relating to the various types of three-wire dynamos that have been placed on the market.

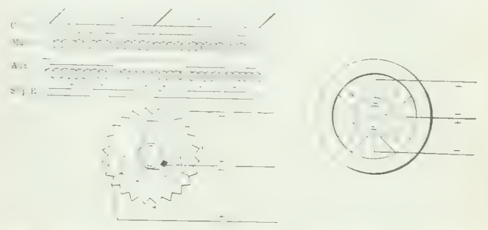
One of the oldest three-wire dynamos is the machine shown in Fig. 1. This dynamo, which is accredited to Hopkinson, is provided with two equal armature windings and two commutators. The two windings are connected in series and to the neutral wire of the lighting system. In regulation, this machine possesses the advantageous feature that any reduction in voltage due to armature reaction affects the e. m. f.'s of the two windings equally, the only difference between the two de-



Figs. 1 and 2—Hopkinson and Dobrowolsky Three-Wire Dynamos. Fig. 3—Lamme's Modification.

livered voltages being the excess of resistance drop in the heavier loaded winding on an unbalanced load. The armature must be made longer than one for a two-wire machine on account of the two commutators, and the shaft somewhat heavier. This requirement makes the saving in floor space and in first cost less than one's ideal of a three-wire dynamo leads him to expect. Furthermore, it is impossible to regulate the voltages independently except by shifting the brushes—hardly a practical method.

The three-wire dynamo of Dobrowolsky is shown in Fig. 2 A choke-coil is tapped into the armature winding at the two points of opposite potential (assuming bi-polar construction), and the center of this coil is connected to the neutral wire. If the choke-coil is mounted so as to rotate with the armature, the neutral is connected to the center of this coil by means of one slip-ring; if mounted in a stationary position, as shown in the diagram, the outside terminals of the coil are connected to the armature through the medium of the two slip-rings and the neutral connection is tapped in solid. The center of the choke-coil is at mid-potential, and any difference in current between the two branches of the system can flow along the neutral and through the coil, which offers no impedance to direct current. The windings of the choke-coil are arranged so that the direct currents in the coil are magnetically opposed, thus avoiding saturation of the core. This feature is only partially accomplished. An alternating magnetizing current and also an alternating core-loss current are present in the coils, and both



Figs. 4 and 5—Osana, and Dettmar and Rothert Three-Wire Dynamos.

these currents increase with unbalanced load because it is not possible to completely eliminate unidirectional magnetization.

Lamme's modification of Dobrowolsky's invention is shown in Fig. 3. It consists in making the slip-ring connection two-phase; there are four slip-rings in addition to the commutator. and two choke-coils connected in "star." The neutral wire is connected to the center of the star. By this means a slight gain is made in the distance the neutral current must traverse the armature winding.

Both of the above machines, while simple in principle, are sufficiently complicated in the connections to render the locating of trouble an irksome task. In addition, the increased length of shaft required for the slip-rings cuts down the saving in floor space, and it is impossible, without added complication and mechanism, to regulate the voltages independently. An admission of this weakness is evidenced by the fact that two large manufacturers have taken out patents on an additional auxiliary device, practically amounting to a balancer, the purpose of which is to regulate the two voltages.

The three-wire dynamo of Osana, which is illustrated in Fig. 4, is provided with an auxiliary winding laid in the same slots as the main winding, usually in the bottom of the slots. Sections of this auxiliary winding are proportioned to develop opposed voltages of half the value of the main voltage. It is tapped into the main winding at the opposed points of connection, and the center of each section is connected to a slip-ring, which is in turn connected by a brush to the neutral. If the conductors of Dobrowolsky's choke-coil were placed in slots on the armature surface and connected so as to develop an e. m. f. equal and opposite at every instant to that impressed on the terminals of the coil by the main winding of the armature, there would be no alternating current in the coil and the magnetizing and core-loss components would not exist. This, in fact, is the embodiment of Osana's machine. It is said that there is no gain without some sacrifice, and the sacrifice in this case lies in placing the auxiliary winding in the armature slots —the most valuable space in a dynamo. On account of the heating of the auxiliary conductors and the increased slot depth required, it is necessary to make the armature of a machine of this type of increased diameter. The old weakness, lack of independent voltage regulation, is common to this machine also. One attempt has been made to overcome the difficulty by mounting the positive and the negative brushes on independent rockers, and supplying means for shifting these brushes independently. In order to regulate the voltages in this manner the machine must be designed with an unusual margin in commutation.

An interesting machine is that of Dettmar and Rothert

illustrated in Fig. 5. Here a two-pole armature is mounted in a field having four salient poles. Poles of like polarity are situated in juxtaposition, each pair forming a single magnetic pole. In reality, the machine is a two-pole dynamo with a wide gap in the center of each pole. The neutral brush is placed opposite this gap. Armature reaction, even with balanced load, weakens the upper south pole and strengthens the lower south pole; likewise, the lower north is weakened and the upper north strengthened. The result is that the voltage on the positive side of the system becomes lowered and that on the negative side increased. This is overcome by compounding the weakened poles cumulatively and the strengthened poles differentially. This same winding is effective in balancing the voltage automatically. It is also possible, by connecting the shunt field-coils in two independent circuits, to regulate the voltage independently by hand. This machine accomplishes in regulation all that can be done with a generating unit consisting of two dynamos in series. The chief disadvantage is its excessive weight, the yoke and armature core being twice the cross-section of an ordinary four-pole machine. If made with more than four poles, the construction is limited to an even number of pairs of poles.

An objection to all three-wire dynamos is that, in order to compound them so as to deliver the necessary total voltage at any load, the series field-winding must be divided into two circuits, half the total number of coils being connected in series with each main. The connections of the Dettmar and Rothert machine have just been described. In the other machines the series coils are all made cumulative, and coils that are mounted on poles of like polarity are connected in series with one leg and those of the opposite polarity in series with the other leg. To connect from coil to coil in either circuit requires a jumper

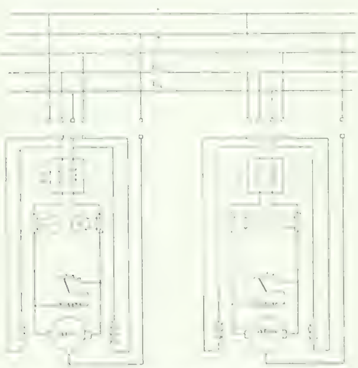


FIG. 6.—THREE-WIRE DYNAMOS IN MULTIPLE.

spanning a complete pole. As stated, this compounds for the *total voltage only* and has no effect whatever in balancing the voltages.

To operate two compound three-wire dynamos in parallel two equalizer bars are necessary, one for each series field-circuit. This requirement entails an additional and expensive feature for the switchboard, and in switchboards of large central stations there would be difficulty in finding room for the extra equalizer. A diagram for multiple operation is shown in Fig. 6. There are six heavy cables of full-load capacity running to the switchboard, and, in addition, there is a neutral cable. In the case of the choke-coil system the coils are often placed back of the switchboard or at some place equally distant from the machine, requiring in this case four small cables leading from the machine. All of these wires are multiplied for every three-wire machine in the plant; the item of expense is considerable, and should not be neglected when comparing different three-wire systems. One might think that four full-current cables would suffice, two for the equalizers and two for the leads. The figure shows that two additional cables leading from the armature are necessary in order to obtain adequate protection for the machine. These two cables lead to the ammeter shunts and the two circuit-breaker coils. An attempt has been made to avoid the use of these two cables by mounting the ammeter shunts on the terminal blocks of the machine and running long lead wire from these shunts to specially-calibrated ammeters on the switchboard. In this case the circuit-breakers are placed in series with the cables leading from the series field-coil. This is not the proper place for a protective device, because it is liable to throw the machine out of service when the armature is not at all overloaded; since the coil of the circuit-breaker might be actuated by the sum of the armature current and an equalizer current from the other machines just at the time when equalization is most needed. In order to get equalization comparable to that of two-wire dynamos, it is imperative to use the six big leads to each machine.

In order to operate a compound two-wire dynamo in parallel with compound three-wire dynamos, it is necessary to split its series field windings into two circuits and supply two equalizers. Standard two-wire dynamos must therefore be remodeled to the extent of a reconnection of the series field coils and the addition of at least one new terminal block for the extra equalizer. Many machines are so built that it is difficult to make these changes without considerable expense; for example, a machine with rectangular poles having the series-coil leads coming out between the poles may require rewinding of the series field coils.

The author stated that the little that is gained over the old Edison system with two separate generators in series by combining two-wire and three-wire dynamos in one plant is more than lost in the inability to regulate the pressures. Another difficulty common to all machines with double equalizers is that, unless the voltages of the two machines are equal before the equalizers are thrown in, a short-circuit of the most violent nature is likely to occur through the armature of the incoming machine, because the equalizers are at the full terminal difference of potential.

A Central Station in Bermuda, West Indies.

A central station recently placed in operation is that of the Bermuda Electric Light, Power & Traction Company, at Hamilton. This is the first central station in Bermuda and contains the largest of the three generators on the island. The difficulties that had to be contended with were peculiar, owing to the difficulty in obtaining coal and supplies, and the lack of a regular

FIG. 1.—EXTERIOR OF HAMILTON, BERMUDA, POWER STATION.

water supply. It was therefore necessary to adopt a system requiring a minimum consumption of coal and a small amount of water. This was successfully accomplished by using a high efficiency gas engine and producing the gas by the Tate process which requires water for scrubbing only.

The power plant is situated on the ground floor of a building 40 ft. x 80 ft. situated on East Broadway, facing the harbor. At present only the rear part of the floor is used for power purposes, the front being occupied as a carpenter shop. An option

is held, however, for the whole building, thus providing ample space for the plant's growth in proportion to business. The building, Fig. 1, is entirely of coral stone with concrete main floor. It is two stories high, having a 20-ft. extension the entire height of the building at the rear. This extension, divided from the main building by a fireproof wall, makes an ideal producer room and will be used entirely as such as soon as additions are made to the plant. At present this extension contains the producer and scrubber, blower, compressor, circulating pump, the gas engine for the generator and an old boiler which furnishes power for the carpenter shop and which will be shortly removed.

The producer plant consists of a 100-hp Otto producer and scrubber using about 1¼ lbs. of coal per hp-hour. The Tate process which is used for gas production requires no gas reservoir or steam. The producer is started by means of a small rotary blower and thereafter the draught is maintained by the vacuum caused by the engine intake. The coal used is anthracite pea coal obtained from New York. The blower for starting the producer and a small compressor for starting the gas engine are driven by a small Otto gasoline engine. This apparatus is run only for a short time in starting up each day.

Water for the scrubber and for the cooling system of the engine is circulated by a pump belted to the main engine. Rain water is depended upon almost entirely, a supply of salt water from the harbor being available in case of drought. This is not likely to occur, however, owing to the heavy annual rainfall in that climate. Drainage from a roof surface of about 10,000 square feet, several buildings, is collected in a 78,000-gallon storage tank situated below the floor of the main building.

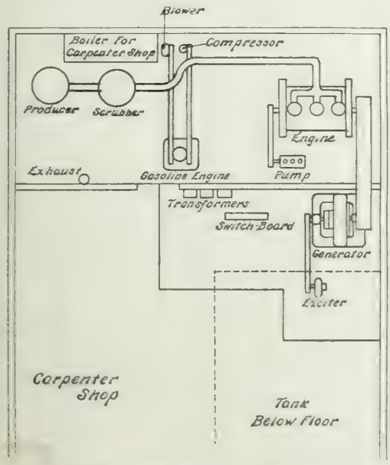


FIG. 2. PLAN OF HAMILTON STATION.

From this tank water is pumped by means of the circulating pump to a roof tank, from which it descends to the scrubber and the cooling system. The cooling water is returned to the storage tank and re-used and the scrubber water is run to waste. The engine requires a circulation of about 500 gallons an hour and the scrubber about 100. This last is the only water waster.

The main engine is a three cylinder, 75-hp Nash gas engine running at 250 r. p. m. It is belted to the generator in the main building, the belt running through the fireproof wall. The generator, Fig. 3, is a 50-kw, three-phase, six-pole, 2300-volt machine, running at 1200 r. p. m. The adaptability of these machines for parallel operation even with the somewhat variable drive of gas engines, made it particularly applicable for a plant of this kind where early additions are contemplated. The exciter is a 1.35-kw generator belted to the main generator to run at 1450 r. p. m.

When additions are made the boiler will be removed from the producer room and three more producer sets will be installed. The engine and generators will then be installed in the main room. The plant at present supplies a 32-ft. sign containing 163 16-cp lamps on the front of the building, several arc lamps and about 15 incandescents in the building. As soon as the pole

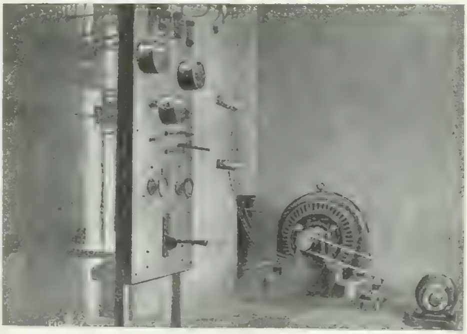


FIG. 3.—INTERIOR OF HAMILTON, BERMUDA, GENERATING STATION

lines are completed it is proposed to light streets, residences and stores in Hamilton and later to transmit to distant points. The plant was installed under the direction of Mr. W. F. Hurlbutt, erecting engineer of the Crocker-Wheeler Company, which company supplied the electrical equipment.

LETTER TO THE EDITORS.

Simplified Spelling.

To the Editors of Electrical World:

SIRS:—Referring to the letter of Prof. Brander Matthews in your issue of June 8, I am glad to know that you intend to "adhere to the spelling which has the sanction of general good usage." Prof. Matthews says, "Good usage varies widely and no two dictionaries agree." I should say, however, that when two modern dictionaries do agree on a certain word that it should be considered good usage, and if another dictionary stands by itself in spelling a word differently, that should be considered bad usage. The "Standard" dictionary may be somewhat in advance of the "Century," but it has made an advance in the direction of confusion, and it ought to take a step backward in its next edition. Several newspapers are following the "Standard" dictionary now and are spelling "practice" *practise*, both noun and verb, instead of "practice," the older form for both, or "practice," noun, and "practise," verb. It has been the custom as long as I can remember for physicians, lawyers and doctors to speak of their "practice," and all the literature in relation to their practice spells it with a *c*. Why should we now spell it with an *s*, just because the "Standard" dictionary spells it that way, while "Webster" and the "Century" do not? I have an old edition of "Noah Webster," which has the following:

"Practise, v. t., i.—See practice. (There is no reason why the noun and verb should not both be spelled with c, as in notice, sacrifice, apprentice, and all like cases where the accent precedes the last syllable. The distinction in spelling between the noun and verb properly belongs only to words which are accented on the last syllable, as device and devise, where the verb had the sound of ize. The spelling practise tends to give it the same sound, as we see in uneducated persons; and hence it is desirable to follow the regular analogy and write the noun and verb alike.)"

That was good advice given by Webster, and I do not see any reason for not following it now.

As for the simplified spelling of the committee, I am willing to go just as far in the direction of cutting off useless letters as "Webster" and the "Century" dictionaries go, but not a step farther. I strongly object to having one word *mist* mean both a fog and the past tense of "miss," and to have the past tense of the verb "to pass" spelled like the adjective *past*. I have a particular antipathy to *thru*, for this reason: Nine people out

of ten still use the pen and not the typewriter. Eight out of these nine write the letter *n* just like a *u* and four out of the eight write the letter *r* like some other people write the letter *e*. Some people will write what they think is *thru* and it reads *then*, and they will write *then* and it reads *thru*. If we could get everybody to write the letter *e* in the good old-fashioned way with a loop like a shortened *l*, this trouble would not arise, but so many try to write the small letter *e* similar in shape to the [illegible] the most desirable quality is legibility. If a man is a very bad penman he can scarcely write "through" so badly that it cannot be read, or at least guessed at, on account of the *gh* at the end, but even a fairly good penman may write *thru* to look like *then*.

[illegible]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

[illegible] TURNER.—In a place in Italy where insulation difficulties on some air-cooled transformer coils were experienced, and where steam for heating the drying ovens was not available, while coal was very high priced, coke was employed for this purpose, with the result that the temperature of the ovens fluctuated with the firing to a very wide extent. Insulation troubles, due to insufficient baking and hardening of the insulation varnishes, were overcome by adding ventilating fans to supply fresh air for oxidizing and hardening the varnish. The oven temperature was raised and kept more uniform by the aid of automatic temperature recorders and the varnishes were thinned to a better working density. The following system of electric drying was found to be quite effective. A motor-generator set was installed in the winding department from which direct current was supplied to the transformer coils which were being insulated. The coils had already been given a first dipping and been oven-dried over night so that the insulation and varnish next to the copper was perfectly dry and hard. The coils were connected six in series and sufficient current passed through them to keep the temperature, as registered by thermometers placed on the coils between 80 and 90 degs. C. Bias-cut treated linen tapes were used instead of cotton tapes and insulating varnish was applied immediately after each layer of tape. Two men put on the tape and applied the varnish consecutively to each of the coils. As soon as the last coil of the series had been taped and varnished the first one was dry enough for the next layer of tape and varnish. In this way several layers of tape could be applied in a day, so that instead of eight weeks less than one week was required for this work. In addition there was another great advantage, as the finished coils were at least 12 mm thinner than by the old method, thus allowing more air ventilating space between the coils when installed. The result was a considerable saving in time, labor and material so that two of the four drying ovens were permanently shut down.—*Elec. Jour.*, July.

[illegible] (British) patent of Ganz & Company for regulation of alternators. The pressure is regulated according to the load by including a resistance of negative temperature coefficient in the continuous-current field circuit, or a resistance of positive temperature coefficient in connection with the field of the exciter, these resistances carrying a current dependent upon the pressure and the load on the machine and influencing the current through the fields of the exciter so as to control the excitation to the main machine. In Fig. 1 the polyphase generator *G*, has continuous current field magnets *F*, energized by an exciter with an armature *g*, and shunt field-winding *f*. A counter winding f^1 in series with the positive temperature-coefficient resistance *W* is connected in shunt to the field winding *f*. The resistance, *W*, is traversed by the continuous shunt current in the counter winding *f*, and by an alternating current depending upon the load and the voltage of the main generator, and obtained, for example, from two small transformers, *i* and *v*, connected respectively in shunt across the terminals of the main machine, and in series with it, the secondaries being connected in series to the resistance *W*. The connections [illegible] ing the resistance of *W* to increase so that the current through the counter winding f^1 is weakened, and the excitation of the exciter correspondingly strengthened. The resistance, *W*, can be arranged in shunt across the field winding *F*, of the alter- [illegible]

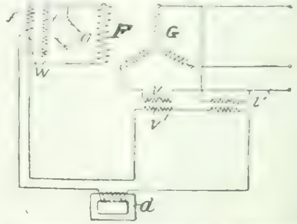


FIG. 1.—FIELD REGULATION OF ALTERNATORS.

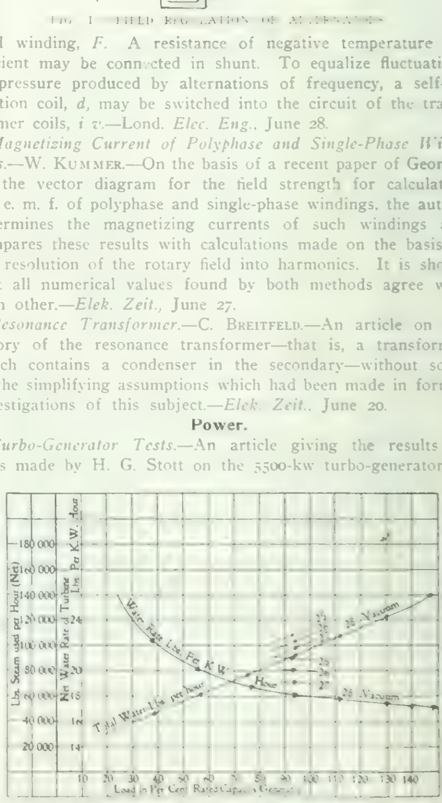
field winding, *F*. A resistance of negative temperature coefficient may be connected in shunt. To equalize fluctuations of pressure produced by alternations of frequency, a self-induction coil, *d*, may be switched into the circuit of the transformer coils, *i v*.—Lond. *Elec. Eng.*, June 28.

Magnetizing Current of Polyphase and Single-Phase Windings.—W. KUMMER.—On the basis of a recent paper of Georges on the vector diagram for the field strength for calculating the e. m. f. of polyphase and single-phase windings, the author determines the magnetizing currents of such windings and compares these results with calculations made on the basis of the resolution of the rotary field into harmonics. It is shown that all numerical values found by both methods agree with each other.—*Elek. Zeit.*, June 27.

Resonance Transformer.—C. BREITFELD.—An article on the theory of the resonance transformer—that is, a transformer which contains a condenser in the secondary—without some of the simplifying assumptions which had been made in former investigations of this subject.—*Elek. Zeit.*, June 20.

Power.

Turbo-Generator Tests.—An article giving the results of tests made by H. G. Stott on the 5500-kw turbo-generator at the power house of the Interborough Rapid Transit Company [illegible]



[illegible]

termined were the variation of steam consumption with load (constant thrust-bearing settings) and the variation of water rate with vacuum (constant load 5000 kilowatts). The results of the tests are given in Fig. 2. The operating record for the year 1906 is also given in the table. During 65 per cent of the time the turbine was in operation and carried an average load of 2 per cent above rating, while during the month of December it averaged 13 per cent above rating. The total output for the year was 32,054,250 kw-hours. For five different periods of 10 days under continuous load, the turbine averaged 140,422 kw-hours per day. Comparing this with the economy of a large Corliss engine with an assumed mechanical efficiency of 91 per cent, the engine would have to show an equivalent water rate of close to 10 lbs. per hp per hour to equal the performance of this turbine.—*Elec. Jour.*, July.

Power Transmission to Paris.—BLONDEL, HARLE AND MAHL.—A long report on the project of power transmission from the Rhone district, where abundant water power is available, to Paris. The estimate refers to a plant which could furnish per year 1,010,000,000 kw-hours. The project considers in the first place direct-current transmission at 120,000 or 160,000 volts, but they may decide to use three-phase current transmission.—*L'Industrie Elec.*, June 25.

Direct-Current Power Transmission.—A critical discussion of the recent paper by Highfield on the direct-current high-tension series system of Thury. The anonymous author sums up the disadvantages of this system, compared with polyphase transmission, and concludes that the direct-current series system has no promising future for power transmission.—*Elek. und Masch.*, June 23.

Electric Power in Sewage Works.—An illustrated description of the use of electric power in the Hanley sewage works where electricity is used for driving the sewage distributers by induction motors and for lighting.—Lond. *Elec. Eng.*, June 21.

Single-Phase Traction.—L. LICHTENSTEIN.—The author gives an account of experimental tests made by the Siemens-Schuckert Company on a track of the Marienfelde-Zossen road. The principal object of the experiments was the determination of the alternating-current resistance and of the "equivalent permeability" of the rails for different currents and frequencies. "Equivalent permeability" is that value of the permeability which is to be used in Maxwell's formula for the self-induction of a loop, in order to get accurately the self-induction of the loop formed by the copper trolley wire and the iron rail. The chief results of these measurements are given in the following table:

Frequency.	Amperes.	R_1	R_2	Equivalent Permeability.	
58.5	49	[illegible]	4.65	[illegible]	
48.7	[illegible]	[illegible]	6.3	–	
[illegible]	62.5	[illegible]	[illegible]	14.8	Joints with
[illegible]	108.4	[illegible]	4.1	15.0	Copper Bonds.
[illegible]	36.4	[illegible]	2.65	16.	
[illegible]	[illegible]	[illegible]	3.23	[illegible]	
58.6	35.	[illegible]	4.84	[illegible]	
48.6	[illegible]	[illegible]	6.05	[illegible]	Unbonded
[illegible]	46.2	[illegible]	[illegible]	[illegible]	Joints.
[illegible]	169.	[illegible]	[illegible]	14.4	

In this table R_1 is the ratio of the alternating-current resistance of the track per km to the direct-current resistance of the track per km, while R_2 is the ratio of the alternating-current resistance of the rail iron per km to the direct-current resistance of the rail iron per km. Besides these tests, measurements were made of the conduction of current through the earth, the resistance between earth plates, the tension of the rails against earth, the influence on telephone and telegraph circuits in the neighborhood and various capacity determinations.—*Elek. Zeit.*, June 20 and 27.

Single-Phase Railway in Italy.—A note on a single-phase electric railway in Italy which is stated to have all the characteristics of an ordinary railway. It is already open for merchandise for a length of 18½ miles, passing in its journey through 17 tunnels and crossing three large bridges constructed across the River Brembo at different parts of the route. Vignoles rails are employed weighing 27½ kg per metre, or about 56 lbs. per yard. Besides the two terminal stations, there are seven intermediate stations, all of which are provided with sidings for goods traffic. The levels vary from 810 ft. to 1300 ft. above sea level. The maximum gradient is 2.4 per cent for a length of 2300 ft., and there is a large number of curves, the minimum radius being 490 ft. The single-phase energy is supplied at 6000 volts. Throughout the entire length of the line the overhead conductor is erected, together with a feeder of 0.3 in., two wires each of 0.15 in. for supplying light to the stations, and a telegraph line. The trolley wire is supported by a steel cable composed of seven wires, each of 0.075 in. in diameter, suitable for a tension of 5500 lbs. The copper conductor attached thereto has the form of the figure 8 rolled to a section of 0.078 sq. in. Numerous methods of support are adopted along the line; in many cases 2½-in. channel iron is supported on either side of the line by wooden posts, and to it the steel cable is attached. The insulators used have been tested, when dry, to 50,000 volts, and in abundant rain to 15,000 volts. They consist of concentric bobbins slipped one over the other. The poles used are generally 6½ ins. at the top and 32 ft. long, 5 ft. 9 ins. being put in the ground. The lower ends are treated with creosote and chloride of zinc. The generating station is about one mile from Santa Giovanni Blanco, on the left bank of the Brembo. Three Riva-Monneret electric generators, coupled direct to turbines, are installed, each of 500 kilowatts at 500 revolutions, and for 25 periods. Separate exciting machines are installed, each of 30 kilowatts at 125 volts and 1000 revolutions, each of these again being coupled direct to turbines. Each locomotive is provided with four single-phase motors, each of 75 horse-power, suitable for a voltage of 250; each motor operates through gearing one axle of the motor truck. At the base of the locomotive a lightning arrester is located. Five of these locomotives have now been at work for the last few months drawing trains up to 175 tons, and notwithstanding the heavy gradients, an average speed of 12¼ miles per hour, including stops, has been obtained with a maximum speed of 34 miles.—From *L'Elettricita;* abstracted in Lond. *Electrical Engineer*, June 28.—An illustrated description, by A. Soulier, of the same railroad in *L'Industrie Elec.*, June 25.

Power in Denmark.—An illustrated article on the recently opened generating station of the Tuborg-Klampenborg Tramway Company at Skovshoved, near Copenhagen, which is the first alternating-current station in Denmark and forms the nucleus of a power transmission system. The station contains at present two direct-current dynamos, each of 150 kilowatts, supplying the traction current and also a pair of 150-kw motor generators, which convert to three-phase currents at 10,000 volts for supply to the power feeders. A battery is in parallel with these motor-generators. There are now being installed a pair of turbo-alternators, each capable of an output of 500 kilowatts, three-phase. When these turbo generators are running the two motor generators will be used in the opposite way; that is, to convert from 10,000-volt alternating to 550-volt direct current so as to supply traction current when the direct-current generators are shut down. About 10 miles of transmission line have been laid down to 14 transformer substations, the transmission voltage being 10,000. For further extensions it is intended to install two turbo-generators of 1200 kilowatts, and three sets each of 2500 kilowatts, all generating directly alternating current at 10,000 volts.—Lond. *Elec. Eng'ing*, June 13.

Electric Drive.—A fully illustrated description of the use of electric power in the Sheffield works of Vickers, Sons & Maxim. Every machine is being run at the highest possible speed for the work in hand and the introduction of high-speed tool-steel simultaneously with electric driving has increased the output of some of the shops by 100 per cent. Variable speed motors are employed, giving in most cases a range of speed of 3 to 1 simply by varying the shunt excitation, and whenever possible speed cones and back gear have been dispensed with. One of the [illegible] in use has a speed range of [illegible] from [illegible] to 200 [illegible].—Lond. *Elec. Eng'ing*, June 20.

Pumping [illegible] before the recent Engineering Conference of the British Institution of Civil Engineers on comparative costs of pumping by steam, internal-combustion engines and electricity based upon actual work, together with the discussion which followed.—Lond. [illegible], June [illegible].

Installations, Systems and Appliances.

Neutral Currents of a Three-Phase Grounded System.—G. I. RHODES AND C. F. SCOTT.—A paper, by G. I. Rhodes, illustrated by numerous oscillographic curves, on the effect of harmonics in three-phase circuits, with an editorial discussion on the subject by C. F. Scott. The fundamental and the third harmonic have quite different characteristics. One connection of circuits is impervious to the harmonic, although freely admitting the fundamental, while another connection allows the harmonic current to flow without the fundamental. The 5000-kw generators described in the present article generate similar e. m. f. in each of the three branches of the armature winding, which are connected in the ordinary star form. The e. m. f. measured between the neutral point and either of the main terminals of the generator contains both the fundamental and the various harmonics. The e. m. f. measured between the main terminals of the generator, and therefore including in series the e. m. f. generated in two of the branches of the armature winding, contain the fundamental and certain harmonics, but others do not appear for the reason that they oppose one another in the two branches; or, in other words, the third harmonics (and those which are a multiple of three) tend simultaneously towards the central or neutral point in all three branches. The two three-phase generators being connected in parallel on three bus-bars; the third harmonic does not appear in the bus-bar e. m. f. It does occur, however, in the e. m. f. measured between a neutral point and either bus-bar. If the two machines are operated under exactly similar conditions, there is no occasion for current to flow between the neutral points. If, however, the two generators have third harmonics of different value, then the e. m. f.'s between the neutral and the three main terminals of the first generator do not correspond with those in the second generator. Each of the three branches of one generator is in parallel with one of the three branches of the second generator. These three circuits have a common connection in the conductor, connecting their neutral points. Consequently, it affords a path for the currents which tend simultaneously to flow toward the center in all three circuits. If, therefore, the third harmonics in the two machines are not quite equal, the current flows in each of the three branches of the winding through the neutral conductor from one generator to the other and returns through the three bus-bars. The conditions which give rise to unequal third harmonics are due to field distortion caused by the armature current. If the armature currents in the two machines are similar, then the e. m. f.'s generated will be similar. If, however, the armature currents are not similar, for example, if the load on one machine is large while that on the other is small, or if the currents delivered are of different phase, or if there is a local current of fundamental frequency flowing between the machines, which is therefore leading in one machine and lagging in the other, then the field distortion and the e. m. f. produced are not the same in the two machines. A connection between the neutral points allows these unequal e. m. f.'s to cause a flow of current at three times the normal frequency. This current returning through the bus-bars affects the form of the bus-bar current. This high-frequency current, however, does not get beyond the bus-bars to the load if there be no connection between the neutral point of the generators and the load. In the present case, the 5000-kw generators run well in parallel under various conditions of load, excitation and engine conditions when the neutral points are not connected together, but encountered difficulties when the neutral points are connected and the conditions in the individual machines are materially dissimilar. Fortunately, however, it was found that the protection [illegible] the neutral of a single generator instead of all of the generators in parallel, as was at first proposed.—*Electric Jour.*, July.

Storage Batteries in Alternating-Current Networks.—Notes on some recent British patents of Siemens Brothers & Company. One of them relates to the regulation of alternating-current circuits by means of automatically-operating buffer devices. An alternating-current booster is interposed between the main leads and the rotary converter and buffer battery employed. The field of the booster is excited by a current which varies with the load on the network, and may also be dependent upon a current derived from the storage battery. In the arrangement shown in the lefthand diagram of Fig. 3, the

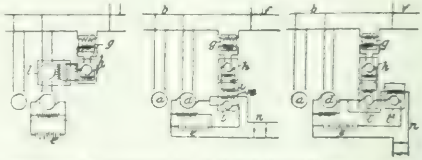


FIG. 3.—STORAGE BATTERIES IN ALTERNATING-CURRENT NETWORKS.

excitation of the booster, *l*, is effected through the series transformer, *g*, and the auxiliary rotary converter, *h*. In a modified arrangement, the excitation is effected by means of a current from the battery, *e*, the current being regulated by a variable resistance controlled by a solenoid carrying a current proportional to the network load. A second patent (see middle diagram) describes a means for reducing fluctuations of current in an alternating-current network, *f*, by a buffer battery, *e*, in parallel with the alternating-current generator, *a*, for the case in which the battery is also utilized to feed a direct-current network, *n*. The rotary converter, *d*, is provided with a booster, l^1, the field excitation of which varies according to the currents traversing both networks. One part of the field winding, *i*, is fed from a rotary converter, *h*, which in turn is fed from a series transformer, *g*. The other part, *m*, carries a current proportional to the current through the network, *n*. A modified form (see the righthand diagram) has two separate boosters, l^1, l^2, in series, the respective windings of which differ like the respective parts in the first modification.—Lond. *Elec. Eng.*, June 21.

Efficiency of Alternating-Current Plant with Storage Battery.—L. SCHROEDER.—With reference to a recent description of a three-phase plant, in connection with which a storage battery is used, the author determines the different losses which occur and finds that for full load the efficiency of the total plant, including the storage battery, is 89 per cent.—*Elek. Zeit.*, June 20.

Draught Regulator for Boiler Plants.—A note on an electric device for automatically regulating the air inlet to boiler furnaces. As shown in Fig. 4, it consists of a perforated pipe,

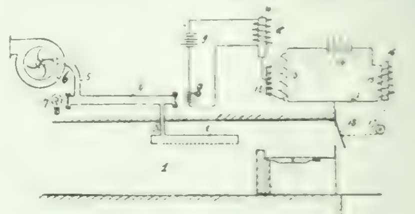


FIG. 4.—DIAGRAM OF DRAUGHT-REGULATING APPARATUS.

2, fixed in the flue, 1, behind the grate, and connected to the chimney through the tube, 4, and the small fan, 6, so that a portion of the flue gas passes along the tube 4. This tube is 4 cm or 5 cm in diameter and 1 m long, and is closed at both ends by transparent mica plates. An incandescent lamp, 7, is arranged at one end of the tube, and serves to throw more or less light on to the selenium cell, 8, according to the smokiness of the flue discharge. The selenium cell forms part of

the battery circuit, 9, which also includes the relay solenoid winding, 10. The solenoid core, 11, is drawn up more or less, and varies the resistance in the circuit of the main battery, 14, and so controls the position of the air damper, 18, by means of the solenoid, 16. If desired, the selenium cell may be replaced by a bolometer arrangement.—Lond. *Elec. Engineer*, June 28.

Wire, Wiring and Conduits.

Electric Cables for Collieries.—G. G. L. Preece.—A paper, read before the Manchester Geological and Mining Society, on two improvements for electric cables for coal mines. In the first place he describes a method of filling up the interstices between the wires of a stranded copper conductor with a special solid compound which will not run or become displaced by the heating of the conductor through overload. The method is to cover the center wire, and each succeeding layer of the stranded conductor, with a thin tube of plastic bituminous compound. This compound gets thoroughly worked up into the interstices of the strand. The principal advantage is that all passages for moisture are said to be stopped. The second improvement described by the author is a new construction of a three-core bitumen cable for three-phase currents, as shown in Fig. 5. The conductors of this cable are

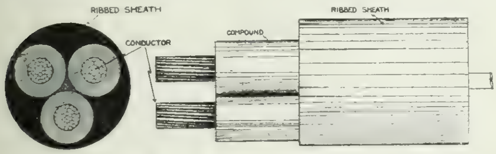


FIG. 5.—SECTIONS OF BITUMEN CABLE

each separately insulated with bitumen compound, then laid up together round a shaped core of bitumen, which fills up the central space, and is sheathed over all with a solid tube of bitumen, which is so forced on as to be ribbed internally and exactly fit the interstices between the three cores. The cable can then be taped and protected by armor, etc., as is necessary. This special construction obviates the introduction of fibrous material as padding.—Lond. *Elec. Eng.*, June 21.

Fuse Wires.—F. Emde.—A highly mathematical paper discussing the phenomena during operation of a fuse wire.—*Elek. und Masch.*, June 16 and 23.

Electrophysics and Magnetism.

Experiments with Vacuum-Gold-Leaf Electroscopes.—J. T. Bottomley and F. A. King.—A description of some striking mechanical effects which the authors observed in the gold leaves of vacuum electroscopes and which, at first sight, might be taken to simulate electrification of bodies by light and radiating heat falling on the gold leaves. The present account of the experiments is only a preliminary one.—*Phil. Mag.*, June.

Electrons and Ether.—A highly theoretical paper by C. B. Burton giving notes on ether and electrons; a note by A. H. Bucherer on the action of uniform electric and magnetic fields on moving electrons; and a note by Oliver Lodge on the ether and on the hypothetical magnetic flow.—*Phil. Mag.*, June.

Electrochemistry and Batteries.

Corrosion of Iron as an Electrochemical Phenomenon.—A. S. Cushman.—An abstract of a paper read before the American Society for Testing Materials. In the rusting of iron, oxygen is not the primary cause; its rôle is only secondary. When iron rusts there is first dissolving of iron in moisture, if the latter in contact with the iron contains hydrogen ions. The iron thereby passes into the state of ferrous ions and is later on oxidized by the oxygen in the air to ferric, with the resulting precipitation of the insoluble red hydroxide known as rust. Rusting may be prevented if the occurrence of hydrogen ions in solution in contact with the iron is prevented. This is stated to be possible by treating the iron in a potassium bichromate solution, which brings it into the condition of an oxygen electrode. The same issue contains a paper by W. H. Walker on the effect of stress upon corrosion of iron. Both papers are discussed in a long editorial.—*Electrochem. and Met. Ind.*, July.

Electric Steel.—A profusely illustrated description of a steel plant using the Héroult process for making steel of crucible steel quality. The metallurgical features of the Héroult process are also dealt with. The process consists first in the making of steel in the open-hearth furnace whereby the phosphorus is reduced to any desired extent; the overoxidized and decarbonized metal is then introduced in molten state into the electric furnace where the sulphur is eliminated and the metal is deoxidized and recarburized.—*Electrochem. and Met. Ind.*, July.

Storage Batteries.—V. Karapetoff.—A second article in which the operation and control of storage batteries are discussed. The author deals with the selection of the system of control; charging two halves of a battery in parallel; charging batteries in sections; the use of end-cell switches, and end-cell switch control of storage batteries.—*Elec. Jour.*, July.

Ozone.—A. W. Ewell.—An illustrated account of a test of an ozonizer the construction of which is shown in diagrams. The efficiency curves of the production of ozone are given.—*Electrochem. and Met. Ind.*, July.

Carbon Tetrachloride.—J. R. Crocker.—An illustrated article on the manufacture of carbon tetrachloride from electrolytic chlorine and on the uses of the tetrachloride.—*Electrochem. and Met. Ind.*, July.

Units, Measurements and Instruments.

Measurement of Mutual Inductance.—A. Campbell.—An abstract of a (British) Physical Society paper. Carey Foster's method of comparing a mutual inductance with a capacity is one of the most convenient methods, and the formula is very simple, being $M = K R r$, where K is the capacity and R and r are resistances. The great advantage gained by the use of a vibration galvanometer in methods for measuring inductance led the author to apply it to the Carey Foster and the Hughes-Rayleigh methods. He found, however, that with alternating currents it was necessary to modify the Carey Foster method by adding a series resistance in the condenser branch; this left the formula $M = K R r$ unaltered and gave an additional formula involving the ratio of a mutual and a self-inductance. The modified method is extremely convenient, the two adjustments required for a balance being independent and the result not involving a knowledge of the frequency; the use of the vibration galvanometer is a great improvement, making the method independent of the wave-form of the current used. If the detecting instrument used in a zero method (with alternating current) is adjusted so that its natural period is in tune with that of the applied voltage, it will be set into strong resonance and will be enormously increased in sensitivity for this particular frequency, practically ignoring in comparison all the other components of the wave-form. The author exhibited a vibration galvanometer having a moving-coil controlled by an adjustable bifilar suspension. By adjusting the tension of this the tuning is very easily effected. For measuring the frequency to which a tuned instrument is responding, it is convenient to use the Hughes-Rayleigh method, in which a known self-inductance is compared with an unknown mutual inductance, the balance being dependent on the frequency. The author showed such an arrangement in which the slide-wire was graduated directly in frequency. With accurately known frequency, on the other hand, the method gives absolute values of L and M.—Lond. *Elec. Rev.*, June 21.

Testing.—V. W. Shear.—Some notes of a general character on testing. The author recommends strongly to make diagrams of all circuits on switchboards, tables, relays, etc., which are not in plain sight. A good tester never anticipates results, though it is his chief temptation.—*Elec. Jour.*, July.

Telegraphy, Telephony and Signals.

Tuning in Wireless Telegraphy.—J. Hettinger.—In an article entitled "Wireless Telegraphy: A Solution of the Problem of Selectivity," the author describes a method based on the

following principle. The ratios of any two or more values of the resonance curve corresponding to different free frequencies of the receiving oscillatory circuits do not substantially change whatever the absolute value of the energy received might be. The author concludes that he has therefore a method of selectivity which is substantially independent of the power and distance of transmission. Several methods of applying this principle are described.—Lond. *Elec. Eng.*, June 21.

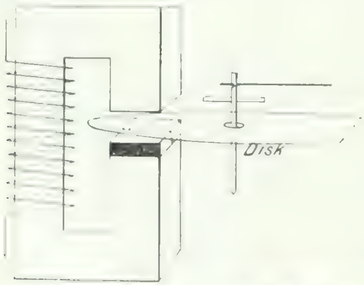
Speaking Condenser.—P. Seve.—A paper on the speaking condenser of Argyropoulos and Deprez. The author explains why the production of speech by means of an "electrostatic" telephone can only be counted upon when a strong auxiliary e. m. f. is applied to the condenser. When the primary e. m. f. obeys the equation $e = a \sin b t$ the attraction between the condenser plates is proportional to $\sin^2 b t$, and is, therefore, always positive, though intermittent. This means that musical notes will be rendered an octave higher than they are given. The circumstance makes no essential difference to a musical piece, but has the effect of seriously distorting spoken words, as one can verify by running a phonograph at twice the speed of the original record. The device of Argyropoulos makes the attraction practically proportional to $\sin b t$, and therefore reproduces all tones in unison. The author quotes an experiment made with an electrostatic telephone with and without an auxiliary e. m. f. Without it the notes 34 and 1000 were given, whereas with an auxiliary 270 volts the original pitches 42 and 500 were correctly rendered. The principle is really the same as that adopted in the heterostatic voltmeter and the telephone with polarized cone.—*Comptes Rendus*, June 3; Lond. *Elec. Eng'ing*, June 20.

Railway Signals.—W. E. Foster.—In a continuation of the illustrated serial on railway signals, the principles of automatic block signaling are discussed.—*Elec. Jour.*, July.

Induction Type Ammeters, Voltmeters and Wattmeters.

By Paul MacGahan and H. W. Young.

To the consulting engineer, central station manager and in fact practically everyone connected with electrical development, the subject of alternating current measurements is one of much importance. The ammeters, voltmeters and wattmeters described below all operate upon the "Induction Principle," de-



[illegible] AMMETER

pending for their action upon the generation of a torque or turning moment in a pivoted metallic shell located within the influence of a rotating magnetic field energized by the current to be measured.

[illegible]

In order to clearly understand the principle upon which the modern induction ammeter operates it is necessary to take up the simplest form of moving disk meters of which the present drum type [illegible]

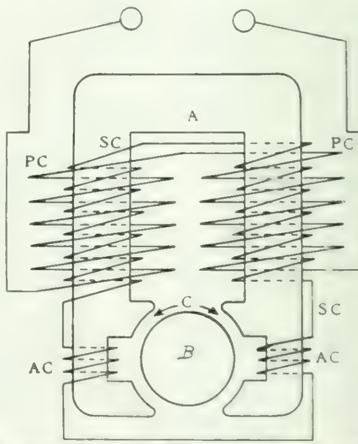
electromagnet wound on a laminated iron core of C section (Fig. 1) in the air gap of which rotates a disk-shaped armature suitably pivoted and controlled by a spring in the usual manner.

In order to produce rotation, one-half of one iron pole is surrounded by a short-circuited conducting loop which acts to displace the flux enclosed within itself relative to the flux of the non-enclosed section of the iron pole face. This displaced enclosed flux reacts upon the eddy currents induced in the disk by the other flux and produces a tendency to rotation which is counterbalanced by the restraining action of the control spring.

The effect on the disk and consequently the deflection will be proportional to the strength of the magnetic field (or approximately to the magnetizing current of the coil) multiplied by the current induced in the disk, which latter is proportional to the induced voltage produced by the strength of the magnetic field and the rate at which it varies; hence, the pull on the disk will be proportional to the square of the current and to the frequency of the circuit. As the resistance of the disk varies directly with the absolute temperature, the pull or rotative action on the disk will vary inversely as the absolute temperature.

To overcome the influence of change in frequency of temperature a compensating device has been employed consisting of coils of copper wire wound non-inductively and connected in parallel with the actuating magnetizing coils. As the frequency increased the compensating coils took more of the current, and as the temperature increased they took less, thus compensating in quite a satisfactory manner for the errors introduced by variations in temperature and frequency. This, however, was at the expense of efficiency and torque and the windings were more or less complicated, so that efforts were made to develop a design which would be inherently independent of such variations. The result of these efforts is the development of the "Drum Type" ammeters, voltmeters and wattmeters herein described.

Fig. 2 illustrates diagrammatically the ammeter construction, the various elements of which are as follows: *A*, laminated iron [illegible]



[illegible]

primary coils connected in series or parallel; *SC*, secondary coils connected in series or parallel; *AC*, auxiliary coils connected in series with *SC*.

The winding *SC* is placed next to the iron laminated core *A*, and the winding *PC* placed over *SC*. The primary windings [illegible] placed on each leg of the iron laminations. One coil on each [illegible] giving two series windings in the meter, each winding having half its turns on each set of iron laminations, resulting in a

balanced magnetic circuit. The meters are provided with two heavy binding posts and four smaller posts. When it is desired

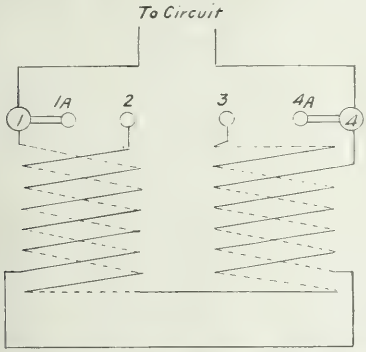


FIG. 3.—ARRANGEMENT OF PRIMARY CIRCUIT. "DRUM" TYPE INDUCTION AMMETER.

to use the lower ampere capacity the windings are connected in series by bridging the two central binding posts, and when it is desired to use the higher ampere capacity the windings are connected in parallel by bridging together binding posts 1*A* and 2 and 4*A* and 4. The circuit leads are connected to the large binding posts.

The moving element consists of a light aluminum cylindrical shell mounted on a shaft provided with highly polished steel pivots, and is located in the annular gap *C*. The shaft, which is supported in jeweled bearings, also carries an indicating pointer and a control spring, the outer convolution of which is fastened to a stationary support.

The meter action can best be understood by considering the windings *PC* and *SC* as the primary and secondary windings respectively of a series transformer, the secondary of which is short-circuited on itself and the primary connected in series with a suitable load. To obtain an induction ammeter system of this kind inherently correct, it is obviously necessary to make the induction vary inversely as the frequency and directly as the temperature. Such a system can be secured in a simple, automatic manner without any corrective devices in the series transformer with a non-inductive copper resistance secondary.

Assuming the current in the primary to be constant, the secondary current will be approximately constant. Thus as the frequency increases, the induction will decrease in direct proportion. Also as the temperature and consequently the resistance of the secondary coil increases, the induced voltage and consequently the induction increases proportionately. If, therefore, the magnetism of the series transformer is made to drive the rotor of an induction meter, the meter will, within wide limits, be theoretically independent of frequency and temperature.

In the simple vector diagram of a series transformer (Fig. 4) let *OS* represent the secondary ampere-turns when the resistance of the secondary is entirely ohmic. Then neglecting losses, *OP* (the primary ampere turns) will equal *OS* and

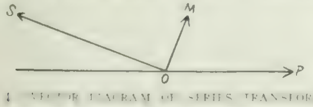


FIG. 4.—VECTOR DIAGRAM OF SERIES TRANSFORMER.

will be approximately 180 deg. out of phase, the angle *SOP* depending upon *OM* which represents the magnetizing current required. The resultant magnetic flux produced will be in phase with *OM*.

The current *OS*, instead of passing through a non-inductive secondary winding can be made in turn to magnetize a portion of the magnetic circuit, in which case the magnetism it produces will be in phase with this secondary current, or in the direction *OS*. The more nearly perfect the device, considered as a series transformer, the more nearly will the two fluxes of *OM* and *OS* be at right angles. In order to have a perfect rotary field, it is only necessary to properly place the coils *OP* and *OS* with reference to each other.

The series transformer principle can be made to serve the double purpose of producing a rotating field without using a "phase splitter" and of producing a field which, in conjunction with a proper rotor, will produce a torque independent of the frequency and of the temperature, within wide variations. It is also found that by keeping the induction and losses very low, variations in wave form produce no appreciable effect whatever upon the torque. These principles, when properly applied to a meter, produce a device which is practically ideal.

The construction employed gives an electromagnet having a rotating field within which is pivoted a rotable closed secondary, the two producing a torque or turning movement which is opposed by the restraining spring, and the point of equilibrium will be indicated by the pointer which affords, in conjunction with a suitably graduated scale, an accurate means of measuring the current value producing the deflection.

VOLTMETERS.

Voltmeters employ the same construction as ammeters with the exception of the primary winding, *PC*, which has a large number of turns of fine wire in series with an internal resistance of zero temperature coefficient. In order that the voltmeter may be used upon either 25 or 60 cycle circuits it is provided with taps in the series resistance brought out to two plug connections. By using the proper tap the meter will read correctly on either frequency.

WATTMETERS.

Fig. 5 illustrates diagrammatically the single-phase wattmeter construction which, as will be noted, has the same general appearance as the ammeter. The arrangement and distribution

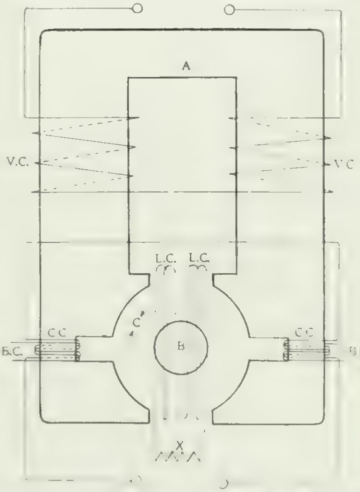


FIG. 5.—ARRANGEMENT OF PARTS. "DRUM" TYPE INDUCTION WATTMETER.

of the windings, however, are entirely different, as the transformer principle is not employed, the rotating field being obtained as in an induction motor.

The various elements shown are as follows: *A*, laminated iron structure; *B*, laminated iron core; *C*, annular air gap; *VC*, voltage coils connected in series or parallel; *CC*, current coils connected in series or parallel; *LC*, lag coil connected in series; *X*, non-inductive resistance for *LC*; *BC*, balance coils.

The current windings, *CC*, are wound and connected to binding posts in a manner identical to that shown in Fig. 3 for ammeter primary windings, *PC*. The voltage windings *VC* consist of two fine wire coils, one on each leg of the laminated iron structure and arranged for series-parallel connection by

bringing the terminals to suitable stationary studs and flexible connections. The meter can, by means of these connections, be quickly adapted for either 100-200 volts or 200-400 volts.

The moving element is identical in construction to that employed in the ammeter, differing only in the metal used, which is a special alloy having low temperature coefficient rather than aluminum, for the reason that not having the automatic temperature correction effect offered by the series transformer construction employed in the ammeter, a metal is necessary whose resistance is practically unaffected by temperature variations. The actual temperature coefficient is .07 per cent per degree Centigrade. In general appearance the single-phase wattmeter is similar to the ammeter and voltmeter.

From the illustration (Fig. 5) it will be seen that the principle involved is that of a miniature induction motor having for a rotor the pivoted drum and a bipolar field built up of thin laminated iron, the polar projections of which partially surround a mass of circular laminations, thus giving the annular gap, *C*, in which the rotor is pivoted.

The voltage windings, *VC*, consist of a large number of turns on the iron core, *A*, having high self-induction owing to which fact the current in this winding lags approximately 90 deg. behind the impressed e. m. f. of the source of supply or line voltage. The series or current windings, *CC-CC*, consist of a few turns of comparatively heavy wire wound on the pole pieces of the iron laminated structure *A*. This winding is of very low self-induction and is connected in series in the circuit the current in which is to be measured.

Neglecting for the moment iron loss and resistance loss in the shunt or voltage coil, *VC*, and therefore assuming the magnetism of this circuit to lag exactly 90 deg. behind the impressed e. m. f. or line voltage, it will be seen that with a non-inductive load consisting of incandescent lamps, the current in the series coil, *CC*, is in phase with the line voltage and the current in the shunt circuit *VC* is behind the voltage. Therefore, as the currents in the circuits *VC* and *CC* differ 90 deg. in phase, there are produced magnetic fields at right angles to each other and these fields passing through the pivoted rotor produce a rotary field which gives the rotor the required torque or turning moment. The movement of this pivoted rotor is opposed by the restraining force of a control spring, so that the point of equilibrium between the turning torque of the rotor and restraining action of the control spring will be indicated by the pointer and in conjunction with a properly calibrated scale gives a direct indication of the power in the circuit.

If, however, a meter involving only the windings *VC* and *CC* referred to above is employed, it will register correctly on non-inductive load only, reading incorrectly as the load becomes inductive and the power factor becomes less than unity. The reason for this difference in reading on non-inductive and inductive loads is that the phase angle between the circuit in coils *VC*

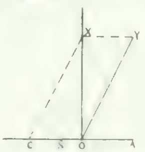


FIG. 6.—VECTOR DIAGRAM.

and *CC* is not exactly 90 deg., owing to the iron and copper losses in the shunt or voltage coils *VC*, and therefore the angle between the shunt and series magnetism acting on the rotor is somewhat less than 90 deg. A meter, therefore, will not read correctly on low-power factors unless this discrepancy in phase angle is compensated for in some manner. The necessary compensation is accomplished by the auxiliary lagging windings, *LC*, connected in series and short circuited on themselves through a short piece of German silver wire, *X*, forming a non-inductive circuit. This auxiliary lagging winding is so located that its field reacts on the field of the shunt or voltage coil *VC*, and by properly adjusting the resistance, *X*, the resultant magnetic field is exactly 90 deg. behind the impressed e. m. f. This method of securing the resultant field can be better understood by referring to Fig. 6, in which *OA* represents the voltage of shunt coil *VC*; *OY*, the current passing through *VC*, and *YOA*, the angle less than 90 deg. due to iron and copper losses in *VC-VC*.

OS represents the induced voltage of lagging winding *LC* approximately opposite in phase relation to that of *OA*, but very small in value—the current passing through resistance *X* being in phase and equal approximately to *OC*. This current, *OC*, and the main current, *OY*, have a combined magnetizing effect on the iron core, which effect is found by forming the parallelogram *OCXY*, when *OX* is the resultant effect now practically at right angles to the impressed e. m. f. of the circuit. By varying the amount of resistance *X*, the magnetism can thus be shifted back to the proper angle, so as to make the meter read correctly at all conditions of power factor for a given frequency.

The polyphase meter consists of two separate single-phase elements mounted in a single case and having a common shaft carrying the two rotors, which thus revolve in separate fields. This construction insures a meter which is correct on either two-phase or three-phase circuits under any condition of unbalancing, power factor, etc. One of these is shown in Fig. 7.

The meter indications are practically free from disturbing effects of stray or external magnetic fields generated by heavy currents or magnetic material in proximity to the meters, this freedom being secured by the electromagnetic construction which gives an intense concentrated field much stronger than any field to which the meters will ordinarily be subjected. The dead-beat qualities of the meter indications are due to the damping action resulting from movement of the metallic drum across the electromagnetic field produced by currents passing through the various windings, this movement giving rise to "Foucault" or eddy currents, the magnetic field of which, acting in opposition to the generating field, tends to damp and prevent oscillation of the closed conductor. Slight motion of the pointers sometimes observed during readings is due to actual variations in the power, which the pointer exactly follows.

The torque or turning moment is very high for indicating

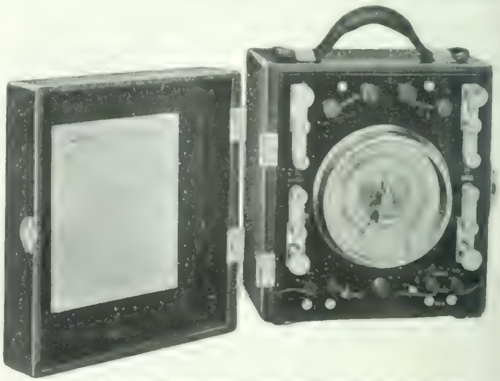


FIG. 7.—PORTABLE INDUCTION TYPE POLYPHASE WATTMETER.

meters, thus permitting the use of heavy controlling springs which, in conjunction with the light weight and highly polished bearing surfaces, insures a construction which will quickly, accurately and positively respond to the slightest changes in load, current or pressure. The full scale torque of the various meters is approximately 20 millimeter grammes.

The scale of ammeters and voltmeters gives deflections proportional in degree to the square of the current or voltage and gives very open readings except at the lower end. The wattmeter scales are uniform from zero to full scale reading and are very satisfactory as to length and legibility. The length of the scales forms one of the most noticeable features of the meters, materially adding to their value in service.

When it is desired to measure currents in excess of the meter

capacity, the portable series "Plug Type" transformers (Fig. 8) are found useful. For instance, assuming it is desired to accurately measure currents varying from 1 to 100 amperes, an ammeter having series parallel windings of 5 and 10 amperes would be used in conjunction with a "Plug Type" series transformer having a 5-ampere secondary and primary of 25, 50 and 100 amperes. With this construction the useful range of the ammeter would be as follows: 1 to 5 amperes reading in .05 ampere divisions; 2 to 10 amperes reading in .1 ampere divisions; 5 to 25 amperes reading in .25 ampere divisions; 10 to 50 amperes reading in .5 ampere divisions; 20 to 100 amperes reading in 1. ampere divisions.

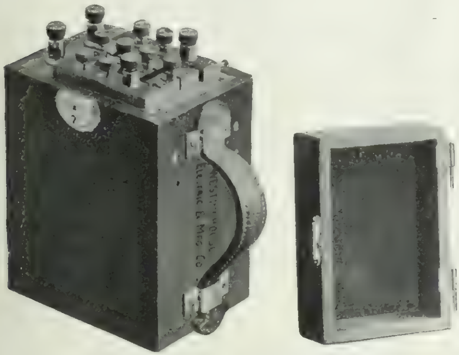


FIG. 8.—PLUG TYPE SERIES TRANSFORMER.

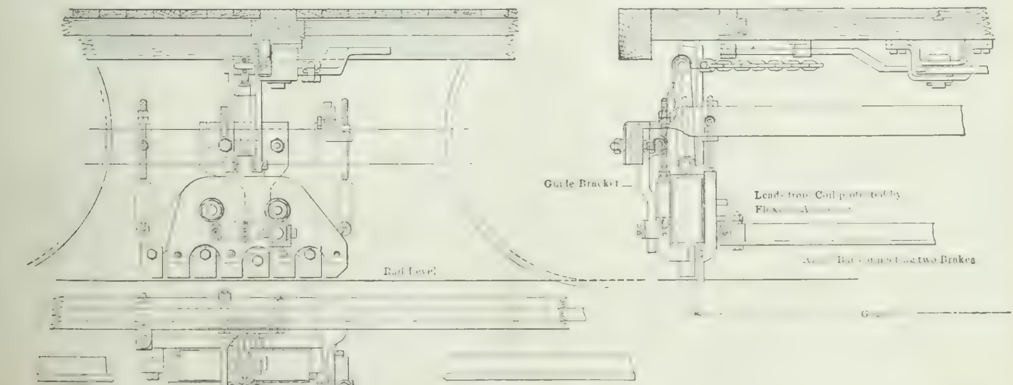
The transformer can also be profitably employed with the wattmeters, as for instance, assuming it is desired to measure single phase loads varying from 50 to 10,000 watts at 100 volts a wattmeter having series parallel winding of 5 and 10 amperes would be used in conjunction with the series transformer recommended for use with the ammeter and the following full scale capacities could be secured in the wattmeter: 0-500 watts reading in 2 watt divisions; 0-1000 watts reading in 4 watt divisions; 0-2500 watts reading in 10 watt divisions; 0-5000 watts reading in 20 watt divisions; 0-10,000 watts reading in 40 watt divisions. The meter also being provided with 200 volt potential winding could be used to measure loads double the capacities given above.

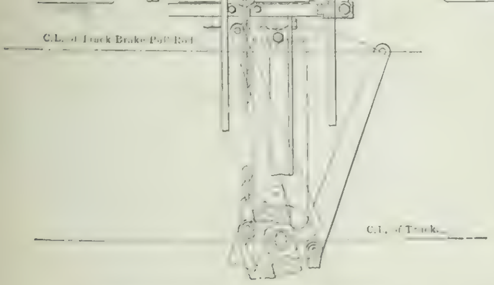
With the ordinary single-scale meters it would (in order to secure sufficient scale deflection at each load) be necessary to employ at least one each of the following capacities: 5, 10, 25, 100 amperes. In this way a sufficiently large deflection could be obtained on each meter to enable them to be used at their most accurate capacity. The combination suggested, however, accomplishes with one meter and one transformer the same results as would be secured by the use of four ordinary meters. The same combinations are also applicable to polyphase measurements by employing two series transformers with a 5-10 ampere polyphase meter.

The advantages of the "induction type" meters are briefly as follows: Absence of moving wire or iron, light and simple moving elements, long open scales, freedom from stray field effect, inherently dead-beat.

Development of Track Brakes.

An improved form of track brake has been supplied to the Sheffield Corporation by the British Thomson-Houston Company which is a combined magnetic and mechanical track brake, so designed that it can be applied by the driver either as an ordinary mechanical slipper brake, or as an electro-magnetic track brake, or as both combined. The general features of the brake will be apparent from the accompanying drawing. The track slipper consists of the usual form of "B. T. H." track brake magnet, one attached to each side of the truck, with an extremely simple system of levers by which the slipper is pressed against the rail when the driver operates the hand-brake wheel on the platform. There is an adjustment device in the leverage system, readily accessible from the side of the truck, by means of which the height of the magnet above the rail may be adjusted if found necessary. Experience has shown at Sheffield, however, that practically no adjustment whatever is required, because the radial wear of the tires and of the wearing shoes of the magnet is about equal. This feature also allows the track brake wearing shoes to be renewed when the car is re-wheeled, instead of each day.





DIAGRAMMATIC VIEW OF TRACK BRAKE.

The power of the magnetic track brake and its ability to control a car is well known. Of the power of the brake when applied mechanically, the following test, carried out at Sheffield, gives ample testimony. The car was driven at full speed on a level track with the motors in full parallel. The track brake was then applied mechanically by hand without shutting off power. This rapidly brought the car to rest, the wheels spinning on the track through being driven by the motors. The

ability of the brake to stop the car when the full power of the motors is acting to keep the car in motion, is ample proof of its great power and efficacy. When it is also remembered that the action of the brake is in no way dependent upon the rotation of the wheels, and that the brake cannot in any case lock the wheels it will be appreciated that it is thoroughly reliable.

Porcelain Insulators for High-Tension Circuits.

The porcelain insulators shown in section herewith have been designed by the Karlsbader Kaolin Industrie Gesellschaft, of Merkelsgrün bei Karlsbad, in Bohemia, to combine all the theoretical and practical experience thus far gained by those engaged on high-tension work. The characteristics necessary in insulators for proper protection are attained according to the various kinds of porcelain employed. On this latter point a few words on porcelain for insulation purposes may not be out of place.

Porcelain consists of a mixture of kaolin (a material made plastic in the damp state by the clay and silicic acid contained in it), quartz (silicic acid) and felspar (a dissolvable mineral consisting of clay, silicic acid and potash). The glazing is composed of the same materials with the exception that it contains a larger quantity of felspar and an addition of lime or some substance containing magnesia, in order that it may flow easily when fired. The porcelain material consists of silicates and double silicates of clay, potash and lime together with silicic acid, only mechanically combined, in which when subjected to heat, the melting molecules cement together with those not melting, but only softening.

For high tension insulators the combination of materials employed so far does not suffice; but the mass must be closely united so that its surface as an insulator may be effective. Experiments have proved that not only the flux, but also the materials richest in silicic acid possess the greatest power of insulation. On the plasticity of the kaolin depends the quantity of flux and silicic acid absorbed, and only pure Zettlitz kaolin from the company's own mines is used. While the mass must contain a certain amount of clay to give it the necessary firmness when subjected to heat, the glazing must at the same temperature become quite liquid and spread over the surface of the mass.

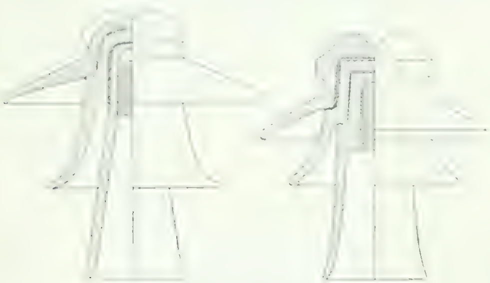


FIG. 1.—HIGH-TENSION INSULATOR.

Insulation against loss of current in consequence of its leakage on the surface during rain or fog has been considered just as much in the construction of the insulators as insulation against puncture. The causes which bring about losses are too well known to need further mention here. The separate mantles or petticoats are so arranged that no insects or dirt can collect between them and the slope and form are such that even in heavy rains, water cannot collect. The various insulators are so constructed that with a higher tension larger upper surface insulation has been taken into consideration. An endeavor was made in the construction of the high-tension insulators to guard against the formation of sparks during rainfall. The insulators are made with petticoats which easily shed the water, and as a further protection a special porcelain carrier encircling the iron bolt rests on the support in such manner that the stretching of the wire will not affect it. These supports prevent discharges from the surface of the insulator to the bolt. The insulators are designed for cables of 50 mm. diameter and a maximum span of 75 yards. These measurements are the result of dynamic experiments, changes of temperature and the weather being taken into consideration. In the case of insulators for tensions under 15,000 volts, a thinner wall would have sufficed; but in order to insure mechanical stability, the thicker wall is preferred. The insulators shown will stand tensions of from 6000 to 60,000 volts. Each insulator is tested before shipment, the company having facilities for varying the voltage from 500 to 120,000 volts. A 180-kw, three-phase alternator is used to supply the testing transformer, and the insulators filled with water are subjected to the high tension current for two hours.

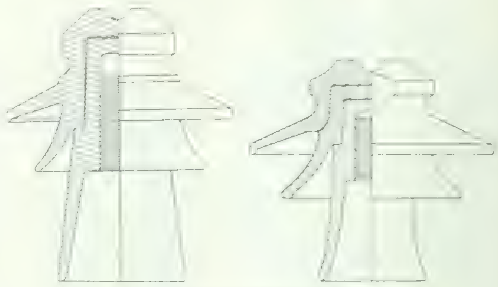


FIG. 2.—HIGH-TENSION INSULATOR.

Insulating Varnishes.

There has recently been placed in the market a new insulating varnish known as "Benolite" which is claimed to possess high dielectric strength and great flexibility, and yet contains no linseed oil and no metallic driers, nor is it an alcohol or spirit varnish and does not depend upon China wood oil (Tung oil) for its characteristics. Many of the present insulating varnishes depend on linseed oil for their principal characteristics. Linseed oil dries by oxidation, the oxygen being furnished by metallic driers mixed with the oil. There would be no objection to this, providing the metallic driers were well selected, if the oxidation could be stopped at the desired point. This, however, is impossible, it is said, and in any linseed oil varnish oxidation continues until flexibility is destroyed and the insulating properties considerably lessened.

Benolite is a black, water-proof, oil-proof, flexible varnish which can be air dried in four to six hours and can be baked at 212 deg. F. in one to two hours. It consists of a combination of materials which dry by chemical action but not by oxidation. This action is such that no metallic driers are necessary and the action stops altogether at a point where the varnish retains a permanent flexibility. The gums which form a considerable part of the varnish are such as to make it entirely water-proof, but for the first few days these gums may be affected by oil. After this time, however, the chemical change which takes place renders them absolutely oil-proof. Benolite is stated to have considerable power of penetration into cloth, one remarkable fact being that the entire varnish and not simply the volatile solvent penetrates the cloth. Once dry, Benolite is absolutely acid and alkali proof, the varnish not only being unaffected itself but absolutely protecting the copper or cloth beneath from corrosive action.

A single layer of cotton tape painted with Benolite, the total thickness being about .025 in., is stated to have a dielectric strength of from six to ten thousand volts. A superior in-

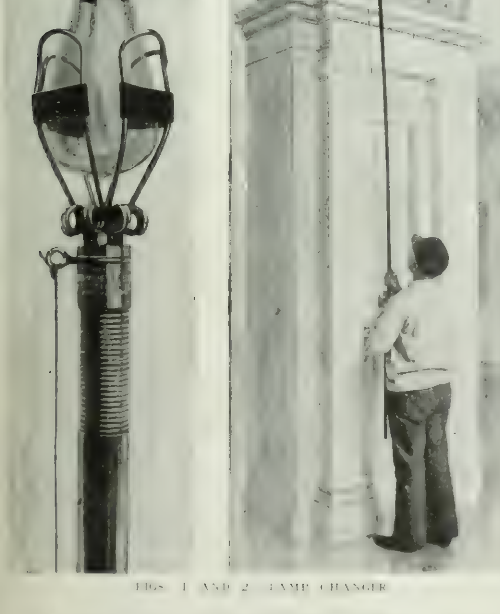
sulation can be obtained by taping the article with cotton or linen tape, painting four or five times with Benolite, drying each coat about two hours, then applying a second layer of tape and painting with Benolite as before, repeating the taping and painting as many times as is desired. The Benolite thoroughly penetrates the tape and forms a fine, glossy surface over each layer. The result is a thoroughly homogeneous mass of insulation having a high dielectric strength.

Benolite can also be used to advantage as a compound for field coils. The fact that it dries by chemical action makes it unnecessary to be in contact with the air to dry, and its penetrating qualities and flexibility make it an excellent material for this kind of work. In the repair shops, where facilities are not always at hand for baking, Benolite shows up to advantage. Field coils can be dipped in the varnish and set aside to dry, the result being fully as satisfactory, it is asserted, as coils impregnated by means of expensive vacuum apparatus. Armature coils can be built up with Benolite, and within a few hours a result obtained which would require as many days with a baking varnish. After the machine is assembled, the whole can be painted with Benolite and the result will be a machine of high dielectric strength, which is proof against water, oil, acids and alkalies.

The new material is made by the Benolite Company, of Pittsburg.

Changing Lamps in the Socket.

Some kind of special device is always necessary for reaching incandescent lamps on high ceilings, lofty chandeliers, etc., and herewith is illustrated in Figs. 1 and 2 the "Easy Lamp Changer," which W. N. Matthews & Bro., of St. Louis, took



FIGS. 1 AND 2.—LAMP CHANGER.

over recently from the Partridge Shade & Reflector Company, of Chicago, and are now putting on the market themselves. Fig. 1 shows the appliance in detail, holding a lamp which has just been removed from its socket. Fig. 2 shows the ease with which decorative lamps out of ordinary arm's reach can be dealt with by the device.

The "Easy Lamp Changer" is built on the same principle as the human hand. It has a set of artificial fingers which close over and grasp the lamp firmly while it is being removed or replaced in the socket. The rubber bands over the ends of the fingers prevent the lamp from slipping while it is being turned in. The double coil spring permits the shaft or wrist to this hand-like device to be bent at any angle. This is accomplished by holding the pole firmly in one hand and pulling down on the string with the other. By turning the pole to the right the lamp may be inserted, or it may be taken out by turning it to the left.

The changer fits all lamps from 6 cp up to and including 32 cp. Anybody with ordinary dexterity can use the device with success without previous experience.

Equipment in a Paper Mill.

The Willamette Pulp & Paper Company, of Oregon City, Ore., has just added to its plant a second factory which, with the older mill enables the company to produce 140 tons of paper per day. The complete plant of the Willamette Pulp & Paper Company is one of the largest of the kind on the Pacific Coast and supplies paper for the principal daily newspapers of the Northwest. The new mill, being for the most part electrically driven, furnishes an excellent example of the advantages of this flexible method of power distribution. The Willamette River at this place has a fall of about 25 feet and the old mill of the company is located at the brink of the falls. The new mill is about 1000 feet distant and is driven by induction motors supplied with current from a water wheel driven generator located in the old mill. By utilizing the electric system in this way, it has been possible to develop some 750 additional horsepower at the falls and at the same time locate the mill advantageously.

The electrical equipment was furnished by the General Electric Company, and consists of a 600-kw, three-phase, 600-volt revolving field, alternating-current generator direct connected to a 1000-hp water wheel built by the Platt Iron Works. The power is transmitted directly at the generator voltage. To insure against a shutdown in the new mill, arrangements have been made with the local company for power, should any accident happen to the paper company's generating equipment.

In the new mill, both group and individual induction motor drives have been arranged. The motors are all of the squirrel-cage type and operate at 550 volts. One group consists of a 12-in. x 13-in. chipper, a chip separator, a saw dust conveyor and a bucket-hoist, driven by a 200-hp induction motor. The motor is operated about eight hours per day and carries load easily no matter how hard the chipper is crowded. The bucket-hoist carries the chips into bins ready for the digester. A second group, driven by a 200-hp induction motor consists of three pumps and four beaters, each handling 650 lbs. of pulp. This motor runs continuously 24 hours per day. The beater load fluctuates greatly, varying with the amount of moisture in the pulp and the amount of pressure exerted by the operation. Owing to the large starting effort required for the beaters, a friction clutch is inserted in the line shaft so that the motor can come up to speed without load and then take the load gradually by means of the clutch.

A third induction motor having a capacity of 100 hp drives two chest-agitators and three pumps. The paper is reduced to the proper consistency for the paper machines in a Jordan engine which is driven by a 100-hp motor. A 10-hp motor is belted to the elevator. This motor runs continuously, taking full load only when the elevator is in use. The four wet machines and three Decker machines are also driven from a counter-shaft belted to a 50-hp induction motor.

Steam power is used for the operation of the 152-in. Fourdrinier paper-making machine. A 650-hp noncondensing engine is used for this purpose, the exhaust steam being piped to the drying cylinders on which the paper is rolled before being calendered and reeled.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—With continued favorable weather, improved conditions are reported in retail and jobbing lines, the crop outlook and in mercantile collections. Jobbers and wholesalers are receiving liberal orders for fall and winter merchandise, and interior buyers are active in the primary markets. Crop reports are more encouraging than the latest official statement, indicating much improvement since July 1, on account of favorable weather. Manufacturing returns tell of large orders on hand and very heavy production during the first half of the year. Freight tonnage is well maintained, gross railway earnings in the first week of July exceeding last year's by 12.1 per cent. The latest figures available show that railway gross earnings in June exceeded those of the same month last year by 13.4 per cent, the mileage represented aggregating 93,500. For the full fiscal year ending with June the increase over the corresponding period for 1905-06 is 9.6 per cent. Returns for May indicate large gains in net earnings, the increase as compared with May, 1906, being something over 13 per cent. Foreign commerce at the port of New York for the last week shows gains of $4,253,375 in imports and $269,555 in exports, as compared with the corresponding week of 1906. Great activity is noted in the leading industries. The demand for iron is quiet, but production is at the maximum, and the six months' production breaks all records. The demand for structural material is light, but it is stated that some heavy business is pending. Lake ship builders are specifying heavily on materials for vessels. Copper is much lower, the long-expected "official" break in prices having materialized. Some new business followed as the result of the reduced prices, but thus far there was no general buying movement, and there was a disposition to question whether prices have been lowered sufficiently to induce an active demand from American concerns. The closing quotations are 22c. for Lake; 21⅝c. for electrolytic and 20¾c. for casting stock. The commercial failures in the United States during the first half of 1907, were 5607 in number and $69,568,662 in amount of defaulted indebtedness. This is the best statement as to number of bankruptcies for the corresponding six months of any year since 1899, but liabilities were slightly above the average on account of a few very large failures in New York. In the first half of 1906 there were 5612 failures, involving $62,664,074. The number of failures during the past week as reported by *Bradstreet's* was 185 against 135 in the week previous and 143 in the corresponding week last year.

THE ENGINEER COMPANY, Trinity Building, New York City, has just issued the following announcement: "We beg to advise of a change in policy and personnel of the Engineer Company. Mr. Henry B. Haigh and Mr. John MacCormack have resigned as president and second vice-president, respectively, and their interests in the Engineer Company have been absorbed by Mr. Embury McLean as president. Mr. MacCormack will engage independently in the manufacture of his stoker, the Engineer Company having relinquished to him its rights in his patents. This relieves the Engineer Company of the commercial development of a stoker and leaves a free field for the installation of 'balanced draft' in connection with any boiler furnaces, whether hand-fired or operated with any of the various mechanical stokers. At the present writing upwards of half a million horse-power of boilers are being operated with 'balanced draft' under license from the Engineer Company. Tables showing fuel economy and capacity increases resulting from the use of this system will be gladly furnished upon request. The present officers of the Engineer Company are: Messrs. Embury McLean, president; John C. Quinn, vice-president; North McLean, treasurer; R. E. Fox, secretary and manager of sales department, and the new board of directors includes, besides the above, Messrs. J. F. Tapley, R. M. Searle and George Davies."

ELECTRIC VEHICLE COMPANY.—It is announced, as already foreshadowed in [illegible] Hartford, Conn., will take place. Harry W. Kyte, who has been secretary and assistant treasurer, was elected third vice-president and made manager of the sales department. H. W. Nuckols, who has been assistant to Mr. Kyte, was elected secretary and assistant treasurer. These appointments were made at a special meeting of the directors. Hiram Percy Maxim, chief engineer of the company, is to resign on Aug. 1, as already stated in this column. He is to form a company in Hartford to manufacture automobiles. Mr. Kyte has been five years in Hartford and for five years previous he was in Chicago with the Electric Vehicle Company and its subsidiary companies. Heretofore, President M. J. Budlong and other officials have had an oversight of the sales department. The office of third vice-president was created for Mr. Kyte and he will give much of his time to the salesmen. When Mr. Maxim leaves the employ of the company on Aug. 1 he will open an office and start operations on a new automobile company, which is to be formed of Hartford and New York men. The company will build electric pleasure cars and commercial vehicles at first, and later will build gasoline cars. As soon as possible it will put up its own buildings.

ELECTRIC PROPELLER FANS.—Summer weather marks a great increase in sales of electric propeller fans by the B. F. Sturtevant Company, of Boston, Mass., who, among others, report the following: The Hollenden Hotel Company, Cleveland, Ohio; Electric Supply Company, Charleston, S. C.; Seymour Packing Company, Topeka, Kan.; American Laundry Company, Grand Rapids, Mich.; E. Greenfield's Son & Company, Brooklyn, N. Y.; C. C. Richardson Paper Company, Lockland, Ohio; John K. How Company, Baltimore, Md.; Winchell School, Boston, Mass.; R. T. Ford, Rochester, N. Y.; Patchogue Manufacturing Company, Patchogue, L. I., N. Y.; the Pueblo & Suburban Traction & Light Company, Pueblo, Col.; Armour Packing Company, Kansas City, Mo.; Chronophone Company, Collinwood, Ohio; New York Telephone Company, New York City; Alton Paving, Building & Fire Brick Company, Alton, Ill., and Waterbury Farrel Foundry & Machine Company, Waterbury, Conn.

STEEL CONCRETE CHIMNEYS.—At Worcester, Mass., a new steel-concrete stack, the largest of its kind in this country, has been completed at the north works of the American Steel & Wire Company and put into use. The new stack is 220 feet in height and has an inside diameter of 9 feet and outside diameter at the base of 12 feet 6 inches. The structure is of concrete reinforced with steel and was erected by the Weber Steel-Concrete Chimney Company of Chicago. The stack will carry a battery of 12 boilers used in connection with an economizer. It is said that the stack is the largest of steel-concrete structures in this country and only one in the world is larger, and this is located in England. Steel-concrete chimneys have been popular in England many years, but only recently have been introduced into American manufacturing plants.

WESTINGHOUSE SHIPMENTS.—During the month of May the Westinghouse Electric Works at East Pittsburg shipped 750 carloads of electrical machinery, or an average of 30 carloads a day, aggregating 10,000 tons and representing in value about $4,000,000. This exceeds by 110 cars any shipping record for one month that has ever been made at these works. The high record heretofore was held by the month of August, 1906, when 640 carloads were shipped. The shipments at the Westinghouse Machine Company's shops during May also reached the high-water mark, the company having sent out from the works 90 engines, aggregating 50,000 horse-power. These engines included gas engines from 10 to 1000 horse-power and steam turbines from 1000 to 10,000 horse-power.

COOL AIR FOR JAPAN.—Just now when we are treating our excellent Japanese friends to so much "hot air," it deserves note that recent exports to Yokohama have included a large shipment of electric propeller fans.

E. H. FREEMAN ELECTRIC COMPANY.—The Trenton *Times* has the following item: Compelled by rapidly increasing business to extend its manufacturing facilities, the E. H. Freeman Electric Company of this city is making arrangements to add a third plant to the two already operated by the company. The concern manufactures all kinds of fittings for electric wiring and lighting. It conducts a pottery at Prince and Meade Streets, East Trenton, where the porcelain parts are turned out. The brass and copper work is done in a factory at Hamilton Avenue and the Delaware and Raritan Canal. The assembling is done at the latter place. The Freeman Company turns out the fittings complete, with porcelain and metal work combined ready for installation. The company has secured the large brick building on Chambers Street, near State Street, formerly occupied by George W. Price as a pork packing establishment. This will be renovated, refitted and made into an up-to-date assembling plant. The new building will be ready for business July 1. With the assembling department removed from the Hamilton Avenue plant additional room that is badly needed there for manufacturing purposes will be obtained. After the assembling department is removed from the metal factory that plant will be extensively improved. The interior will be remodeled and additional machinery installed, largely increasing the manufacturing capacity. By improvements at the pottery, also, that plant will be almost doubled in capacity. The present kiln shed will be torn out and a new kiln erected. This will give additional space in which several new presses will be installed, thus greatly increasing the porcelain output. The new Chambers Street plant will have 7000 sq. ft. of floor space, and altogether the three plants will give the company more than 25,000 sq. ft. of manufacturing floor space. Though the company has been organized only since April, 1904, it has built up a large trade. When the changes here outlined are completed about 200 hands will be employed in the three plants. E. H. Freeman is president of the company and Lambert Alpaugh is treasurer. The company has also just commenced the manufacture of a new socket. The company has just put this on the market, but has already received orders for 100,000 sockets. The Freeman Company furnished all the fittings for the Jamestown Exposition and has just shipped an order of 25,000 fuse plugs to Spokane, Wash. Goods are being exported to Manila, South America and other foreign countries.

LARGE SIGNAL ORDER.—The General Railway Signal Company, Rochester, N. Y., has received the contract for all the signal and interlocking appliances to be installed in the tunnels of the Hudson Companies. The first section to be signaled consists of the double-track line about 2½ miles from the terminal station at Henderson Street, in Hoboken, N. J., through the completed tunnels under the Hudson River to the foot of Morton Street, New York, and through to the station at Christopher and Greenwich Streets, a total of about 5¼ miles of track. The contract calls for the complete installation on this section of the signal apparatus, ready for operation, by Sept. 1. The contract also includes the signal apparatus in the river tunnels and terminal station at Cortlandt Street, and in the extension of the Morton Street tunnels north under Sixth Avenue to the terminal station at Thirty-Fourth Street. These parts of the system will not be completed for some time. The road is to be operated with direct current, using the third rail, and trains of two or more cars will be run. The alternating-current track-circuit apparatus of the General Railway Signal Company, which has been installed in the electric zone of the New York Central will be employed, with some slight modifications. The automatic block signals are to be arranged with double overlap and the Kinsman automatic stop. The latest form of Kinsman contact rail and shoe apparatus will be employed, the contact rail for the automatic stop being placed outside of the track rails and between them and the third rail.

COPPER IN EUROPE.—A recent cable dispatch from Paris on the copper situation in Europe, quotes as follows the secretary of the Compagnie Electro Metallurgique, a large concern using quantities of copper: "The decline is too small to make any difference to us. We are virtually dependent on America for our copper supply, and the price is still so high that we are compelled to restrict purchases. We could go ahead if the metal were obtainable for £80 a ton, but £98 is an almost prohibitive figure. Unfortunately, I see small prospect of any substantial reduction. I look upon the recent decline as a merely speculative movement, unlikely to have an important bearing on industrial affairs. Undoubtedly mines which formerly could not be worked profitably are contributing to make the world's supply larger, but the effect has hitherto been small. As consumers we can only hope that the addition of numerous small sources will follow the principle of little streams making big rivers and bring copper to a reasonable figure. Japan is making progress as a producer. I am constantly receiving offers of lots of 400 or 500 tons of Japanese copper, which, though unsuitable for some purposes owing to its large proportion of silver, competes to some extent with American copper."

APPARATUS FOR CANADA.—The Board of Control, Winnipeg, Manitoba, Canada, desires tenders for the whole works, groups, or individual contracts, for the following: (3) telephone system; (4) general works at Point du Bois; (5) 4000-hp turbines (five); (6) 450-hp turbines (two); (7) 3000-kw generators (five); (8) 250-kw generators (two); (9) induction motors (one); (10) step-up transformers (five); (11) generating station, switching and accessory apparatus; (12) generating station, light, heat and power systems; (13) generating station, oil and air systems; (14) erection of transmission system (75 miles); (15) steel towers; (16) high-tension insulators; (17) electric transmission cable; (18) terminal station; (19) step-down transformers (five); (20) terminal station, switching and accessory apparatus; (21) terminal station, light, heat and power systems; (22) terminal station, oil and air systems; (24) testing transformers and apparatus; (25) electric traveling cranes (three); (26) turbine governors (seven); (27) auxiliary apparatus; (28) repair shops. Specifications can be obtained from the power engineer, Carnegie Library Buildings, Winnipeg.

ADDITIONS TO WESTINGHOUSE WORKS.—Most of the Westinghouse companies are now making considerable additions to their works, among which is a new eight-story steel structure for the Electric Company, which will be ready for occupancy by Aug. 1. This will give an addition of 250,000 sq. ft. of floor space, to be utilized for the construction of details and supplies. The Air Brake Company, in Wilmerding, has now in course of erection a core shop 85 ft. x 140 ft., a pattern shop and pattern storeroom 80 ft. x 330 ft., and is about to begin the erection of a new carpenter shop 45 ft. x 120 ft. The Union Switch & Signal Company has several hundred men at work on the site recently acquired for the erection of additional shops.

NERNST LAMP ORDERS.—The Nernst Lamp Company reports that within the last week it has received contracts which represent a larger number of candle-power than any individual lighting contract made since electric lamps became the popular form of artificial lighting. One of these contracts, from the Baltimore Electric Company, calls for lamps aggregating 1,300,000 candle-power, and another from Marshall Field & Company, of Chicago, for lighting their dry goods store, calls for 700,000 candle-power, making a total of 2,000,000 candle-power. Another contract which the company is now turning out in its shops is 1,000,000 candle-power for the new terminal station of the Pennsylvania Railroad in New York City.

THE ELECTRIC CABLE COMPANY, of New York, has just bought the entire business of the Eastern Wire & Cable Company, of Roxbury, Mass. The latter company is one of the oldest and largest manufacturers of rubber-covered wires and cables in New England. Its entire equipment will be removed to Bridgeport, Conn., where is will be installed in the plant of the Electric Cable Company, which has in course of construction a large addition to its plant. The officers of the Electric Cable Company are: President, Edwin W. Moore; vice-president, F. H. Cowles; treasurer, J. Nelson Shreve.

SOUTH AMERICAN SUBWAY.—A South American firm writes to the U. S. Bureau of Manufactures, Washington, that the country in which it is located is likely, within the next two years, to commence to build a tunnel system to handle the increased traffic. The system will embrace 70 miles of tunnel and the firm desires to be placed in communication with American engineers who are interested in the project.

REINFORCED CONCRETE POLES.—Nearly a year ago, experiments were begun at Richmond, Ind., with a view to discover a substitute for wooden telephone and telegraph poles. Mr. William Bailey, superintendent of the Richmond Home Telephone Company, made a series of tests with reinforced concrete, with the result that he has produced a pole 30 ft. in height, octagonal in shape, tapering toward the top, with

mortises to be used in climbing and for the insertion of cross-arms. A number of these poles were erected on one of the main lines of the company, and a short line in the bottom was constructed wholly of concrete poles. After a year in service, it has been found that the poles have given as much satisfaction as the wooden ones, and have the additional virtue of being almost indestructible. Mr. Bailey has been the recipient of scores of letters of inquiry by pole-line companies all over the country as a result of publicity given to his experiments. The pole itself could not be patented, but the manner of construction has been patented. On July 8, the American Concrete Pole Company was organized at Richmond with James A. Brailey, of Toledo, Ohio, as president. Associated with Mr. Brailey are Messrs. William Bailey, the inventor; W. P. Orr, S. K. Statler and L. M. Flesh, of Piqua, Ohio; A. C. Lindemuth, Jno. M. Lotz, E. H. Cates and L. E. Brown, of Richmond. The company will incorporate at once, and proposes to establish a number of plants throughout the country.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market closed with firmer prices and moderate activity after having shown sharp declines, in the midweek, as a result of higher money, the reduction in copper values, governmental attacks on corporations, and other adverse developments. The practical failure of the Atchison and Union Pacific bond subscriptions was also regarded as unsettling. Union Pacific took the lead in the decline which began on Tuesday, and became quite severe in Wednesday's transactions. At the same time, a comparatively few stocks, like Amalgamated, Union Pacific, St. Paul and other active speculative features, supplied the bulk of the dealings, the declines in other directions being of a sympathetic nature. Thursday's market showed more or less indecision. In spite of the fact that money inclined to harden, the renewal rate for call loans rising to 6½ per cent, the market halted and scattered covering created a slightly better range of prices in many cases, this movement assuming a more decided form on Friday. The week closed with an active market, with broad buying and general gains throughout the list. More favorable financial and speculative prospects abroad, together with the increased short interest, seemed to be responsible for this improvement. The electric stocks, however, did not feel the stimulus of the closing activity of other shares and the last quotations of the week were all lower, the heaviest decline being in General Electric—2¾ points net. The curb market was attended with quite heavy liquidation during the early part of the week, in sympathy with the declines on the stock exchange, but the market as a whole rallied later on though without any material increase in public interest. Following are the closing quotations of July 16:

NEW YORK.

	[illegible]	July 16		[illegible]	July 16
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
Electric Boat pfd......	80	80	Western Union Tel....	77½	77½
[illegible]	—	—	[illegible]	[illegible]	[illegible]
Electric Vehicle pfd...	—	—	Westinghouse pfd......	142	153

BOSTON.

	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	—	—	[illegible]	[illegible]	[illegible]
Mass. Elec. Ry........	16¼	17	West. Tel. & Tel. pfd..	*70	70

[illegible]

	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	—			

CHICAGO.

	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	—	
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			

LONG LEASE IN JERSEY.—Notwithstanding the opposition of the holders of one-half of 1 per cent of the stock of the United Electric Company of New Jersey, that concern was leased to the Public Service Corporation for a period of 999 years in Newark last week. The resolution favoring the lease was passed by the board of directors two weeks ago, at which time the directors of the Public Service Corporation accepted the proposition. The resolution provided that the lease be ratified by the stockholders of the United Electric Company, and the meeting was held in Newark last week. It was expected that of the 4000 shares of stock outstanding and not held by friends of the Public Service Corporation a big majority would co-operate with the known interests antagonistic to the plan, but when President Thomas N. McCarter showed how useful the Public Service Corporation had been to the United Electric, making possible the payment of dividends, more than half of the 1650 shares held by the opposition decided to vote for the lease. The opponents of the plan were represented by counsel, Judge Thomas L. Raymond, representing James M. Seymour, Jr., Leo Stern, several small holders, and Louis Hood, other holders, aggregating 300 to 400 shares. Further opposition is promised.

WESTINGHOUSE ACTIVITY.—Secretary Terry, of the Westinghouse Electric & Manufacturing Company, when asked if he had any comment to make concerning an article in New York *Sun*, replied that legal requirements make necessary a formal offering to stockholders of the company of any new shares to be issued, and, as is usual in such offerings, the directors of the company had authorized its treasurer to sell from time to time, at the price offered to shareholders of $75 per $50 share, any of the shares not subscribed for under the offering recently made. It is not the intention of the company to make a formal extension to the shareholders, because such an extension is not necessary. The officials of the company, considering the general conditions prevailing, regard subscriptions for 33,000 shares out of 100,000 as satisfactory, and the proceeds, coupled with other resources of the company, are sufficient to meet the needs of the company, which is making the largest sales in its history on a cash basis, with a manufacturing profit approximately 20 per cent on its shipments. Mr. Terry added that, with the sale of 33,000 shares, the company will also when needed have available $5,000,000 of its convertible sinking fund bonds to meet the requirements of a greatly enlarged business.

DIVIDENDS.—Directors of the Milwaukee Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable July 31. Directors of the International Steam Pump Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Aug. 1. The directors of the Boston Edison Electric Illuminating Company have declared an extra dividend of 1 per cent, and it is said that they will distribute 12 per cent per annum hereafter. All the Westinghouse Companies have declared the usual quarterly dividend, the Air Brake Company 2½ per cent regular and 2½ per cent extra, the Switch & Signal Company 3 per cent on the preferred and 3 per cent on the common stock, the Machine Company 2½ per cent, and the Electric Company 2½ per cent. The directors of the Central District & Printing Telegraph Company, of Pittsburg (Bell Telephone), have declared the regular quarterly dividend of 2 per cent, payable July 31. The Grand Rapids, Mich., Railway Company has declared the regular quarterly dividend of 1¼ per cent.

STROWGER TELEPHONE BONDS.—The Strowger Automatic Telephone Exchange, the company owning the Strowger patents, is receiving subscriptions in Chicago for $50,000 7 per cent five-year bonds. These bonds are being issued for the purpose of providing funds for the general development of the company. One of the large items is the litigation which the company is carrying on with the company holding the manufacturing rights of the Strowger patents in this country. President J. L. Kesner said that the entire issue of $50,000 of bonds would be issued at once. As these bonds come ahead of the stock the issue of the bonds tends to weaken the stock.

CONNECTICUT STOCKS.—Application has been made to the New York Stock Exchange to list $8,142,000 preferred stock, $8,077,200 common stock, and $1,578,000 first and refunding mortgage 4½ per cent bonds of 1951 of the Connecticut Railway & Lighting Company.

WESTINGHOUSE NOTES.—Kuhn, Loeb & Company announce that all of the $6,000,000 Westinghouse Electric & Manufacturing Company 3 year, 6-per cent, collateral notes purchased by them recently have been sold.

GENERAL NEWS

Construction News.

PHOENIX, ARIZ.—The Harona Hola Development Company, recently incorporated, has chosen Captain F. S. Ingalls president; S. S. Green, vice-president, and C. T. Bonney, treasurer. The capital stock is $25,000. At Point of Rocks the company will build a submerged dam 500 feet wide and put in steel tubing and three miles of concrete tubing. The water power will be developed.

EUREKA SPRINGS, ARK.—M. D. Jordan, general manager of the Citizens' Electric Company, has made application for a receiver. The company operates the electric railway system and the electric light and ice plants. The company's embarrassment is due to the failure of the Citizens' Bank.

PINE BLUFF, ARK.—Ford, Bacon & Davis are constructing a combined gas, water and electric plant for the Securities Company, of New York, N. Y.

BISHOP, CAL.—The Bishop Light & Power Company is planning to increase the capacity of its plant to 500 horse-power and will install a water wheel, new machinery and make some line extensions. J. M. Lennon is manager.

FAIRVIEW, CAL.—Plans are being prepared for an electric light and power plant for Fairview.

SAN BERNARDINO, CAL.—Extensive improvements and additions are contemplated by the Lytle Creek Power Company, which will involve an expenditure of about $50,000. Duplicate engines, boilers and dynamos will be installed. W. A. Ball is manager.

SANTA ROSA, CAL.—The Board of Supervisors on July 3 sold the franchise applied for by Frank M. Burris to erect lines over the county roads for the transmission of electricity for lighting and power purposes. Mr. Burris purchased the franchise for $200.

OURAY, COL.—A new electric plant is being installed in the Torpedo-Eclipse mine.

MANITOU, COL.—The Manitou Electric Company is planning to extend its line to the Cave of the Winds and the Grand Caverns, a distance of about 3½ miles. H. H. Van Dusen is superintendent.

SALIDA, COL.—The Salida Light, Power & Utility Company is contemplating increasing the capacity of its power station and will install a new water turbine, one 45-kw General Electric dynamo, and will also construct 6000 feet of pipe line and erect 1½ miles of transmission line. B. Disman is manager.

STEAMBOAT SPRINGS, COL.—The Steamboat Springs Electric Company will install an entire new plant, changing from direct to alternating current at 2300 volts. W. E. Carver is manager.

BRIDGEPORT, CONN.—Beginning with August the price of electricity for lighting purposes will be reduced from 12½ cents to 11 cents per kw-hour, with a minimum charge of $1 a month. All bills of 100 kw-hours per month will be subject to a discount of 10 per cent; for 200 kw-hours per month the discount will be 15 per cent and for 400 kw-hours 20 per cent.

HARTFORD, CONN.—The State Legislature has passed a resolution authorizing the Hartford Electric Light Company to increase its capital stock from $3,000,000 to $5,000,000. A provision in the original resolution, permitting the company to acquire various other corporations, was eliminated on account of the objections which developed to the granting of wholesale powers of merger.

NEW HAVEN, CONN.—The United Illuminating Company announces that tne rate for electricity in this city after Aug. 1 will be 11 cents per kw-hour. On bills of 100 kw-hours per month a discount of 10 per cent will be made; for 200 kw-hours per month the discount will be 15 per cent, while for a monthly consumption of 400 kw-hours the discount [illegible] per cent. The minimum charge is $1 a month. The rate is now 12½ cents per kw-hour.

PUTNAM, CONN.—The City Council has entered into a contract with the Putnam Light & Power Company for lighting the streets of the town. The contract calls for 49 arc lamps of 1200 cp and 61 incandescent lamps [illegible] per month.

STRATFORD, CONN.—The citizens of this town are agitating the question of a public lighting service. A special town meeting will soon [illegible] on the proposition.

WASHINGTON, D. C.—Bids will be received until July 23 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing supplies at the Boston Navy Yard as follows: Schedule 82—insulating tape. Schedule 72—Motor-drive outfits at the navy yard, Charleston, S. C.

[illegible], GA.—William [illegible] associates, who have been granted franchises for the establishment of an electrical power plant and street railway system have financed their enterprise with Pennsylvania capitalists, who subscribed for the entire bond issue. The company is capitalized at $200,000 and will soon apply for a charter. Work will soon commence on the construction of the system.

BRUNSWICK, GA.—The City Council has granted F. D. M. Strachan and associates a 40-year franchise for an electric light and gas plant and electric railway.

CALHOUN, GA.—At an election held recently the citizens voted to issue $12,500 in bonds to construct an electric light plant and for water works improvements.

COLUMBUS, GA.—H. O. Orr, president of the Savannah River Power Company, announces that the Calhoun Falls property will be developed this summer with 35,000 horse-power. Cherokee Falls, also on the Savannah, will be developed this summer and will furnish 10,000 horse-power. Other powers to be developed by the company this summer are: The Hatton Shoals, on the Tugaloo River, 10,000 horse-power; on Broad River, in Georgia, at Anthony Falls, near Elberton, and the 3000 horse-power at Gregg Shoals, will aggregate 58,000 horse-power.

MILLEN, GA.—J. B. McCrary, of Atlanta, is reported to have prepared plans for an electric light plant, water works and sewerage system for Millen.

LEWISTON, IDAHO.—J. L. Bright, manager of the Citizen's Electric Company, is contemplating installing an electric light plant at Harlowton.

ST. MARIES, IDAHO.—Application has been made to the Town Board for a franchise for an electric light plant.

CHRISMAN, ILL.—The City Council has granted a franchise to the Paris & Northern Railway Company. The franchise is for a term of 20 years.

EARLVILLE, ILL.—J. G. Durrell, of Fergus Falls, Minn., has purchased the plant of the Earlville Electric Company. The plant is to be enlarged and improved.

LEBANON, ILL.—C. L. Robinson, city clerk, writes that the Atlas Engine Company, St. Louis, Mo., has secured the contract for furnishing the engine for the electric light plant for $2,000.

MARISSA, ILL.—The citizens are contemplating extending the lighting service of the municipal electric lighting plant and will install 50 new arc lamps and 100 series incandescent lamps of 30 cp and will also introduce meters. J. R. Creighton is manager.

STREATOR, ILL.—The plant of the Illinois Light & Traction Company was recently sold for taxes.

SWANSEA, ILL.—The village is contemplating the erection of a municipal electric lighting plant, for which bids have been asked. Otto J. Keller is village clerk.

EVANSVILLE, IND.—A. L. Swanson has secured the contract for wiring and installing all of the dynamos at the new E. & T. H. depot. Iron conduits will be used. Mr. Swanson is in the market for 700 incandescent lamps and 25 arc lamps. He has also secured the electric contract for the Elenor Ice Company's building in Vincennes and the new Vendome Hotel in this city.

LAFAYETTE, IND.—The Merchants' Electric Light & Heating Company on July 3 awarded contracts for new equipment and the remodeling of its power house, at a cost of $35,000. Joshua Chew secured the contract for additions to the plant and the Lafayette Engineering Company, of Lafayette, for the construction work. Among the new machinery to be installed will be a new 300-hp Hamilton-Corliss engine and a centrifugal pump.

GARY, IND.—Frank Gavitt and associates, of Whitney, have been granted a franchise to construct a street railway here. The franchise is for a term of 50 years.

ROCKVILLE, IND.—The Park County Telephone Company has sold a controlling interest to the Central Union Telephone Company, with division headquarters in Indianapolis. The old stockholders are still a part of the new organization. The new managers are: A. M. Adams, president; W. B. Thomas, secretary, and Russell Burrin, manager.

TERRE HAUTE, IND.—The Commissioners have granted a 50-year franchise to the Terre Haute & Merion Traction Company to construct and operate an interurban line through Vigo County. The company will build a line between Terre Haute and Merion, a distance of 30 miles.

SAPULPA, I. T.—The business men of this city have closed a deal with E. C. Reynolds to build an electric railway in Sapulpa and to the oil fields southeast of this place. Part of the machinery for the power house has been ordered.

BOONE, IA.—The Fort Dodge, Des Moines & Southern Railway Company has filed amendments to its articles of incorporation increasing its capital stock from $2,500,000 to $6,700,000.

DES MOINES, IA.—The Iowa Light, Heat & Power Company and the Des Moines Heating Company have transferred their franchises to W. D. Kinnick. J. S. Polk and G. B. Hippee are the principal stockholders in the two companies.

[illegible] held July [illegible] the proposition to grant a [illegible] year franchise to Z. G. Houck, of Dubuque, Ia., to operate an electric light plant in this place was defeated. The citizens will soon hold an election to vote on the question of establishing a municipal electric light plant.

[illegible] amendments to its articles of incorporation increasing its capital stock [illegible]

SIOUX CITY, IA.—Bids will be received until Aug. 6 by the city clerk for lighting the streets with electricity for a period of five, seven and ten years, beginning June 1, 1908. Bids are to be on moonlight and all-night schedule and to provide for not less than 80 arc lamps of 2000 cp and not less than 880 incandescent lamps, bids to be furnished for both 25 and 32-cp lamps. T. W. Bayne is chairman of committee on lights.

CAMPTON, KY.—Milton Garver, of this city, and associates have purchased the plant and holdings of the Campton Fuel & Light Company. [illegible]

BATON ROUGE, LA.—The officials of the Baton Rouge Electric Company have decided to rebuild the electric plant on the company's site on North Boulevard.

NEW IBERIA, LA.—The Bayou Teche Electric Railway & Light Company has applied to the City Council for permission to locate the new power house 1½ miles below the city limits, at Nelson's Canal. R. H. Fine is manager of the company.

ORONO, ME.—The contract for the construction of the new power house of the Maine State University in this place has been awarded to J. W. Bishop Company, of Boston, Mass.

BALTIMORE, MD.—The Consolidated Gas & Electric Company has awarded the contract for the construction of a concrete power house to be erected at Westport to the Baltimore Terro-Concrete Company, to cost about $170,000.

BALTIMORE, MD.—The Baltimore, Frederick & Hagerstown Electric Railway Company is said to be contemplating extensions into the coal fields of Maryland and possibly West Virginia and Pennsylvania for the purpose of carrying freight to tidewater at Baltimore. The plan is to make the road an extensive freight-carrying line and will involve an expenditure of $25,000,000.

BALTIMORE, MD.—The Baltimore Electric Company has submitted a proposition to Mayor Mahool to furnish electricity for lighting the court house, city hall and city hall annex at the rate of 3 cents per kw-hour, which will mean a saving of about $25,000 a year. The annual cost of the court house plant is estimated at about $32,000, and the company offers to furnish the service for $7,500 for 250,000 kw-hours a year, or a measured service basis of 3 cents per kw-hour.

BRIGHTWOOD, MASS.—The Baush Machine Tool Company is operating its factory by electricity generated at its new power plant.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has withdrawn its petition recently made to the Board of Selectmen for pole locations in the north part of the town, for the purpose of erecting a high-tension power line between the local power house and the plant of the Franklin Power Company in Turners Falls.

MARLBORO, MASS.—The Marlboro Electric Light Company has submitted a proposition to the Board of Aldermen offering to install and maintain an incandescent lamp on every pole on Florence Street, from Main to Garfield Street, free of charge, and also offers for every arc lamp that the city will place on Main Street to install one at its own expense. The Aldermen voted to give the company permission to place the lamps on Florence Street, and the latter proposition was referred to the committee on street lighting.

WINCHENDON, MASS.—It is reported that the Winchendon Electric Company will soon move from its present site to Centerville, where an excellent water privilege can be secured.

CRYSTAL FALLS, MICH.—Bids will be received until July 25 (readvertisement) by the City Council for erecting an addition to the power station. Robert Munns is city clerk.

ESCANABA, MICH.—The Escanaba Electric Power & Pulp Company, H. P. Lucas and the Weber Gas Engine Company are bidding for the contract to furnish light for the city of Escanaba for a period of 10 years. The Escanaba Electric Power & Pulp Company will erect a power plant on the old Flat Rock mill site. Three turbines with an estimated capacity of 300 horse-power will be installed and provisions made for the addition of others. The dam will be raised to 8 ft. and the water at this head will generate 1300 horse-power. O. L. Huie is directing the work.

GRAND RAPIDS, MICH.—Contracts have been awarded by the Board of Managers for the new electric lighting plant to be installed at the Soldiers' Home, to cost $3,600.

GRAND RAPIDS, MICH.—By the terms of a new franchise which the City of Grand Rapids will grant to the Grand Rapids-Muskegon Power Company will furnish electricity for lighting at 8 cents per kw-hour and for power on a sliding scale. The old franchise of the Grand Rapids Edison Company, which is now controlled by the power company, made the rate 12 cents for lighting purposes. The franchise runs for 20 years and will become effective about Oct. 1. It has been ratified by the company and the ordinance committee of the Council and only remains to be passed upon by the Council. The complete schedule of rates is as follows: Electricity for light, 8 cents per kw-hour; for power according to the amount used per month, 25 horse-power, 2 cents to 3 cents per hp-hour; 25 to 75 horse-power, 1¾ cents to 2 cents per hp-hour; [illegible] more than 150 horse-power, 1 cent to 1½ cents per hp-hour. The minimum lighting charge is to be 50 cents a month and for power $1.

LANSING, MICH.—Work has commenced on the construction of the new power house of the Michigan Power Company at the Piatt dam.

LANSING, MICH.—During the fiscal year the city lighting plant earned $78,174.93, and the operating expenses were $32,779.75. The indebtedness is being rapidly paid off despite improvements made. The operating expenses were reduced over $3,000 last year.

PONTIAC, MICH.—Bids are being received for the remodeling of the plant of the Pontiac Light Company. A 250-hp Hamilton-Corliss engine and 150-kw alternating-current generator will be added. The large generator and transformer of the Standard Lighting Company will be utilized and the rest of the Standard plant will be sold.

BRAINARD, MINN.—Repairs to the municipal electric light plant are contemplated.

MANKATO, MINN.—The Knox Construction Company, of Chicago, Ill., it is said will build the railway for the Mankato Electric Traction Company.

JACKSON, MO.—William Paar, city clerk, writes that the contract for constructing an electric light plant and pumping station has been awarded to the Electric & Steam Engineering Company, St. Louis, Mo., for $32,932.

PAGOSA SPRINGS, MO.—The Pagosa Springs Electric Light & Power Company is contemplating the construction of a 100-kw water power plant and erecting two miles of three-phase transmission lines. E. M. Hampton is manager.

OMAHA, NEB.—The Shimer Chase Company is seeking a franchise for an interurban railway to Seymour Park.

ELY, NEV.—The Utah, Nevada & Idaho Telephone Company has acquired several telephone lines in the northeastern part of Nevada and is planning to construct a network of new lines over this part of the state. This company controls the Eureka and Ely line, the W. T. Smith lines in Elko County and another line in Idaho. It will build new lines connecting Salt Lake, Pioche, Austin and Tonapah with Ely.

RENO, NEV.—The City Council on July 9 adopted a resolution prepared by the city attorney, requesting the officials of the Reno Power, Light & Water Company to appear and show cause why the rates for electricity, water and gas should not be materially reduced. The mayor and City Council are trying to secure reduced rates and the company states that it will fight any attempt made by the city officials to reduce its prices.

JERSEY CITY, N. J.—D. A. Reynolds, president of the Coastline Telephone Company, is trying to secure a franchise in this city and has offered to enter into an agreement with the city the terms of the franchise to be as follows: The company agrees to construct a subway system, to be turned over to the city as fast as built, at cost plus 10 per cent and charge the same to "subway account," carrying the same on its books at 4 per cent per annum until paid in rentals or otherwise. The company also agrees to pay the city $200 per year per mile for each duct occupied by its cables, the city to have the right to lease the ducts to any other company using a low potential current, at whatever rate it may determine. The city is to have a discount of 25 per cent on all telephone service over its lines, this discount extending to all parts of its system. The company will spend approximately $1,500,000 in this city.

MADISON, N. J.—The Town Council on July 9 passed a resolution calling for a report on the advisability of changing the lighting system from 1100 to 2200 volts.

MORRISTOWN, N. J.—The Board of Aldermen on July 5 granted the new Morris & Somerset Electric Company a franchise to operate an electric light system in this town. The franchise is for a term of 50 years.

NEWARK, N. J.—The Newark Block Lighting Company has decided to make a new application to the board of public works for a franchise to lay conduits in Lawrence and Market Streets. The Public Service Corporation has asked for a writ of certiorari to review the action of the Newark Common Council, which granted the Newark Block Lighting Company a franchise some time ago.

SOUTH ORANGE, N. J.—The village officials have decided not to wire the village hall for electric fans or light, as the Public Service Corporation has no franchise to supply electricity to consumers in this village.

LA CRUCES, N. M.—B. L. Berkey, manager of the La Cruces Electric Light & Ice Company, writes that the company is now installing a 150-hp boiler in its plant and will install an alternator this fall.

DUNKIRK, N. Y.—[illegible] Dunkirk water works, and the board of water commissioners is in the market for this machinery. The board is now considering the installation of a steam turbine. Thomas B. Donovan is superintendent.

GLENS FALLS, N. Y.—The Hudson River Power Company has made application to the Public Utilities Commission for permission to issue bonds to the amount of $3,232,000 on a $30,000,000 mortgage. The money [illegible] Conklingville.

HERKIMER, N. Y.—The street lighting system of the municipal electric lighting plant is being changed from the open-arc lamps to enclosed arc lamps.

ITHACA, N. Y.—The Ithaca Street Railway Company has authorized a new mortgage to secure an issue of $750,000 in bonds. Part of these bonds will be used from time to time to cover the cost of reconstruction and new equipment, and the balance will be held in reserve to retire prior

liens. The system in the city is to be rebuilt, and 3½ miles of new track is being constructed.

LITTLE VALLEY, N. Y.—The Cattaraugus Cutlery Company has decided to equip its factories with electrical power and has placed a contract with the Allis-Chalmers Company for a 150-kw, three-phase, 440-volt alternator, one belt-driven exciter and an 18 in. x 42 in. horizontal Reynolds-Corliss heavy duty engine, three 30-hp and four 40-hp motors. William W. Hildreth is chief engineer.

LITTLE VALLEY, N. Y.—The two high-speed automatic type engines belted to alternating-current generators in the municipal electric lighting plant are being replaced with a 150-kw, single-phase, Allis-Chalmers alternator and direct-connected 8-kw exciter, both to be driven by an 18 in. x 42 in. horizontal Reynolds-Corliss engine of heavy duty type. One of the high-speed units has been disposed of, while the other will be held for reserve and the light day loads. A new 6½ in. x 18 in. horizontal tubular boiler has been purchased of McEwen Brothers to be placed in the plant. C. P. Rice is superintendent.

NEWPORT, N. Y.—The Newport Electric Light & Power Company has applied to the Public Utilities Commission for permission to issue first mortgage bonds to the amount of $50,000. The proceeds will be used to rebuild the dam of the company which recently gave away. The company also asks for consent to supply the villages of Poland and Cold Brook, in Herkimer County, with electricity.

NEW YORK, N. Y.—The Long Acre Electric Light Company has been assigned space in the subway conduits for its electric conductors for furnishing electricity for light, heat and power in this city. The company proposes to proceed immediately with the building of its plant.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, until July 22, for installing electric equipment in addition to and alterations in Schools 14 and 29, Borough of Manhattan.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic & Power Company has filed application for permission to erect its new power house below the bank.

NORTH TONAWANDA, N. Y.—The Common Council has awarded the contract for street lighting to the Tonawanda Power Company for $57.50 per lamp per year for a term of three years. This is a reduction of $12.50 a lamp from the price paid under the last contract with the company, which was for two years. The new schedule goes into effect Aug. 1.

NORWICH, N. Y.—The State Gas and Electric Commission has finally granted the Oriskany Hydro-Electric Company permission to carry on business in the counties of Oneida, Madison and Chenango. The balance of the stock is to be issued when the charter is amended to cover all towns where consents have been granted. The company proposes to build an electric transmission line and electric railway from the terminus of the Utica & Mohawk Valley line, at Clinton, south to Norwich. E. H. Risley, of Utica, is one of the promoters.

OSWEGO, N. Y.—Thomas N. Devine, city clerk, writes that plans are now being prepared for the power house to be erected in connection with high dam. For further information address F. W. Ormsby, superintendent, water works.

UTICA, N. Y.—The Herkimer County Light, Heat & Power Company has been merged with the Utica Gas & Electric Company. By this consolidation, the latter company takes in all the river towns in Herkimer County and extends as far north as Dolgeville.

WILMINGTON, N. C.—The Tidewater Power Company has filed amendments to its charter increasing its capital stock from $700.000 to $1,200,000.

ARLINGTON, OHIO.—The city of Arlington has rejected all the bids for the $[illegible] lighting bonds. The issue will be readvertised.

ATLANTA, OHIO.—A special committee has been appointed by the City Council to consider the question of establishing and operating a municipal electric light plant.

CLEVELAND HEIGHTS, OHIO.—Bids will be received until Aug. 6 by William G. Phare, village clerk (Fairmount P. O.) for furnishing material and lighting certain streets and roads in Euclid Heights allotment.

COLUMBUS, OHIO.—A special meeting of the stockholders of the Cuyahoga Telephone Company will be held July 22 for the purpose of authorizing an increase of the capital stock of the company by $500,000.

TOLEDO, OHIO.—New bids will be received until July [illegible] by the county auditor, separately or as a whole, for all labor and material required in the building of a heating and power house, including stack for the same, at the Lucas County Infirmary; also at the same time for installing in the heating and power house, boilers, dynamos, [illegible] and appurtenances, conduits and piping outside of said power house. The estimated cost is $27,000. J. W. Kerr is chairman of county commissioners.

KLAMATH FALLS, ORE.—Building operations have been commenced by the Southern Pacific Railway Company at Spencer, on the Klamath River, for the construction of a large hydro-electric [illegible]. It is reported that the company intends to utilize the power for operating its trains on the Sacramento, Siskiyou and Klamath divisions. The plant is located about 18 miles from this city.

PANAMA.—Bids will be received until July 30, at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., for electric fan motors, etc. Blanks and general information relating to this work can be obtained at the above office, referring to circular (No. 376) or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal., and 410 Chamber of Commerce Building, Tacoma, Wash.; also from chief quartermaster, Chicago, Ill.; depot quartermaster, St. Louis, Mo.; depot quartermaster, Jeffersonville, Ind., and chief quartermaster, Atlanta, Ga. D. W. Ross is general purchasing officer.

LEBANON, PA.—It is stated that the Pennsylvania Steel Company, owners of the Cornwall ore mines, five miles from Lebanon, purpose erecting a modern electrical plant in Lebanon to supply electricity for the mines in the Cornwall hills, and also for operating the electric railways in this territory. The new plant will have 2000 horse-power capacity, arrangements having been made for the installation of three 750-kw engines, all of which will be operated with the gas from the coke ovens.

SCRANTON, PA.—Anticipating the ordinance providing for the placing of wires underground, the Scranton Electric Company has commenced the work of placing its wires in underground conduits in the central part of the city.

WEST NEWTON, PA.—At a meeting of the Town Council held July 5, arrangements were made for the sale of the local municipal electric light plant to the Pittsburg, McKeesport & Westmoreland Street Railway Company. The company will furnish electricity for lighting the town and also contemplates enlarging the plant to furnish electricity to operate the electric railway which is to run from this place to Irwin. The town began to operate the plant in 1893, but the service has been unsatisfactory as well as expensive. Work on the construction of the electric railway in this town will commence soon.

WILKES-BARRE, PA.—Joseph Dunn is reported interested in a new lighting company recently formed here, which is about to apply for a charter.

WILKES-BARRE, PA.—The Wilkes-Barre Subway Light & Power Company has applied to the Secretary of State for a charter. Dr. Lewis Edwards, county treasurer, Fred Darte and Reese Lloyd are among the incorporators. It is stated that the company does not contemplate building a plant of its own to generate electricity, but will purchase electrical power, probably from the Laurel Line Company.

PONCE, P. R.—The Ponce Electric Company will extend its tracks to the new government wharf and will install a new water-tube boiler, a water softening plant and purchase two motor flat cars.

PROVIDENCE, R. I.—The directors of the Providence Telephone Company have voted to increase the capital stock of the company from $1,600,000 to $2,100,000, the proceeds of which will be used to increase the capacity of the system and improve the service. The company has been granted permission by the Town Council to lay conduits on Hope Street and Poppasquash Road.

ROCKINGHAM, S. C.—The Federal Construction Company is building the hydro-electric plant of the Rockingham Power Company. Thomas F. Richardson is resident manager of the company.

GARY, S. D.—The question of erecting an electric light plant is under consideration.

PLATTE, S. D.—John Alsher, of Wagner, has been granted a franchise to construct and operate an electric light plant in this place.

CLARKSDALE, TENN.—The Clarksdale-Colliersville-Covington Interurban Railway Company has filed an application for a charter. The capital stock of the company is $50,000, and the incorporators are R. F. Tate and others.

MARYVILLE, TENN.—A contract has just been closed by the lighting committee of the Maryville Council with the Rockford Electric Company for lighting the streets of the town. The contract provides for thirty-five incandescent lamps and is for the term of one year, at the rate of $50 per month.

MONTEREY, TENN.—The citizens have voted to issue $25,000 in bonds for the construction of an electric light plant and water works system.

BAIRD, TEX.—The local electric light plant has been shut down, and it is reported that a new company will be organized with ample capital to put in an up-to-date plant.

BROWNSVILLE, TEX.—Surveys and plans are being made for an electric plant and water works system.

EL PASO, TEX.—Plans have been prepared by the El Paso Electric Company for the construction of a large electric power plant on the Rio Grande River at El Paso, for which a site has recently been purchased.

EL PASO, TEX.—Extensive additions and improvements are being made to the power station of the El Paso Electric Railway Company. Two 500-kw turbo-alternators, one 300-kw motor generator and boilers of 2000 horse-power and condensers are being installed.

GALVESTON, TEX.—The capacity of the power plant of the Galveston Electric Company is being increased by the installation of a 300-kw alternating-current generator and a 500-hp boiler.

GONZALES, TEX.—The Gonzales Electric Light & Power Company is contemplating installing additional machinery that will double the capacity of the plant.

HAMLIN, [illegible] erected in this place.

HOUSTON, TEX.—The Houston Electric Company has recently in- [illegible] to a Crocker-Wheeler generator.

SHERMAN, TEX.—The City Council has granted the Sherman, Whitesboro & Gainesville Railway a franchise over Pecan and Walnut Streets. It also granted the company the right to furnish electricity for lighting and power purposes.

STAMFORD, TEX.—The Stamford Gas & Electric Company is making improvements to its plant and installing new machinery. H. W. Wright, of Shreveport, La., has charge of the work.

TERRELL, TEX.—A. M. Wooly, city secretary, writes that the citizens on July 9 voted to issue $15,000 in bonds for constructing an electric light plant.

TOYAH, TEX.—The Toyah Electric Light Company has been organized to operate an electric light plant in Toyah.

WHARTON, TEX.—H. P. Phiel, of Fredricksburg, Tex., is interested in the construction of an electric light plant in this place.

STARKSBORO, VT.—Messrs. Blackwell and Chandler, of Brandon, have been in town investigating the water privilege owned by Baldwin, Carpenter and Verper Thompson with a view of purchasing the same for the purpose of developing a hydro-electric plant.

CHEHALIS, WASH.—Arrangements are being made by San Francisco capitalists to erect a large electric power plant on Packwood Lake, a few miles distant from Cora. H. K. Green has charge of the work.

NORTH YAKIMA, WASH.—The franchises and other assets of the Inter-Valley Traction Company has been taken over by the Yakima Valley Transportation Company. It is the intention of the new company to rush the road to completion. George Rankin, president of the Yakima Valley Trust Company, is interested in the company.

SPOKANE, WASH.—A franchise has been granted by the County Commissioners to the Spokane Traction Company to build a street railway line across Monroe Park, north of the city.

TACOMA, WASH.—We are informed that no bids were opened on July 3 for the proposed municipal power plant (steam, gas or hydraulic). New bids will be received until July 31 by Owen Woods, commissioner of public works. The plant will have a capacity of not less than 4000 horsepower. Contractors are to furnish their own plans.

ASHLAND, WIS.—It is reported that bids are wanted Aug. 1 for a municipal electric light plant.

MENOMINEE, WIS.—This town will shortly have a new electric light plant. During the last three years the streets and business places have been lighted by electricity furnished by the plant of the Wisconsin Sugar Company, and light has been available only from dark until midnight, from Oct. 1 to Feb. 1. The new plant will give 24-hour service and many local concerns have decided to operate their plants with electricity.

MILWAUKEE, WIS.—Under a new law passed by the Legislature, Mayor S. M. Becker will have the appointment of a commission of five members to take charge of the erection and management of the municipal electric lighting plant. The matter is now in the hands of the Board of Public Works, assisted by an advisory committee of aldermen. The mayor once appointed such a commission, but the city ordinance under which he acted was found insufficient to make the body legal.

OSHKOSH, WIS.—Richard H. Hackett has been appointed receiver of the Winnebago Traction Company.

LANDER, WYO.—The Lander Electric Light & Power Company is contemplating making improvements and additions to its plant and system, which will involve an expenditure of about $15,000. E. Amoretti, Jr., is manager.

GRAND FORKS, B. C.—The City Council is considering the question of making a contract with the West Kootenay Power & Light Company to furnish the city with electrical power.

CHATHAM, ONT.—This city is making arrangements to apply to the Ontario Railway and Municipal Board for permission to submit a by-law to the people providing for an expenditure of $15,000 for extensions to the electric light system.

OTTAWA, ONT.—The Civic Electric Commission is negotiating with the Ottawa Electric Company to purchase the equipment now used by the company under its street lighting contract, and to take over the contract for the unexpired term. The commission recommends that the city solicitor be instructed to prepare an offer to the Ottawa Electric Company of $24,000, the amount of the valuation for the hangers, wires, lamps and apparatus used by the company for street lighting purposes. Also that in case the company does not accept the offer, that the city solicitor prepare the necessary notice appointing the official arbitrator to determine the amount to pay the company.

PETERBORO, ONT. The negotiations entered into some time ago by the city with the Peterboro Light & Power Company for the purchase of the electric light business has fallen through. The company refuses to go any further with the matter, unless the Ontario Hydro-Electric Power Commission agrees to sanction any agreement entered into by the ratepayers and the company, which the City Council will not agree to. The Council has decided to apply to the Hydro-Electric Power Commission to acquire water power privileges and construct the necessary works to supply [illegible]

ST. CATHERINES, ONT.—The Niagara, St. Catherines & Toronto Railway is contemplating building an extension during the present season from this place to Niagara-on-the-Lake, Welland and Grimsby Park. The electric line is also to be extended from Niagara Falls to Fort Erie.

DAWSON, Y. T.—The Yukon Milling, Dredging & Power Company has been granted water rights on the Klondike River, three-quarters of a mile above Rock Creek. The grant is for 5000 inches and for a term of 20 years. The company proposes to develop the water power and to transmit electricity for commercial purposes.

Company Elections.

BALTIMORE, M. D.—At the annual meeting of the Consolidated Gas, Electric Light & Power Company held recently, the stockholders elected the following directors: Charles Adler, Alexander Brown, Anthony N. Brady, S. R. Betron, Charles T. Crane, John B. Dennis, Charles H. Dickey, Francis H. Hambleton, Thomas J. Hayward, Fairfax S. Landstreet, Ferdinand C. Latrobe, Alten S. Miller, S. Davies Warfield, Frederick W. Wood, Thomas J. Shryock and Charles M. Cohn.

MT. WASHINGTON, MD.—At a meeting of the directors of the Mt. Washington Electric Light & Power Company, held June 25, the following officers were elected: Thomas W. Offutt, president and general manager; Alten S. Miller, vice-president, and Harry J. McIntyre, secretary [illegible]

New Industrial Companies.

THE BERKSHIRE ELECTRIC COMPANY, of North Adams, Mass., has been incorporated with a capital stock of $10,000 by W. F. Waterman, of Boston, and Joseph Lyons, of North Adams. The purpose of the company is construction and allied work in the building of electric railways.

THE ELECTRIC DEVELOPMENT & CONSTRUCTION COMPANY, of Portland, Me., has been incorporated with a capital stock of $1,000,000 by James E. Manter, Clarence E. Eaton, Charles D. Fullerton and Millard W. Baldwin, of Portland, Me.

THE OLSON-BOETTGER ELECTRIC MANUFACTURING COMPANY, of St. Paul, Minn., has been incorporated with a capital stock of $25,000 by H. C. Boettger, J. L. Olson and H. G. Olson.

THE RUMSEY ELECTRIC COMPANY, of Camden, N. J., has been incorporated with a capital stock of $125,000 by G. A. Rumsey, Sr., of Salem, N. J.; W. T. Thomas, of Glenside, Pa., and C. L. Butler, of Philadelphia, Pa. The company proposes to manufacture and deal in electrical machinery devices and goods.

THE STEVENS MANUFACTURING COMPANY, of Woodbury, N. J., has been incorporated with a capital stock of $50,000 by F. Stevens, G. F. Stevens and F. W. Wanderer, of Philadelphia, Pa. The company proposes to manufacture electrical supplies, etc.

THE SOUTHERN INDIANA ELECTRIC COMPANY, of New Albany, Ind., has been incorporated by Charles D. Knoefel, Frank Beaucond, of New Albany, Robert S. Donaldson and Philip S. Pogue, of Louisville, Ky. It is the intention of the company to engage in the manufacture of electrical appliances, among which will be a terminal box for the protection of cables. The capital stock is placed at $5,000.

THE YETMAN TYPEWRITER TRANSMITTER COMPANY, of New York, N. Y., has been formed to manufacture transmitting typewriters, telegraphic transmitters, automatic telegraph machines, etc. The capital stock of the company is $1,500,000 and the directors are: Charles F. Yetman, Samuel Johnston, William M. Williams, and Gabriel Morton, of New York, N. Y., and James J. Stevenson, of Oshkosh, Wis.

New Incorporations.

SAN FRANCISCO, CAL.—The United Water & Power Company has filed articles of incorporation, with a capital stock of $2,500,000. The company proposes to conduct a system of water supply and transmit electricity to this city. The directors are Arthur L. Pease, James D. Stewart, Balfour D. Adamson, J. L. Gould and Charles H. Town.

MARSHALL, ILL.—The Charleston, Westfield, Marshall & Terre Haute Interurban Railway Company has been incorporated by James Dawson, William B. Scholfield, Seymour Hurst, Norman Bennett, W. L. Biggs, M. L. Briscoe, W. R. Patten, T. M. Berkeley and E. T. Pinnell.

GREENFIELD, IND.—The Spring Town Telephone Company has been incorporated with a capital stock of $180 by James Parish, Frank Carrier and others.

[illegible] land Telephone Company, with a capital stock of $800, by B. M. Benson and others.

JEFFERSON, IA.—The Jefferson Mutual Telephone Company has been incorporated with a capital stock of $10,000 by M. R. Cline and others.

MANKATO, MINN.—The Mankato Electric Traction Company has been organized, with W. L. Hixon, president; Fred Kron, vice-president; W. D. Willard, secretary and treasurer, and H. E. Hance, superintendent.

NETCONG, N. J.—The Willsbrook Electric Light Company has been [illegible]

heating and power purposes. The capital stock of the company is $30,000 and the incorporators are J. S. Kennedy, H. H. Neiden and D. M. Cooke, of Stanhope.

GUTHRIE, OKLA.—The Enid, Blackwell & Osage Interurban Traction Company has been chartered, with a capital stock of $1,000,000, to build a railway from Enid to Pawhuska, a distance of 85 miles. The incorporators are: George W. Bear, Frank Bradfield, S. I. Hudkins, John R. Clover and Guy S. Manatt, all of Enid.

AUSTIN, TEX.—The Texas Interurban Company has been chartered for the purpose of building a system of interurban electric railways, with Austin as the center. The company is capitalized at $400,000, and the incorporators are: Thomas Moore, of Elizabeth, N. J.; Ephraim Miller, of White Plains, N. Y.; Henry M. McKay, of Hempstead, N. Y.; C. P. Scrivener and S. M. Posey, of Austin. It is announced that the company will soon commence the construction of an interurban line from Austin to Lockhart, a distance of about 30 miles.

STEPHENVILLE, TEX.—The Stephenville Light & Water Company has been incorporated, with a capital stock of $40,000, by C. H. Bencini, D. H. Burroughs and W. D. Head.

WACO, TEX.—The Home Light & Power Company has been incorporated, with a capital stock of $25,000, by C. R. Boyton, M. L. Lane and others.

SEATTLE, WASH.—Articles of incorporation have been filed for Puget Sound International Railway & Power Company, of Portland, Me., with a capital stock of $2,250,000, by J. H. Drummond, G. M. Drummond, W. G. Chapman, of Portland, Me.; Benjamin Joy, J. S. Lovering, P. L. Warren, A. K. Todd and J. E. Rousmaniere, of Boston, Mass.

SPOKANE, WASH.—Articles of incorporation have been filed for the Panhandle Electric & Power Company, with a capital stock of $1,000,000. The directors are S. W. Payne and others.

BURKHARDT, WIS.—The Burkhardt Mill & Electric Power Company has been incorporated, with a capital stock of $50,000, by Frank P. and C. Burkhardt.

Legal.

PROHIBITION OF CONTRACTS OR COMBINATIONS IN RESTRAINT OF INTERSTATE COMMERCE AND IN VIOLATION OF THE ANTI-TRUST ACT.—In an action to recover treble damages from the defendant company under section 7 of the act of Congress, entitled "An act to protect trade and commerce against unlawful restraints and monopolies," the complaint alleged that the defendant was engaged in purchasing and contracting for the purchase of window glass from the manufacturers for certain jobbers and wholesale dealers doing business in different states, who owned and controlled practically all of defendant's stock; that such dealers comprised over 75 per cent of all those in the United States, and sold more than 75 per cent of the window glass sold therein; that on a certain date the defendant entered into a combination and agreement with them and with a manufacturer which owned and operated factories in different states and manufactured 70 per cent of all the window glass made in the United States, by which the defendant and the dealers agreed to buy window glass from no other manufacturer unless at a materially lower price, and the manufacturer agreed to sell to no other dealers, except at higher prices than it charged them. The agreement limited the quantity of glass to be purchased by each dealer and gave them the power to fix arbitrarily excessive and unreasonable rates which were to be charged to retail dealers, which prices the wholesale dealers were to maintain under the penalty of heavy fines. It was held that the declaration charged a contract or combination in restraint of interstate commerce, in violation of the statute mentioned, which, as construed by the Supreme Court of the United States, makes unlawful any contract or combination in restraint of interstate trade or commerce, and not merely those which are in unreasonable restraint of trade and therefore illegal at common law. "It was obviously designed," said the court, "to destroy or minimize competition between certain wholesalers and jobbers, alleged to be 75 per cent of the whole number so engaged in the United States, and, in the language of the Supreme Court, 'to destroy or restrict free competition in interstate commerce is to restrain such commerce.' "

LIABILITY OF CASUALTY COMPANY TO TELEPHONE COMPANY ON POLICY INSURING LATTER AGAINST LOSS FROM LIABILITY FOR DAMAGES.—A policy issued by a casualty company insured a telephone company against loss from liability for damages on account of bodily injuries accidentally suffered by any person as a result of the negligence of the telephone company. The policy limited the casualty company's liability arising from the death of or injury to one person to $5,000, provided for notice to the casualty company of any injury or claim for damages therefor, and prohibited the assured from making any settlement, incurring any expense or interfering in any negotiations for settlement or in any legal proceeding without the consent of the casualty company. While the policy was in force an employe of the telephone company was killed at Owensboro, Ky., by coming in contact with a telephone wire which had been negligently allowed to rest upon an electric light wire. The telephone company gave notice of this accident to the casualty company and an action, which was brought by the administrator of the deceased employe, was defended by counsel employed by the casualty company. The action resulted in a verdict for $12,000 in favor of the plaintiff. During the course of the trial the telephone company had paid the costs of the plaintiff and the casualty company had incurred considerable expense. The casualty company attempted to deduct from the $5,000 due the telephone company under the policy the amount which it had expended in connection with the defense and the telephone company claimed to be entitled to the entire $5,000 and, in addition, the sums which it had paid out in connection with the case. It was held that, construing the policy as a whole, the casualty company was liable, in addition to the $5,000, for the costs and expenses which the telephone company had been compelled to pay. A policy of insurance prepared with much care for the interests of the insurer should be construed favorably to the other party, if the language leaves the matter in doubt. New Amsterdam Casualty Company vs. Cumberland Telephone & Telegraph Company, U. S. Circuit Court of Appeals, 152 Fed. Rep. 961.

RAILROAD COMPANY CANNOT KEEP TELEGRAPH COMPANY FROM ERECTING ITS POLES AND WIRES ALONG THE RAILROAD RIGHT OF WAY.—The same principle which justifies a railroad corporation in condemning a right of way over the lands of private individuals in the first instance will stand for the subsequent condemnation of a right of way by a telegraph company against the railroad. This is an old and just proposition of law recently reiterated by the United States Circuit Court in a case involving an attempt by the Atlantic Postal Telegraph Cable Company to acquire a portion of the right of way of the Georgia Railroad & Banking Company, between the cities of Augusta and Atlanta, wherein to erect its poles and wires, and an effort on the part of the railroad company to keep the right of way entirely for its own use on the plea that the installment of the telegraph line would interfere with its business. In the proposed line of the telegraph company it was planned that the poles would not be over 20 feet in height and that they should be removed at least 20 feet from the end of the nearest cross-tie. The railroad company declared that at certain points its right of way was far too narrow to permit of the execution of this plan. The court, however, was of the opinion that this statement applied at those attenuated points on the Georgia line where it seemed to enjoy nothing but roadbed, and that contiguous territory upon which a pole might rest would probably be found in the neighborhood. The railroad company argued against the admission of the telegraph company upon its domain that there were many curves in the road and that, at these points, the wires would have a tendency to pull the poles down upon the tracks, which argument was met by the court in this wise: "In railroad construction and maintainance curves are not novel, and it would seem easy enough by proper bracing to protect the roadbed and track." The railroad company then complained that the Western Union already was in possession of part of its right of way putting it to the same use as that contemplated by the Atlantic Company and said, in effect, that one was enough. But the court again favored the telegraph company in holding that because one telegraph company had secured a prior occupancy for its lines could not be made a ground upon which to hold that other companies might not thereafter institute additional lines. The existence of competing lines along the same right of way was a means of insuring fair service to the public. The president and general manager of the Southern railroad testified that during a sleet storm of 1905 several hundred telegraph poles were strewn across the various lines of railroad in his section, causing great delay to the trains, and that telegraph poles, when in close proximity to a railroad track, were often caused to fall by taking fire. "These conditions, while obviously distressing," said the court, "would in this day scarcely enbarrass the wonderful profession of engineering, which has woven the gigantic suspension bridge, constructed the transcontinental railway, conducts mighty steamships over the shallows where Israel escaped and Pharaoh perished, and even now is rushing to completion that Isthmian canal, which for more than 400 years has quickened the imagination of the discoverer, the geographer and the statesman." It was held that none of the grounds advanced by the railroad company was sufficient to warrant the court in enjoining the telegraph company from proceeding with the work of erecting the proposed line. Georgia Railroad & Banking Company vs. Atlantic Postal Telegraph Cable Company, 152 Fed. Rep. 991.

Obituary.

MR. J. MENASCO.—Advices from Monroe, La., state that Mr. John Menasco, the city electrician, was struck by a train there on July 2 and instantly killed. The body has been sent to his daughter at Bisbee, Ark., for interment. He had held his position at Monroe for the last four years, and was about 40 years of age.

MR. H. L. CARTER.—Advices from Harrisburg, Pa., of July 15, report the death there of Mr. Henry L. Carter, 50 years old, the president of the York Haven Power & Paper Company, of a stroke of apoplexy at his home. He leaves a widow and eight children. The York Haven plant is a modern and interesting one, and has been described in our pages during the past year.

MR. N. HAMILTON.—The death is announced at Hot Springs, Ark., of Mr. Nandaior Hamilton, of Harrisburg, Pa., aged 50 years. He was quite active in local Democratic politics. He was largely interested in the Paxtang Electric Company, was one of the organizers of the Southwest Missouri Electric Railway system, and was president of the Union Telegraph & Telephone Company, operating exchanges in Rock Island. [illegible]

MR. [illegible] Railway [illegible] While endeavoring to fix a trolley wire he slipped from the ladder which had been placed against the guy wire and fell into the street. Mr. Gotschalk was identified with the Columbus Company and its constituents for a number of years, going to Columbus from Chicago in 1889. He was [illegible]

Personal.

MR. J. A. STANTON, of Cincinnati, Ohio, has been made secretary and treasurer of the Mt. Carmel, Ill., Gas & Electric Company.

PROF. V. KARAPETOFF, of Cornell University, has written a textbook on "Experimental Electrical Engineering," which will be published this fall.

MR. A. H. WALTON, of the British Thomson-Houston Company, is now in this country and has been visiting various plants in order to study the latest American developments in power plants.

PROF. H. H. NORRIS, of Cornell University, has prepared for the use of students a work entitled "An Introduction to the Study of Electrical Engineering," which will issue from the press Aug. 15.

MR. A. W. ZAHM, who was formerly business manager of the People's Gas & Electric Company, of Mason City, Ia., has been appointed manager of the Fort Dodge, Ia., Light & Power Company.

MR. GUY W. TALBOT, vice-president and general manager of the Corvallis & Eastern Railroad, has resigned to take the position of vice-president and general manager of the Oregon Electric Railway.

MR. CHARLES H. MERZ, of London and Newcastle-upon-Tyne, England, consulting electrical engineer, announces that the style of his firm will hereafter be Merz & McLellan. His new associate is Mr. W. McLellan.

MR. B. W. TRAFFORD, manager of the Chesapeake & Potomac Telephone Company, Baltimore, Md., has been appointed general manager of the Michigan State Telephone Company, with headquarters at Detroit.

MR. A. S. KALENBORN, formerly assistant electrical engineer of the California Gas & Electric Corporation, has charge of the newly established offices of F. G. Baum & Company, 497 Arcade Annex, Seattle, Wash.

MR. W. J. ECK has been appointed electrical engineer of the Southern Railway Company, with headquarters at Washington, D. C., vice Mr. Gray W. Johnston. The road's superintendent of telegraphs is Mr. C. P. Adams.

MR. MARSDEN J. PERRY, vice-president of the Union Trust Company, of Providence, R. I., and past president of the National Electric Light Association, has been elected vice-president of the Night and Day Bank of New York.

MR. J. S. VIEHE, formerly with the Southern Power Company, has been appointed electrical engineer for the Federal Construction Company, which is building the dam, power house and transmission line of the Rockingham Power Company, of Rockingham, N. C.

DR. ALFRED BERLINER, director of Siemens & Halske, etc., is on a visit to this country, and is making a trip around the world. He will proceed next to Japan, and thence across Siberia. Dr. Berliner is familiar with this country, having spent some few years in Chicago.

MR. HENRY C. HAZZARD, of New York City, has been appointed chief clerk of the division of light, heat and power of the second district (up state) Public Utilities Commission. He was the secretary of the old State Commission of Gas and Electricity at a salary of $3,000.

MR. F. C. LEWIS, superintendent of the Denison, Tex., exchange of the Southwestern Telephone Company, has resigned and accepted a position in the engineering department of the Home Telephone Company, of Los Angeles, Cal. Mr. T. G. Wilkins will succeed Mr. Lewis.

DR. N. M. HOPKINS, electrical engineer for consolidated power plants, Department of the Navy, contributed recently to the *Journal of the American Society of Naval Engineers* some interesting data on standard lighting protection for power plant chimneys at U. S. yards. It has now been issued in pamphlet form.

MR. RAYMOND H. SMITH, superintendent of the Bridgeport division of the Connecticut Railway & Lighting Company, has tendered his resignation is to take effect as soon as his sucessor is appointed. Mr. Smith has accepted the position of superintendent of the Albany & Hudson Electric Railway & Lighting Company, of Hudson, N. Y.

MR. ANTHONY J. BRADY has been elected a director of the British Columbia Copper Company, to succeed Colonel John Weir, who resigned because of ill-health. Mr. Brady sailed suddenly for England last week, in connection, it is believed, with his large interests in the American Tobacco Company and its English allies, now under fire of litigation with the government legal authorities in Washington.

MR. GEORGE W. MARTIN, formerly editor of the *Electrical Age*, and latterly with the engineering department of the New York Edison Company, has been appointed by Ford, Bacon & Davis as assistant to the resident engineer for the construction of a combined gas, water and electric plant at Pine Bluff, Ark., for the Pine Bluff Water & Light Company.

MR. HERBERT S. WHITON, chief engineer of the Ponce Electric Company, of Ponce, Porto Rico, has been appointed manager of the company in place of Mr. Gardner Rogers, who is returning to the Boston office of Stone & Webster. Mr. James B. Walker, of the Boston office, has been appointed assistant treasurer at Ponce, to take the position of Mr. William H. Stone, who is leaving the company to become manager of the Mayaguez Light & Power Company, of Mayaguez, Porto Rico.

MR. H. M. HIRSCHBERG, of the Excello Arc Lamp Company, has gone on a two months' trip to England and Germany and through the continent generally in order to study lighting conditions and to make arrangements for a new line of lamps next year. The Western traveling representative, Mr. C. W. Armstrong, will be in New York for a number of days in connection with work at the head office. Mr. O. Baerwinkel has returned from an extensive tour through Canada, where he visited the largest power and lighting plants in the provinces of Manitoba and Ontario.

MR. H. MILLIKEN, who recently joined the engineering staff of W. S. Barstow & Company, New York City, leaves this week for their Portland, Ore., office, where he will be permanently located as resident electrical engineer. Graduating from the Massachusetts Institute of Technology with a degree of E. E. he entered the engineering department of the General Electric Company, at Schenectady, later taking a post graduate course at the Case School of Applied Science, Cleveland, Ohio. For the last two years he had been identified with the operating department of the New York Edison Company, prior to his association with the Barstow staff.

A BROOKLYN NIGHT.—On Monday, July 8, at the Brighton Beach Hotel, the contract department of the Edison Electric Illuminating Company, of Brooklyn, had as its guests at dinner, W. W. Freeman, W. F. Wells, P. A. Atkinson and J. F. Becker, Jr., the vice-president, general superintendent, treasurer and general agent of the company. Mr. J. F. Becker, the able contract chief, acted as toastmaster. Toasts were responded to briefly by some six or eight of the diners, after which Mr. W. W. Freeman, through his thoughtfulness and generosity, made it possible that this dinner become an annual affair. After the banquet the open doors of the Music Hall swallowed officers and men, where a splendid bill was thoroughly enjoyed by all.

MR. PUTNAM A. BATES, under whose direction a large consignment of apparatus has just been shipped to Manila, P. I., for the electrical equipment of Fort Wm. McKinley, has closed contracts for a complete electric generating plant, storage battery, steam heating and ventilating installation for the Sevilla Home and Hospital now in the course of construction in the Borough of the Bronx. His services have also been engaged by the architects in charge of the Wadsworth Atheneum, of Hartford, Conn., to which institution the Colt estate, of Hartford, and Mr. J. P. Morgan have recently given liberal sums for the erection of new wings to contain art galleries and museums. The heating, ventilating and lighting systems for these buildings are now being designed by Mr. Bates.

MR. W. J. WILGUS, vice-president of the New York Central & Hudson River Railroad Company, has tendered his resignation, to take effect Oct. 1. The following is the official announcement issued by the company: "Mr. Wilgus has several times during the last two years suggested his desire to retire from his official connection with the service of the company, but the great work of changing from steam to electric power in the electric zone and the reconstruction of the Grand Central terminals made it almost impossible for the road to comply with Mr. Wilgus' wishes. The initial installation of electricity having been completed and the practicability and success of handling the business of the road by the new power having been fully demonstrated by months of successful operation, Mr. Wilgus renewed his request to be relieved at as early a date as practicable, suggesting July 1 as the date. At the earnest request of President Newman, however, Mr. Wilgus has consented to remain in his present position until Oct. 1, and with this understanding his resignation, effective on that date, was reluctantly accepted."

MR. PETER COOPER HEWITT has transferred his energies from the electric and automobile fields and has lately been working on high-speed marine craft of the "gliding" type, on the plan of a flying machine, and capable of 60 miles an hour. In the model from each corner of the frame there are dropped into the water perpendicular steel arms. These arms extend 18 inches below the bottom. To the arms are fastened steel planes, having a slant upward in front of about 1 in 8. The bottom submerged planes have 2 square feet of surface and those above it are larger. The total supporting surface of the four principal planes, therefore, is 8 square feet. The motor is set forward and the single screw turns just back of the front sets of planes. On either side of the shell is a gasoline tank. In operation the screw driving or pulling the craft forward forces the slightly slanted planes through the water and, on account of their slant, the craft is forced upward. The greater the speed the higher the craft rises. When it has reached a speed which forces the topmost vanes out of the water, or partly out, part of the supporting surface is lost and the craft settles lower, this principle constantly operating to maintain a perfect level for the shell at a given distance above the surface of the water.

Trade Publications.

MECHANICAL DRAFT.—With this title the Green Fuel Economizer Company, Matteawan, N. Y., has issued a pamphlet describing and illustrating the application of mechanical draft in connection with economizers.

COOL THOUGHTS [illegible]

issued by the B. F. Sturtevant Company. It describes various types of electric propeller fans and illustrates their application.

TRUMBULL CHEER for July is full of good things, including a monthly calendar for the desk. The Trumbull Electric Manufacturing Company's factory at Plainville, Conn., is shown, besides several excellent illustrations of switches. Price lists of the switches made by this company are also given.

"PLANT ECONOMY" is the title of a pamphlet by Mr. H. P. Dennis, M. E., an authority on power plant equipment. It deals with the important uses of automatic recording instruments and is issued by the Bristol Company, of Waterbury, Conn., which will send copies of the bulletin to any person interested.

"PAISTERY."—Bulletin No. 44, of the H. T. Paiste Company, Philadelphia, Pa., relates to bushings, rosettes, fusible hanger boards for multiple arc lamps, taplets, etc. These goods are well illustrated and the prices given. June being the brides' month, the front cover has an illustration of a young lady in bridal garments.

WESTINGHOUSE LAMPS.—A 38-page pamphlet in a cover of artistic design and execution, has been issued by the Westinghouse Lamp Company to describe and illustrate various types of incandescent lamps of its manufacture. Twenty-six half-tones from refinished photographs, printed on as many pages, show the principal types of lamps, which are described in the opening pages. Information is also given as to the selection of lamps.

ELECTRICAL MEASURING INSTRUMENT.—The Leeds & Northrup Company, of Philadelphia, has issued a third and much-enlarged edition of its catalogue of electrical measuring instruments. The pamphlet, which is 7 ins. by 10 ins. in size, and substantially bound, contains 125 pages of text and illustrations, the latter aggregating more than 100. A considerable number of the instruments have not been previously catalogued, among which are a line of resistance-thermometers, fault-finder, synchronizing and speed-controlling apparatus, alternating-direct-current comparator, bridge for locating faults in power circuits, etc.

Business Notes.

WESTINGHOUSE MOTORS.—Among the orders which the Westinghouse Electric & Manufacturing Company has taken since the first of June are one for 16 locomotives for coal mines in West Virginia and Kentucky, and orders for one for an iron mine in Sweden, another for a power company in the State of Washington, and one for a plate glass mill at Charleroi, Pa.; a complete electric motor equipment for a phosphate mine in Florida; and for a lumber camp at Mount Pleasant, Pa.; an order for 39 motors to drive machinery in a cash register manufacturing plant at Dayton, Ohio; 59 motors for driving textile looms at East Hampton, Mass., and a large number for running spindles in a worsted mill at Passaic, N. J.; 15 motors are going to a paper mill in Canton, N. C., and 20 to a paper mill in Fulton, N. Y.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 9, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

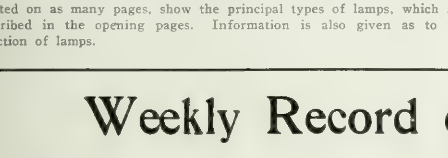
859,200. ELLECTRIC-SWITCH HANDLE; Charles A. Clark, Hartford, Conn. App. filed May 7, 1907. A construction of handle for a rotary snap switch provided with yielding means whereby it may be attached to the switch spindle so as to hold the cover in position without requiring the spindle to be of exact length with relation to the base or frame.

859,201. TELEPHONE SYSTEM; Henry P. Clausen, Chicago, Ill. App. filed July 18, 1903. Complete diagram including cord circuits and ringing connections.

859,219. BLOCK-SIGNAL SYSTEM; Laurence A. Hawkins, Schenectady, N. Y. App. filed Dec. 5, 1906. Relates to block-signal systems for electric roads, in which both rails are made conductive for all currents without inductive bonds or special connections. Has normally open circuited transformers connected across the rails at intervals.

859,221. TELEPHONE SUPPORT; Stephen C. Houghton, Rome, N. Y. App. filed July 10, 1906. Construction of switchbox adapted to contain switches for the local circuits.

859,255. SHUNT FOR ELECTRICAL MEASURING INSTRUMENTS; Frank W. Roller, Plainfield, N. J. App. filed Jan. 13,



859,255.—Shunt for Electrical Measuring Instruments.

1905. A shunt for electric measuring instruments comprising a resistance strip having heat radiators in good thermal relation at distributed points along its surface.

859,276. TELEPHONE SWITCHBOARD; Frank W. Wood, Newport News, Va. App. filed July 12, 1906. The combination with a support, of a shutter hinged thereto, and contacts, operating means therefor, drops and an operator's set mounted upon the shutter.

859,278. SWITCH-CLIP; Gilbert Wright, Pittsfield, Mass. App. filed June 17, 1905. A switch clip comprising abutting plates having offset portions and provided with a threaded opening, a portion of which is formed in each plate.

859,283. POWER CONVERTING AND TRANSMITTING MECHANISM; Patrick J. Collins, Scranton, Pa. App. filed Oct. 12, 1904. The combination with an engine and a driving shaft operatively connected thereto, of a dynamo electric machine comprising an outer member secured to said driving shaft, an intermediate stationary member and an inner rotatable member having a shaft operatively connected to the mechanism which is to be driven and a clutch for connecting said shafts together.

859,292. ELECTRIC LIGHTING; Johannes Harden, Schenectady, N. Y. App. filed Dec. 10, 1903. In combination for use in an alternating-current arc lamp, an electrode containing a predominating amount of titanic material, and an electrode composed principally of carbon.

859,316. SNAP-SWITCH; Walter S. Mayer, Philadelphia, Pa. App. filed April 4, 1907. A snap-switch having various detail features of improvement.

859,318. DYNAMO-ELECTRIC MACHINE; Edgar W. Mix and Paul Bunet, Paris, France. App. filed Nov. 20, 1906. In a multipolar dynamo-electric machine, a parallel-wound drum armature, a field magnet having commutating poles, and means for producing in each pole two magneto-motive forces proportional respectively to the currents flowing through the two adjacent commutator brushes.

859,333. METER; William H. Pratt, Lynn, Mass. App. filed Sept. 25, 1905. A watt-hour meter designed to show the energy consumed in charging a storage battery, and the energy supplied by the battery, and which is so arranged that it will not be influenced by exterior magnetic fields.

859,350. UNIPOLAR GENERATOR; Elihu Thomson, Swampscott, Mass. App. filed Sept. 28, 1905. In a unipolar machine, a pair of collecting brushes independent of the brushes carrying the main armature current connected to the field winding and bearing on a pair of collector rings, connected to opposite ends of a single armature conductor.

859,358. ALTERNATING-CURRENT MOTOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Aug. 19, 1905. In an alternating-current motor, a slotted core provided with distributed coils all equal in size, alternate coils being connected in independent sets to form two separate windings of different numbers of poles.

859,359. FREQUENCY-CHANGER; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Aug. 24, 1905. In a frequency changer, two relatively-movable magnetic cores, and two windings of different pole numbers on each core, both windings on one core being connected to the same alternating-current circuit, and one of the windings on the other core being connected to a second alternating-current circuit and the other short-circuited.

859,361. ROTOR FOR HIGH-SPEED DYNAMO-ELECTRIC MACHINES; Bernard A. Behrend, Norwood, Ohio. App. filed Nov. 30, 1906. Covers features of construction of the rotating members of high-speed dynamos, such as the rotary fields of turbo-alternators.

859,363. SECTIONAL GANG-BOX FOR PUSH-BUTTON SWITCHES; Leon W. Bossert, Utica, N. Y. App. filed Feb. 19, 1906. Improvement in multi-sectional gang boxes for rotary or push-button switches. Provides means whereby sections, preferably drawn up from metal, may be assembled together to accommodate varying numbers of switches.

859,367. ELECTRICAL PUSH BUTTON; Frederick W. Cohn, New York, N. Y. App. filed March 5, 1907. Details of construction of a "midget" push button.

859,368. DYNAMO-ELECTRIC MACHINE. Patrick J. Collins, Scranton, Pa. App. filed Nov. 16, 1904. In a dynamo-electric machine, an outer stationary member, an inner rotatable member, an intermediate rotatable member coacting with said inner and outer members, and a mechanical driving connection between said rotatable members.

859,369. DYNAMO-ELECTRIC MACHINE; Patrick J. Collins, Scranton, Pa. App. filed Nov. 30, 1904. The combination with an engine, of a dynamo electric machine comprising an outer stationary member, an intermediate rotatable member having a shaft operatively connected to the engine, an inner rotatable member having a shaft journaled within the shaft of the intermediate member, and a clutch for connecting said shafts together.

859,431. APPARATUS FOR THE ELECTROLYTIC PRODUCTION OF CHEMICAL COMPOUNDS; Courtland F. Carrier, Jr., Elmira, N. Y. App. filed June 9, 1906. Provides an apparatus whereby compounds which require the use of a free metallic element in their preparation by electrolysis may be continuously produced by an economical method.

859,435. SAFETY DEVICE FOR ELECTRIC MOTORS; Frederick M. Conlee, Madison, Wis. App. filed Dec. 9, 1905. The field circuit of the motor has a no-voltage magnet and device controlled thereby for closing the armature circuit.

859,437. PRIMARY BATTERY; William P. Divine and Albert J. Shinn, Philadelphia, Pa. App. filed Aug. 1, 1906. Construction of battery having a plurality of porous tubes and a hollow header connecting and supporting the electrodes.

859,449. TROLLEY-HARP; John Hensley, Huntington, Ind. App. filed Oct. 25, 1906. Provides a trolley-harp having a guard to prevent the trolley wheel from coming down on top of the wire when trying to replace it after it has left the wire.

859,464. ANTI-BUZZING DEVICE FOR TELEPHONES; August Schaffer, East Columbus, Ohio. App. filed Dec. 24, 1906. An anti-buzzing device for telephone receivers comprising essentially in combination, a wire screen, a washer-like device, and a concavo-convex piece, adapted to be placed together and secured in the ear piece of the receiver.

859,473. ELECTRIC SIGNALING SYSTEM AND SELECTIVE MECHANISM THEREFOR; Jean F. Webb, Jr., Chicago, Ill. App. [illegible] selected station from a home or central station. Employs a step-by-step ratchet controlled switch arm at each station.

859,479. GUARD ATTACHMENT FOR TELEPHONES; George L. Blackburn, Greensboro, N. C. App. filed March 7, 1907. Sheet metal device applied to ordinary desk telephone to protect receiver.

859,515. ELECTRIC LIGHTING; William J. Phelps, Detroit, Mich. App. filed July 15, 1903. Covers features of the switch of an incandescent lamp having two separate filaments of different illuminating power.

859,523. MAGNETIC CLUTCH; Lewis D. Rowell, Milwaukee, Wis. App. filed May 1, 1905. Relates to improvements in magnetic clutches in which the driven member may be gradually accelerated and after it has attained full speed the two members positively connected.

859,524. ELECTRICAL CONTACT-FINGER; Henry K. Sandell, Chicago, Ill. App. filed Jan. 21, 1907. Electrical contact finger for self-playing instruments adapted to a perforated sheet and make contact with the metallic roller there-beneath.

859,534. TELEPHONE SELECTING APPARATUS; William D. Watkins, San José, Cal. App. filed April 30, 1906. In selecting signaling apparatus, circuit-closing contacts, an oscillatory selecting member, an electromagnet for actuating the same, and means for guiding the selecting member in a zigzag path into circuit closing position.

859,545. DYNAMO-ELECTRIC MACHINE; Patrick J. Collins, Scranton, Pa. App. filed Dec. 27, 1904. In a dynamo-electric machine, a generator armature, a motor armature, and an intermediate field member wound and arranged to produce a magnetic flux passing in a single path through both armatures.

859,547. SAFETY-FUSE FOR ELECTRIC CIRCUITS; Charles S. Davis, Somerville, Mass. App. filed Oct. 27, 1905. Safety fuse for electric circuits of the cartridge type, in which the fusible wire is enclosed in a casing and surrounded by gas absorbing materials. The caps of the fuse are secured thereon by a bayonet point.

859,551. CUT-OUT SWITCH FOR SERIES-PARALLEL CONTROLLERS; Arthur C. Eastwood, Cleveland, Ohio. App. filed Sept. 27, 1906. Relates to means for cutting out one motor or group of motors operated in series-parallel by means of single operating controller.

859,556. METHOD OF AND APPARATUS FOR FAULT LOCATION ON ELECTRICAL CONDUCTORS; Herbert M. Friendly, Portland, Ore. App. filed April 10, 1905. Electrical testing device intended for locating grounds or crosses on cables or insulators. Form of Wheatstone bridge.

859,565. APPARATUS FOR DETINNING TIN-SCRAP; Meredith Leitch, Elizabeth, N. J. App. filed Feb. 17, 1906. Has a tubular U-shaped basket through which a conveyor passes and a tank adapted to contain a liquid for treating the contents of said basket.

859,566. METHOD OF DETINNING TIN-SCRAP; Meredith Leitch, Elizabeth, N. J. App. filed Feb. 17, 1906. Relates to the method of the above patent.

859,578. ELECTRIC SOLDERING TOOL; Nicholas Porrella, New York, N. Y. App. filed Feb. 20, 1906. Provides a soldering tool in which the heating coil is disposed within the soldering head so as to be protected against corrosion and oxidation, and in which the tool may be heated to either of two degrees of heat.

859,579. ARC-LIGHT ELECTRODE; Robert H. Read, Schenectady, N.

859,703. Insulating Strain.

Y. App. filed May 18, 1901. An arc-light electrode containing carbid of aluminum.

859,598. ELECTRIC SIGNALING AND TESTING MECHANISM; John Doran, Jr., Schenectady, N. Y. App. filed June 28, 1906. Covers signaling and testing mechanism for use in an open circuit electric signaling and testing system having a rectifying electrolytic cell incorporated in the circuit.

859,608. ELECTRIC RESISTANCE ELEMENT; Albert L. Marsh, Lake Bluff, Ill. App. filed Feb. 18, 1907. An electric resistance element composed of an alloy consisting of metal having the properties of nickel and cobalt, and a relatively small proportion of aluminum.

859,620. ELECTRICAL SELF-PLAYING INSTRUMENT; Henry K. Sandell, Chicago, Ill. App. filed Feb. 5, 1906. An electrical xylophone.

859,621. CIRCUIT CHANGER; Edmund O. Schweitzer and Alfred [illegible] switch and a thermal actuated device included in the circuit and [illegible] hold and release the same.

859,641. ELECTRIC FURNACE; Edward A. Colby, Newark, N. J. [illegible] a refrigerating circulation system.

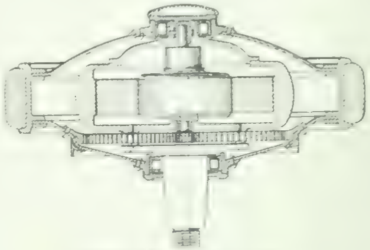
859,667. AUTOMATIC TROLLEY-GUARD; Henry A. Kenned, Natick, R. I. App. filed Jan. 29, 1907. Construction of trolley wheel having a perforated yieldingly supported revoluble and endwise movable guard flange.

859,674. MASSAGE APPARATUS; Carl O. Lindstrom, Chicago, Ill. App. filed May 26, 1906. Vibratory massage apparatus designed to be driven by a motor and in which the force or range of the vibration can be changed as required.

859,703. INSULATING-STRAIN; Louis Steinberger, New York, N. Y. App. filed May 1, 1906. Construction of strain insulator having circumferential ribs to prevent creepage currents in wet weather.

859,731. ELECTRICAL CONDENSER; Sidney A. Reyland, Elyria, Ohio. App. filed Jan. 10, 1907. A combined contact and securing bolt by means of which a telephone condenser can be held upon a a suitable rack.

859,753. PROCESS FOR THE BUILDING UP OF SPONGY LEAD PLATES FOR ELECTRIC STORAGE BATTERIES; Julius Diamant, Gyor, Austria-Hungary. App. filed Nov. 28, 1906. The pro-



[illegible] Motor Wheel.

cess of building up spongy lead plates for electric storage batteries which consists in dividing the plates into sections and then varying the relative order of the sections to bring the internal surfaces to the outside and the deteriorated surface to the inside.

859,774. TWO-WIRE MULTIPLE TELEPHONE SYSTEM; Jacob W. Lattig, West Bethlehem, and Charles L. Goodrum, Philadelphia, Pa. App. filed June 6, 1903. Complete diagram of circuits for multiple exchange system including phantom line circuit.

859,783. TROLLEY-FINDER; Frederick A. Selley, Nashville, Tenn. App. filed July 26, 1906. Has a pair of pivoted fingers pivoted to the trolley harp and gear connections for moving them upwardly so as to keep the wheel on the wire.

859,792. DETINNING; Raymond S. Wile, Pittsburg, Pa. App. filed Oct. 19, 1906. The process of detinning which consists in dissolving the tin in a solution and subjecting such solution to the action of a current of sufficient voltage to cause the separation of the tin, said solution consisting of stannic chloride having hydrochloric acid added thereto.

859,816. LIQUID-FLOW ALARM; Raymond S. Kelsch, Montreal, Quebec, Canada. App. filed May 3, 1907. Provides means whereby a cup rising and falling within a casing will sound a suitable alarm at the limit of its movement.

859,820. ELECTRIC MOTOR-WHEEL; Karsten Knudsen, Grand Rapids, Mich. App. filed Oct. 4, 1906. Has a driving shaft mounted coaxially with respect to the driven member, a pinion thereon, gearing between opposite sides of the pinion and opposite sides of the driven member and equalizing means.

859,821. CONTROLLER FOR INCANDESCENT ELECTRIC-LIGHT BULBS; Theodore Kopp, Philadelphia, Pa. App. filed Oct. 13, 1906. An electric light controller provided with contact arms and a short circuit pin, said contact arms and short circuit pin being normally held out of engagement, a resistance coil and connections for [illegible]

859,826. VARIABLE-SPEED MOTOR; George Martinka, Jersey City, N. J. App. filed July 17, 1906. Relates to electrical generators and is designed to produce an easy adjustment of the variable speed necessary on such motors as are usually employed in direct-connected electrically driven machinery.

859,827. HYGIENIC TELEPHONE APPLIANCE; Charles H. Molyneux and Max Braunstein, Rochester, N. Y. App. filed Sept. 12 1906. A device of the character described comprising an upper casing having a stationary shaft to support a rolled strip of mate- [illegible] able sections and a hinged door, a winding shaft carried by said door, and means for preventing retrograde movement of said shaft.

859,840. ELECTRIC LIGHT ILLUMINANT; Robert H. Read, Schenectady, N. Y. App. filed Sept. 16, 1904. An arc-light electrode containing magnesium carbid.

859,867. TROLLEY; Charles A. Bluhm, Michigan City, Ind. App. filed Feb. 27, 1906. Contact shoe for threaded shells having a roller on a short pivoted arm which can be raised off the rail by a rod or wire connection.

859,868. THIRD RAIL; Charles A. Bluhm, Michigan City, Ind. App. filed Feb. 27, 1906. Construction of third rail in which the flow of current to the collector shoe will not be interrupted at crossings, etc.

859,872. RAILWAY BLOCK-SIGNAL SYSTEM; Winthrop M. Chap[illegible] features including lamps and solenoid mechanism for moving the semaphore arms.

[illegible] TELEPHONE [illegible] APPARATUS [illegible] Ossipee, N. H. App. filed Aug. 18, 1905. Two-party line subscribers instrument.

859,889. ARC-LIGHT ELECTRODE; Robert H. Read, Schenectady, N. Y. App. filed Oct. 10, 1902. An arc-light electrode formed of carbid of titanium.

859,890. ARC-LIGHT ELECTRODE; Robert H. Read, Schenectady, N. Y. [illegible]

859,891. ARC-LIGHT ELECTRODE; Robert H. Read, Schenectady, N. Y. [illegible] conium carbid admixed with a suitable binding material.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

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NEW YORK, SATURDAY, JULY 27, 1907.

CONTENTS

TECHNICAL GRADUATES.

Elsewhere is given the result of a census of the universities, colleges and technical schools of this country, instituted in order to obtain data as to the number of students enrolled in electrical engineering courses during the past scholastic year, and the total number of graduates to date from the time the first fledgling electrical engineer issued from the academic shades into what at the period was an extremely unsympathetic world. As will be seen from the tabulation, the number of students enrolled was little short of 9000, the graduates in June numbered 1358, and the total number of graduates to date has reached, in round numbers, 11,000. Lack of previous data prevents comparisons with former years, but it can safely be assumed that instead of high-water mark being reached, the immediate future will show large increases in the number of students enrolled and in the number graduated. The returns show a considerable number of schools, particularly in the newer states, which have only recently organized electrical engineering courses that will require some time for development, and the avidity with which graduates have of recent years been sought by manufacturing companies, and lately by operating companies, must have had an effect in rendering the promise of an electrical course attractive to the budding youth and the fond parent.

The magnitude of the figures we print may cause uneasiness to those who fear that the influx of graduates is greater than the absorptive capacity of the electrical industry. If the graduates were only fitted for purely technical careers, there would be cause for real alarm as the actual requirements in this line could any year be supplied by a small percentage of the graduates. In point of fact, however, we doubt if the schools are turning out nearly as many men as could be utilized with benefit to the electrical industry and with profit to the graduates. It seems now thoroughly established in the electrical field, and is becoming recognized in other industrial fields, that the technical graduate is ideal raw material from which to recruit every branch of an industry: that if taken at the plastic stage upon entry into the work-a-day world, he can be shaped, almost at will, to fill any position in the electrical industry, technical, administrative, manufacturing or commercial. In the day when both the graduate and the public considered a degree a certificate of ability to practice a branch of engineering in all of its details, the employer never thought of the holder of a sheepskin in connection with other duties than merely technical ones. In time, however, it was found that the training of the sound judgment which really constitutes the engineer took time, and that in the same period the graduate could not only be equally well qualified for the duties of any non-technical branch of the industry, but more quickly and more efficiently qualified than young men not technically educated.

In other words, it was found that the mental training and discipline of character received in the schools are of the highest

practical value in life entirely aside from the technical bearing of the studies pursued; and, moreover, that technical knowledge is constantly of value in enabling commercial manufacturing, and, in fact, all non-technical situations of an industry to be grasped more confidently and more firmly. The electrical schools are thus rapidly becoming the sole avenue to the positions of profit and power in the industry. This is already true with respect to the manufacturing branch, and the movement appears to be gaining strength progressively in the central station and electric railway branches. Any fear as to the schools at the present time over-supplying the market for technical graduates is, we believe, groundless.

The I. E. S. Convention.

The first annual convention of the Illuminating Engineering Society is a milestone in the progress of a new art. It is altogether astonishing that so little attention had been paid until within a few years to the proper utilization of artificial light and the new society seems actually to have found and filled a long-felt want in bringing together the men who are directly interested in proper illumination. The trouble heretofore has been that the engineering of illumination in so far as it has existed at all has been merely a neglected branch of something else. Possibly the electrical side of the matter has been better developed than any other, but though electrical bodies have met and passed resolutions about illumination, they have carried no weight whatever because they represented merely the electrical side of the question and rightly or wrongly were under suspicion of self-interest. The Illuminating Engineering Society as a whole has no axe to grind for the benefit of any especial illuminant. The list of papers announced for the convention next week covers a wide range of topics. Of the 17 papers promised less than half are purely on the side of electric lighting, the rest being devoted to other illuminants and to the general problems of the art. Illuminating engineering covers a much broader ground than electric lighting, although to-day electricity is, of course, the chief illuminant in large installations.

It is high time for this subject to take a place in engineering education and especially in the higher schools of technology and of architecture. We are not aware of a single course in illumination given to students of architecture anywhere in the world, although the architect above all others is the man who has to deal with it most frequently and during the only stage at which proper provision can be made for it. The modern city is rapidly becoming an advocate of the 24-hour day and its night conditions are of very great importance. Hence its aspect and efficiency as a nocturnal being must be scrupulously considered. For this reason the art of artificial lighting has assumed an importance during the past ten years greater than it could have acquired in the previous ten centuries. The expert on illumination must have a broader training than if he were dealing merely with gas or electricity or oil, for he must gain a very clear idea of the technical features of all of them and of a good many special matters besides. We know of no technological course yet planned to cover the needful ground, although something is being done in connection with a few electrical courses. We hope the coming convention will help to bring people to a realization that there really has arrived a new branch of engineering and the beginnings of a new profession. When one considers that the expert in illumination often is able to double the efficiency of the illuminating plant, whatever it is, thereby doubling the useful light or halving its cost, the economic importance of the subject is at once apparent. The coming convention should draw a large attendance and should arouse keen interest in the possibilities of improvement. The program is a most promising one even from the standpoint of the layman. The engineers who gather to discuss it form a representative body from all over the country and we trust the Hub to give them a hearty welcome.

Illegal Penalty Clauses.

Some of the recent anti-corporation laws, in various states, especially the laws directed against railroads and seeking to enforce lower rates, have been extreme in their severity; leading already to a marked revulsion in popular sentiment on the subject. It would seem that some of this new legislation is also tainted with illegality, and the decision of Judge Pritchard, of the U. S. Court, in North Carolina this week, is likely to attract an unusual amount of attention, from its strong pronouncement in this respect. The state has passed a low-rate law, inflicting heavy penalties, and under it a ticket agent had been sent to the chain gang. This man the judge has set free on habeas corpus proceedings, declaring the law unconstitutional. Moreover, he pointed out that the penalties inflicted by the statute would close the doors to a judicial hearing and would amount to two and a half million dollars a day if the penalty was enforced on the sale of each ticket, which is eight times more than the amount involved in the original suit; also that it would do violence to the comity which exists between the State and Federal courts. While not imputing any improper motives to officials or State courts, Judge Pritchard remarked that if such conduct were permitted to be pursued it would have the effect of defeating the jurisdiction of the United States courts.

In thus protecting private property against confiscation, the judge has touched points of vital interest to corporations such as those engaged in the field of light and power with rates subject to all kind of dictation from municipal or state edicts and authorities. The rule has a direct bearing, for example, on the 80-cent gas dispute in New York, and is likely to be cited hereafter in other conflicts over public utilities, especially where heavy penalties might be involved capable of bankrupting a company by their enormity. Moreover, as Judge Pritchard remarked: "If the criminal prosecution against the agents, conductors and employees is permitted to continue, the managers of the railroads cannot successfully operate their trains, carry the mails, or continue their usefulness in inter-state commerce."

Spans and Transmission Line Towers.

Until recently, electrical engineering hardly came into contact with structural engineering or bridge building. Now it involves structural engineering not only in the construction of large alternators, but also in tower-construction for transmission lines. A paper on the latter subject was recently read by Mr. D. R. Scholes before the American Institute of Electrical Engineers. It is shown in the paper that if the weight of the

steel in a tower be divided into three items—that for supporting its own weight, that for supporting its load and that for supporting wind stresses—then if the linear dimensions of the tower are varied in any definite ratio the strengths of resistance in each of these ways can be readily deduced without recalculations. Allowing a cost of 4½ cents per pound for the structures delivered in the field, the paper makes the cost of a tower for a three-phase transmission line about $60, the price depending to some extent upon the width of the tower base. Estimates of the cost of the tower line are given which show that the cost of the foundations is about $600 per mile, scarcely affected by the length of span. The cost of the tower structures, if set ten to the mile, is also about $600 per mile, and the cost of insulators $160, making the total cost of the tower line without conductors $1,360 per mile, the towers weighing, each, about 1300 lbs. The cheapest length of span is indicated to be 425 feet, or 12½ per mile. Between 300 and 600-ft. spans, however, the total estimated cost does not vary materially. Beyond 600-ft. spans, the cost of the tower-line increases rapidly, owing to the greater size of the tower rendered necessary, both owing to the greater sag and to the extra stresses. It would be interesting to ascertain how closely the estimates given in the paper are reliable in actual tower-line construction.

Transformer Insulation and Testing.

With the increase in distances to which electric power is transmitted comes increase in line voltage, and, next in sequence, an increase in insulation of all conductors and windings connected with the lines. In high-voltage transformers, the available winding space has to give so much to insulation that only about 10 per cent can be reserved for the copper. That is, 90 per cent of the winding space has to be occupied either by solid insulation or by oil-ventilating ducts. There is difficulty in providing sufficient insulation for the first few turns of the transformer winding which, being nearest to the high tension lines, are especially exposed to occasional voltage stress due to high-frequency surges. Transmission transformers frequently require to have their ratio of transformation varied at will, by the use of taps to various parts of their windings, so that the extra heavily insulated part connected to the line may have to be changed at different times. This means that a considerable portion of the whole high-tension winding, all told, may have to be re-enforced with extra insulation.

Two papers bearing on this question have recently been read before the American Institute of Electrical Engineers, by Messrs. S. M. Kintner, and Walter S. Moody, respectively. These attack the extra insulation problem of transformers in two different ways. One advocates the use of external choking coils, of highly insulated wire, submerged in oil inside the transformer casing. By this means the high-tension lines always connect directly to the choking coil, which, in turn, connects to the proper tap in the high-tension winding. Thus if the choking coil does its duty properly, the high-voltage waves are rolled back along the line, leaving a smooth, normal voltage level in the transformer, just as a breakwater protects the harbor behind it from the surges due to a distant storm. The advantage of the choke-coil, or electromagnetic breakwater, is that it has no other purpose but to interpose an insulating barrier to high-frequency surges, so that it can be built solely for electromagnetic strength. Moreover, if it should break down under very heavy stress, it is likely to save the transformer winding, and it is then a comparatively simple matter to take out the injured choke-coil and replace it by a new one. The other method of attacking the problem is to make the taps and voltage-changing connections on the inside windings of the transformer—that is, upon parts remote from the ends connected to the high-tension lines. In this way, the extra high insulation is confined to single sections. It is true that these re-enforced sections have to perform breakwater duty as well as generator duty, but the advantage of the plan is that the reactance and regulating defect of separate choke-coils are avoided, while the connections are simpler, and space is saved. Each of the above two methods has its particular advantages that apply with special force in individual cases. It would seem likely that for ordinary service, where the pressures to be expected are not excessive, the locally re-enforced insulation on the transformer ends would be preferable, whereas, in cases of the highest working stresses and of greatest danger, the separate choking coil would be more suitable.

A paper by Mr. H. W. Tobey, on transformer testing under the most recent conditions, cites nine specific tests to which transformers may be subjected under routine in the factory—namely, conversion, polarity, resistance, copper-loss, core-loss, regulation, high-potential, high-voltage and temperature rise. At first sight, there seems to be no difference between a "high-potential" test, and a "high-voltage" test and, in fact, these names are ill selected since they require definition with respect to their distinctions. The high-potential test is a dielectric test of the insulation between primary and secondary windings or between either and the core, and the high-voltage test is a dielectric test made with over-excitation, so as to increase the generated voltage in the windings, and thus to test the insulation of different layers or different turns in each layer. The paper gives a curve of dielectric strength of a certain sheet insulation as measured between two opposed brass disks, by observing the time of break-down under different impressed voltages. The curve represents roughly a variation of voltage inversely as the sixth root of the time between the limits of one minute and one hour, so that the insulation stood 65 kilovolts for one minute and 32 kilovolts for 64 minutes; that is, the voltage that could be sustained fell to ½, in 2^6 minutes. It is not safe to assume, however, that this law would apply to all kinds of insulation. The effects of temperature and of accumulation of ionization products are very different, and modify the behavior of the insulation. This fact is pointed out in the paper. The paper contributes a renewed plea for a standard sine wave form of voltage in the testing of transformers, especially for dielectric strength and for core-loss. An instance is cited of a transformer tested for core-loss with two different generators successively, at the same terminal voltage and frequency; but one giving a sine wave and the other a peaked wave. The sine-wave core-loss was 1177 watts with 33.5 amperes of exciting current. The peaked-wave core-loss was only 924 watts with 15.4 amperes. It is well known that a peaked wave of e. m. f. reduces the core loss, but it is not generally known that the exciting current may be reduced to one-half in this way. Nevertheless, it is generally admitted that it does not pay to use such peaked wave forms.

steel shell is 82 ft. in diameter it was quite an engineering feat to handle it on the waters of the bay.

Owing to the cost of rehabilitation, the rapid extension of its lines, the improvements noted above and incidentally the lowered gas rate in San Francisco, the board of directors of the Pacific Gas & Electric Company, controlling the San Francisco Gas & Electric Company, the California Gas & Electric Corporation and other subsidiary companies, have voted to levy an assessment of $3,000,000 on the stock of its shareholders. The assessment on each share will be $10 on 100,000 shares of preferred stock and 200,000 shares of common. The expenses of the company for the last year and a half are roughly figured at $7,000,000. It was the decision of the board to assess the stockholders rather than borrow the amount.

According to the statements of its officials the cost of rehabilitation has been enormous. In addition has come the enlargement of the company and the building of new power houses throughout the state. A heavy expense has been the purchase of subsidiary companies and the whipping of them into shape to supply the cities of California. Not the least of the company's troubles has been the lowering of the gas rate to the consumers of San Francisco, according to an official announcement made recently.

The majority of the stockholders were represented by the board of directors at its meeting. Fully 70 per cent of the company's shareholders were represented directly or indirectly by the various directors and no complaint is anticipated. The company estimates that $3,500,000 has been expended in San Francisco alone and a similar amount throughout the state, and believes that the stockholders will see the wisdom and necessity for the move.

General Electric Copper Mining.

The General Electric Company is reported to be expending about $1,000,000 in developing and placing its Bully Hill copper property in California upon a producing basis. For a year and a half development work has been progressing without net returns of any moment. It is understood that it has been definitely decided to double the capacity of the Bully Hill smelter, and instead of two furnaces there will be four with reduction capacity of 1200 to 1500 tons per day. Most of the old machinery will be utilized in reconstruction. The old buildings have been torn down, the briquetting plant removed and the McDougall roaster and converters dismantled. President Riordan, who is now in California, says that the whole plant will be reconstructed at a cost of between $300,000 and $400,000. The Bully Hill Company is expending at least $500,000 in the building of 18 miles of railroad connecting its smelting plant at De Lamar with the Southern Pacific about two miles above Kennet. Over 400 men are employed in the construction of this road, of which about 10 miles have been built. It is expected to have the line completed by Nov. 1. It will be called the Sacramento Valley & Eastern, and on Aug. 1 a meeting will be held in California, when the capital stock will be increased from $300,000 to $500,000. It is estimated that this road will effect a saving to the Bully Hill Company of $4 per ton in coke supplies and a pro rata saving on all freight. The wagon road to the Bully Hill mine is 30 miles in length. Within 60 days after the completion of the road, the smelter should be ready to blow in. The Bully Hill should be able to supply 25,000,000 pounds of copper per annum to the General Electric Company at a cost of about 10 cents per pound. On 15-cent copper this would mean an annual saving to the General Electric Company of $1,250,000 and on 20-cent copper $2,500,000. The company's total investment, including the purchase of the property, will probably be in the neighborhood of $2,500,000, so that the General Electric Company may get its total investment back in between one and two years. The copper requirements of this company are said to amount to about 1,500,000 lbs. per week, which is at the rate of 75,000,000 lbs. per annum.

Expert Investigations in Municipal Ownership—II.

In favoring municipal ownership, Prof. Parsons declares that in most discussions of the subject too much attention is given to the purely financial side of the question. "Dollars and cents are not to be neglected," he says, "but life, liberty, justice, virtue and intelligence—the whole character product and social product of our institutions—are of greater moment than their money product." Taking up financial results, Prof. Parsons gives it as his view that the municipal plants are more economical. "Broadly speaking," he says, "recognizing that there are exceptions to all rules, the facts show that municipal plants tend to make lower prices to ordinary consumers than private plants in the same country working under similar conditions, and they do not grant electric rebates or other favors by secret agreement with large users, as is not infrequently the case with the larger companies. In the comparatively few cases where municipal systems do not make low charges the public still gets the benefits that under private operation go to the stockholders, for the profits of the public plants are used to improve the service, pay off the capital, relieve taxation or accomplish some other public purpose. Municipal plants are found, as a rule, to have a lower capitalization than private plants, both in relation to output and in relation to assets."

Discussing so-called failures of municipal ownership, Prof. Parsons claims that some of such cases are really failures of private ownership. "Take Philadelphia gas, for example," he says. "It does not appear that Philadelphia ever had real public ownership of the gas works. She had government ownership of gas works. But government ownership is not public ownership unless the people own the government. Philadelphia had the paper title to the gas works, but the people did not own or control them because they did not own the city government. The Councils were full of the agents and allies of the private street railway, telephone, gas and electric light interests and they purposely mismanaged the gas works, allowed them to be filled with supernumeraries and let them get out of repair by refusing year after year to appropriate, even out of the receipts of the plant itself, the money necessary to keep it in order, so that they might have an apparently good excuse for executing a lease of the works to themselves. Philadelphia did not have real public ownership of gas, but one of the worst forms of private ownership—ownership by political grafters, in the pay of corporations, but masquerading as public servants."

Richmond, Va., is cited by Mr. Bemis as a city where a municipal gas plant has not only reduced prices, but has also turned a profit into the city treasury. The city authorities declined, however, to permit a full investigation to be made, saying that a recent investigation had been very unfair. Enough was learned to show that the Richmond plant was free from the spoils system and from graft, and that the workmen were white men who were paid nearly twice as high wages as were the negro laborers in the privately owned works at Atlanta. Mr. Bemis' review of the Philadelphia gas situation is in marked contrast to that of Messrs. Edgar and Clark. Mr. Bemis also quotes Dr. Rowe as authority on the subject, to show that when direct municipal operation began, Dec. 31, 1886, the plant had been entirely paid for out of profits, with the exception of $1,802,948. After including the expenses of collection, maintenance of street lamps, etc., borne by other city departments, the net cash turned into the city treasury during the years 1888-1897 inclusive was $2,937,719.56. To this should be added the amount spent for extensions of the works, mains and services, which is easily computed from Prof. Rowe's data as [illegible]. This would make a total apparent profit during the 11 years of municipal operation of $7,282,036.48. Since this profit was computed after including the operating expenses, and the expenditures for repairs of 8 cents to 10 cents per 1000 cu. ft. a year, the depreciation could not have eaten up any large part of this apparent profit. The price of gas was reduced from [illegible] to $1 at the close of 1893. At

first there were deficits, but these rapidly declined. According to Prof. Rowe, there was a net profit during 11 months of city operation in 1897 of $123,915.06, after paying the expenses incurred on account of gas in other city departments.

"By reason of municipal ownership, Philadelphia was able to lease to the United Gas Improvement Company most valuable street mains, land and holders, to say nothing of such portions of its other plant as with moderate repairs could be put in good shape. By asking for no rental or taxes on this plant which had been paid for out of the profits of city ownership, Philadelphia was able to secure a lease under which it received 10 cents per 1000 cu. ft. of all gas sold to private consumers during the first 10 years of the lease, 15 cents during the next five years beginning next January, 20 cents from Jan. 1, 1913, to Jan. 1, 1918, and 25 cents for the remaining 10 years. The city also receives free of charge 700,000,000 cu. ft. of gas yearly for street lamps and public buildings, and the maintenance of those street lamps by the company.

"On the other hand, in New York City during the past 10 years, barring two years of the so-called gas war, 1899-1900, the people have not only paid $1 as in Philadelphia, but they have also paid both for the gas used by the city and for the care and maintenance of the street lamps, while the taxes received by the city and state have not been as much per 1000 cu. ft. as the payment of 10 cents in Philadelphia."

That the municipal electric light undertaking at South Norwalk, Conn., is one of the most successful plants, either public or private, in the United States or Europe is the opinion expressed by Mr. Bemis. The operation of the Chicago plant, also, is commended, the expert quoted by Mr. Bemis estimating the profit to the city on the plant up to the close of 1905 at $710,433. The spoils system has been singularly kept out of the Chicago plant, according to Mr. Bemis, although the plant itself is not all that could be desired. "During the year 1905," continues Mr. Bemis, "the accountants estimated that the cost in Chicago, including interest and depreciation, was $100.06 per lamp, as compared with $102.92 per lamp charged by the private companies, but the cost of $100.06 was reached by allowing about $10 per lamp more for the value of water used, and for depreciation than the accountants used in any of the previous years, or than they had found necessary to tally with the measurements of water actually used and the depreciation necessary to reduce the original cost of the plants to their present appraised value. The important point, however, from the standpoint of municipal ownership is that the cost is less per arc than the city is paying for similar lamps from the private company.

"Next to South Norwalk the most successful municipal electric lighting plant has been that of Detroit. If it had been allowed to do a commercial business, its success would have been even greater than has been possible with only the lighting of streets and public buildings. The only criticism of the plant, and that not clearly proven, has been that it was unduly conservative in replacing its open arcs and small generating units with inclosed arcs and larger generating units. Much progress, however, has in fact been made in this direction, and more is being made during the present year. Allegheny, although confined to street lighting, and suffering from the spoils system and a poor location, has nevertheless saved up enough to pay for her plant out of the difference between her operating expenses and the $96 a year which Pittsburg has had to pay for similar arc lamps prior to 1906."

Mr. Bemis closes with a reference to political and labor conditions, which he finds, generally speaking, more favorable under the municipal undertakings. On this subject, he sums up as follows: "In electric light, as well as in water, the municipal employees usually get as good wages as are paid elsewhere in their respective cities for similar work, and also usually work but eight hours, while the employees of the private plants—except in the highest paid positions—never get more, and often receive less, per day than the municipal employees, and sometimes work nine or ten hours instead of eight, that is practically universal to-day in public employment. The Chicago and South Norwalk plants are, and apparently always have been, out of politics. The same is true of the Detroit plant so far as party politics is concerned. In all municipal plants trade union conditions prevail and the majority seem to be members of the union, but those who are not members of labor organizations are freely employed. One exception to absence of politics in the electric light plants is in Allegheny, but here again, as in the Wheeling gas works and the Syracuse water works, or in the Philadelphia gas works, when public and private management existed side by side, the same conditions which permit the spoils system in municipal plants bring private companies into close touch also with the spoils system, and with party organizations and city governments."

Following the sections of the report of the National Civic Federation commissioners on American private and municipal plants, are reports dealing with British municipalities. The preliminary reviews of the experts' reports, written by Messrs. Milo R. Maltbie, Walton Clark, vice-president of the United Gas Improvement Company of Philadelphia, and Charles L. Edgar, president of the Edison Electric and Illuminating Company of Boston, are divided in opinion as to the success of the undertakings as a whole. Mr. Maltbie, whose review is made from the viewpoint of an advocate of municipalization, is one of the members of the newly created Public Utilities Commission for Greater New York. This body has the widest powers and the greatest responsibilities of any commission to which the regulation of corporations has been entrusted, up to this time in the United States. Mr. Maltbie says that municipal operation of public utilities in Great Britain has passed the experimental stage. He declares that of the plants examined in Great Britain, those operated by municipalities in almost every instance gave a superior service at a lower cost, as compared with the privately owned companies. This condition he finds to be due to the higher rate of interest and profit and the greater amount of liabilities of the private companies. By far the most interesting part of Mr. Maltbie's conclusion, however, is that actual ownership and operation is not necessary for the success of the municipal ownership idea. He says that the power to operate, if necessary or desirable, in many instances has been as effective as actual operation—that the mere fact that a city has the power to step in and operate an undertaking itself often makes the exercise of its power unnecessary. "It has been found in Great Britain that no system of control or regulation is complete without the power in the hands of the municipalities to purchase and operate," says Mr. Maltbie. "If one company may be succeeded only by another or only hedged about by restrictions, there come times when action, not repression, is wanted, and then no remedy is adequate unless it be the power of the city to step in and operate the undertaking itself. But the mere fact that it has the power often makes its exercise unnecessary, and what the Britisher desires is not the universal adoption of some method of producing results, but the results themselves.

"In the following analysis of the results of public and private management it should be borne in mind that such a comparison is not a comparison of municipal with private operation subject to no restraining force, but with private operation under systems of regulation which are claimed to be the best which have yet been devised in Great Britain and with private management that has been chastened and bettered by the fear of public condemnation, by the restraint of government regulation and the possibility of municipalization. Thus the low price at which gas is supplied by the Sheffield company is largely the result of the avowed determination of the men in control to head off municipalization. If municipal operation had not been a possible alternative looming above the horizon, it is likely that even now the consumers would be paying very much higher rates; and the present low rates so far as they are due to the desire to prevent municipal operation should be counted as one of its indirect results."

The reasons that have led to British municipalization, Mr. Maltbie finds, are many. First among them, although not the

most general nor the most important, is the desire to secure for the public the financial profits of the undertakings. Second, there is the desire to keep the city from being mulcted by a private company and third, the general demand for better service at lower rates. He mentions, also, a fourth cause, which has played a prominent part in the United States, and which is not unknown in Great Britain, namely, opposition of privately operated public utilities companies to the welfare of the city. A fifth factor has been the belief that municipal operation would permit the co-ordination of public services in a way that is not possible where different services are operated by private companies.

Quite a different view of the subject is taken by Messrs. Edgar and Clark. They favor some form of regulation of private companies rather than the adoption of the municipal ownership idea. Basing their opinions upon the same reports of experts from which Mr. Maltbie draws his favorable conclusions, the other reviewers declare it to be plainly proven that municipal ownership is productive of many and serious ills with little or no compensating good. They hold that the solution of present difficulties is to be found, not in municipal ownership and operation of the public utilities, but in the election of municipal officers who will protect the governed against injustice on the part of individuals or corporations.

The electric lighting plants investigated by the Civic Federation Commission were the municipal ones at Manchester, Liverpool, Glasgow, and the Borough of St. Pancras, London, and those operated by the Newcastle Supply Company, the Newcastle District Company and the four London companies: the city of London, Westminster, St. James and Central. Charges by the municipal plants were more economical, according to Mr. Maltbie, the cities charging .529d. per unit less than charged by the private companies. As to efficiency of service, there was no difference between the municipal and the company undertakings, as regards the promptness with which current was turned on and complaints attended to, the convenience of the location of offices, the testing of meters, the restoration of paving after streets were opened, the care given to street work generally, although there were more complaints upon this score against companies than municipalities the construction of extensions, and the extent to which the entire area of supply was served and appliances carried in stock for sale or rent.

The character and equipment of the plants investigated is discussed. Mr. Maltbie summarizes the result of this branch of the examination, saying it appears that one of the company stations is more modern and efficient than any one maintained by a municipality; but it is also true that two of the companies are more backward and have a more antiquated equipment than any municipality. Upon the whole, the municipal undertakings seem to be as modern as those belonging to the companies, but not so well located or arranged, and perhaps not quite as efficient.

In concluding his review of the reports of the experts, Mr. Maltbie says: "The opponents of municipal activity have frequently tried to scare the British voter and to prejudice him against the operation of public utilities by local authorities by citing the large increase in total indebtedness within the last fifty years, as compared with the decrease of the national debt. They have pointed out that the local debt has more than trebled in the 25 years from 1875 to 1900, and that the amount of local debt per £100 of ratable value of property has doubled in the same period, while the national debt has decreased almost 18 per cent.

"Over 40 per cent of the local debt is for water, gas and electricity works, tramways, markets, harbor improvements, wharves, cemeteries, baths, workingmen's dwellings, etc. In every one of these cases the debt is represented by physical assets. Besides, there are parks, street improvements, school houses, almshouses, bridges and many other investments which are now being used for public purposes and by which the present citizens are being benefited. What does the national debt represent? To a certain extent, public works of present use and value, but principally war expenditures or expenditures to guarantee success in case of war.

"Further, debt for productive undertakings, such as gas works, electricity supply and tramways, has a quite different character from debt for schools, parks, prisons, etc. The latter do not produce a financial return, however necessary and valuable they may be. They may be even more important than electricity works, but the mere fact that they are not self-supporting places them in a distinct class. Their debt is a burden upon the taxpayer, for he must pay the interest thereon as well as the cost of maintenance. But in the case of the three public utilities here considered, it has been thoroughly demonstrated that the interest and fixed charges are paid by users or consumers and that in no instance has the taxpayer been called upon to make up any deficiency, except possibly temporarily, and then he has been repaid at a later time.

"But this is not all. It has been definitely shown not only that the debt is not a burden upon the taxpayer, but that the taxpayer gets a financial benefit from municipal operation, and therefore from the very debt which is claimed to be a burden upon him. It is not evidence, but it is suggestive, that the local rates (tax rates) were lower for every group of towns when there was municipal operation of gas, electricity or trams than where companies were operating."

CURRENT NEWS AND NOTES.

[illegible] have become conciliatory all along the line and have decided to accept the terms of settlement offered by the Western Union and Postal companies. As expected, the strike is "all off."

OHIO ELECTRIC LIGHT ASSOCIATION.—The 13th annual convention of the Ohio Electric Light Association will be held at Toledo, Ohio, Aug. 20, 21 and 22, 1907, with headquarters at the New Boody Hotel. The subjects of papers to be read are as follows: Factory Lighting (two papers); Experience in Operation of Luminous Arcs (one paper); Co-operative Commercialism in the Electrical Field (one paper); Best Form of Power for Stations of 500-kw Capacity or Less (one paper); Helps to a Solicitor (three papers); Best Ways to Meet Gas and Gasoline Competition (five papers). In addition there will be reports on results with heating devices; high efficiency lighting units; uniform accounting, and cost determinations. An excellent entertainment will be provided. For the ladies there has been placed at the disposal of the association 25 valuable prizes to be distributed among those who attend. D. L. Gaskill, Greenville, Ohio, is secretary and treasurer of the association.

ELECTRIC GAS ARCS.—According to a London contemporary, electricity is to be employed in connection with a type of the so-called "gas arc lamps." In order to supply enough air for complete combustion—the Bunsen arrangement is not perfect in this respect—a small fan is used, which is driven by an electric motor. Forced pressure systems are not new, of course, but they are not self-contained and they have many drawbacks. In the Denayrouse burner, for instance, electricity was supplied from an external source, but in the present case a thermopile affords enough energy for the purpose. It seems like trying to light a house with Leclanché cells, but is said to work. The hot gases rising from the flame pass over the thermopile, which is arranged in the upper lantern. The motor is vertical and its armature lies between the two mixing tubes. The mixing is claimed to be more thorough than with other types of lamp. When first the lamp is lighted it burns under normal pressure with rather a dull flame. The hot gases in the chimney soon heat up the thermopile, the motor begins to turn, and it is said that in half a minute a speed of 2000 r. p. m. is obtained.

AN EASTERN TRIP.—The members of the board of supervising engineers of Chicago tractions on an eastern tour include Messrs. Bion J. Arnold, chief engineer; Harvey B. Fleming, Chicago City Railway and George V. Weston, assistant chief engineer for the city. They will inspect the Pennsylvania Steel works and the shops of the William Wharton, Jr., Company at Philadelphia, also the Brill Manufacturing plant and the new subway of the Philadelphia Rapid Transit Company and will inspect the New York subway and the new Manhattan Island tunnels.

COPPER PRODUCTION in this country continues on an enormous scale. It reached, in the calendar year 1906, according to figures compiled by the United States Geological Survey, 906,591,947 pounds, an increase of 18,000,000 pounds over 1905. The stock on hand at refineries on January 1 last amounted to 92,470,792 pounds, 25,773,236 pounds less than on January 1, 1906. The consumption of refined copper for the year, including 215,000,000 pounds of foreign copper imported, was 680,000,000 pounds, exceeding that of 1905 by 80,000,000 pounds. The exports for the year aggregated nearly 450,000,000 pounds.

BLOCK SIGNALS.—It is stated that out of a total mileage on the Pennsylvania Railroad's eastern lines of 6032 miles of track, more than 1500 additional miles have within the last three years been equipped with block signals, at a cost of $856,520 to the railroad company, and adding $210,816 to the annual operating expenses. The signal report shows that the company now has every mile of its main lines protected by block signals, and of the entire mileage of the lines east but about 500 miles are not equipped with block signals. Most of the latter, however, are short, industrial lines or branch lines on which the traffic is so light and of such a character as to render the block signal unnecessary.

TWO-CENT TELEPHONY.—It is stated that the Fagan administration in Jersey City, which proposed a municipal street car line with 3-cent fares, is now backing a scheme for a telephone system for which the charges to Jersey City users would be 2, 3 and 5 cents, according to the time consumed in the use of the wire. The proposal has been made by the Atlantic Coast Line Company, a rival of the present telephone company. The 2 and 3 cent proposal met the instant approval of the Fagan reformers, who are now urging the grant of a franchise to the new company on liberal terms. It is said that the company, in addition to giving the citizens the cheaper rate, is willing to install telephones in the City Hall and other departments of the City Government at a merely nominal compensation, and in addition to pay $100,000 for a franchise.

COMPETING TELEPHONE COMPANIES MUST CONNECT.—Judge W. H. Hunt, of the U. S. District Court in Montana, has decided that competing telephone companies cannot withhold the use of their lines from each other. The suit in which the decision was rendered was between the Rocky Mountain Telephone Company, a Bell interest, and the Montana, Wyoming and Mutual Telephone companies. The latter companies had applied to the court for an order compelling the Rocky Mountain Telephone Company to furnish connections when desired at reasonable compensation. This was resisted on the ground that the lines were built for its patrons and not for those of competing companies. Judge Hunt found for the complainants, and stated that within a few days he would name a commission to fix the division of charges when such use is made of connecting lines.

LIMITING HOURS.—At Albany, N. Y., on July 20, Gov. Hughes signed the bill of Assemblyman Northrup regulating the hours of labor of block system telegraph and telephone operators and signalmen on surface, subway and elevated railroads. The measure provides that it shall be unlawful for any such corporation to permit any telegraph or telephone operator whose duties pertain to the movement of trains by use of the telegraph or telephone, to be on duty more than eight hours in a day of 24 hours. In cases of emergency the rule may be broken, but extra compensation must be given. Violations of the act are punishable by a fine of not less than $100, one-half to be paid to the informer and the other half to the school fund of the state. The act takes effect on Oct. 1. It was shown in the arguments in support of the measure that many men upon whose alertness the safety of thousands of passengers depended were compelled to work 12 and even 16 hours a day.

BRYAN ON OWNERSHIP.—Some months ago, on returning from his trip around the world, Mr. W. J. Bryan came out with a strong advocacy of government ownership. He now abandons it, and says: "Government ownership is not an immediate issue. A large majority of the people still hope for effective regulation. While they so hope they will not consider government ownership. While many Democrats believe, and Mr. Bryan is one of them, that public ownership of railroads is the ultimate solution of the problem, still those who believe that the public will finally in self-defense be driven to ownership, recognize that regulation must be tried under the most favorable circumstances before the masses will be ready to try a more radical remedy. Regulation cannot be sufficiently tried within the next year. There is no desire anywhere to make government ownership an issue in 1908. Mr. Bryan fully agrees with those who believe that it would be unwise to turn attention from regulation, on which the people are ready to act, to government ownership, on which the people are not ready to act. To inject the government ownership question into the next campaign would simply give representatives of the railroads a chance to dodge the issues of regulation and deceive the public."

DOCTRINE OF POST-ROADS.—An interesting article on "The Post-roads Power of Congress," by J. Walter Lord, appears in the July 19th number of the *North American Review*. He traces his theme historically and comes to the conclusion that the *post-roads* clause "will apply to every avenue upon which the mails are carried by merely declaring such avenue to be a post-road." Then he goes on to say: "If, therefore, Congress might exercise a control over railroads, might it not exercise a like control over trolley systems, the streets of the cities, the highways of the States, all of which in their primary nature are essentially instruments of State sovereignity? Where would this control stop? It is difficult to perceive. For, under the guise of facilitating the postal service or keeping it up to the highest point of efficiency, there would seem to be no legal barrier to the scope of Congressional action, once the principle is asserted and sustained that Congress might exercise the control which is contemplated. The necessity of any Act which Congress might deem expedient to facilitate the postal service would not be subject to consideration by the Courts, because questions of expediency in legislation belong to the legislative and not to the judicial department of Government. Is, then, the *post-roads* power to supersede the *commerce* power, as it certainly will if the construction proposed becomes effective? Is a power regarded by the founders of our Government as 'in every view a harmless power' and surrendered by the States without question or deliberation, to be substituted for a power regarded by these founders as one vital to the Union and surrendered by some States only after considerable protest? Is a power heretofore rarely exercised, and then, too, always in a guarded manner and with due recognition of the rights of the States, over a century of national existence, to be given a broader scope than one which, during that period, has served to preserve the integrity of the Union, and which, for this purpose, is comprehensive enough to meet all the necessities of the future? The time may be close at hand when these questions will have to be answered."

TUNGSTEN MINERAL.—According to a bulletin of the U. S. Geological Survey, tungsten to the value of $393,667 was produced last year in the United States, for use in the manufacture of steel for high-speed tools. The price has advanced from 30 cents per pound in 1905 to 60 cents per pound in the spring of 1907. Large deposits of tungsten have been found in Australia, and a special investigation has been commenced in this country with a view to locating further deposits here.

POLICE SIGNAL SYSTEM.—Police Commissioner Bingham, of New York City, states that he intends to improve the police telegraph system in Manhattan and the Bronx. The work will begin at once. Prof. George F. Sever, consulting engineer of the department, will aid in rehabilitating the system. The commissioner wants a system through which it will be possible to notify policemen on duty at railroad stations, ferries, and other posts when they are urgently wanted either at their stations or at headquarters. It is proposed to accomplish this by the display of different colored lights by night and by the sounding of a bell by day from various signal boxes. The signals will be sent out direct from the telegraph bureau at headquarters. It is understood that both the police and fire alarm systems are in a serious state of inefficiency.

PAY AS YOU ENTER is a rule that has long applied to the elevated and subway lines in New York City, but has not been recognized as applicable to surface trolley cars. For some two years past, however, "pay-as-you-enter" cars have been in operation on the street car lines of Montreal, Canada, with marked success, and it is now announced that the Madison and Fourth Avenue line has been selected by the management of the New York City Railway Company as the one on which to try the pay-as-you-enter cars now being built for the company. If found to be practicable they will be introduced on other lines. The Fourth and Madison Avenue line has been chosen for this experimental purpose as it is as free from curves and intersecting points as any of the lines in New York. The question of curves has much to do with the installation of the cars. They necessarily have long, extending platforms, capable of accommodating 30 or more passengers, but it is thought that no difficulty will be experienced on the line selected. It is understood that the conductor will be stationed in some kind of a box or railed space at the car entrance; but the details of the car have not been given out yet.

LONDON UTILITIES.—In a discussion of public utilities in London, the *Financial Times* of that city says: "Anyone who compares the position of tramway and gas and electric lighting companies in New York State with the position of similar companies in Great Britain will admit that there is a worse fate than having to submit matters for arbitration and inspection to a tribunal of five trained, independent men. With us the fate of such public utilities is placed in the hands of local authorities, with whom it is almost impossible to negotiate on a proper business basis. The full experience of British capitalists and engineers in negotiating tramway and lighting concessions with local authorities has never been made public, since no good purpose can apparently be served by making an open record of vexatious delays, irritating vacillations, impossible demands, and the other elements in a struggle with ignorance, stupidity and political prejudice. But it is notorious that the local authorities have used their almost absolute power to extort onerous conditions from companies, and to impose upon them obligations which could not be justified by any legitimate argument. No Board of Commission, composed of men of education and position, free from political promises and sentimental fads, could ever bring about such disastrous results, no matter what blunders they might make. No company which has had any dealings with local authorities would [illegible]

PROFIT SHARING.—The Boston, Mass., Consolidated Gas Company has credited to the most efficient of its employees the sum of $26,029, which amount is 7 per cent of the earnings of each employee for the nine months ending June 30. This profit-sharing scheme establishes a partnership between the company and its employees in a similar manner that the sliding scale provides a like interest between the public and the company. Premiums, in addition to the regular compensation, are provided for the best employees of the company. These premiums are based on the annual salaries of the employees at the same rate as the dividends for the same period are paid on the stock of the company. These premiums, in general, are applied towards the purchase of the preferred stock in the Massachusetts Gas Company, the same to be the absolute property of the employee. By the operation of the so-called sliding scale act, the future divisible profits of the company are made to depend upon the price charged for gas. For every reduction of 5 cents per 1000, the company may pay 1 per cent additional in dividends. As the amount of the premium allowed each employee depends upon the rate of dividends on the stock of the company, and as the rate of these dividends depends upon the price of gas, the employee has a strong added incentive to do his work as economically and efficiently as possible. Every man in the company, as a possible profit sharer, or as an owner of stock in the Massachusetts Gas Company, thus has an owner's interest in promoting the welfare of the business. It is intended by the company ultimately to include as profit sharers all employees who are, in their judgment, temperate, energetic, honest, capable and efficient. But if all such employees are not included in any year, it is the aim of the company to have the list made up of these employees who have displayed the greatest regularity, intelligence and energy in the business of the company.

MOVING SIDEWALKS.—The Public Service Commission of New York City has taken under consideration a project for the construction of a moving platform under Broadway, between Fourteenth and Forty-Second Streets, which it is contended would not only greatly relieve the congestion on this thoroughfare, but would be of special benefit to the shopping and theater-going crowds. This project was explained in a communication from the Continuous Rapid Transit Securities Company, asking for an opportunity to give a demonstration of its moving platform railway. The company claims a capacity equal to three times that of a five-car train service, under a one-minute headway, and six times that of the best surface-car trolley traffic. There was submitted with this letter an engraving of the proposed "moving platform arcade." This shows an endless train, or, as it appears, an endless row of cross-seats for three persons, approached by two intermediate, narrow platforms or strips, moving at slower speed. The company's prospectus states the capacity of the proposed installation as follows: "The proposed moving platform railway will afford a seating capacity exceeding 47,000 passengers an hour in each direction. This is three times the seating capacity of a train system operating five-car local trains upon one-minute headway. It is approximately six times the seating capacity of a system of surface tram-cars operated upon 150-ft. headway. In respect to safety, as compared with train and tram-car operation, particularly in places where traffic is congested, a moment's consideration will show that, even should an individual fall in boarding or leaving the platform, the risk of serious injury is slight, and the aggregate of damage sustained incomparably less than by the existing systems." It is also stated that heat radiated from motors, power brakes and rheostats, being the principal cause of the high temperature in the present subway, the moving platform arcade would be comparatively cool. The total energy required to propel the train of platforms in the proposed arcade during a period of 24 hours will only be about eight per cent of the amount of energy required to move local trains in the present subway service, it is claimed.

Electrical Equipment of the Hall of Records in Manhattan Borough, New York City.

Within the portals of the new Hall of Records, in Manhattan, are the Department of Taxes and Assessments, the Register's office, the Surrogate's court and the Corporation Counsel's office. The structure itself occupies the block north of City Hall Park bounded by Chambers Street, Elm Street, Reade Street and Ottendorfer Square. It is magnificent in conception and palatial in development, and on it were expended over eight years of labor and over $5,000,000 in money. The exterior of the structure is of granite Above the entrance on Chambers Street is a group of emblematic statuary, and along the cornice are heroic statues of former governors and mayors who have left their impress in the development of the state and city.

The interior finish is in keeping with the exterior in artistic treatment. The main entrance, on Chambers Street, is wainscoted entirely with sienna marble and capped with a beautiful mosaic ceiling. The foyer, designed after that in the Opera House in Paris, is finished also in sienna marble. Broad stairways of sienna marble wind from the entrance to handsome open colonnades on the second floor; while overhead is an elliptical-shaped bronze and glass ceiling. The artistic tendencies of the architects, however, find their best expression in the two court rooms on the fifth floor occupied by the Surrogates. The room on the Reade Street side is finished in English oak with high and elaborately carved wainscoting. The south court room, or the one facing on Chambers Street, is finished in mahogany. Each of the court rooms is provided with a handsome balcony from which visitors may view the proceedings.

While the Hall of Records is noted for its artistic features, it also possesses abundant facilities of a purely utilitarian nature, for in it are stored the countless and invaluable records which bear upon every foot of land on Manhattan Island and upon estates in which hundreds of thousands of persons are interested. All the vaults and cases are of fireproof construction and the desks and interior finish have been treated to render them likewise proof against flame.

POWER PLANT.

The steam and electrical equipment occupies the entire basement floor, and the lay-out is such that each division is provided with a separate room. In the boiler room are three 300-hp water-tube boilers, and two 350-hp water-tube boilers. The fronts are finished with enameled brick and the furnaces are fitted with shaking grates. Pop safety valves are also provided and non-lifting injectors connected so that any boiler can be fed by any injector. The coal bunkers are located under the Reade Street sidewalk, where provision for 500 tons is made. An industrial railway system carries the coal to the boiler room and the ashes are removed to the sidewalk by the aid of a hydraulic elevator.

Each boiler feeds steam into a 12-in. main through 8-in. steam connections. The main runs through the boiler room and passes out at each end into and through a corridor separating the boiler and engine rooms. Pump rooms are located at each end of the boiler room. In the pump room on the Ottendorfer Square side there are three duplex pumps for boiler feeding purposes connected to take water from the city water mains or from the steam heat drip lines. A tank located in a pit in this room receives the clean water from traps on the drip lines on the power main and its branches, from which the water is returned to the boiler by a duplex pump. The unclean water is collected in another tank and is pumped thence into the city sewer. Blow-off pipes connect to a third tank. The pumps with one exception are all controlled by governors, and the pumps in the pit are cross-connected so that either pump may be used on either tank. All the exhaust steam mains and the various drip lines of the entire plant are carried in trenches in the floor covered with cast-iron cover plates. The main exhaust line is run to a muffler tank, and thence to a feed-water heater. After passing through the feed-water heater the steam

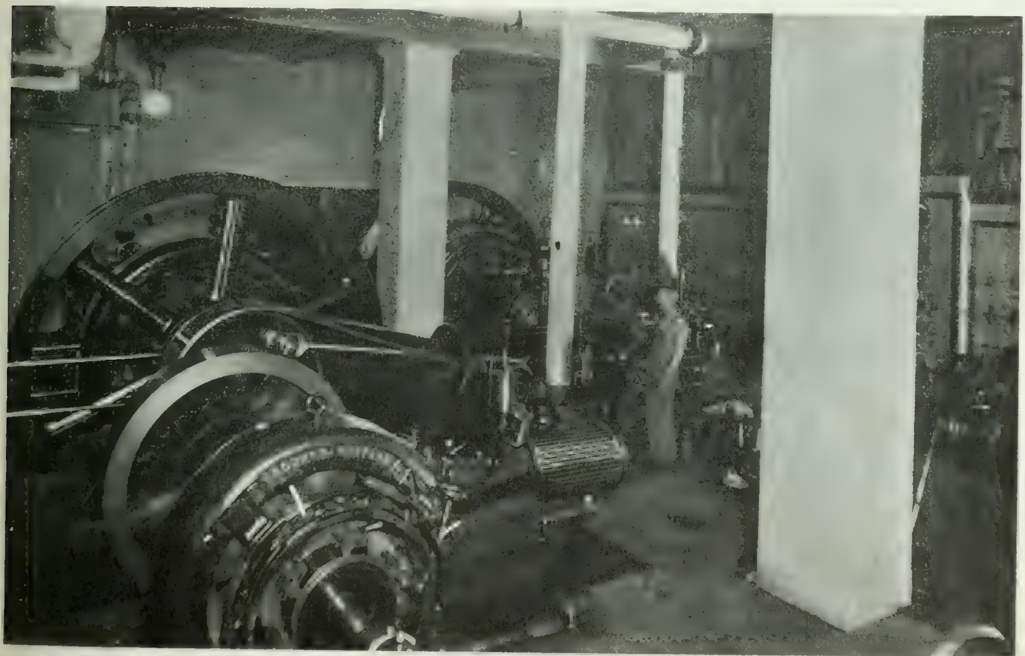

FIG. 1. POWER PLANT, HALL OF RECORDS, NEW YORK CITY.

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POLICE SIGNAL SYSTEM.—Police Commissioner Bingham, of New York City, states that he intends to improve the police telegraph system in Manhattan and the Bronx. The work will begin at once. Prof. George F. Sever, consulting engineer of the department, will aid in rehabilitating the system. The commissioner wants a system through which it will be possible to notify policemen on duty at railroad stations, ferries, and other posts when they are urgently wanted either at their stations or at headquarters. It is proposed to accomplish this by the display of different colored lights by night and by the sounding of a bell by day from various signal boxes. The signals will be sent out direct from the telegraph bureau at headquarters. It is understood that both the police and fire alarm systems are in a serious state of inefficiency.

PAY AS YOU ENTER is a rule that has long applied to the elevated and subway lines in New York City, but has not been recognized as applicable to surface trolley cars. For some two years past, however, "pay-as-you-enter" cars have been in operation on the street car lines of Montreal, Canada, with marked success, and it is now announced that the Madison and Fourth Avenue line has been selected by the management of the New York City Railway Company as the one on which to try the pay-as-you-enter cars now being built for the company. If found to be practicable they will be introduced on other lines. The Fourth and Madison Avenue line has been chosen for this experimental purpose as it is as free from curves and intersecting points as any of the lines in New York. The question of curves has much to do with the installation of the cars. They necessarily have long, extending platforms, capable of accommodating 30 or more passengers, but it is thought that no difficulty will be experienced on the line selected. It is understood that the conductor will be stationed in some kind of a box or railed space at the car entrance; but the details of the car have not been given out yet.

LONDON UTILITIES.—In a discussion of public utilities in London, the *Financial Times* of that city says: "Anyone who compares the position of tramway and gas and electric lighting companies in New York State with the position of similar companies in Great Britain will admit that there is a worse fate than having to submit matters for arbitration and inspection to a tribunal of five trained, independent men. With us the fate of such public utilities is placed in the hands of local authorities, with whom it is almost impossible to negotiate on a proper business basis. The full experience of British capitalists and engineers in negotiating tramway and lighting concessions with local authorities has never been made public, since no good purpose can apparently be served by making an open record of vexatious delays, irritating vacillations, impossible demands, and the other elements in a struggle with ignorance, stupidity and political prejudice. But it is notorious that the local authorities have used their almost absolute power to extort onerous conditions from companies, and to impose upon them obligations which could not be justified by any legitimate argument. No Board of Commission, composed of men of education and position, free from political promises and sentimental fads, could ever bring about such disastrous results, no matter what blunders they might make. No company which has had any dealings with local authorities would hesitate to select such a commission to be its judge and controller in preference to any municipality or county council."

PROFIT SHARING.—The Boston, Mass., Consolidated Gas Company has credited to the most efficient of its employees the sum of $26,029, which amount is 7 per cent of the earnings of each employee for the nine months ending June 30. This profit-sharing scheme establishes a partnership between the company and its employees in a similar manner that the sliding scale provides a like interest between the public and the company. Premiums, in addition to the regular compensation, are provided for the best employees of the company. These premiums are based on the annual salaries of the employees at the same rate as the dividends for the same period are paid on the stock of the company. These premiums, in general, are applied towards the purchase of the preferred stock in the Massachusetts Gas Company, the same to be the absolute property of the employee. By the operation of the so-called sliding scale act, the future divisible profits of the company are made to depend upon the price charged for gas. For every reduction of 5 cents per 1000, the company may pay 1 per cent additional in dividends. As the amount of the premium allowed each employee depends upon the rate of dividends on the stock of the company, and as the rate of these dividends depends upon the price of gas, the employee has a strong added incentive to do his work as economically and efficiently as possible. Every man in the company, as a possible profit sharer, or as an owner of stock in the Massachusetts Gas Company, thus has an owner's interest in promoting the welfare of the business. It is intended by the company ultimately to include as profit sharers all employees who are, in their judgment, temperate, energetic, honest, capable and efficient. But if all such employees are not included in any year, it is the aim of the company to have the list made up of these employees who have displayed the greatest regularity, intelligence and energy in the business of the company.

MOVING SIDEWALKS.—The Public Service Commission of New York City has taken under consideration a project for the construction of a moving platform under Broadway, between Fourteenth and Forty-Second Streets, which it is contended would not only greatly relieve the congestion on this thoroughfare, but would be of special benefit to the shopping and theater-going crowds. This project was explained in a communication from the Continuous Rapid Transit Securities Company, asking for an opportunity to give a demonstration of its moving platform railway. The company claims a capacity equal to three times that of a five-car train service, under a one-minute headway, and six times that of the best surface-car trolley traffic. There was submitted with this letter an engraving of the proposed "moving platform arcade." This shows an endless train, or, as it appears, an endless row of cross-seats for three persons, approached by two intermediate, narrow platforms or strips, moving at slower speed. The company's prospectus states the capacity of the proposed installation as follows: "The proposed moving platform railway will afford a seating capacity exceeding 47,000 passengers an hour in each direction. This is three times the seating capacity of a train system operating five-car local trains upon one-minute headway. It is approximately six times the seating capacity of a system of surface tram-cars operated upon 150-ft. headway. In respect to safety, as compared with train and tram-car operation, particularly in places where traffic is congested, a moment's consideration will show that, even should an individual fall in boarding or leaving the platform, the risk of serious injury is slight, and the aggregate of damage sustained incomparably less than by the existing systems." It is also stated that heat radiated from motors, power brakes and rheostats, being the principal cause of the high temperature in the present subway, the moving platform arcade would be comparatively cool. The total energy required to propel the train of platforms in the proposed arcade during a period of 24 hours will only be about eight per cent of the amount of energy required to move local trains in the present subway service, it is claimed.

Electrical Equipment of the Hall of Records in Manhattan Borough, New York City.

WITHIN the portals of the new Hall of Records, in Manhattan, are the Department of Taxes and Assessments, the Register's office, the Surrogate's court and the Corporation Counsel's office. The structure itself occupies the block north of City Hall Park bounded by Chambers Street, Elm Street, Reade Street and Ottendorfer Square. It is magnificent in conception and palatial in development, and on it were expended over eight years of labor and over $5,000,000 in money. The exterior of the structure is of granite Above the entrance on Chambers Street is a group of emblematic statuary, and along the cornice are heroic statues of former governors and mayors who have left their impress in the development of the state and city.

The interior finish is in keeping with the exterior in artistic treatment. The main entrance, on Chambers Street, is wainscoted entirely with sienna marble and capped with a beautiful mosaic ceiling. The foyer, designed after that in the Opera House in Paris, is finished also in sienna marble. Broad stairways of sienna marble wind from the entrance to handsome open colonnades on the second floor; while overhead is an elliptical-shaped bronze and glass ceiling. The artistic tendencies of the architects, however, find their best expression in the two court rooms on the fifth floor occupied by the Surrogates. The room on the Reade Street side is finished in English oak with high and elaborately carved wainscoting. The south court room, or the one facing on Chambers Street, is finished in mahogany. Each of the court-rooms is provided with a handsome balcony from which visitors may view the proceedings.

While the Hall of Records is noted for its artistic features, it also possesses abundant facilities of a purely utilitarian nature, for in it are stored the countless and invaluable records which bear upon every foot of land on Manhattan Island and upon estates in which hundreds of thousands of persons are interested. All the vaults and cases are of fireproof construction and the desks and interior finish have been treated to render them likewise proof against flame.

POWER PLANT.

The steam and electrical equipment occupies the entire basement floor, and the lay-out is such that each division is provided with a separate room. In the boiler room are three 300-hp water-tube boilers, and two 350-hp water-tube boilers. The fronts are finished with enameled brick and the furnaces are fitted with shaking grates. Pop safety valves are also provided and non-lifting injectors connected so that any boiler can be fed by any injector. The coal bunkers are located under the Reade Street sidewalk, where provision for 500 tons is made. An industrial railway system carries the coal to the boiler room and the ashes are removed to the sidewalk by the aid of a hydraulic elevator.

Each boiler feeds steam into a 12-in. main through 8-in. steam connections. The main runs through the boiler room and passes out at each end into and through a corridor separating the boiler and engine rooms. Pump rooms are located at each end of the boiler room. In the pump room on the Ottendorfer Square side there are three duplex pumps for boiler feeding purposes connected to take water from the city water mains or from the steam heat drip lines. A tank located in a pit in this room receives the clean water from traps on the drip lines on the power main and its branches, from which the water is returned to the boiler by a duplex pump. The unclean water is collected in another tank and is pumped thence into the city sewer. Blow-off pipes connect to a third tank. The pumps with one exception are all controlled by governors, and the pumps in the pit are cross-connected so that either pump may be used on either tank. All the exhaust steam mains and the various drip lines of the entire plant are carried in trenches in the floor covered with cast-iron cover plates. The main exhaust line is run to a muffler tank, and thence to a feed-water heater. After passing through the feed water heater the steam

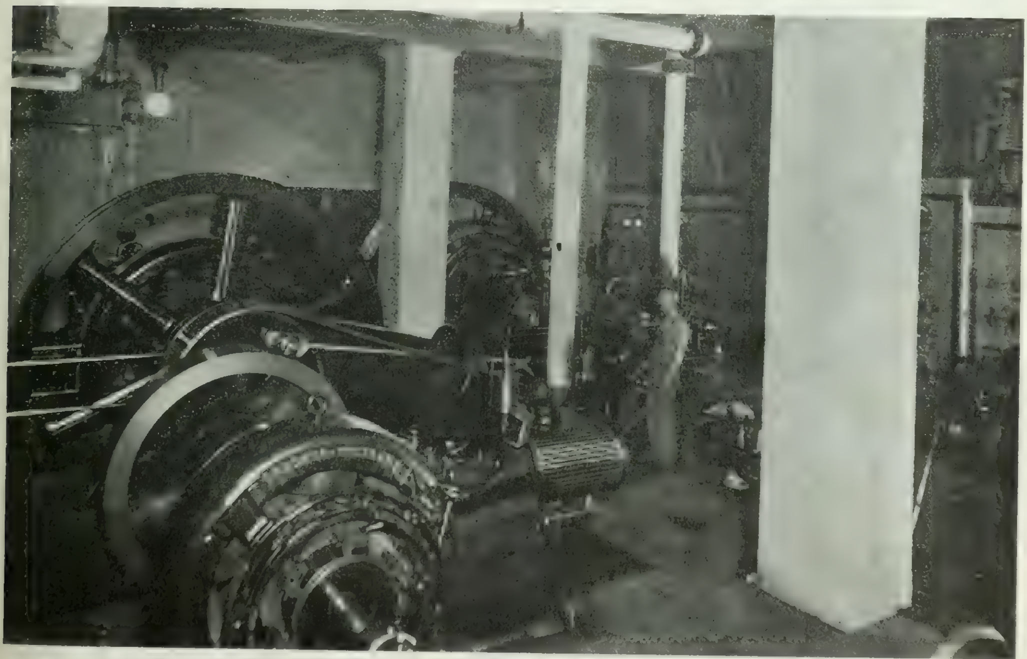


FIG. 1.—POWER PLANT, HALL OF RECORDS, NEW YORK CITY.

[illegible] to the atmosphere, depending on the season of the year. The feed-water after passing through the heater and before being pumped into the boilers passes through a feed-water filter.

In the pump room on the opposite side of the boiler room are filters for the drinking water used in the building; steam [illegible]

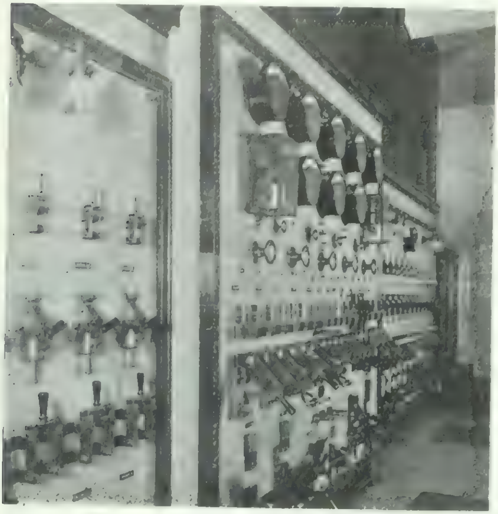


FIG. 2.—SWITCHBOARD, HALL OF RECORDS.

the top floor; hot water tanks, etc. A distilled water plant for supplying drinking water to the cooling tank of an absorption ice machine is also installed in this room.

A very thorough system of ventilation is installed. This is electrically driven and is in brief as follows: At each end of [illegible]

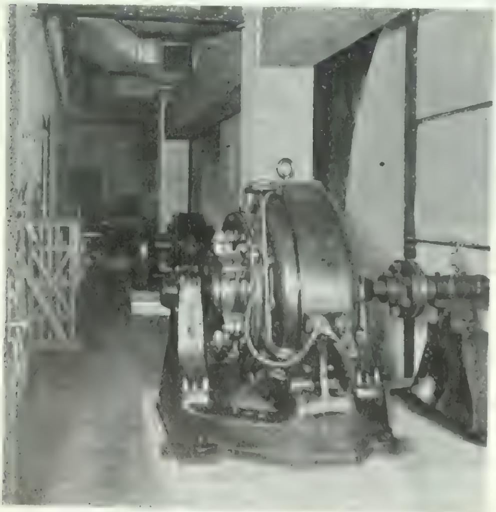


FIG. 3.—[illegible] APPARATUS.

the basement [illegible] face of large mesh wire screens covered with cheese cloth. The screens are [illegible] very easily for renewal and repairs. Located in the west end [illegible] and coupled to two 9-ft. blowers; also one 40-hp motor, [illegible] to a 7-ft. blower and one 8-ft. exhaust fan on the same [illegible]

FIG. 4.—PANEL BOARD SHOWING [illegible] SWITCHES.

as in the west end, and one 25-hp motor wound to run at 180, 225 and 270 r. p. m. and coupled to a 5-ft. blower and a 5½-ft. exhaust fan on the same shaft. The four 20-hp motor-driven fans supply the fresh air to all the floors except the basement, which is supplied by the 40-hp motor-driven set in the west end and the 25-hp motor-driven set in the east end. On the top floor are four exhaust fans 6 ft. in diameter used for removing the foul air from all the rooms above the basement floor. These fans are driven by 5-hp motors running at 250 r. p. m. The motors and blowers are set on bases of white-enameled brick capped with bluestone.

The engine room is located in the center of the basement

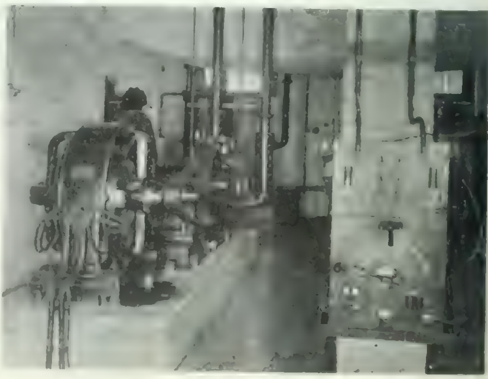


FIG. 5.—[illegible] CLEANING APPARATUS.

and has walls of white tile and a [illegible] floor. Air ducts [illegible] the switchboard and at each end of the room provide ventilation. The room is lighted by four enclosed arc lamps and by incandescent lamps on wall brackets. The generating

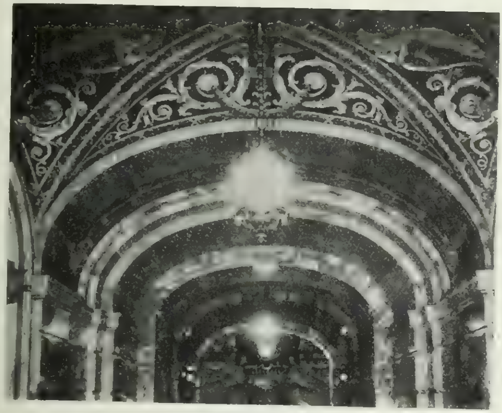


FIG. 6.—OTTENDORFER SQUARE VESTIBULE

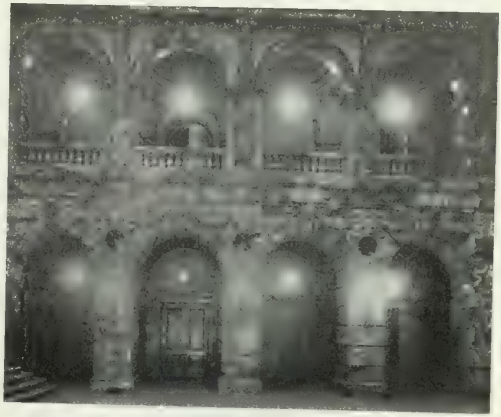


FIG. 9.—FOYER FROM MAIN ENTRANCE.

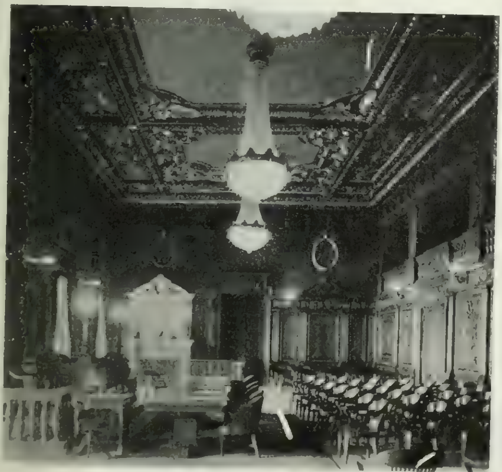


FIG. 7.—SOUTH SURROGATE'S COURT ROOM

FIG. 10.—NORTH SURROGATE'S COURT ROOM

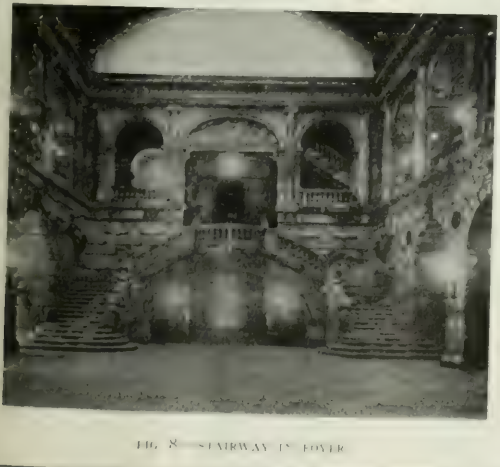


FIG. 8.—STAIRWAY IN FOYER

FIG. 11.—GENERAL VIEW OF LAW LIBRARY

SPECIAL LIGHTING FEATURES, HALL OF RECORDS, MANHATTAN, NEW YORK CITY

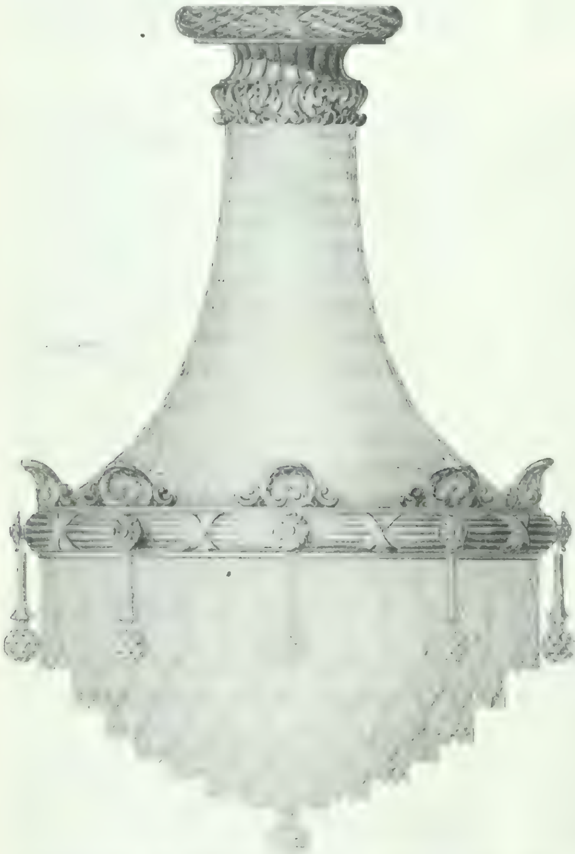
equipment consists of two 150-kw generators direct-connected to horizontal Corliss engines, one 100-kw generator, direct-connected to a Corliss engine and a 50-kw generator, driven direct by a high-speed engine. The generators are compound-wound and deliver direct-current at a potential of 120 volts. Connection from the steam main in the corridor is made to each engine. On an enamelled brick base at one end of the engine room is a small booster set for supplying a battery installed in a room back of the engine room and separated from it by a corridor. The battery has a capacity of 1000 ampere-hours.

The switchboard which is placed on the Chambers Street side of the engine room is 33 ft. long and 10 ft. high. It is made of Tennessee marble bordered with Belgian black marble. In the center of the board are the machine panels fitted with the usual arrangement of switches, rheostats, equalizers, circuit-breakers, meters, etc. The panels to the west are for motor is employed in the building and in a room on the Chambers Street side is a vacuum pump driven by a 35-hp motor.

[illegible]

The building contains eight floors besides a mezzanine floor between the fifth and sixth stories, a cellar, basement and attic. Outlets for circuit wiring are provided as follows: 16 outlets for as many enclosed arc lamps; 1792 outlets for 4557 incandescent lamps; 289 outlets for as many insertion plugs; 208 outlets for 208 local switches not including 140 outlets for cut-outs; 6 outlets for 6 elevator cable junctions; 8 outlets for 8 out-door outlet junctions, making the total number of outlets requiring outlet boxes 2319. The outlets are connected to distributing or branch circuits fed from feeders or mains through cutouts grouped at various centers of distribution. The circuits and feeders are two-wire throughout and all wires are enclosed in rigid conduit.

The feeder system includes distinct feeders for office and



[illegible]

[illegible]

[illegible]

and hall lighting circuits; a separate circuit controlled from the switchboard being provided for the hall-lamps for watchmen at night. The panels to the east are used for controlling the general lighting circuits throughout the building. Each circuit is provided with a knife switch and circuit breaker.

There are about 100 clocks throughout the building, all of which are electrically controlled from a master clock in the basement. A telephone switchboard having 125 connections is also located in the basement. The vacuum cleaning system other general lighting, for hall lamps, and for motor circuits respectively. The feeders run to certain floors only and are prolonged by mains to floors immediately above and below. For lighting purposes the floors may be considered as being sub-divided into various sets of floors, each set having its own feeder system, which is symmetrical with, though independent of, the others. Each floor is divided into four sections, each corresponding to an electrical center of distribution serving as feeder points for the branch circuits in the section. Feeder

lines connect with the first, third, fifth and seventh floors. The feeders on the first floor supply the first floor only. The feeders on the third floor supply the second and fourth floors also. The feeders on the fifth floor supply the sixth also and the feeders on the seventh floor supply the eighth floor in addition. From the eighth floor two mains are extended to the attic.

The hall lamps are supplied from separate feeders located in the basement, third and fifth floors respectively. The feeders

FIG. 15.—VESTIBULE LANTERN.

in the basement supply all the hall lamps up to the second story. The feeders on the third floor also supply the lamps in the second and fourth stories in addition to the lamps over the skylight. The feeders on the fifth floor supply the hall lamps on the fifth, sixth, seventh and eighth floors.

There are forty-two feeders and sixty-two mains apportioned as follows: 31 feeders for lamps; 11 feeders for motors; 51 mains for lamps; 6 mains for motors, and 4 switch mains. There are forty-three distributing centers variously located and the aggregate number of cut-out groups at these centers is 88. There are 800 branch circuits in the building.

The standard voltage of the installation is 116 at the lamps. This allows for a total loss of four volts in the circuit work, one volt of which is allowed in the branch circuits. Each conductor in the feeders and mains is encased in a separate conduit, while each pair of conductors in the branch circuits is provided with a single conduit. The conduits for the greater part run in lines parallel with the walls of the building or rooms.

Special arrangements are made for lighting desks and book cases as follows: Roll-top and flat desks are used and as a rule the floor outlet boxes for the roll-top desks are placed at the center and near the back of the desk. Rigid conduit rises from the floor outlet to a distance of about one foot above the floor and the extension to the fixture is made by flexible steel conduit, a special cable being provided for connection between the two kinds of conduit. In the case of flat-top desks, which usually have two or more fixtures, the circuit is enclosed in rigid conduit which rises from the floor to a distance of three or four feet, and from this point the connection to the fixture is made with flexible steel conduit. Special wiring is provided for all metal furniture so that the lamps on the cases may be controlled from opposite ends by means of three-point switches. Rigid conduit rises from the floor to these switches and the conduit extends thence to the top of the case, connecting with the various outlet boxes and push-button switch at the opposite end. Where the cases are set against the wall the circuits are run in a somewhat different manner. In these instances the circuit is extended from a wall outlet in rigid conduit to the top of the case, thence to the switch, from which it rises again to the top of the case connecting with an outlet box and finally with the switch at the opposite end.

The space above the skylight over the foyer is lighted by forty lengths of reflectors with a total of 360 32-cp lamps and the circuits for these lamps originate at cutouts located near the elevators on the third floor. There are 60 circuits in all, each circuit containing six lamps. The reflectors are wired so that the lamps may be controlled in groups. These lamps are switched into circuit by 100-ampere solenoid switches, themselves controlled by push buttons on the floor of the foyer.

In the book-binding department on the third floor there are four special circuits provided for electric heating apparatus. The apparatus consists of glue pots and heaters for tools used for leather-burning and book-binding purposes.

Besides the conduit system for electric light wiring, there is an elaborate system of conduit installed for electric signalling, call bell and telephone circuits. An interconnecting cable consisting of 300 wires is run from the main interconnection box in the cellar to the telephone room in the basement. Extension cables are run, in rigid conduit, from the main interconnection boxes to the service boxes located in rooms on the various floors. In each service box is an interconnection strip with a capacity for ten conductors and at each service point where electric signal or service appliances are installed,

FIG. 16.—CORRIDOR ON FIRST FLOOR.

an iron outlet box is provided similar to that used for electric light wiring. This conduit system is used for telephone wires, thermostat wires, call-bell wires and electric clock wires.

FEATURES OF ILLUMINATION.

The corridors throughout the building are lighted from three-lamp fixtures; the lamps being enclosed in an opalescent globe as shown in Fig. 14. The fixtures are suspended from the center of the groined arches in the vaulted ceilings on the lower floors and from the center of the plain dome and the arched

[illegible] special fixtures are provided. The lanterns in the vestibule (Fig. 15) are hexagonal in form and approximately two feet between parallel sides. The distance from the top to the bottom of the fixture pendant is about six feet. The body of the fixture has moulded and ornamented corner pilasters with voluted base and leaf work, and caps also voluted and surmounted with richly embellished cartouche. The hood or crown of the lantern is somewhat conical in form and has six dolphins, the head of each centering over the pilasters and the tails entwining and forming a decorative leaf attachment for a ball apex to which the supporting chain is attached. The base pendant has masks centered below the body pilasters and between these grotesques are decorative cartouches each converging in the manner of an inverted cone towards a pendant ornament consisting of leaf work and fruit clusters in high relief. In the Chambers Street vestibule there are three of these chandeliers. There are also installed in this vestibule twelve brackets with three lamps each. The backs of the bracket

FIG. 17.—DETAILS OF CHANDELIER.

[illegible] wide and 25 ins. long, making a massive rectangular cartouche, the field of which is moulded and embellished with acanthus leaves in relief. The bracket springs from the lower part of the cartouche somewhat in the form of a voluted cluster of acanthus leaves changing to form into a shorter arm and encircling band to hold the vertical arm of the fixture. The arm is in the form of a torch with trumpet head to hold the bronze shade holder and in addition four Roman facies in relief project from the arm with battle-axe head and spear ends to form a decorative termination. Smaller lanterns are provided in the Ottendorfer Square vestibule (Fig. 6) and in the Elm Street vestibule. In addition each of the latter vestibules is provided with two six-lamp fixtures.

The foyer (Fig. 9), as stated previously, is lighted by lamps behind the domed-glass roof overhead. In addition there are eight three-lamp brackets and four bronze standards under the stairway as shown in Fig. 8. In the corridor to the rear of the foyer are 22 three-lamp fixtures of a design as shown in Fig. [illegible].

Each of the court rooms on the fifth floor is lighted by three massive crystal chandeliers arranged for 24 16-cp lamps. The fixtures are well shown in the views of the court rooms and in detail in Fig. 12. The chandeliers are a combination of cast bronze and hand-cut glass pendants. The cast rim of the fixture is a massive band, 6 ins. wide and 4½ ft. in diameter with a large bead, reeded and ribboned and with 4-in. rosettes in relief. From the rosettes 12-in. pendant bronze drops are attached to the fixture and each motif of the pendant consists of a large cut-glass sphere, approximately 3-ins. in diameter, standing clear of the fixture. Below the bronze band there are seven tiers of flat, cut-glass pendants hung in circles of diminishing diameter and finished at the center with a 6-in. cut-glass sphere. These tiers form an inverted cone giving the effect of a solid crystal. Each prism is hung closely so as to conceal the metal supports. The bronze rim is supported by cast bronze arms in the form of double reversed consols and the projecting volutes of engaging consols support pendants of cut glass.

On each judge's desk there are provided two cast bronze standards of pleasing design. These are about four feet high and have opalescent glass globes in which three lamps are enclosed. The brackets about the room each contain two lamps. The bracket is shown in detail in Fig. 13. It will be noted that these are fixed at different heights in each court room to conform to the decorative scheme. In the galleries back of the court rooms small crystal fixtures somewhat similar in design to the larger ones in the court room provide for the illumination. There are four of these fixtures in each gallery and each fixture holds three lamps.

Fig. 11 shows the method used for lighting the law library on the sixth floor. As stated elsewhere, the lamps around the metal cases may be controlled from either end of the case by means of three-point snap switches. There are 75 lamps provided for the cases. The design of a fixture somewhat similar to those in the law library, the only difference being in the number of brackets, is shown in detail in Fig. 17. Each fixture holds 12 lamps. There are six two-lamp standards provided for the desks. These standards are 16 ins. high. The base is in the form of a tripod, 8 ins. extreme diameter, with crouched legs and claws and an ornate cartouche on three sides. The shaft is 1½ ins. in diameter at the base and one inch at the top, which is carried through the shade and terminates in a hood and acorn top. The shaft is reeded and holds a cast bronze shade frame divided into six divisions for holding opalescent glass. These lamps are fed from outlet boxes in the floor.

Heating Effect of Quadrature Currents in Rotary Converters.

By J. H. Hunt.

Under the condition of constant armature heating, currents in time quadrature to the impressed e. m. f. reduce the rating of rotary converters to a greater extent than the same percentage of [illegible] alternating-current generators. As proof of this statement consider a two-pole n-ring converter and let

E_0 = volts at the commutator

I_0 = amperes of direct current

E_n = volts between adjacent slip-rings

[illegible]
adjacent slip-rings.

Then

[illegible]

assuming initially that there are no losses and that the alternating current [illegible] e. m. f.

[illegible]

and

$$E_0 I_0 = n I_a \frac{E_0}{\sqrt{2}} \sin\frac{\pi}{n}$$

$$I_a = \frac{\sqrt{2}\, I_0}{n \sin\frac{\pi}{n}} \qquad (3)$$

Let r and r' (Fig. 1) be the points of attachment of adjacent collector rings, and let the line $O\,M$ bisect the arc $r\,r'$. Consider any armature conductor C between r and r'. Let wt be the angle between $O\,M$ and the axis of the field $x\,x'$. The alternating current between the collector rings is at its maximum value $\sqrt{2}\, I_a = \frac{2 I_0}{n \sin\frac{\pi}{n}}$ when $wt = 0$, and its value at any instant $= \frac{2 I_0}{n \sin\frac{\pi}{n}} \cos wt$. The direct current, $\frac{I_0}{2}$, in C is reversed each time it passes a brush. Then, in any conductor C situated at an angle α from $O\,M$, the actual current,

$$i = \frac{2 I_0}{n \sin\frac{\pi}{n}} \cos wt \mp \frac{I_0}{2} \qquad (4)$$

in which the double sign is to be taken as plus from $wt = 90° - \alpha$ to $wt = 270° - \alpha$, and as minus from $wt = 270° - \alpha$ to $wt = 450° - \alpha$, or from $wt = -(90° + \alpha)$ to $wt = 90° - \alpha$ these being the times when the conductor C passes under a brush.

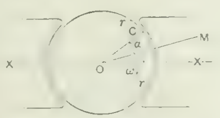


FIG. 1.—SIMPLE ROTARY, TWO-POLE MODEL.

Although α is a space angle, it determines also the time phase of the alternating current at the instant that the direct current is reversed.

Equation (4), taken between the limits $wt = -(90° + \alpha)$ to $wt = (90° - \alpha)$, gives the instantaneous value of the actual current in the conductor during the time this conductor is moving from one brush to another. Then the average rate at which heat is generated in this conductor is proportional to

$$\frac{1}{\pi} \int_{-(90° - \alpha)}^{(90° - \alpha)} i^2\, d\,(wt)$$

$$= \frac{1}{\pi} \int_{-(90° + \alpha)}^{(90° - \alpha)} \frac{I_0^2}{4} \left(\frac{4 \cos wt}{n \sin\frac{\pi}{n}} - 1 \right)^2 d\,(wt)$$

$$= \frac{I_0^2}{4} \left(1 - \frac{16 \cos\alpha}{\pi\, n \sin\frac{\pi}{n}} + \frac{8}{n^2 \sin^2\frac{\pi}{n}} \right) \qquad (6)$$

Since the rate at which heat would be generated in the chosen conductor C by the direct current alone is proportional to— $\frac{I_0^2}{4}$ equation (6) shows that the same conductor C, when the armature is running as a rotary converter has

$$\left(1 - \frac{16 \cos\alpha}{\pi\, n \sin\frac{\pi}{n}} + \frac{8}{n^2 \sin^2\frac{\pi}{n}} \right)$$

times as much heat produced in it as when run as a direct-current generator with the same output. As is evident from the above factor, less heat is generated in the conductor situated on $O\,M$ than in any other, and the heating increases as the angle α increases. As α is determined by the number of rings, the greater the number of rings the smaller the difference in the heating in different conductors.

Assuming perfect conduction of heat within the armature, the rating is determined, so far as heating is concerned, by the average heating of all the conductors between adjacent slip-rings. The average heating between adjacent slip-rings is proportional to

$$\frac{1}{\frac{2\pi}{n}} \int_{-\frac{\pi}{n}}^{\frac{\pi}{n}} \frac{I_0^2}{4} \left(1 - \frac{16 \cos\alpha}{n \sin\frac{\pi}{n}} + \frac{8}{n^2 \sin^2\frac{\pi}{n}} \right) d\,(\alpha)$$

$$= \frac{I_0^2}{4} \left(1 - \frac{16}{\pi^2} + \frac{8}{n^2 \sin^2\frac{\pi}{n}} \right) \qquad (7)$$

Thus the average heating in the armature of an n-ring converter is $1 - \frac{16}{\pi^2} + \frac{8}{n^2 \sin^2\frac{\pi}{n}}$ times as much as though the armature were giving the same output as a direct-current generator; and for the same heating, the rating may be

$$\frac{1}{\sqrt{1 - \frac{16}{\pi^2} + \frac{8}{n^2 \sin^2\frac{\pi}{n}}}}$$

times as much.

The demonstration above, which may be found in many text books on alternating current machinery, is limited in its application, because it is based on the assumption that the alternating current is exactly opposite in time phase to the alternating e. m. f., and is, therefore, either exactly in time phase with, or opposite in time-phase to, the direct current.

Assuming now the same value of direct current and put $E_0\, I_0$ as before, and also assuming that the alternating current is a time angle of $180° \pm \theta$ away from the alternating e. m. f., it is evident that this current may be divided into two components, one opposite in time phase to the e. m. f., and one in time quadrature with the e. m. f. The maximum value of the power component is $\frac{2 I_0}{n \sin\frac{\pi}{n}}$ or the same as the maximum value of the alternating current at 100 per cent power factor and the instantaneous value of this component is $\frac{2 I_0}{n \sin\frac{\pi}{n}} \cos wt$. The

[illegible]

$$= \frac{i^2}{4}\left(1 - \frac{16}{\pi^2} + \frac{8\sec^2\theta}{n^2\sin^2\frac{\pi}{n}}\right)$$

Therefore the heating is an n-ring rotary taking alternating current $180° \pm \theta$ time degrees away from the e. m. f. is $\left(1 - \frac{16}{\pi^2} + \frac{8\sec^2\theta}{n^2\sin^2\frac{\pi}{n}}\right)$ times as [illegible] as [illegible] the same armature giving the same output as a direct-current generator, and on the basis of heating may be rated

$$\sqrt{\frac{1}{1 - \frac{16}{\pi^2} + \frac{8\sec^2\theta}{n^2\sin^2\frac{\pi}{n}}}}$$ times its rating as [illegible] direct-current generator.

When $\sqrt{1 - \frac{16}{\pi^2} + \frac{8\sec^2\theta}{n^2\sin^2\frac{\pi}{n}}} = 1$

or when $\left(1 - \frac{16}{\pi^2} + \frac{8\sec^2\theta}{n^2\sin^2\frac{\pi}{n}}\right) = 1$

the rating will be the same, so far as heating is concerned, as the direct-current generator. The following table has been obtained from equation (11):

Number of rings on the rotary converter	Power factor at which the rating equals that of a direct-current generator
3	[illegible]
4	[illegible]
6	[illegible]
[illegible]	[illegible]

[illegible] in which [illegible] has to be [illegible]

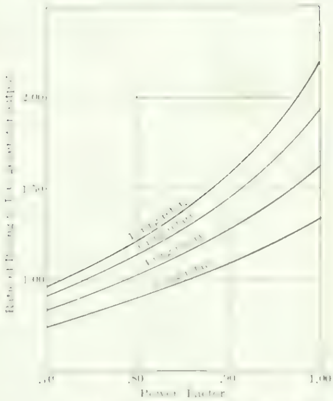


FIG. 2.—COMPARATIVE RATING AND POWER FACTOR FOR CONSTANT HEATING.

method used with equation (4). The average heating of one conductor is proportional to

$$[illegible] \qquad (9)$$

The average heating for the entire armature is proportional to

$$\frac{1}{2\pi n}\,\frac{i^2}{4}\int \left(\ [illegible]\ + \frac{8\sec^2\theta}{n^2\sin^2\frac{\pi}{n}}\right) d\,a$$

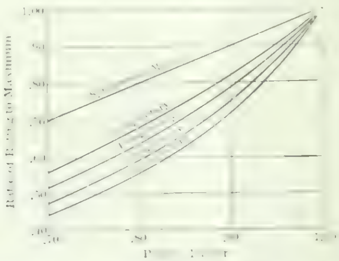


FIG. 3.—PERCENTAGE RATING AND POWER FACTOR FOR CONSTANT HEATING.

Fig. 2 shows how the ratings of rotary converters having various number of rings increase to the maximum as the power factor increases, the ratings being taken in their ratio to the ratings of the same machines used as direct-current generators. Fig. 3 shows the same relations, with the various ratings plotted in per cent of their maximum. The curve for a synchronous motor having any number of phases is added in this figure to show the greater heating effect of the same percentage of quadrature current in the rotaries (same power factor), as compared with the synchronous motor. Fig. 4 shows the decrease of the copper losses as the power factor rises, both for rotary converters and synchronous motor, based on the assumption that the total input is constant.

For the purpose of checking the above results, two heat runs were made on a small four-phase (so-called two-phase) four-

pole 60-cycle rotary converter, having a nominal rating of 10 kilowatts at 125 volts on the direct-current end. Power was supplied through four slip-rings on the alternating-current end, and a three-hour run was made under the following conditions:

Input				Speed.	Field.	Output	
Volt.	Amp.	Kw.	P. F.	R. P. M.	Amp.	Volt.	Amp.
89	47.5	3.32	.785	1200	.66	114	48

Rise in temperature in degrees Fahrenheit: Core, 50 degrees; comm., 64 degrees.

The brushes were then shifted forward to give good commu-

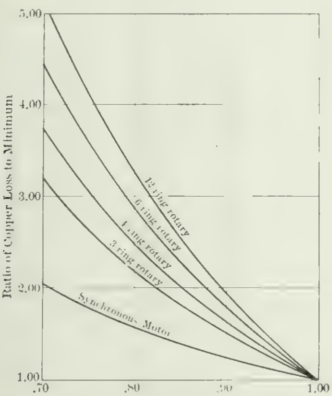


FIG. 4.—COPPER LOSS AND POWER FACTOR FOR CONSTANT INPUT.

tation as a direct-current generator, and a three hours' run made under the following conditions:

Output		Field.	Speed
Volt.	Arm. Amp.	Amp.	R. P. M.
114	48	1.08	1200

Rise in temperature in degrees Fahrenheit: Core, 49 degrees; comm., 61 degrees. It will be observed that the power factor when run as a rotary converter was adjusted to .785, the value at which the armature copper losses in a four-ring rotary converter equal the armature copper losses in the same machine delivering the same current output as a direct-current generator. The temperature rises were found to be closely the same for the two tests. Since the stray power was supplied by the alternating current during the first test, and by the belt in the second case, we would expect slightly greater heating in the first case than in the second

Sub-station Equipment and Operation, Chicago Edison Company and Commonwealth Electric Company.

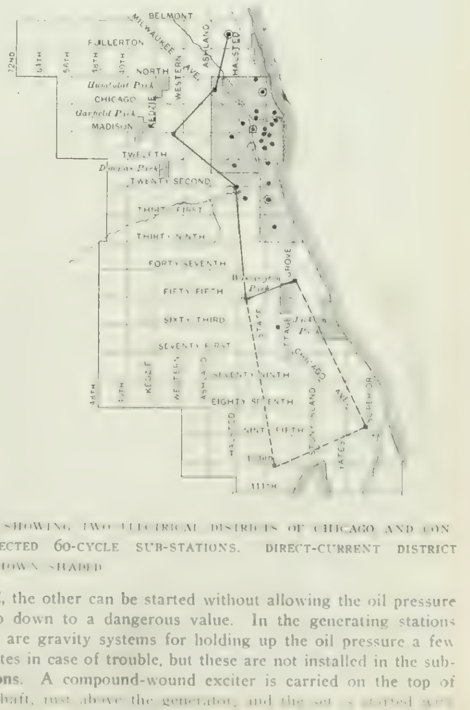
By R. G. Grant.

There are two general systems of secondary distribution in Chicago—continuous current is supplied over the Edison three-wire system at 250 volts and 60-cycle lighting and power service by the three-phase, four-wire system at 2200 volts to the centers of distribution, where it is stepped down to 220 and 110 volts. The direct-current district, as seen by the map, extends throughout the business section of the city and the more densely populated portions, while the outlying districts are supplied with 60-cycle current. The former extends from North Avenue on the north to Thirty-ninth Street on the south, and from Ashland Avenue to the lake, and the latter takes care of the portions outside of these boundaries. There is a chain of 60-cycle sub-stations extending around the outside of the direct-current district, as shown by the accompanying sketch. There are also transformer sub-stations at South Chicago and Fernwood, which are supplied with 60-cycle current from the two stations at the southern part of the chain, as indicated by the dotted lines. All of the 60-cycle sub-stations are tied together with tie-lines. The direct current stations are also tied together, since they feed into mains which form a network throughout the direct-current district.

The sub-stations are supplied from two main generating stations in which are installed star-connected turbo-alternators aggregating 60,000-kw capacity. These alternators furnish three-phase, 25-cycle current at 9000 volts over three transmission wires to the sub-stations, and therefore two classes of converting apparatus are necessary, viz., frequency changers for transforming from 25 to 60 cycles, and rotary converters for the direct current output.

The transformation from 9000 volts, 25 cycles to 2200 volts, 60 cycles is effected by means of synchronous motor-generator sets, the machines being Y-connected and the generator having a neutral lead for the three-phase, four-wire system. They are made by the General Electric Company and are 500, 1000 and 2000-kw capacity. The 500 and 1000-kw machines are of the horizontal, two-bearing type, with revolving fields. The small sizes have concentrated windings on the motor, but on the larger sizes the windings are distributed. The motors have a squirrel-cage winding laid in the revolving core, and are started as induction motors at approximately half voltage from an auto-transformer. When synchronous speed is nearly reached, the field circuit is closed, and then, by means of interlocking switches, the machine connections are transferred to the running bus.

There are at present three installations of 2000-kw motor-generators, one in each of three sub-stations. These machines are of the new vertical type with a step and guide bearing for the revolving fields, which is sustained by oil under a pressure of 480 pounds per square inch for the step bearing and 20 pounds for the upper, or guide bearing. The oil pressure is maintained by means of three cylinder pumps driven by motors of 5.5-hp capacity. There are two of these pumps used interchangeably, and the piping system for the oil is provided with check valves, so that in the event of one pump becoming dis-



MAP SHOWING TWO ELECTRICAL DISTRICTS OF CHICAGO AND CONNECTED 60-CYCLE SUB-STATIONS. DIRECT-CURRENT DISTRICT SHOWN SHADED.

abled, the other can be started without allowing the oil pressure to go down to a dangerous value. In the generating stations there are gravity systems for holding up the oil pressure a few minutes in case of trouble, but these are not installed in the substations. A compound-wound exciter is carried on the top of the shaft, just above the generator, and the set is started [illegible]

[illegible] large amount of current it would take for a considerable time if started in the usual way, it is brought up to nearly synchronous speed by means of the exciter run as a cumulative compound motor from a source of direct current, as other exciters, or from rotary converters if they are installed in the sub-station. About five minutes is consumed in bringing the machine up to speed, and it is then thrown to the half voltage or compensator bus, from which point the operations proceed as in the case of the smaller machines. It is necessary to provide switches to reverse the exciter field, since at starting the armature reaction would be dangerously great if the machine were started as a shunt or differential compound motor. After the motor is running from the high-tension bus, the field circuit is opened and reversed and the exciter is allowed to supply its own field current.

These vertical type machines are the first to be installed, and a comparison of their various features with those of the horizontal type may be of interest.

The principal disadvantages of the horizontal type of frequency-changer are mechanical; the friction loss is considerably greater than in the vertical type where the revolving parts are floated on an oil film, and there is danger of the journals becoming sufficiently worn to allow the pole pieces to strike the armature windings, which danger is eliminated in the vertical type. The low friction losses, combined with a low and well-balanced electrical loss, unite to give an unusually high efficiency. A continuous output of 2667 kw at 75 per cent power-factor is maintained with a temperature rise of 40°F. above the surrounding atmosphere. The efficiency at full load is 91 per cent and at half load, 85 per cent. The regulation from no load to full load is about 6 per cent.

The following figures are given in the comparison of the mechanical features of a 2000 kw vertical type machine, and a 1500-kw machine of the horizontal type:

	Vertical	Horizontal.
Floor space	101 sq. ft.	188 sq. ft.
Height (with exciter)	14 ft. 6 in.	
Height (without exciter)	11 ft. 6 in.	[illegible] ft. 6 in.
Weight	6[illegible],000 pounds	60,000 pounds
Weight of shaft	[illegible],900 "	9,100 "
Weight of mechanical parts	39,000 "	49,000 "

From these figures the advantage of the new type can be readily seen.

The total rated capacity of motor-generators installed in the two companies is about 16,500 kw. In addition to this, two of the stations have auxiliary steam plants which can be used in case of emergency, or at the peak of the load.

The direct current output is furnished by means of rotary converters built by the General Electric Company, and of 500, 1000 and 2000-kw capacity. They are designed to take six-phase, 25-cycle current at 186 volts and deliver direct current at 250 volts to the low-tension bus. At present there are but two 2000-kw rotaries installed. There are also two or three installations of two 100-kw, 125-volt machines in series, the neutral being tapped to the series connection, and several 250-kw, 250-volt rotaries; also two railway machines which are not a part of the Edison system, but supply current for the traction companies and the Illinois Tunnel Company.

The exposition of the equipment of a standard sub-station is best accomplished by tracing the current from the transmission line to the center of distribution, and this method will be followed.

The current flows from the transmission line to the high-tension bus through an oil switch, which is generally a type "C" or type "F"—General Electric—and consists of three pairs of oil cans, each containing one terminal of one phase of the line and of the bus, the two members of each pair being short-circuited by a copper rod when the switch is closed. This short-circuiting mechanism is operated by some kind of an electro-magnetic device controlled from the switchboard by a single pole, double-throw switch. In the case of a type "C," the operating device is a pair of [illegible] and in the case of a type "F" [illegible].

The high-tension bus may supply power to either rotary converters or motor generators. Taking the case of a direct-current station first, the current flows from the high-tension bus through an oil switch for each machine, thence through a transformer, where the voltage is reduced from 9000 to 186, and from three to six phase in the double delta or double star connected secondary. From the transformer secondary it passes through a potential regulator and thence to the six slip-rings of the rotary, through the armature, and from the direct-current brushes to the direct-current bus.

The potential regulator is a transformer in which the primary and secondary are movable with respect to each other through a portion of a revolution. It contains six coils—one for each phase—which are in series and parallel respectively with the leads from the secondary to the rotary. The relative positions of the primary and secondary determine the inductive action of the regulator on the transformer secondary, and hence the pressure at the slip-rings of the rotary, which in turn fixes the direct-current pressure. The movable coil is operated by means of a small induction motor controlled from the switchboard. The neutral point of the transformer is connected through a switch to ground, and is thus at the same potential as the middle point of the three-wire system, which is also grounded. It is therefore possible to operate a rotary on but one side of the system in order to compensate for an unbalanced condition of load. This is generally accomplished, however, by a balancer arranged for the purpose.

Between the oil switch and the transformer are the series transformers—one for each phase—which send current through the solenoids of the overload relays and the current coils of the wattmeters and the power-factor indicators. These transformers are designed for a full load secondary current of 5 amperes. Potential transformers are also shunted across the phases to feed the pressure coils of the wattmeters, the machine voltmeter, the pressure coils of the power-factor indicator and the synchronizer. A potential transformer is also connected across one phase of the high-tension bus to indicate the line pressure and to furnish feed for the fields of the synchronizer. On the direct current side there are—two machine ammeters, + and —, one machine voltmeter, or its equivalent, connected across the outside leads, two standard voltmeters, + and —, which can be connected to any of the direct-current feeders at whose ends the pressure is to be kept constant, or to any of the buses in operation. There are also recording voltmeters connected to pilot wires from the feeder ends—one on each side of the three-wire system.

The machines are protected from damage due to excessive speed or a heavy reverse current by automatic devices designed to open the circuit-breakers under these conditions.

The batteries installed throughout the direct current district are intended for use in emergencies, and not to relieve the generating station at the peak of the load, although this is sometimes done. At each station where batteries are installed, the cells are divided into two equal groups, one on each side of the system, with a neutral leading from the middle point of the battery to the ground. Where a large capacity is desired, a number of these groups are installed. There are generally 75 cells per side, about 5 of which are end cells. The rated capacity in amperes per side for one hour varies from about 1000 to 16,000, the large ones being in the downtown district. The total capacity of the batteries of this systen. (one hour rate per side) is 60,000 amperes, which would carry the peak load for about 20 minutes at a discharge rate of 120,000 amperes. The largest battery is at the Adams Street station, where three of 5700 amperes per side are installed.

The plates are made by the Electric Storage Battery Company, and range in size from an "H" plate—31 in. x $15\frac{1}{2}$ in. to a "G" [illegible] 15 [illegible] in. square. The largest cells have 87 plates—43 positive and 44 negative, and the smaller ones 49—24 positive and 25 negative. The batteries are kept floating on the system ready to take up the load in the event of the 25-cycle supply being interrupted. End cells are cut in or out by means of motor operated end-cell switches controlled from the switchboard, and

floating is accomplished by keeping the pen of a Bristol recording meter (connected across the main battery) on the floating line by the operation of the end cells. Conditions obtaining during charge and discharge are determined by means of the recording voltmeter charts and by observing the specific gravity and voltage of the cells.

Conditions sometimes warrant the use of the batteries to feed back through the rotaries into the high-tension system, and such operations are directed by the load dispatcher. In this case the inverted rotaries are not allowed to operate independently on account of the lack of frequency control, and the danger of running away on an inductive load. Complications of this nature sometimes arise, an instance being a case in which the transmission line failed and the battery discharged back through the rotary, feeding an under-excited synchronous motor on the same high-tension line. The speed-limiting device failed to operate, and the machine was destroyed before the operator could reach the switchboard. The present practice is to run separate lines for rotary converters and motor-generators in order to eliminate this difficulty.

25—60 *cycle transformation*.—This is accomplished by means of synchronous motor-generator sets as described above. The switches connecting the motor to the 25-cycle bus are type "G"—G. I., or type "K₂"—G. E., interlocking, by means of which the motor can be thrown from the compensator bus to the running bus with the field circuit closed. The generator switches are type "A," motor-operated, or type "K." Overload relays are connected to operate each phase independently, so that an overload on one phase will not open the others, as is the case on the motor side. These relays are of the bellows type, capable of adjustment to operate at any predetermined current overload, and after any given number of seconds.

Each generator may be connected to either of two 60-cycle buses through selector switches or interlocking type "K₂" switches. In two of the stations the interlocking feature has been dispensed with in order to operate the two buses together from one machine.

The 60-cycle circuits may also be connected to either of the two buses by the interlocking switches, or by means of hand-operated oil switches made by the Stanley Electric Company, and furnished with a tripping coil actuated by the overload relays, which are of the same form as those on the machines. The different phases of the circuits are operated independently. Regulation of the circuits is accomplished by the use of I. R. S. induction regulators made by the General Electric Company, and operated by three-phase induction motors controlled from the switchboard. The operating current is obtained from transformers on the 60-cycle bus. The feeder-end potential is indicated by voltmeters in connection with line-drop compensators, the settings being determined when the circuit is put into service. Automatic regulation is also used in a few cases, employing potential relays to operate friction clutches, which connect the regulator quadrant to a line of shafting for rotation in the desired direction.

The rated output of each of the regulators in use on the circuits is 75 amperes and 18 kw on the tie-lines, 100 amperes and 24 kw, giving a maximum boost or choke from the neutral position of 240 volts. In the event of a regulator becoming disabled, it can be cut out entirely and the circuit put on bus pressure, or else thrown in parallel with another regulator by means of a transfer board. The bus pressure is maintained constant by using a Tirrill regulator.

A new departure in the operating procedure of these companies was put into effect the first of the year (1907) by means of which two independent 25-cycle buses are maintained at the generating station, the object being, of course, to reduce the possibility of a complete shut-down, due to the failure of a transmission line or a break-down at the generating station. No trouble has as yet been caused by paralleling these two systems in the sub-stations, due to a mistake in executing the orders of the load dispatcher, and the most rigid orders are out covering the operation of lines on the two systems.

Test of a Gas Engine Plant in Boston.

An exhaustive efficiency test of the gas engine electric plant of the J. P. Eustis Manufacturing Company, Boston, was made recently by Messrs. P. R. Nichols and R. F. Knight, of the Massachusetts Institute of Technology. The plant consisted of a 55-hp Bruce-Abbott-Merriam engine direct connected by a flexible coupling to a 30-kw Bullock generator of the 230-240 volt, direct-current type; the auxiliaries consisted of a circulating pump and motor, switchboard for controlling the generator output, starting device and storage battery. The engine was of the vertical, twin-cylinder type with throttling governor, operating on the four-cycle principle. Governing was effected by varying the richness of the explosive mixture. The water circulation was insured by a centrifugal pump driven by a 0.5-hp motor. The water was used over and over, being pumped to a tank on the roof and back. The engine was started by compressed air stored in two steel tanks at a pressure of 240 lbs. per sq. in. These air tanks were filled by an air pump driven by a 1-hp motor. In starting a special set of cams is thrown into service on one cylinder and the air turned on. The engine then begins to turn over, and when the other cylinder has taken up regular explosions, the air is turned off, and the regular set of cams is thrown back into position while the engine comes up to speed.

The gas used by the engine was taken by the company from the city mains at a pressure of about 2 ins. of water, and was measured by a 100-light meter. The engine room is 10 ft. by 20 ft., and the load is light and power for a brass working establishment employing about 60 persons. The power load is on from 7 a. m. to 5:30 p. m., and consists of polishing motors, motor generators for electroplating, etc. The load is of a fluctuating character. A constant load was obtained by a water rheostat when necessary. German silver coils were used for this purpose, each coil having a capacity of 35 amperes. The heating value of the gas was determined by a Junker's calorimeter. The efficiency of the set was found by constant load runs after 6 p. m., the runs averaging one hour in length. All-day runs were also made from 7 a. m. to 6 p. m. In all the runs the voltage was maintained constant at 220 volts. To secure data on the gas used and the energy generated over a longer period of time, the watt-hour meter used was left in circuit 2 weeks, during which time several readings were taken of the watt-hour meter and the gas meter. The gas averaged 590 B. T. U. per cubic foot. The average of all tests after 6 p. m. was 573 B. T. U. per cubic feet. The efficiency results were:

Run. No.	Efficiency of Set.	Efficiency of Engine.	H. P. by Engine.	B. T. U. per H. P. Hour.
1	[illegible]	[illegible]	[illegible]	[illegible]
2	6.47	8.35	8.7	30,400
3	[illegible]	[illegible]	[illegible]	[illegible]
4 A	[illegible]	[illegible]	[illegible]	[illegible]
4 B	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	18.4	20.55	25.8	[illegible]

In the two weeks' run the total kw hours were 3146 and the total gas used, 92,900 cubic feet. The loss in the circulating pump was 31.9 kw hours, leaving 3114 kw hours as the net energy delivered in the two weeks. The gas consumption per kw hour was 29.8 cu. ft.: the B. T. U. per kw hour output 17,580, and per hp hour of engine assuming an average efficiency of the generator of 89.5 per cent, 11,730 B. T. U. The average thermal efficiency of the engine was 21.7 per cent, and of the set 19.4 per cent. The cost of energy as generated by the set was figured as follows per kw hour from the two-weeks' run assuming a gas cost of $0.70 per thousand cu. ft.:

Cost of gas, 2.09 cents per kw-hour.

Cost of oil, assuming that 1 qt. is consumed per day, the rest being available for use again, .029 cents per kw-hour.

Cost of attendance, 2 hours per day, 0.193 cents per kw-hour.

Total net cost of manufacturing, per kw-hour, 2.312 cents.

On the assumption that the plant represents $3,000 invested, taking 15 per cent interest and depreciation, the fixed charges were 0.555 cents per kw hour. Total energy cost per kw hour, 2.87 cents.

New Telephone Patents.

EXCHANGE IMPROVEMENTS.

With party lines there has been a constant demand for the overcoming of the necessity for a special symbol. With three-wire common-battery systems this demand has been readily met without any essential change in the usual arrangement of circuits and apparatus. For a two wire system of the Dunbar type, J. M. Storkerson, of La Crosse, Wis., has patented an arrangement to give this same result. A separate string of multiple jacks is assigned for each side of the line and these are associated with a single answering jack and signal. Each set of multiple has its own cut-off relay, and these are so interconnected that the line is connected up in opposite direction by the two relays. Thus a call from one jack rings on the opposite limb of the line from a call from the other. Provision is also made to interconnect the busy test so that both sets of jacks will show busy, no matter which carries the plug.

E. B. Heaford, of Omaha, has invented a common-battery system in which the cut-off relay is double wound. One coil is in the line circuit in series. This is the main actuating winding and it is shunted by a non-inductive resistance. The second winding is of high impedance and is connected in series with a condenser across the line. This coil holds up the cut-off relay while ringing current is applied, and thus prevents such current from lighting the line lamp.

A night service attachment for magneto exchanges forms the subject of a patent granted to C. E. Ackerman, of Vernon Township, Mich. This consists of a switch by means of which all the exchange lines may be connected to a bus. Another switch opens the common wire of all the drops. An operator's station is connected from the bus to ground, and one side of certain telephones which are to receive night calls are grounded. Stations allowed to make night calls are given temporary grounding keys. It is suggested that doctors may be given night call code rings. As the night service is grounded, the stations as a whole will not receive the signals.

STATION APPARATUS.

A swinging desk arm has been patented by W. B. Oliver, of Collingswood, N. J., which has some novel features. The arm swings in both vertical and horizontal planes, and carries at its upper end a swinging transmitter, which remains in the vertical position. A receiver hook is arranged to swivel about a horizontal axis, integral with the switch lever. This latter is pivoted at an angle to the vertical so as to come into play as the arm comes down into the horizontal position. The whole apparatus is designed with counterbalancing springs and spring joints so as to "stay put."

As a means of notifying a returning subscriber of a lost call, Mr. W. H. Stinson, of De Funiak Springs, Fla., has invented an indicator. A cup is mounted below a tube, in which small balls may be placed. These latter are retained by a wire passing into the bore of the tube. When the ringer operates it pulls the wire out and allows the balls to fall into the cup.

The breaking of a circuit containing much inductance has always been a source of annoyance due to burning of the contact points. The currents handled in telephony are fortunately [illegible] tolerated for a considerable period before cleaning of the points is necessary. With the switching currents of automatic systems some counteracting means becomes almost necessary, in the actuating magnet circuits. In order to overcome the difficulty, Mr. C. M. Thompson, of Chicago, has patented an arrangement in which a double wound operating magnet has first one of its windings energized and then the second winding, to neutralize the magnet, when both windings are broken simultaneously, thus avoiding a discharge potential.

AUTOMATIC SYSTEM.

In a patent recently granted to N. E. Norstrom, of Junction City, Kan., an automatic system is described wherein the primary selecting currents are in the form of inpulses sent from a generator at the station of the user. An all-metallic line and polarized relay are used. The index at the subscriber's station is set and the crank turned. The impulses sent out are of a direction to cause the polarized relay to operate the hundreds magnet. When the required number of impulses has been sent the generator is automatically reversed and opposite impulses are sent out to the relay to affect the units selection. The bell is rung by the same movement of the generator. All switching is accomplished automatically, a spring gear transmission for driving the generator assuring a proper speed of rotation for its armature.

LETTER TO THE EDITORS.

Edison Current.

To the Editors of Electrical World:

SIRS:—The exploitation of the name of Edison receives an amusing illustration in an editorial in your issue of July 20, in the statement "The United States central station Edison voltage is nearly always limited to 250 volts between outers." To the term "Edison current" our eyes have become accustomed through its persistent use for advertising purposes by some of the original direct-current central stations, and I hope that the quotation is not a revelation of a plan of these interests to complement that term with "Edison volts." The use of both terms and even of the addition of "Edison watts," "Edison henries" and similarly the whole line of electrical terms, would be merely amusing were it not for the effect on the electrically uninformed public. The use of "Edison current" for 110-125 volt direct current has led to a widely extended belief among the laity that this term applies to a kind of electricity different from and superior to other kinds, of which the distinction implies the existence. It should be a duty incumbent on all connected with the application of electricity to promote correct ideas relating thereto, and not take part in still more befuddling the ideas of the public in relation to the "subtle fluid." The use of the term "Edison current" is particularly anachronistic at this late period, when practically all of the original Edison companies generate alternating current, and direct-current distribution will soon be a memory of the past.

CHICAGO, ILL. JAS. T. CHAMBERS.

[The appearance of the word which our correspondent criticizes was due to bad penmanship, combined with poor proofreading. The qualifying word should have read "direct-current."—EDITORS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Reluctance Control.—L. TORDA.—An illustrated description of a new variable-speed electric motor or variable-voltage dynamo. The control is based on the variation of the magnetic reluctance of the machine, as shown in Fig. 1, which is a side elevation and an end view of the machine. Air ducts are formed in the magnet cores between the field coils and the yoke. Iron masses in the form of plates are placed in the air ducts, and they are so arranged that they can easily be moved in axial direction inwards or outwards in the air ducts. Two of the plates are supported at one end on rollers, mounted to rotate in slots in the ends of the plates and running freely on the surfaces forming the bottoms of the air ducts. Each [illegible]

traversing frame, which is provided with a screw-threaded central boss for the reception of the adjusting spindle. The spindle is mounted to rotate in the two-arm bracket fixed to the frame of the machine. Hitherto in machines with reluctance control the construction has been so arranged that the insertion of the reluctance, while weakening the main field reduces the field distortion. In the present machine no attempt has been made to influence the field distortion, as the

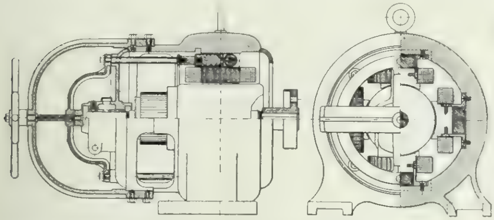


FIG. 1.—VARIABLE-SPEED MOTOR.

air ducts and the adjustable iron masses are placed inside the field magnet system remote from the armature. This has several practical advantages. From a constructional point of view, a simpler and safer arrangement is obtained with movable parts farther away from the rotating armature. Further, the air-gap in the armature in the pole phases may be made as small as mechanically admissible. There is also a reduction of the weight of the adjustable masses by arranging the

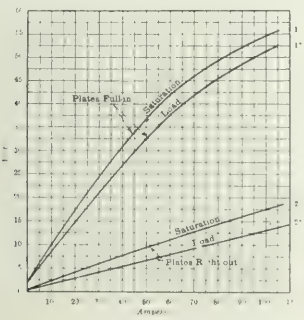


FIG. 2.—RESULTS OF TESTS.

air ducts and the plates in places inside the field magnet system where the magnetic induction is the highest. Fig. 2 gives the results of tests showing the relation between the current and the voltage within the limits of control, one set of curves being for the plates full in and the other for the plates full out. For the maximum current of 100 amperes, the range of voltage is from 13 to 52.—Lond. *Elec.*, July 5.

Lamps and Lighting.

Electric Arc.—UPSON.—An abstract of a (British) Physical Society paper on an experimental investigation of the production of electric arcs between cooled-metal and carbon terminals, in air and hydrogen. Apparatus was exhibited for maintaining the arc in various gases, while one electrode was cooled by means of water circulation. Arcs were described in which the electrodes consisted of carbon, copper, iron and aluminum in different combinations, maintained in air, hydrogen and coal-gas. With a 110-volt supply, metal arcs in hydrogen took the form of a spark discharge. At that voltage the maximum length of arc it was possible to obtain, with current up to 15 amperes, was 0.05 in., except where both electrodes were of the same metal. When carbon is one of the electrodes, a true arc is formed. If carbon is negative the maximum length of arc with the above voltage is 0.07 in. Volt-ampere characteristic curves were shown for arcs in air and hydrogen 0.05 in. in length. The general position of the curve is determined by the material of the negative electrode. With carbon negative, in hydrogen, the curves for various positive electrodes very nearly coincide. With carbon positive, they keep the same curvature, but vary in distance apart, according to the material of the negative. In general the position of the curve is governed by the negative, but its particular shape seems to come from the influence of the surrounding gas. The slope of the curve (ampere horizontal, volts vertical) of the carbon arc in air is much less steep than that of the curve of any arc in hydrogen. The former curve cuts the latter in the neighborhood of 6.5 amperes. The curve for the arc with carbon positive, aluminum negative, in air, is very steep, being equal in this respect to the curves for arcs in hydrogen. Volt-ampere characteristics were shown for copper arcs in air, with (1) positive electrode cooled, (2) negative electrode cooled and (3) neither cooled. Equations for various arcs were obtained giving the voltage in terms of current and arc-length. It was much more difficult to obtain a carbon arc in hydrogen with alternating currents, and no arc could be obtained when the electrodes were copper positive and carbon negative, with 100 volts supply and frequencies of 50 and 80. Similar results were obtained in coal-gas. Apparatus was devised, in accordance with a suggestion by Fleming, to interrupt the arc for a definite period of time. Experiments were tried to determine how long the arc could remain extinguished without losing the power of restarting itself when the e. m. f. was again applied. Curves were shown for arcs with electrodes of solid and cored carbons in air. With cored carbons the time of interruption is greater than with solid, and both are much greater than that for the copper-carbon arc. In hydrogen the copper-carbon arc could not be made to restart itself, if the e. m. f. was removed for more than 0.04 of a second, and for this arc the minimum interruption possibly is far shorter than for any carbon arc in air.—Lond. *Elec.*, July 5; *Phil. Mag.*, July.

Power.

Electric Power on Docks.—W. W. SQUIRE.—A paper read before the Engineering Conference of the (British) Institution of Civil Engineering on electric power for dock equipment, including the relative advantages of electric and hydraulic appliances. The author says that the tendency towards the use of electric appliances is decidedly on the increase and the advantages are such as to indicate still further development with increased experience.—Lond. *Elec. Eng'ing,* June 27.

Water Power Practice.—H. VON SCHON.—The concluding part of his serial on hydroelectric power versus steam for industrial plants. The author describes how to carry on systematically the engineering study of a water power project.—*Eng'ing Mag.*, July.

Electric Power in Steel Works.—J. B. VAN BRUSSEL.—A fully illustrated description of the use of gas and electric power in steel works in Continental Europe.—*Eng'ing Mag.*, July.

Gas Producers.—R. E. MATHOT.—An illustrated article summing up the general principles in the construction of modern gas producers.—*Eng'ing Mag.*, July.

Efficiency in Fuel Burning Under Steam Boilers.—W. D. ENNIS.—The second article in his serial. In the present installment the author deals with the measurement, regulation and control of furnace draft.—*Engineering Magazine*, July.

Traction.

Electric Traction on Railways.—P. DAWSON.—A second article on this subject in which he gives some financial considerations in connection with electric railways. The gist of the paper is summed up as follows: After referring to the character of an electric railway load on the generating station, the author discusses two main causes which conduce to electrification of existing railways, viz., (1) reduction in working expenses and (2) the desire for the better utilization of existing facilities. A steam locomotive in suburban work consumes fuel for about 76 per cent of its life, but does useful work only during about 28 per cent. Detailed figures are given for

the running costs of steam locomotives. Another basis of comparison is by weight and carrying capacity, which often apparently tells in favor of steam owing to the internal arrangement of coaches adopted for electrical working. Running costs are given for a number of railways, including the Mersey Railway, which is a good example for comparative purposes. Finally, the general results obtainable are discussed and illustrated by examples taken from the London, Brighton & South Coast Railway.—Lond. *Elec.*, June 21.

Installations, Systems and Appliances.

Condensers for Lightning Arresters.—A note on the application of the Moscicki condenser which is made of a glass tube with thick necks and has a chemical deposit of silver inside and out, over which is a thicker layer of copper. Such

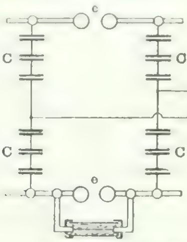


FIG. 3.—ARRANGEMENT OF CONDENSERS.

condensers are used in lightning arresters as follows: By the use of condensers it is possible to protect circuits simultaneously against induced high-frequency currents, against static charges and against excessive voltages produced by the sudden variations of the load on the machines and by the working of the switches. The principle of the working of these lightning arresters is based upon the fact that the flow through a condenser is proportional not only to the difference of potential between the two plates, but also to the frequency of the current. Consider a battery of condensers through which a current of 0.1 ampere passes to earth under the influence of the normal voltage of the line, and assuming that the frequency of the line current is 50, a current of 1000 amperes will be sent through the same battery, if the frequency of the line current is 500,000, without the voltage being any higher. Atmospheric discharges have frequencies of this kind, and the flow to earth can be enormous without the pressure in the line exceeding the normal. By arranging the in-

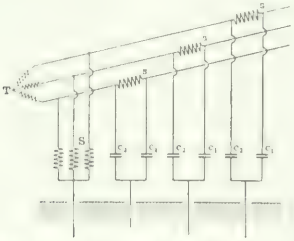


FIG. 4.—ARRANGEMENT OF CONDENSERS.

stallation, as shown in Fig. 3, where *A* and *B* are feed wires coming from a high-pressure generator having a frequency of 50, *C*, *C*, condensers, *e* the balls of the air-gap, it is possible to regulate the capacities so as to obtain in the circuit formed by the four condensers and the two air-gaps resonance currents of very high frequency, for instance 500,000 to 600,000. Now place as a shunt in one of the gaps, a resistance consisting of a german silver wire enclosed in a glass tube full of water. Let the resistance of this wire be 7 ohms. If the circuit is caused to resonate, sparks will be produced between the balls of the gap when the balls are placed at such a distance apart that the arc corresponds to an e. m. f. of 14,000 volts. Since this figure also represents the voltage at the terminals of the resistance, it follows that for a moment a maximum current of about 2000 amperes is produced in the resistance. This maximum exists, however, only during an exceedingly short time. The cases in which it is impossible to find on the apparatus of the circuit (generators or transformers) a sufficient number of neutral points for completely protecting it are very rare. In such cases the method shown in Fig. 4 is adopted, which consists of inserting a choking coil branched directly between the conductors of the circuit. The working will be the same but the apparatus will be more expensive.

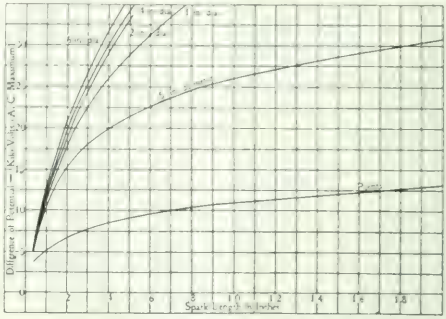


FIG. 5.—DISRUPTIVE VOLTAGES.

Condensers must be installed at each entrance to a station, but one choking coil will be sufficient to protect a circuit with a radius of from 30 km to 35 km against the static charges. —Lond. *Elec.*, June 21

Electrophysics and Magnetism.

Dielectrics.—A. P. M. FLEMING.—An article on the physical characteristics of dielectrics. The author first gives an outline of the ionic theory of electric conduction, and discusses the conduction of electricity through gases. The disruptive voltage depends to some extent on the distribution of the field which is determined by the shape of the electrodes. Since the formation and the velocity of the ions depend largely on the intensity of the field, the conductivity will increase and the voltage required for disruption be reduced as the radius of curvature of the electrodes is reduced. The relation between disruptive voltage and sparking distance for various shaped electrodes is shown by the curves in Fig. 5. Within wide limits the disruptive voltage varies directly as the pressure of

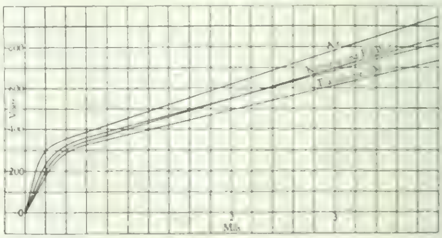


FIG. 6.—CONDUCTION OF LIQUIDS.

the gas. When, however, this is reduced to a "critical" value of the order of a small fraction of an atmosphere, the disruptive voltage increases as the pressure is diminished. This is due to the fact that sufficient ions cannot be produced from the small quantity of gas available, and disruption does not take place until the intensity of field is raised high enough for the necessary quantity of ions to be liberated from the electrode surfaces. When the spark gap is only of the order of a few mils, the disruptive voltage is independent of the pressure, but it varies with the metal used for the electrodes, and the ions supporting the conduction appear to be derived from them. The author then passes over to a discussion of the conduction of liquids and gives in Fig. 6 curves for the dis-

ruptive voltages for very short spark lengths in gaseous and liquid dielectrics, the electrodes being a plate 2 ins. in diameter and a sphere 1 in. in diameter. Finally, the conduction through solid dielectrics is discussed and the effect of temperature is shown in Fig. 7, which indicates a decrease in the resistance as the temperature increases up to about 80 degs. C. The upward bend at higher temperatures is due partly to the moisture being dried out and partly to a change in the nature of the

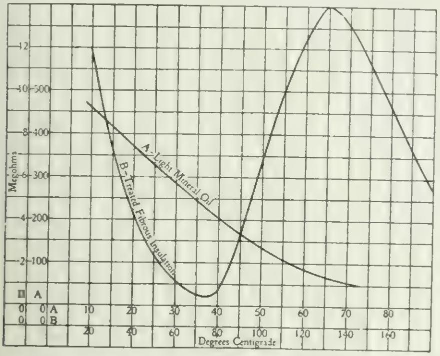


FIG. 7.—EFFECT OF TEMPERATURE ON SOLID DIELECTRICS.

material. The ultimate downward bend occurs when the material has become carbonized, and at that temperature the material is a partial conductor. Excepting when the pressure is instantaneously applied, the disruptive voltage does not vary directly as the thickness. This is indicated by the curves, in Fig. 8. (*A* electrodes, 1 in. sphere, *B* electrodes 1 in. flat plates.) The exact shape of the curve will vary according to the ventilation of the material, the cooling effect of the electrodes, the

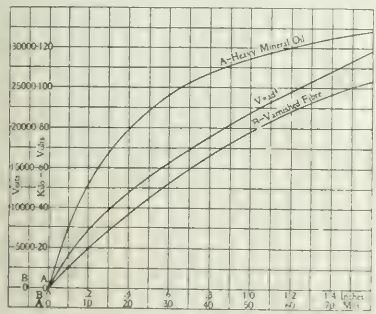


FIG. 8.—DISRUPTIVE VOLTAGES.

external temperature and the intensity of the field, which, neglecting the effect of surface discharge, will be determined by the shape of the electrodes and the thickness of the dielectrics. The law, $V = a\, d^{2/3}$, where a is a constant depending on the dielectric and d its thickness, has been suggested as giving approximately the relation between disruptive voltage and dielectric thickness.—*Elec. Jour.*, July.

Superposition of Mechanical Vibrations and Electric Oscillations upon Magnetization.—JAMES RUSSELL.—An illustrated paper on the superposition of mechanical vibrations (electric oscillations) upon magnetization and conversely in iron, steel and nickel. Vibrations may be superposed upon a constant field, or change of field may be superposed upon permanently acting vibrations. Under the former conditions, vibrations lessen those differences of magnetization to which hysteresis without vibrations has already given rise. Under the latest conditions, hysteresis loss, for instance, is increased or decreased as the fields are low or high; and in quenched nickel vibrations increase residual magnetism, when the field producing the same induction with and without vibrations is in both cases withdrawn. Such results cannot be concisely stated in terms of magnetic hysteresis, but they are subject to this condition—that vibrations increase the differential permeability in low fields, and diminish it in high fields. The effects of electric oscillations upon magnetization, when superposed under both of the above conditions, are essentially the same as those produced by purely mechanical vibrations.—Lond. *Elec.*, July 5.

Stress and Magnetization.—K. HONDA AND T. TERADA.—A very long account of experiments in which the authors first investigated the change of magnetization by applying successive stress under constant fields and further investigated the magnetization by applying the magnetizing field under different constant stresses, wherefrom they deduced indirectly the change of magnetization by stresses.—*Phil. Mag.*, July.

Inductance of Straight Wires.—K. W. WAGNER.—An article on the definition of the self-inductance of a straight wire. If an attempt is made to calculate the magnetic flux produced by a straight wire of definite length according to the Biot-Savart differential law, an infinitely large value is obtained because the application of that law to circuits which are not closed is not proper. Therefore, inductances can be defined only for loops (closed circuits) if the definition is intended to be generally valid.—*Elek. Zeit.*, July 4.

Dielectric Constant of Ice.—F. BEAULARD.—An account of measurements of the dielectric constant of, first, ice; second, mixture of water and ice; and, third, melted ice. The results are as follows:

Ice from pure water	K =	1.455
Mixture of ice and water	K =	1.987
"		2.280
"		2.477
"		2.586
Water (near 0 deg.)	K =	3.072

The dielectric constant of ice is approximately of the magnitude of the square of the refractive index, according to Maxwell's law.—*Comptes Rendus*, April 29; Lond. *Elec.*, June 21.

Magnetic Rotation.—R. W. WOOD.—An account of an experimental investigation of the magnetic rotation of sodium vapor at the D lines.—*Phil. Mag.*, July.

Radioactivity.—G. A. SCHOTT.—A note on the explanation of the radioactivity of radium. The theories of radioactivity may be conveniently divided into two classes, first, the theories which assume the positive charge of the atom to be at rest, while the negative charges are also at rest (theories of Lord Kelvin), or are in motion (theories of Nagaoka and of J. J. Thomson); second, theories which assume both the positive and the negative charges to be in motion with high velocities. Theories of the first class ascribe the energy of alpha and beta particles to potential energy stored in the atom, at any rate for the greater part; those of the second class attribute a considerable portion of it to kinetic energy existing as such in the atom. In the present note the author emphasizes that these two classes of theories lead to essentially different conclusions as to the proportion in which the energy emitted by radium is distributed between alpha and beta particles so that they can be subjected to the test of experiment. As far as experimental evidence is available it is in favor of the second class of the above theories. This brings up the problem of constructing a system of positive and negative charges, both of which are in rapid orbital motion, and which shall be sufficiently stable and permanent to exist for long periods, and yet capable, as it were, of occasional lapses, from stability, producing a sudden explosion with expulsion of positive and negative charges.—*Phil. Mag.*, July.

Radioactivity.—An account of the following papers presented at the recent meeting of the German Bunsen Society concerning radioactivity and the hypothesis of atomic disintegration: Voller spoke on radioactivity; W. Marckwald on the chemical behavior of radioactive substances; G. Meyer on the formation of helium from radioactive substances; F. von Lerch on the nature of radioactive radiation; O. Hahn on the hypothesis of atomic disintegration; M. Levin on some consequences of the hypothesis of atomic disintegration; F. Heinrich on the radio-

activity of air and of pure water.—*Zeit. f. Elektrochemie*, July 5.

Radiation.—An account of an investigation of the secondary radiation from a plate exposed to the rays from radium.—*Phil. Mag.*, July.

Alpha Rays.—E. Meyer.—A paper on the absorption of alpha rays by metals. He maintains the results of his former paper. It is not necessary to assume a diffuse defraction of the rays in metals for the explanation of the absorption of the alpha rays in metals.—*Phys. Zeit.*, July 1.

Electronic Theory.—A. Schidlof.—A mathematical paper on the integration of the Lorenze-Poincaré potential equations of the electronic theory and a paper by G. A. Schotte on the foundation of the electronic theory.—*Phys. Zeit.*, July 1.

Canal Rays.—J. Stark.—A paper on the conditions for the photographic observation of the Doppler effect with canal rays. —*Phys. Zeit.*, June 15.

Electrochemistry and Batteries.

Ionization Theory.—W. Sutherland.—A highly theoretical paper proposing a modification of the electrolytic dissociation theory. In a previous paper the author had shown that the theory of the conductivity of electrolytic solution is complicated by the entry of the dielectric capacity of the solvent and of the ions. In the present paper he shows that the subject is still further complicated by the operation of a new type of viscosity, but that when the electrical and dynamical complications are taken into account there emerges an ideally simple result, namely, that the ionization of all ordinary electrolytic solutions, gaseous or other, is complete at all concentrations. The fraction which is currently called the degree of ionization (or of electrolytic dissociation) really originates in a resistance which the ions offer to one another's motion because of their forming with the solvent through their electric action on one another a medium which offers a special vicous resistance to the motion of each individual ion. This is one new type of viscosity of electric origin. But the charge of each ion causes electric induction through the surrounding solution, and with this is associated a second new type of viscosity, also of electric origin. These, with the ordinary viscosity of the solution give three resistances to the motion of an ion. When the sum of these is equated to the electric driving force, a formula is obtained for the molecular specific conductivity which has been tested by the author with experimental results of very wide range, especially those of Walden for non-aqueous solutions, those of Kohlrausch for aqueous solutions at ordinary temperatures, and those of Noyes and Coolidge for aqueous solutions at high temperatures. The author thinks that the current theory of solutions will need to be entirely rewritten. The idea of partial ionization, while it can give a formal qualitative account of the chief phenomena of solutions, being dynamically wrong, cannot furnish a correct quantitative correlation of their properties. The theories of the raising of the boiling-point and the lowering of the freezing-point of solutions will have to be put upon a sound molecular dynamical basis.—*Phil. Mag.*, July.

Units, Measurements and Instruments.

Demonstration of the Angle of Phase Difference.—H. Starke. —A description of a stroboscopic method for demonstrating directly in the lecture room the angle of phase difference between two alternating currents of the same frequency. The principle is as follows: On the axle of a small synchronous motor supplied with alternating current a circular black disk of cardboard of a diameter of 15 cm to 20 cm is mounted, on which a thin strip of white paper in the direction of a radius is pasted. When continuously lighted, the rotating disk appears uniformly white. If, however, the lighting is done by intermittent flashes of light which occur with the frequency of the alternating current so that a new flash appears every time after the completion of a full period, the white radial strip is seen to rest invariably at one and the same place. These intermittent flashes of light may be easily produced by the discharge sparks of a Leyden jar, which is connected to an induction coil operated by the same alternating current. Since the sparks occur after each half period, two radii are observed opposite to each other in the circle so that one white diameter appears on the black disk. According to the phase of the spark, this diameter has a different position, so that this phenomenon may be easily used to illustrate phase differences by showing directly the angle of phase difference.—*Phys. Zeit.*, June 15.

Motion of Flames Produced by Electricity.—K. Marbe.—A description of a number of experiments, the first of which is as follows: A battery of 124 volts is connected to a circuit which contains an air-gap of 5 mm between two horizontal electrodes (brass or carbon electrodes). Within the air-gap an acetylene flame burns perpendicular to the electrode plane; it may touch the electrodes, although this is not necessary. When the circuit is closed the flame shows a visible displacement towards the negative pole. When the circuit is broken again, the flame comes back into its original position. This phenomenon may be graphically represented by passing a paper strip over the flame, the brass or carbon electrodes being placed at right angles to the direction of the motion of the paper. If instead of the closing and breaking of a direct current, an alternating current is employed, a continuous motion of the flame is visible on the paper strip, one motion corresponding to each alternation, so that the frequency may be easily determined by this method.—*Phys. Zeit.*, June 15.

Conductivity Bridge.—R. Appleyard.—An abstract of a (British) Physical Society paper. The author exhibited a direct-reading conductivity bridge for testing rods of steel or other material, where there is considerable range of conductivity between successive specimens and where it is necssary to eliminate the resistance of end contacts. The instrument is provided with two scales and with corresponding sliders. By setting one of the sliders with reference to its scale, compensation is made for any small difference of diameter or of mass between the standard rod and a test rod. The second slider is then adjusted to the position of the balance, and the conductivity is read off the second scale as a percentage, according to Matthiessen's standard, or in terms of any desired unit. All arithmetic is avoided and the results are obtained at the rate of two or three a minute. The author gave the equation for the calibration of the scales, and showed that the errors involved by the use of the compensation scales were for practical purposes negligible.—Lond. *Elec.*, July 5.

Meters.—An announcement of the German Reichsanstalt concerning direct-current motor-meters of the Bergmann Electric Company, which have been admitted for testing and calibration.—*Elek. Zeit.*, July 4.

Telegraphy, Telephony and Signals.

Continuous Electric Oscillations by Means of the Electric Arc.—J. A. Fleming.—An abstract of a (British) Physical Society paper on the Poulsen arc as a means of obtaining continuous electric oscillations. The author showed and described an apparatus for forming an electric arc in an atmosphere of coal-gas between a carbon rod kept in slow rotation and a cooled copper anode, the arc being formed in a magnetic field of 600 to 1000 c. g. s. units. The arc was supplied with a continuous current at a pressure of from 400 to 500 volts. A condenser of 0.003 mfd capacity in series with an inductance of 300,000 cm was shunted across the arc, and experiments shown prove the existence of high-frequency oscillations in the condenser circuit. A long resonance helix of insulated wire was then joined to the condenser circuit, and when tuned to it created a powerful high-frequency field round it, in which vacuum tubes glowed brilliantly. By vibrating or rotating a Neon vacuum tube of spectrum type near the helix and showing that the band or disk of light was cut up by dark spaces, Fleming supported the contention that the oscillations so produced are not absolutely uninterrupted, but cut up into groups. Another experiment was shown to confirm this. The oscillations produced by the arc in one circuit were caused to create secondary oscillations in another circuit in which was a condenser shunted by one of Fleming's oscillation valves, and a telephone. The valve rectifies the secondary oscillations, and if they were absolutely continuous the telephone would be

traversed by an uninterrupted direct current.[*] But, as a fact, a discontinuous sound is heard in the telephone which can arise if the primary oscillations come in batches or groups. Fleming then gave some figures showing the kind of values obtained for the efficiency of transformation of continuous to oscillatory current by the arc, and compared them with similar measurements for the spark method. He concluded with some discussion of the modus operandi of the metal-carbon arc in the production of oscillations in a shunt circuit containing capacity and inductance. In the first case the curve was much steeper than in the second. This implied that the same amount of energy could be conveyed to the oscillatory circuit by means of a condenser of smaller capacity and therefore give higher frequency. This was confirmed by the fact that the curve for small currents in the case of the carbon arc in air was steeper than for larger currents, and it was found that a Duddell carbon arc could give high-frequency oscillations when actuated with small currents. He thought that there was still much work to be done before the whole of the phenomena of the oscillatory arc would be understood. In the discussion, W. Duddell pointed out that it is possible to obtain continuous oscillations with the musical arc using high frequencies.—Lond. *Elec.*, July 5.

Submarine Loaded Cable.—Ebeling.—A long and fully illustrated paper giving details of the telephone cable loaded with Pupin induction coils and laid in the Bodensea. The chief result of the work is the proof that lead cables may be laid successfully in depths of several hundred meters, and that the use of Pupin induction coils is possible with submarine cables. In the discussion which followed, Breisig spoke well of the method of Kramp of increasing the self-induction in a continuous manner. Raps pointed out that the Pupin coils are relatively inexpensive, and could not increase very much the total cost while, on account if its smaller dimensions, the Pupin cable is much cheaper than any other submarine telephone cable. The great expense incurred in the laying of the cable in the present case was due to the fact that the cable had to be laid at greater depths than usual.—*Elek. Zeit.*, July 4.

Miscellaneous.

World's Fair.—An editorial discussion of the question whether a World's Fair in Berlin or Frankfort or in some other German city would be a benefit to the German electrical industry. This is answered strongly in the negative. It is said that the expense would be very high, while no corresponding returns could be expected. A young industry has an interest in exhibiting its products so as to attract customers, but the German electric industry is said now to be so well established that it does not need to attract customers by exhibitions. The industries of other countries are said to compete with the German electrical industry not with respect to quality, but by furnishing cheaply and more quickly standard machines. "No world's fair could do anything against that and experience must gradually convince the consumer that the better product is in the end the cheaper one." It is finally said that the arrangement of a world's fair in Germany would certainly offer the cause for a strike of the socialist workingmen.—*Elek. Zeit.*, June 20.

British Municipal Electrical Association.—From the annual report for the year ending June, 1907, it appears that the membership of the association now stands at 388, made up of 152 committee members, 166 chief electrical engineers (members), two honorary members and 68 assistants. The new president is H. Talbot, of Nottingham.—Lond. *Elec. Eng'ing.*, July 4.

Raw Material Supply.—P. H. Knight and C. E. Skinner.—A paper read before the American Society for Testing Materials on the system of purchasing the raw materials for a large manufacturing company (in this case the Westinghouse Company). The list of raw materials comprises in this case not less than 850 items.—*Elec. Journal*, July.

L'Industrie Electrique.—This French journal of the late E. Hospitalier is now edited by H. Armagnat.

BOOK REVIEWS.

Lichtstrahlung und Beleuchtung. By Paul Hogner. Braunschweig: Friedr. Vieweg & Sohn. 66 pages, illustrated. Price, 3.50 marks.

The book is a brief treatise on illumination of surfaces, prepared for the use of illuminating engineers. It contains many useful numerical tables and illumination-constants. It is particularly directed to the use of electric lighting. The treatment is mathematical. The standard of luminous intensity is the hefner and the unit of illumination selected is the lux, or hefner-meter.

La Telegraphie Sans Fils. Par R. De Valbreuze. Paris: Eclairage Electrique. 169 pages, 129 illustrations.

This is another of the many works on wireless telegraphy written for the general reader. The 169 pages contain much clear exposition and many instructive diagrams, but are nowhere ornamented with mathematical symbols of any kind. Any one acquainted with the elements of electricity can derive much profit from the reading of this *brochure*.

Die Verbrennungskraftmaschinen in der Praxis. By H. Neumann. Hannover: Dr. Max Janecke. 320 pages, 138 illustrations. Price, 4 marks.

The author has collected into this little volume a mass of practical information concerning different types and constructions of internal combustion engines. Little or no attention is given to their thermodynamic theory, but in place thereof is a large number of small machine drawings showing the actual arrangement of the parts. The first section of the book is a short introduction, partly historical. The second section divides engines into classes. The third deals with the assembling and general construction of engines. The fourth treats of fuels. The fifth describes the installing of engines. The sixth gives an account of various modern types of engines. The seventh discusses the practical operation of such engines and the special difficulties they may present. The eighth concerns the testing of engines and the ninth the costs of operation and installation. The book will be of value to all students of internal combustion engines who are interested in German practice.

Meter Testing.

By Otto A. Knopp.

The editorial on "Evolution in Meter Testing" which appeared in the Electrical World of June 8 has led the writer to think that an account of a method of meter testing which has been developed in Oakland, Cal., might be of interest to readers.

The Oakland Gas Light & Heat Company formerly used the well-known method of using an indicating wattmeter and a stopwatch which was discarded and a specially designed master-meter for 100-500 volts and 5-100 amperes, both direct and alternating, was introduced. The instrument requires but one man for its operation and has been used to good advantage. The use of the watt-hour meter or master-meter eliminates two difficulties. First, the difficulty of averaging or integrating the reading on an indicating meter over a certain observation time. Second, the difficulty of getting the accurate time of observation with a stopwatch, which is apt to have considerable zero and scale error.

The principle of the new test method is based upon the old indicating method, but to a predetermined load is applied to the meter of a value to cause a correct meter to complete one, two or three revolutions in 1/100 of one hour. A stopwatch having a hand which makes a complete revolution in 1/100 of an hour is provided. If the meter is correct, the watch will just complete one revolution, or return to the starting point or zero point, thus cutting out all zero errors and scale errors. If the meter is not correct, the stopwatch will give the percent-

age correction factor of the meter, since the face of thç watch [illegible]

As each revolution of a meter represents a certain number of watt-hours, called the watt-haur calibrating constant, usually written on the disk of the meter, we obtain the load on any meter by dividing the time in millihours for one revolution into the calibrating constant of the meter. Thus we get for each meter the load in kilowatts, which causes it, if correct, to make one revolution in ten millihours, by dividing the watt-hour calibrating constant K by ten.

For testing an average residence meter, for instance, a 10-100 induction meter, with a calibrating constant of .6 watt-hours, we apply $100 \times .6$ watts or 60 watts. After counting one revolution with the millihour stopwatch, the watch will give the correction factor; that is, if the meter was correct, the watch will have returned to its starting point or show one revolution or the correction factor one. If the meter is slow, the watch will show perhaps 1.05 revolutions, which means that the correction factor is 1.05. If fast, the watch will show less than one, perhaps .96 revolutions, which means a correction factor of .96.

For a heavier load test, we apply, for instance, 10×60 watts and take time for 10 revolutions. Since each 60 watts gives us one revolution, 600 watts will give us 10 revolutions for one revolution on the watch.

The millihour stopwatch thus shows in each case the correction factor. All calculations are avoided by this method, as has been shown, except a multiplication with 100. Load chasing is done away with as the load is applied to the meter with the testing instrument. Integrating or averaging of the load is eliminated as the load is kept steady under fluctuating voltage by means of a regulating resistance. Stopwatch errors are cut out in the final adjustment, as the watch is caused to make complete revolutions only. Any dollar watch will make complete revolutions with an accuracy which is far in excess of the accuracy of the best standard indicating wattmeter.

There are few chances for spoiling the instrument and burning it out, as it is a watt consuming instrument and has the full potential across its terminals, which is not the case with a wattmeter, or the watt-hour meter. In practice this quality proved to be of immense value, as instruments handled by new and inexperienced men have never been burnt out, as has frequently happened with the old instruments, even with experienced men.

The weight of this new outfit is very small. For instance, a portable outfit for loads from 25-600 watts and 110 and 220 volts, for testing residence and other small meters, primary meters, secondary meters with current transformers, etc., weighs only about 7 lbs. This is a noteworthy improvement when compared with the weight of a portable master-meter which is approximately 12 lbs. to 15 lbs., and with an additional loading device often up to 25 lbs.

Electric Ventilating Fans.

At sea where the breezes blow free, the old-time ventilator funnel is giving way to the compact and adaptable fan blower. A wonderfully complete installation was made on the recently completed United States battleship "New Hampshire," which is equipped with no less than 25 electrically-driven Sturtevant fans of varied types and sizes. These are scattered all over the ship, being applied for boiler and engine room ventilation, for renewing the air in cabins, mess rooms and holds; in fact, they have been placed with the utmost ease just where they were wanted. The small fans with cast-iron casings are driven by bi-polar motors, while the larger fans of steel-plate construction have four-pole or eight-pole motors. All of the fans are so made that [illegible] rection by slacking the nuts and turning the casings. For fire room service the motors are of the enclosed type to prevent damage from dust in the air; for general ventilation they are of the semi-enclosed [illegible] type.

National Electrical Contractors' Convention.

The exercises connected with the meeting of the National Electrical Contractors' Association in New York City last week were continued along the lines of the programme given in these pages, and the convention closed very successfully. The intense heat of the three days did not hinder the work or pleasure in any way, and every event was taken up and disposed of with the utmost vim and enthusiasm. One great hit with the "vaudeville extravaganza" given at the Waldorf banquet on Wednesday night, the liberetto being from the witty and facile pen of "Gilpin, V. C.," otherwise the well-known supply agent, etc., of that name. The time and scene of the play were "dated ahead" to 1930, but the personages and dialogue were vital of this present year of grace.

In "Not Yet, But Soon," some of the leading figures of the electrical world were satirized. James Armstrong Tucker, played by George H. Watson, showed James R. Strong, the New York contractor, the association president, who was not content with a beggarly $2,000,000 profit. The electrical engineer came to him pleading for a bid. To reach his lowest bid Tucker used his calculating electrical machine. But a labor leader hiding behind the machine had fouled its action, with the result that the bid was put in at $91,000,000, while Miss Richardson Syracuse—a reference to Miss Rose Richardson, of Syracuse, the only woman prominently in the electrical contracting business—who had bid $81,000,000, got the contract. However, she had met her rival, they had fallen in love, and as a part of her dower, Miss Syracuse withdrew the winning bid, the works of the two were consolidated, and the contract was finished in union. Almost every line was a witty joke, gag or kindly "knock," and the audience was kept in a quiver of perspiring amusement.

Another notable feature was the visit to the telharmonium plant, on Thursday morning, after a brief explanation by Mr. O. T. Crosby, who, as showing the imminence of the new art, stated that one of the contractors in the association in doing work on a new large hotel on Manhattan Island, had had several thousand dollars added to his contract by the wiring for the distribution in the building of telharmonic music from the central plant.

During the week, the attendance was large, running up into the hundreds. A number of manufacturers and supply houses were represented as noted below. The ELECTRICAL WORLD was represented by Messrs. J. M. Wakeman, G. W. Elliott and T. C. Martin.

THE AMERICAN CIRCULAR LOOM COMPANY was well represented through the efforts of Messrs. A. T. Clark and Oscar Hoppe, from Chelsea, as well as those of Mr. Alex Henderson, of New York, and Mr. M. King, of Chicago.

PASS & SEYMOUR, of Syracuse, were represented by Manager Brooks, assisted by W. B. Hall, their New York manager.

The veteran F. M. HAWKINS looked after the interests of the Crouse Hinds Company.

THE AMERICAN CONDUIT MANUFACTURING COMPANY of Pittsburg, had Thomas H. Bibber present speaking for the interests of its product.

MR. J. P. GILLETTE, of the Gillette-Vibber Company, of New London, was present to describe its new line of specialties. Mr. Gillette will shortly make an extended trip West.

PRESIDENT FULLMAN, of the Steel City Electric Company, Pittsburg, was in attendance.

THE D. & W. FUSE COMPANY, of Providence, sent W. S. Sisson to speak for its line of fuses and cutouts.

MESSRS. GARLAND AND [illegible] came from Pittsburg in the interests of the Safety Armorite Conduit Company.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, of New York, was looked after by Mr. J. B. Olson, the sales manager.

R. B. COREY COMPANY was represented by Mr. Harry C. Adams.

MR. FRANK [illegible], of the New York office, was much in evidence for John A. Roebling's Sons Company.

Mr. S. B. Condit, Jr., spoke for the Condit Electric Manufacturing Company, of Boston.

Mr. Harry Waterman was in earnest behalf of the Sterling Conduit.

The Deveau Telephone Manufacturing Company had Mr. A. S. Deveau always on the scene.

The Hart Manufacturing Company, of Hartford, had Messrs. Taylor and Crockett in attendance.

Messrs. V. C. Gilpin and Russell Dart represented the Alphaduct Manufacturing Company. Mr. Gilpin came in for a great amount of praise and congratulation on the success of the humorous sketch presented at the banquet, he being not only the author, but the efficient stage manager.

The Western Electric Company had in attendance Mr. E. S. Keefer, who was on several committees. Messrs. Rockafellow, Oberlander and Edwards assisted him in the convention.

The National Metal Molding Company, of Pittsburg, had its usual array of talent on the scene. Messrs. C. E. Corrigan, H. B. Kirkland and Charles F. Boynton were kept busy every minute looking after their friends and patrons.

Mr. J. A. Vaughan came on from Philadelphia to look after the interests and friends of H. C. Roberts Electric Supply Company.

The New York Insulated Wire Company had Messrs. Hoover and Brewster in attendance.

Mr. H. S. Salt was on hand in behalf of the Dale Company.

Mr. John H. Dale, a familiar figure at all such conventions, was absent, being on a trip to the Pacific Coast.

Mr. Frank Stout was on hand indulging in discursive eloquence as to Frink reflectors.

The Safety Insulated Wire & Cable Company sent Mr. A. P. Eckert.

Mr. E. C. Tibbals was present telling about the excellence of his make of switchboards and panel boards.

The Manhattan Electrical Supply Company sent Convention Specialist McDowell to look out for its interests.

The Chase-Shawmut Company had W. S. Brown, its New York representative, at the meetings.

The interests of the Wirt Manufacturing Company, of Burrage, Mass., makers of porcelain, were ably looked after by a representative of the Steers Supply Company, 88 Maiden Lane, New York, manufacturers' agent.

Speed Regulation of Diesel Engine.

Governing of gas and gasoline engines is effected in a variety of ways, which may be grouped under two headings: the "hit and miss" method and the variable impulse system. A more accurate name for the former would be "constant impulse of variable period," which could be contrasted with "variable impulse of regular period," giving a very clear line of differentiation.

For regulation under variable load and particularly under light load, the first method gives the most economical results of all the usually employed systems of governing, but the mechanical defects introduced by it are held by some to detract from the theoretical advantages of such regulation. The principal drawback urged is the necessity for unusually heavy flywheels. After several successive "misses" there is danger of a powerful explosion action on the very slowly moving parts, which, owing to the inertia of the heavy flywheel, may produce a breakage.

The system of "variable impulse or regular period" divides itself into the method of constant quality with variable quantity of mixture, and that of constant quantity but variable quality. This system requires usually a very heavy governor, and necessitates increased compression in order to produce explosion, because the total quantity of air where admitted is frequently so small that compression falls below the ignition point.

For the same reason the method of constant quantity and variable quality is claimed to be defective. Moreover, the effect of changed fuel supply makes itself felt later, and the change cannot be controlled with sufficient exactness. When there is too much hydrocarbon in proportion to the air, combustion will be incomplete, causing unburned or incompletely consumed fuel to be exhausted, that is, thrown away, and clogging the cylinder walls, piston head, valves and ports with partially burnt carbon as soot and greasy grime. Such impurities, if not quickly scavenged out, are apt to produce preignition and back-firing by becoming incandescent. If the explosive mixture is too much diluted, it will not explode at all.

It is claimed that in striking contrast with such unreliable and uneconomical regulation is the method of governing in use on the Diesel crude-oil engine. A small flywheel governor driven by the main shaft, controls a valve in a bye-pass pipe connected to the fuel pump, which is so arranged as to raise its maximum quantity of the fuel oil at each stroke. The quantity injected into the cylinder depends on whether the governor permits the oil to flow to the injector valve by closing the bye-pass, or whether all or a part of it is returned to the supply tank through the more or less opened bye-pass. There can never be an excess of fuel injected into the cylinder, because the Diesel principle provides for a normal large excess of air in the cylinder. There cannot be a failure to explode from insufficient hydrocarbon admixture, because there are no explosions. Whatever oil is sprayed into the cylinder is consumed as fast as it enters, the air in the cylinder being raised by compression to a temperature far beyond the ignition point of mineral oils. Thus waste by incomplete combustion is simply precluded, no matter what the degree of governing. Be the quantity great or small, there can be no variation of thermal efficiency because every particle of fuel is consumed, as is evidenced by absolutely clean cylinder walls after months of running. It is stated that a white handkerchief held in front of the Diesel engine exhaust is not colored or spotted.

In mechanical detail and in thermal dynamic effect, the Diesel governor works just as positively and as irrespective of conditions within the cylinder, as does the steam engine governor; hence its regulation is just about as close, as economical and as reliable. This engine is claimed to produce in practice almost precisely that degree of efficiency which Herr Diesel had from theoretical considerations judged to be the highest attainable, and which he had set before himself as a goal even before the first model was made.

Induction Motors in the Making of Matches.

The Diamond Match Company has installed at its Oshkosh, Wis., plant a complete alternating-current generating and induction motor equipment, all of Allis-Chalmers manufacture. The equipment consists of two 300-kw generators direct-connected to Reliance engines, a 110-kw generator direct-connected to a high-speed engine, a five-panel switchboard, 24 5-hp variable-speed induction motors and a number of constant speed machines for distribution throughout the plant, all of the apparatus being three-phase, 60 cycles and 440 volts.

The unusual feature in connection with this installation is the fact that the match machines, which have always heretofore been group-driven, will in this new plant each be driven by a 5-hp, 1200 r. p. m. induction motor, 24 machines comprising the initial installation. It was shown by careful tests that individual drive in this plant will decrease the power consumption at least one horse-power per machine by eliminating the use of a mechanical speed changer as well as the long countershafts joining the groups of machines in the older installations. The tests showed that .65 ehp is required to drive the speed changer alone; the machine proper consumes 2.5, 2.7 and 3.4 ehp at speeds corresponding to 160, 194 and 220 strokes of the cutters. Five-hp motors were, therefore, chosen as being of the proper size for the work. Speed reduction becomes necessary only during damp weather in order to allow the matches a longer interval in which to dry.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The favorable weather conditions, improved crop prospects, and the final appearance of fer[illegible] greatly stimulated retail trade which is turning out better than was expected a month ago. Encouraging reports are received from leading commercial centers, the volume of business being exceptionally heavy for the season, and stocks are depleted by the usual clearance sales. Buyers are numerous in the large cities, preparing for an active fall trade, now that the agricultural outlook is less uncertain. Foreign commerce in June eclipsed all previous records for that month, both imports and exports rising $12,000,000 above June, 1906, which in turn exceeded all earlier years. For the last week at the port of New York, exports gained $4,420,799 and imports increased $[illegible],879,[illegible] as compared with a year ago. Railway earnings thus far reported for July show gains of 9.8 per cent over last year's figures. Collections are reported good, and crop developments have been quite generally favorable. With the reports that are coming in from the wheat threshing, the merchants of the Middle West are counting on a prosperous fall business, and a larger interior trade than last year, provided the corn is as good as it now seems likely to be. Iron and steel are quieter with prices tending to ease. The demand for structural material is fair; steel bars are in good demand and specifications are heavy. Business in steel rails and track material is rather quiet, and plates are being delivered more promptly. Steel manufacturers report a satisfactory volume of business coming in, taking into consideration the season, and the large volume of orders already on the books. The percentage of new business to production is somewhat lower than at the same time last year, though it is doubtful if the actual volume is much less. It is not expected, however, that the record of the last quarter, which established new high figures for earnings, will be equalled by the current quarter, or, indeed, by any like period for some time to come. Copper has again receded in price, but new business has not developed to any extent, and lower prices are looked for. Stocks are said to be quite large. The closing quotations are: 21½ cents for lake; 20¾ cents for electrolytic, and 20[illegible] cents for cast copper. *Bradstreet's* reports 177 business failures during the week ending July 18, compared with 185 in the previous week and 188 in the corresponding week last year.

ENLARGING WIRE PLANT.—The occupation of five large new structures, besides the plant it already operates in Phillipsdale, is purposed by the Washburn Wire Compa[illegible] which will move its entire working force from Auburn to Phillipsdale on Jan. 1, 1908, thus centralizing the efforts of the company and increasing the facilities for business. The new structures, which will cover an area of about 52,500 sq. ft., will cost considerably over $100,000. The new buildings will adjoin the present Phillipsdale plant on the banks of the Seekonk River and in close proximity to the plant of the American Electrical Works at Phillipsdale. Contracts for all but one of the five buildings to be erected have been awarded and work on the excavation for the foundations is already under way. The main building will be the wire mill, 164 ft. x 70 ft., to be constructed of brick and have a gravel roof supported by steel trusses. The machinery will be electrically driven by motors developing 500 horse-power. The rod mill will be a steel structure, with roof of corrugated iron and will be 180 ft. x 115 ft. in size. Adjoining the rod mill will be the power house, [illegible] be built of steel and brick. The power house will have two tandem compound engines capable of developing 2000 horse-power, which will be used principally to drive the rod mill machinery. It will also contain two generators of 150 kw. direct connected; one generator of 75 kw. direct connected, and one generator of 100 kw. belted. The boiler house will be 96 ft. x 50 ft. and will contain eight horizontal boilers capable of developing 2500 horse-power. It will be of steel construction. The plans for this building also include the [illegible] 7-ft. flue. The annealing and cleaning rooms will be under the same roof, the building being 96 ft. x 84 ft., and will be constructed of brick.

WESTINGHOUSE ORDERS.—It is stated that the Westinghouse interests have secured a contract for the electrification of one of the largest British shipbuilding yards. The order calls for all the equipment necessary to electrically operate the Laing yards at Sunderland. A Mexican order has been allotted to the company by the Mexican Light & Power Company—the United States-Canadian syndicate headed by F. S. Pearson—which is expending millions of dollars in the development of electrical energy in the southern republic. Eight transformers, each having a capacity of 1000 kilowatts, are to be installed in Mexico City. The electrical energy is to be generated at Necaxa Falls, about 100 miles away, at a pressure of 60,000 volts. The energy is to be transmitted to several sub-stations surrounding the city, where the transformers will be installed. From these the power will be distributed over the city for running the street cars and lighting the city.

BALTIMORE PLANT.—According to President David E. Evans, the capacity of the plants of the Baltimore (Md.) Electric Company is to be increased 50 per cent, or from 9000 kilowatts to 12,000. The plant has already been enlarged since it was put in operation last summer, and the company is in a position to offer electricity to a maximum of 3000 horse-power in one unit if necessary. The company has the Baltimore rights to the Nernst lamp, and now has 14 men on the street after business. It has adopted the slogan "Brighter Baltimore," and with strong financial backing already provided for and increased facilities, the Baltimore Electric Company is said to be in a position to become a powerful factor in the electric light and power field.

ROTARY TYPE BLOWERS.—Among recent sales of high pressure rotary type blowers made by the B. F. Sturtevant Company, of Boston, Mass., are the following: F. A. McCarthy Brazing Company, Boston, Mass.; McGill University, Montreal, P. Q.; Vermont Snath Company, Springfield, Vt.; General Storekeeper, Navy Yard, Brooklyn, N. Y.; Dupaul, Young Optical Company, Southbridge, Mass.; St. Louis Car Company, St. Louis, Mo.; Montreal Light, Heat & Power Company, Montreal, P. Q.; Orange Iron Works, Orange, Texas, and Wile Power Gas Company, Boston, Mass.

POWER IN CALIFORNIA.—Plans are being made by the General Electric Power Company of California for the construction of a hydroelectric plant on the Mokelumne River in central California, where a fall of 1230 ft. will be utilized. It is estimated that 69,000 horse-power can be developed, whose energy will be transmitted to all towns and cities of central California, including San Francisco. Contracts for the construction of the power plant have been awarded to the firm of Walston H. Brown & Brothers, of New York, N. Y.

GOVERNMENT INCANDESCENT LAMP CONTRACT.—The Columbia Incandescent Lamp Company has been awarded a government contract for 270,000 incandescent lamps, to be supplied during the present fiscal year to the Treasury Department, Quartermaster's Department of the Army, Library of Congress and Public Printing Office.

MANUFACTURE OF MACHINERY IN JAPAN.—The Bank of France and Marine Bank of Belgium are at the head of a syndicate to supply $50,000,000 capital to extend the manufacturing industries of Japan. The syndicate is now making an investigation with a view to establishing works for the manufacture of machinery.

CONTRACT OPEN.—The Union Central Light & Ice Company, of Hubbard City, Tex., has franchises to supply Hubbard City and four neighboring towns with electricity, and has issued $25,000 in 6 per [illegible] which are offered at 85 to any engineer or construction company that will contract to build the plant.

PRICE OF PLATINUM.—It would appear that the price of platinum has again been advanced, after having gradually declined from $37 an ounce, which was the price quoted last March, to $25 an ounce, which prevailed until the recent advance of $1. It is now selling at $26 per ounce. A company has been incorporated in London, known as the Platinum Corporation, with a capital stock of $1,500,000, to develop concessions in the platinum-bearing districts of Russia, which for nearly a century has been the producer of nearly 90 per cent of the platinum supply of the world. The decrease in price, before the recent advance, was attributable to financial conditions in Europe. Platinum sold in 1892 for less than $10 an ounce. In two years the price had risen to $18.50, and in December of that year it was $19.50. In April, 1905, it brought $20.50. It continued to advance until in February, 1906, it sold for $25. Last September it was quoted at $34. During the winter the highest price of $37 and $38 was reached.

EXPORT TRADE FIGURES.—Foreign trade for the 12 months ended June 30, 1907, is expressed in these figures:

Total exports	$1,881,078,747
Total imports	1,434,401,092
Excess of exports	$446,677,655

This total trade is about $250,000,000 over that of 1906. There is, however, a decrease from 1906 of excess of imports amounting to $70,852,122. Explanation of this is found in an increase of $94,368,122 in imports free of duty. Most of these are raw materials for use in the manufactures and afford evidence of the growth of our manufacturing supremacy. The figures given are exclusive of the precious metals, movement of which thus resulted:

Gold, excess of imports	$63,086,500
Silver, excess of exports	13,820,283
Net excess of imports	$49,266,217

Financial Intelligence.

THIS WEEK IN WALL STREET.—The stock market was narrow, professional and governed by manipulative influences, activity being confined to a few leading stocks such as the Harriman and Hill issues or Amalgamated Copper. The rise in General Electric reflected the success of the bond offering to which the first subscriptions became due, and were paid to an extent that was said to be entirely satisfactory. Following the publication of the bank statement the market became very strong, but just before the close prices eased off fractionally as a result of traders' profit taking over the week end. Western Union on a few transactions gained nearly three points on account of the settlement of the strike. The traction stocks were weak and closed at declines. On the other hand, General Electric closed at 140 being ½ point below the highest quotation of the week, and a net gain of 4⅛ points. Western Union closed at 80½, a net gain of 2¾ points, and Westinghouse at 146½, the highest price for the week and an advance of 2½ points. Both the Mackay issues are higher, 3 points for the common and ¼ point for the preferred. The curb market reflected conditions on the Exchange and showed moderate gains. The closing quotations of July 23 are given in the table.

NEW YORK.

	July 16	July 23		July 16	July 23
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	135¾	139
Allis-Chalmers Co. pfd	28	25	Hudson River Tel.	—	—
Am. Dist. Tel.	[illegible]	—	Interborough Met com.	16¼	15½
American Locomotive	58	59	Interborough Met pfd	45	43
Amer. Locomotive pfd.	104	[illegible]	Mackay Cos.	67	—
American Tel & Cable	75	75	Mackay Cos pfd.	65⅞	—
American Tel & Tel	116	—	Marconi Tel	—	—
Brooklyn Rapid Transit	58	56	Metropolitan St Ry	—	—
Electric Boat	33	33	N. Y. & N. J. Tel.	—	—
Electric Boat pfd.	80	80	Western Union Tel	77½	79
Electric Vehicle	—	—	Westinghouse com	144½	[illegible]
Electric Vehicle pfd.	—	—	Westinghouse pfd	[illegible]	—

BOSTON.

	July 16	July 23		July 16	July 23
American Tel & Tel	107½	108	Mass Elec Ry pfd	—	57
Cumberland Telephone	—	—	Mexican Telephone	—	2
Edison Elec Illum	219	211	New England Telp	111	110
General Electric	—	—	Western Tel & Tel	—	—
Mass Elec Ry	17	16	West Tel & Tel pfd	70	—

PHILADELPHIA.

	July 16	July 23		July 16	July 23
American Railways	48½	48	Phila Electric	8½	[illegible]
Elec Co of America	9¼	9½	Phila Rapid Transit	23½	[illegible]
Elec Storage Battery	51	51	Phila Traction	—	94½
Elec Stor Battery pfd	—	—			

CHICAGO.

	July 16	July 23		July 16	July 23
Chicago City Ry	—	160	National Carbon	—	[illegible]
Chicago Edison	—	[illegible]	National Carbon pfd	—	[illegible]
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel Co	—	105	Union Traction pfd	—	—
Metropolitan Elec com	—	[illegible]			

WESTINGHOUSE REPORT.—The annual report of the Westinghouse Electric Manufacturing Company for 1906 shows earnings $33,026,240 for the year ended March 31, with net manufacturing profits of $4,179,575. The net income surplus was $2,767,963, and the gross surplus is now $15,414,676. The valuation of property and plants increased during the year $1,939,896 to $12,570,073. It is evident from the report that the company had not felt, up to the close of March, at least, any of the industrial reaction which has been evident in other lines of business. Among other signs of the great increase in business is the growth of the pay roll, exclusive of the selling organization, to 18,386 men, a gain during the year of 3681 men. The year's orders totaled $34,175,548, against $24,939,602 in 1905-1906. Vice-president Herr makes this comment on the position of the company's business: "It is fortunate for our industry that the steam railroads are moving with deliberation in the matter of electrification, not only that the best types for given conditions shall be determined upon, but owing also to the fact that were the business to come at once in any considerable volume our facilities would be unequal to cope with the demand, occupied so fully as they are with already established lines. The very magnitude of the steam railway field will involve a great amount of business even if the railroads go about the work of electrification slowly." The above does not include the orders of the Bryant and Perkins companies, the R. D. Nuttall Company or the Sawyer-Man Electric Company, now the Westinghouse Lamp Company, which for the fiscal year 1906-7 amount to $4,075,671. That the Westinghouse Electric Company loses very little on account of bad debts is evident from the fact that deductions from the above shipments by reason of bad debts amounted to approximately one-tenth of 1 per cent. The policy has been to conduct the business of the Westinghouse Company on a strictly cash basis.

BELL TELEPHONE.—Advices from Boston state that up to the end of last week the stockholders of the American Telephone & Telegraph Company had subscribed for 95 per cent of the recent issue of $21,925,000 of new stock. On this stock $50 per share is payable July 25, and the second payment of $50 per share is due Oct. 25. President Vail is confident that the entire issue will be taken by the stockholders as the five per cent who have not already taken their new stock probably represent many stockholders who are abroad and who were not immediately accessible when the notices were first mailed to the shareholders. It is probable that the company will permit these stockholders to take their pro rata apportionment if they so desire. President Vail is receiving many congratulations by reason of the success of the new stock issue, which was made at a time when money conditions were very strained and when many wise-acres prophesied its dismal failure. As to general conditions, Mr. Vail says: "I have not yet discerned any evidences of a trade reaction. Our business is good, and in net results to the company fully up to that of a year ago. We are striving now for net results and are not seeking to roll up big gross totals which, while they look good, generally mean heavy operating costs. If the business interests of the country would seek to do a little less business and do it a little better and more economically the whole business and money situation would be greatly improved."

CHICAGO TELEPHONE.—At a meeting of the Chicago Telephone Company, it was decided to issue $4,000,000 of new capital stock, thus increasing the outstanding amount to $18,000,000. The company's authorized capitalization is $20,000,000. The 40,000 shares of new stock are offered to stockholders of record at par, in the ratio of one share for each three and one-half shares of stock now held. Subscriptions and assignments of rights must reach the office of the treasurer on or before Aug. 10, 1907, and 25 per cent of the amount of the subscription must be paid not later than that date. The next 25 per cent must be paid by Nov. 5, 1907, and the remaining 50 per cent by Feb. 10, 1908. Any shares unsubscribed for or not paid for, may be sold by the directors or executive committee, and the proceeds paid into the treasury of the company. The American Telephone & Telegraph Company, which owns more than 53 per cent of the Chicago company's capital, will take more than $2,000,000 of the new stock.

DIVIDENDS.—A semi-annual dividend of $2.50 per share will be paid Aug. 1 to holders of preferred shares of Omaha Electric Light & Power Company. Directors of the American Electric Company have declared the regular quarterly dividend of 2 per cent, payable Aug. 1. Directors of the American Light & Traction Company have declared a quarterly dividend of 1½ per cent on the common stock. This is at the rate of 6 per cent per annum, and is an increase of 1 per cent per annum over the dividends heretofore declared on the common stock. They also declared the regular quarterly dividend of 1½ per cent on the preferred stock. Both dividends are payable Aug. 1. Directors of the Twin City Rapid Transit have declared the regular quarterly dividend of 1¼ per cent on the common stock, payable Aug. 15. Directors of the Guanajuato Development Company have declared the regular semi-annual dividend of 3 per cent on the preferred stock. Directors of the American Graphophone Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Aug. 15. Directors of the Butte Electric & Power Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable Aug. 1. Directors of the Montreal Light, Heat & Power Company have declared a quarterly dividend of 1½ per cent, payable Aug. 15, placing the dividend on a 6 per cent per annum basis. The company had been paying 5 per cent per annum for two years. The directors of the Western Telephone & Telegraph have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable Aug. 1. Directors of the J. G. Brill Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock and 1 per cent on the common stock. The preferred dividend is payable Aug. 1. The common dividend is payable Sept. 2. Directors of the North American Company have declared the regular quarterly dividend of 1¼ per cent on the capital stock, payable Sept. 2. Directors of the Chicago Edison Company have declared the regular quarterly dividend of 2 per cent, payable Aug. 1. Directors of the Multiphone Operating Company have declared the regular monthly dividend of 1 per cent, payable Aug. 1. Directors of the New York & Queens Electric Light & Power Company have declared the regular semi-annual dividend of 2½ per cent upon the preferred stock, payable Aug. 10.

CHICAGO EDISON MERGER.—Advices from Chicago of July 15 announced definite plants for the consolidation of the Chicago Edison and the Commonwealth Electric companies. The involve the formation of a new corporation, with a capitalization of $30,000,000, to be known as the Commonwealth-Edison Company, which will succeed to the business of the two big companies now controlling the franchise rights for the manufacture, sale and distribution of electric energy for lighting and power purposes in Chicago. Resolutions have been passed increasing the capitalizations of the Chicago Edison and Commonwealth companies to $15,000,000 each. The new stock of the Edison Company will be sold to stockholders of record Aug. 31, 1907, at par in the ratio of 10.20 per cent of their present holdings, which is to be paid for in five installments, as follows: Sept. 10, 1907, 5 per cent; Nov. 1, 1907, 20 per cent; Feb. 1, 1908, 25 per cent; May 1, 1908, 25 per cent, and Aug. 1, 1908, 25 per cent. The full $15,000,000 of Chicago Edison stock is to be exchanged for stock in the Commonwealth-Edison Company equally at par. The $15,000,000 of capital of the Commonwealth Electric Company is understood to have been pledged in whole or part by its holders as security for the payment of the gold mortgage bonds of the Edison Company to the amount of $6,000,000 outstanding. An adequate amount of the new company's shares will be held in the treasury to secure the mortgage.

BALTIMORE CONSOLIDATED REPORT.—The annual meeting of the stockholders of the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., was held on July 1. The reports indicated that the output of electric energy shows a heavy increase and the output of gas a substantial one. The results of the year were as follows: Net income above operating expenses, $1,711,000; fixed charges, $1,081,000; net earnings, $630,000. Considerable interest was shown at the meeting in the facilities provided during the year to take care of the growing business. In the gas division 18.9 miles of new mains were run and 6,355 new services installed. The Westport electric power plant, which commenced operation on June 23, 1906, is now carrying about 80 per cent of the total load of the electric division and during the ensuing year this will be increased by the shutting down of other stations. Plans for the erection of an addition to this station were announced. These plans provide for a plant to house 72,000 horse-power. One-third will be erected this year and there has been ordered a turbo generator of 7,500 horse-power, with boilers and necessary equipment. The attention of the stockholders was call to the contract closed with the McCall Ferry Power Company, for electrical energy from the Susquehanna River.

NEW HAVEN LIGHTING STOCK.—The directors of the United Illuminating Company, of New Haven, Conn., have decided to issue $200,000 of the $500,000 new stock, authorized last March for the purpose of securing funds to pay for laying the underground conduits through some of the streets in the center of the city. The work is now in progress. The new stock will be offered to holders of record July 1 and will be disposed at par, $100 a share, at the rate of one new share for each five shares of old stock held. Subscriptions will be accepted only for one or more full shares. Subscriptions under holding that are not multiples of five can be adjusted by the purchase on sale of rights which will be handled by local investment brokers. It was expected that the directors of the company would issue at one time the total of $500,000 stock authorized, but as action in this regard is left to their discretion, it is now said issues will be made from time to time when the company is in need of funds for its new work.

LONGING LONG ACRE.—It would seem that the Long Acre Electric Light & Power Company, of New York, is longing and aching to butt into the gas field as well as the electric. It is understood that the Long Acre Company intends applying to the Public Service Commission for the First District for permission to begin the manufacture and distribution of gas. Should the company receive the consent of the commission, upon making application, it is understood that it will at once begin the manufacture of gas. Gas engineers express themselves as confident that the Long Acre company if it enters into competition with the Consolidated Gas Company, will sell gas at a lower rate than that charged at present When the fight is over and one side or the other is vanquished the price of gas will again soar. Although the Long Acre Company has franchises permitting it to manufacture and distribute both gas and electricity, it cannot engage in the manufacture and distribution of gas before obtaining the consent of the Public Service Commission, as provided in Section 68 of the Public Utilities Law.

GENERAL ELECTRIC FINANCES.—The first instalment of 50 per cent on the $13,000,000 five per cent convertible 10-year bond issue of the General Electric Company was payable July 20 at the offices of the Farmers Loan & Trust Company. According to representatives of the General Electric Company the issue is a complete success. The second payment of 50 per cent falls due on Jan. 20, 1908. Including fully paid up subscriptions, the General Electric will have between $7,000,000 and $8,000,000 additional cash available for extensions and other purposes. In spite of reports of a slowing up in business, the new orders of the General Electric Company continue at the rate of between $70,000,000 and $75,000,000 a year. The business of the company for some time past has been averaging the same as in the first quarter of the year. There have been no developments that would indicate a falling off in the business of the General Electric Company, but representatives of the corporation would not be surprised to witness a moderate slowing up before the close of the year.

WESTERN ELECTRIC EARNINGS.—It is reported from Chicago that the Western Electric Company has paid off this year $6,000,000 of the floating debt, which at one time last year amounted to $20,000,000, and it is prepared to make a further reduction. Earnings this year are estimated at $5,000,000 monthly, on the average, which compares with similar results a year ago, though the average for last year was $800,000 a month more, due to the extraordinary rush the last half of 1906 The volume of new business suggests contraction, but with the economies effected, the net this year may quite possibly be equal to that of 1906.

HAVANA TROLLEYS.—A cable dispatch from London, of July 11 says: "At a meeting of the United Railways of Havana here to-day the shareholders unanimously approved the scheme for the increase of capital necessary to acquire controlling interest in the Havana Central Railway Company

GENERAL NEWS

Construction News.

ATHENS, ALA.—The City Council is contemplating installing another dynamo in the municipal electric lighting plant, and is now receiving bids.

CALERA, ALA.—Arrangements are being made for the construction of an electric lighting plant in this place. A site has been purchased on Front Street and Montgomery Avenue, and franchises have been granted by the authorities. The company contemplates building an ice plant in connection with the electric plant. P. J. Jeminez is interested in the project.

DECATUR, ALA.—The Decatur Light & Power Company is considering the question of making improvements and extensions to its plant.

ENSLEY, ALA.—The City Council has granted a franchise to J. J. Walker, H. S. Meade, B. R. Pegram and associates to build a street railway in this city.

CHICO, CAL.—The Pacific States Telephone Company has commenced work on the reconstruction of its local system, which, when completed, will cost about $85,000.

COTTONWOOD, CAL.—James Barry and Charles Tozer, of this place, have filed a claim on 10,000 miner's inches of water of Beegum Creek and are planning to erect a dam at Beegum.

LOS ANGELES, CAL.—Judge Ellsworth has dissolved the restraining order recently issued against the directors of the Owens River Water & Power Company, the matter having been settled outside of court. The city of Los Angeles has bonded itself for the sum of $23,000,000 to purchase the holdings of the Owens River & Water Power Company and develop a water supply.

NAPA, CAL.—Application has been made to the City Council by W. J. Lindow for a franchise for a term of 25 years to erect and maintain poles and wires for the transmission of electricity for lighting and power purposes on the public streets in this city. Bids for the above franchise will be received by the city clerk until Aug. 6.

OROVILLE, CAL.—The Western Power Company, which is erecting a large power plant at Big Bend, is building an electric railway to assist in the work. Electricity for operating the road will be furnished by the Bay Counties Power Company.

OROVILLE, CAL.—It is stated from authentic sources that the Pacific Gas & Electric Corporation will soon resume the work of developing the French Creek power plant. Nearly four years ago the company spent a large amount of money in surveys, road building and in purchasing water rights, machinery, etc., with the object, it was said, of establishing a large power plant on French Creek, a tributary of the North Fork, about 28 miles from Oroville. The plant as originally proposed was to have a capacity of from 16,000 to 20,000 horse-power, but the new project is said to be of much greater magnitude.

PASADENA, CAL.—C. C. Glass, manager of the municipal electric light plant, has submitted a report to Mayor Earley on an underground distributing system, in which he estimates the cost of installing conduits for the electric lighting wires in the fire district, which comprises the business section in general, at [illegible].

SAN DIEGO, CAL.—The South Coast Land Company has been awarded a franchise by the Board of County Commissioners to erect poles and wires for the transmission of electricity along certain streets and highways in the county.

SAN FRANCISCO, CAL.—The board of directors of the Pacific Gas & Electric Company has voted to levy an assessment of [illegible] or $10 a share on the stock of the shareholders for rehabilitation and improvement purposes.

SAN LUIS OBISPO, CAL.—The San Luis Obispo Gas & Electric Company is contemplating replacing its 100-kw, single-phase generator [illegible] three-phase machine. [illegible] is manager.

PUEBLO, COL.—At a meeting of the directors of the [illegible] Power & La [illegible] Railway & Power Company, it was decided to commence at once the work of building and equipping an electric interurban [illegible] officers were elected: Alfred E. Bent, of Lamar, president; George D. [illegible] general manager.

HARTFORD, CONN.—The Hartford Electric Light Company is making arrangements to build a large addition to its boiler plant at Dutch Point. [illegible] per cent.

NEW BRITAIN, CONN.—Plans are being made by the Consolidated Railway to place new equipment in the old steam power station on Chestnut Street in this city so as to make the local plant independent of the power from the Bull's Bridge plant. The plant will be equipped with a 400-kw, 2300-volt, 60-cycle, three-phase generator, with switchboard and panel. The new machinery will be used for lighting and power purposes, and the electric railway system will continue to be operated from the Bull's Bridge plant at New Milford.

WASHINGTON, D. C.—Bids will be received until July 30 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing naval supplies at the various navy yards, etc., as follows: Portsmouth, N. H., schedule 116—electrical wire, etc. New York, N. Y., schedule 103—electrical conduit, wire and supplies, electric lampposts, etc. Washington, D. C., schedule 99—electrical cable, etc. Charleston, S. C., schedule 104—motor drive outfits. Pensacola, Fla., schedule 97—electrical supplies, vulcanized rubber, etc. Mare Island, Cal., and naval training station, San Francisco, Cal., schedule 89—electrical wire, rubber sockets, etc. Puget Sound, Wash., schedule 88—submarine telegraph cable. Schedule 87—annunciators, etc. E. B. Rogers, paymaster general, U. S. A.

JACKSONVILLE, FLA.—The old buoy tender steamer *Wistaria*, in the port of Jacksonville, will soon be equipped with an electric plant, which will provide independent light and fan service. The Hazlehurst Electric Company, of Charleston, has been awarded the contract to install the plant.

ALBANY, GA.—A new water wheel has been received by the Albany Power & Manufacturing Company, and will be installed in its plant located on Muckafoonee Creek, just above the city. A new generator will also be installed, which will double the capacity of the present plant.

DOUGLAS, GA.—Extensive additions and improvements will be made in the municipal electric light plant, and the following new equipment installed: One 200-kw, 2200-volt, two-phase alternator; one 250-hp Corliss or 4-valve engine; one 100-hp Cole boiler; one 12½-kw, 125-volt, direct-current generator; a 12-inch artesian well and an Ingersoll-Rand air compressor. Extensive line improvements will be made, and a day service will be established about Sept. 1. L. M. Alford is manager.

FITZGERALD, GA.—A syndicate of local and foreign capitalists has made application to the City Council for a franchise to operate a street railway in Fitzgerald and to nearby towns. The proposed line will be extended to Ocilla.

TICTON, GA.—A franchise has been granted by the City Council to L. P. Thurman, I. W. Myers, W. W. Banks, O. Daniel, J. E. Cochran and others to construct and operate an electric railway through the principal streets of the city.

BLOOMINGTON, ILL.—Harry E. Rhoades, city clerk, writes that contracts for constructing an electric light plant have been awarded as follows: Engines to the Buckeye Engine Company, Salem, Ohio; generators to the Western Electric Company, Chicago, Ill., and lamps to the Fort Wayne Electric Company, of Fort Wayne, Ind.

CHICAGO, ILL.—The Northwestern Elevated Railroad and the Chicago, Milwaukee & St. Paul Railroad companies are reported to be preparing to accept the ordinances of the city of Chicago and the city of Evanston, authorizing the companies to join their roads at the terminal of the Northwestern elevated by a gradual incline, and to electrify the road between Chicago and Evanston. It is planned to substitute at an early date for the St. Paul suburban steam railroad an improved service on the Evanston division of the electrified road, to be operated jointly by both companies.

ELGIN, ILL.—The trustees of the Illinois Hospital are considering improvements to the hospital, which include the enlargement and improvement of the present power plant, a more adequate water system, etc.

EVANSTON, ILL.—The Evanston Council has granted the Chicago Consolidated Traction Company a franchise to extend its line in North Evanston.

FLORA, ILL.—The managers of the municipal electric lighting plant are contemplating installing a 35-hp producer gas plant next year to furnish a day service for fans, etc. William Parton is manager.

HEYWORTH, ILL.—Charles J. Crump has secured a franchise for an electric lighting, heating and power plant.

JOLIET, ILL.—The contract for the construction of the hydraulic development of the Economy Light & Power Company, of Joliet, on the Des Plaines River, nine miles from Morris, Ill., has been awarded to James O. Heyworth, Chicago, Ill.

KANKAKEE, ILL.—The Kankakee Electric Light Company is con- [illegible]

MT. CARROLL, ILL.—The Mt. Carroll Electric Light Company is [illegible]

PANA, ILL.—The Pana Gas & Electric Company is planning to increase the capacity of its plant and will install a new generator and replace an engine and generator with a direct connected set. H. D. Larabee is manager.

VANDALIA, ILL.—Plans are being considered for increasing the capacity of the municipal electric lighting plant. A new dynamo, exciter and engine will be installed. R. M. Clark is manager.

WESTERN SPRINGS, ILL.—The citizens are contemplating installing two new boilers in the municipal electric lighting plant. Albert Erickson is manager.

DECKER, IND.—Eugene Rush, president of the Hydro-Electric Company, which proposes to erect a dam on White River at this place and establish a hydraulic plant for the manufacture of electricity for light, heat and power, announces that the project has been financed by the Metropolitan Trust & Savings Bank, of Chicago, Ill., which will act as trustee, and that actual work of constructing a plant will begin soon. The company will furnish electricity to towns and cities within a radius of [illegible] miles.

FORT WAYNE, IND.—We are informed that the City Council on July 16 duly ratified the contracts for the municipal electric light plant, bids for which were opened on June 24, and awarded on June 26, and executed by the Board of Works on June 28. The contracts as awarded and ratified and which were published in the issue of the ELECTRICAL WORLD of July 13 are as follows: To Fort Wayne Electric Works, Fort Wayne, for section 3, steam turbine generators and exciters; section 4, condenser equipment; section 7, arc-lamp transformers, switchboard, appliances and station electric works; section 8, arc lamps, and section 10, transformers and connecting public buildings, for a total of $73,899. To McBride Electric Company, of St. Paul, Minn., for section 9, pole line and wiring system and underground (distributing system), and section 11, power plant and coal storage, for a total of $56,002. To the O. K. Engineering Company, of St. Louis, Mo., section 1, boilers and equipments and stack connections, and section 5, feed-water heater, boiler, feed pumps, separators, pipe work and connections, for a total of $19,220. To Alphons Custodis Chimney Construction Company, of Chicago, Ill., for section 2, stack, for $4,400, and to the Moellering Construction Company, of Fort Wayne, section 12, dam in Spy Run, for $1,238. Total contract price, $154,759. Owen Ford, of St. Louis, Mo., is the consulting and supervising engineer.

INDIANAPOLIS, IND.—Frank M. Fauvre, capitalist and promoter of this city, announces that he is organizing a million-dollar company, to construct, equip and operate a large power plant near Seeleyville, east of Terre Haute, to manufacture electricity for transmission to Indianapolis and other cities. Distribution of the electricity in Indianapolis and other cities will be effected through the company's plants already in operation, but its scope will be greatly enlarged when the new plant is put in operation.

SOUTH BEND, IND.—Articles of incorporation and agreement have been filed for the merging of the St. Joseph & Elkhart Power Company, the Elkhart Electric Company and the South Bend Electric Company. The new company will be known as the Indiana & Michigan Electric Company. The capital stock is $1,915,500. The corporation has two dams in the St. Joseph River and will build another at Bristol, Ind. Electricity will be furnished in South Bend, Mishawaka, Elkhart, Goshen, Laporte, Niles, Buchanan, Bristol and other towns. H. K. and H. C. Chapin, C. B. Calvert, M. L. Newell and R. Talbot are the directors.

CARROLL, IA.—Judge McPherson's decision in the controversy over the Carroll Light, Heat & Power Company was made public July 14. The court orders the debts of the company, including the expenses of the receivership, to be paid within ten days, and orders that in default of this being done the plant shall be sold at auction. A condition of the sale is that no bid of less than $50,000 shall be considered, each bidder being requested to deposit $25,000 in cash. No appraisement or valuation is to be made prior to the sale, the court reciting that the plant must be sold as a whole and not dismembered.

FORT DODGE, IA.—The City Council has instructed the city attorney to begin ouster proceedings against the Fort Dodge Light & Power Company for alleged violation of its franchise. The Council a short time ago notified the company that its charges were illegal, but the company paid no attention to the notice. The case will be tried in the January term of court.

MT. AYR, IA.—A. Bartenlanger, of Omaha, Neb., has secured the contract for constructing an electric light plant in this place for $17,626.

COVINGTON, KY.—The City Council has passed a resolution authorizing the committee on light to have 50 arc lamps placed in Central Covington.

LOUISVILLE, KY.—A meeting of the board of directors of the Cumberland Telephone & Telegraph Company has been called for Aug. 6, at which time the question of increasing the capital stock of the company from $20,000,000 to $20,200,000 will be voted on. The company is also contemplating changing its headquarters from Hopkinsville to Louisville.

MAYFIELD, KY.—J. W. Williams, representing J. W. Williams & Company, has purchased the street railway franchise which was sold by the Mayor, July 12, for $200.

BANGOR, ME.—[illegible]

[illegible] towns.

WATERVILLE, ME.—[illegible] on the Sebasticook River, near Fort Hill Cemetery in Winslow, has been purchased by the management of the Augusta & Waterville Electric Railway Company, and the contract for the erection of a large plant will soon be awarded. The cost of the dam and power house is estimated at $130,000 and is to be completed before Nov. 1.

WATERVILLE, ME.—[illegible] Railway has recently completed an arrangement with the Fort Halifax Power Company for a supply of electricity for a term of 30 years. The power company will furnish electrical power for all the lines and extensions between Waterville and Sabattus. The Fort Halifax Power Company has acquired land and water rights along the Sebasticook in Winslow, and a dam and power station will be constructed a short distance above [illegible].

BALTIMORE, MD.—Victor G. Bloede, president of the Patapsco Electric & Manufacturing Company, has announced that he is ready to submit satisfactory evidence of the ability of his company to supply the city with electricity to light the courthouse and city hall at a figure much lower than that quoted by any concern now doing business in the city. The company is now operating in the city on a private right of way on Frederick Avenue [illegible] to use the city's conduits for its wires in the city. The Patapsco Electric & Manufacturing Company has recently completed a large plant at Ilchester, which, with its large plant at Gray's Mills, gives the company a capacity of 25,000 horse-power. The company now furnishes electricity for lighting in Catonsville and Ellicott City, and a large part of both Baltimore and Howard counties. The Gray's Mills plant has been in operation about [illegible] years.

CHARLTON CITY, MASS.—Three new transformers are being placed in the Charlton City power station to replace the ones now in use.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company is planning to erect its pole line to Turners Falls, to take additional power from the plant of the Turners Falls Company before cold weather, in case the supply from Gardiner Falls should fail.

GROVELAND, MASS.—The electric light commission has secured plans and specifications for the proposed power house and will soon be ready to proceed with the erection of the plant. The plant will be erected on land owned by the town.

LYNN, MASS.—Work has commenced on the construction of the addition to the power house of the Lynn Gas & Electric Company. The cost of the building is estimated at $50,000.

NORTHAMPTON, MASS.—The Northampton Electric Lighting Company is installing [illegible].

PETERSHAM, MASS.—John A. Carter, C. H. Eddy and E. C. Dexter, of Petersham, are interested in a project to furnish electricity for lighting the towns of Petersham, Barre and Dana. Power will be furnished from the Swift River, and surveys above the proposed location in Webb village are being made, and all options on the property along the river have been secured.

WEST SPRINGFIELD, MASS.—Owing to not being able to secure sufficient power from the United Electric Company, the United Drop Forge Company has decided to install a power plant of its own. A new power house has been erected in which will be placed boilers and two engines having a capacity of [illegible].

DETROIT, MICH.—Mayor Thompson has decided to request H. H. Crowell, electrical expert, of Syracuse, N. Y., to examine into conditions in connection with the public lighting commission, mainly to see what new machinery it is advisable to obtain to enable the commission to produce [illegible].

MANISTEE, MICH.—The Manistee Traction Company and the Northwestern Michigan Light & Power Company have been consolidated under the name of the Manistee Light & Traction Company.

ST. JOSEPH, MICH.—Representatives of Charles A. Chapin, of Chicago, Ill., have announced plans for the construction of three additional power dams on the St. Joseph River, to cost $5,000,000. The company now has in operation or in course of construction on the river five power plants. The new properties will give them eight stations, with an aggregate investment of $10,000,000.

WYANDOTTE, MICH.—[illegible]

DAWSON, MINN.—[illegible] St. Paul, for an electric light plant and water works system, to cost about [illegible].

MINNEAPOLIS, MINN.—[illegible] and heat.

MINNEAPOLIS, MINN.—[illegible]

Kansas City & Gulf Railway Company to build a double track railway, to be operated by electricity, from Minneapolis to the Gulf. C. D. Holmes, G. A. Barnett and others are interested in the project.

ROCHESTER, MINN.—Engineer Charles L. Pillsbury, of St. Paul, has completed his report on the requirements of the municipal electric light plant and recommends rebuilding the entire plant.

HATTIESBURG, MISS.—The Hattiesburg Light & Power Company, the Hattiesburg Traction Company and the Hattiesburg Gas Company have been merged into one company, and the corporation will retain the name of the Hattiesburg Traction Company. The combined capital is $300,000 and will be increased at once to $500,000. Extensive improvements will be made to the electric and gas plants, and it is expected to have five miles of the street railway in operation within sixty days.

WATER VALLEY, MISS.—The purchase of a 300-hp water-tube boiler for the municipal electric light and water plant is now under consideration. T. M. Early is manager.

CARTHAGE, MO.—The Carthage Electric Light & Power Company is making extensive improvements and extensions to its plant. A new water wheel has been installed at the Belfort power house, and a generator and three transformers are being placed in position. Preparations are being made for the installation of two new transformers at the sub-station on Belfort Street, which may necessitate an addition to the building. A new switchboard will also be installed. When the work is completed the capacity of the plant will be nearly doubled, but for the present will be used mostly as an auxiliary to the present system. At the annual meeting held recently the following named officers were elected: John E. Strickland, president and manager; C. M. Rohr, vice-president; S. M. Strickland, secretary and treasurer, and Frank M. Galloway, general superintendent.

HOLDEN, MO.—Bids will be received until July 31 by O. G. Boissea Mayor, for $6,000 in bonds, the proceeds to be used to enlarge and extend the electric light plant.

FREMONT, NEB.—J. W. Andrews, city engineer, writes that plans have not yet been completed for the proposed municipal water and light station, which will cost about $60,000. Contracts for engines and dynamos have been let. Charles A. Chapman, 204 Dearborn Street, Chicago, Ill., is consulting engineer.

TECUMSEH, NEB.—The citizens voted to issue $16,000 in bonds for an electric light plant.

TECUMSEH, NEB.—Frank L. Dinsmore writes that John Martz, of Seward, is preparing plans for the proposed electric light plant, to cost about $20,000.

RENO, NEV.—Major J. A. Driffil, of Oakland, president of the Ely Electric Company, and Carl Lennhart, of Los Angeles, state that the company will begin immediately the construction of a 1000-hp electric plant and a large reservoir in this city. Cave Creek will supply the water for the reservoir.

MANCHESTER, N. H.—The Amoskeag Manufacturing Company is contemplating a number of improvements to its plant, and may install a central electric lighting plant.

MADISON, N. J.—S. G. Willets, borough clerk, writes that the light committee has under consideration the question of doubling the capacity of the municipal electric light plant, and may recommend the matter to the Borough Council at the August meeting. Nothing definite has yet been done.

MORRISTOWN, N. J.—The Morris & Somerset Electric Company, which has recently secured the contract for street lighting, is making preparations to commence work on the construction of its plant. The company also has an ordinance before the Aldermen granting it a franchise to furnish electricity to private consumers.

NEWARK, N. J.—The Common Council on July [illegible] appropriated $[illegible] for the installation of an electric light plant in the City Hall, and also decided to have the people vote next November on the proposition of building a municipal electric plant for lighting the streets at a cost of $[illegible]. Both resolutions have been signed by the Mayor. The new contract with the Public Service Corporation will run until September, [illegible].

ROSWELL, N. M.—The Roswell Electric Light Company will soon make extensive additions and improvements to its plant. Preparations are being made to install the new equipment, which consists of a [illegible] engine, and a 300-kw, 3-phase, General Electric generator. Luther Stover is [illegible].

BATH, N. Y.—The Board of Village Trustees has abandoned the idea of municipal ownership of the street lighting plant and has completed a contract to be entered into with the Bath Electric Light Company [illegible] the expiration of the present lighting [illegible] September [illegible] for [illegible] arc lamps and for [illegible] together with [illegible] at the fire companies [illegible] per year. Under the old contract the [illegible] 18 cents per kw [illegible] the new contract it is [illegible] cents. In accepting [illegible] the company agrees to install a duplicate set of [illegible] power plant and to replace the old arc lamps [illegible] lamps. A bond of $[illegible] will be given [illegible].

BUFFALO, N. Y.—The Buffalo & Lake Erie R[illegible] with the Ontario Power Company [illegible]. Rapid progress is being made on the line from Erie to Buffalo, and the company hopes to have the road in operation before the end of the year.

CANAJOHARIE, N. Y.—The Montgomery Electric Light & Power Company and the East Creek Electric Light & Power Company are making arrangements to build a new sub-station on West Main Street. As soon as the building is completed the old sub-station will be abandoned. A. B. Cairns is superintendent.

DUNKIRK, N. Y.—The Water Commissioners have awarded the contract for a 500-kw turbo-generator set for the electric light plant and the water works system to the Allis-Chalmers Company, of Milwaukee, Wis., for $19,500.

GOUVERNEUR, N. Y.—The Hannawa Falls Electric Power Company has its transmission line completed to this village, and will soon commence work within the corporation limits. The distributing station will probably be built on the Porter road near the village. The company was granted a franchise last fall. It is understood that the company has placed contracts for furnishing electricity with several manufacturing companies in this village.

NEW YORK, N. Y.—Bids will be received until Aug. 5 (readvertisement) by Robert W. Hebberd, Commissioner Public Charities, New York City, for all materials and labor required for the complete conduiting, electric wiring and all other work in connection with the installation of a complete electric lighting and power system for all the buildings and grounds under the jurisdiction of the Department of Public Charities, and comprising the Metropolitan Hospital District, Blackwell's Island, Borough of Manhattan.

RANDLEMAN, N. C.—The Randleman Electric Railway Company has been granted a franchise to erect an electric power plant to furnish electricity for lighting and power purposes in the city. Work will commence at once on the construction of the plant.

MIDDLETOWN, OHIO.—The Independent Telephone Company has been granted a franchise for a term of 25 years to construct and operate a telephone system in this city. The company will place its wires underground in the business section of the city.

TOLEDO, OHIO.—At the request of Receivers Willis Baldwin, of Monroe, Mich., and I. H. Bergoon, of Fremont, Ohio, the court has ordered the immediate sale of the Toledo, Ann Arbor & Detroit Electric Railway property, which consists of a right of way from the Ohio State line to Ann Arbor, a distance of 45 miles, 21 miles of track laid and a power house at Petersburg, Mich. The property is valued at about $250,000 and will be sold on a cash basis.

COQUILLE, ORE.—The Coquille River Electric Company will soon install a 150-kw, 3-phase, 2300-volt General Electric alternator in its plant. Frank Morse is owner and manager.

LEBANON, PA.—Bids will be received until Aug. 31 by the Police Committee (George D. Krause, chairman) for street lighting. Bids are to be submitted on two propositions and are to be for lighting every night and all night for a term of one and five years as follows: For 150 or more enclosed arc lamps of 2000 cp each; 150 or more series incandescent lamps of 24 cp each.

READING, PA.—The Ridgway Dynamo & Engine Company, of Ridgway, Pa., has secured the contract for engines for the municipal electric lighting plant and the Western Electric Company, of New York, N. Y., for the generators. The work is in charge of R. D. Kimball, of Boston, engineer.

SCRANTON, PA.—The plant of the Economy Light, Heat & Power Company has been sold to the American Gas & Electric Company. The new company will take control in September.

WAYNESBURG, PA.—The Waynesburg & Monongahela Street Railway Company has made application to the Borough Council for a franchise to operate its line in this borough. The company proposes to reach the river by the way of Jefferson, Clarksville and Millsboro.

WAYNESBURG, PA.—W. J. Sheldon, of McKeesport, president of the McKeesport, Carmichaels & Brownsville Street Railway Company, has applied to the Borough Council for two franchises, one for operating an electric railway on different streets of the borough, and the other for the establishment of an electric light and power plant.

WILKES-BARRE, PA.—The Wilkes-Barre Heat, Light & Motor Company has decided to erect a sub-station on South Main Street, near Sullivan Street. It is the intention of the company to supply the residents of the lower section of the city with steam heat.

PROVIDENCE, R. I.—The installation of a new electric lighting and heating plant at the Rhode Island College is under consideration, and a committee consisting of C. D. Kimball and Robert S. Burlingame has been appointed to investigate the matter. The power station, if required, will be erected [illegible] Hall. The cost is estimated at $[illegible].

ABERDEEN, S. D.—The City Council has adopted a report which recommends the passing of an ordinance which will permit the granting of a franchise for an electric lighting and power plant. The city has already voted $35,000 in bonds for an electric light plant, but as this [illegible] is thought advisable to grant a franchise for a private plant.

MITCHELL, S. D.—[illegible] of Wagner, president of the Wagner, Lake Shore & Armour Traction Company, writes that the company is now constructing light and power plants at Armour and Platte, S. D., [illegible]

[illegible] plants now under construction will supply electricity for operating the electric railway as well as to light the different municipalities. The company will soon be in the market for machinery, rails and ties.

BIG SPRING, TEX.—The local electric lighting plant owned by L. L. Stephenson was recently destroyed by fire, causing a loss of $10,000.

[illegible] $27,800.

FLORENCE, TEX.—The construction of an electric lighting plant in this place is now under consideration. A. W. Strange is interested in the project.

GALVESTON, TEX.—Amendments have been filed to the charter of the Martin Telephone Company, of Llano County, increasing the capital [illegible]

HUBBARD CITY, TEX.—The Union Central Light & Ice Company is planning to increase the capacity of its plant to furnish electricity in the neighboring towns. The company has issued $25,000 in bonds, and [illegible] build the addition to the plant, taking the bonds at 85 per cent in payment for the work.

TOYAH, TEX.—The Toyah Electric Light Company, recently organized, has placed contracts for the construction of its electric light plant.

MONTPELIER, VT.—At the annual meeting of the Barre & Montpelier Traction & Power Company held recently the company was reorganized and the new owners placed in control. The company is planning extensive developments, and F. M. Cory, I. M. Frost and E. H. Deavitt have acquired water rights on the Winooski River for the purpose of installing a power plant to furnish electricity for operating the road. About 2000 horse-power can be developed on the property. The cost of the plant is estimated at $150,000. The directors have elected the following officers: F. M. Cory, president; H. K. Bush, vice-president; E. H. Deavitt, clerk and treasurer; I. M. Frost, general manager, and F. H. Andrus, superintendent.

CHEWLAH, WASH.—Bids will be received until Aug. 1 for constructing an electric light plant and water works system. F. C. Ranch is town clerk.

KAHLOTUS, WASH.—The Kahlotus-Washtucna Telephone Company has made application to the Town Council for a 25-year franchise to construct a telephone system in the town.

SUNNYSIDE, WASH.—T. A. Noble, of North Yakima, has made application for a franchise for an electric light plant and water works system in [illegible]

CHIPPEWA FALLS, WIS.—The Chippewa Valley Telephone Company has filed amendments to its charter, increasing its capital stock from $10,000 to $25,000.

EAU CLAIRE, WIS.—We are informed that the Chippewa Valley Electric Railroad Company is planning to purchase a 125 to 250-kw, 600-volt, direct-current generator and two new interurban cars. G. B. Wheeler is general manager.

LADYSMITH, WIS.—H. J. C. Young has secured permission to con- [illegible]

LADYSMITH, WIS.—The John Hein Company is reported to have decided to erect a power plant and develop 12,000 horse-power at Big [illegible]

MARINETTE, WIS.—Perley Lowe, of Chicago, Ill., is contemplating the development of Peshtigo River at Places Rapids, and transmitting power to Marinette.

WAUSAU, WIS.—At the annual meeting of the Wisconsin Valley Improvement Association held recently it was decided to purchase under its options all the existing reservoirs along the Wisconsin River, and to push the investigation of possible reservoir sites for the purpose of enlarging the system; also to engage a general manager and to open a central office in Wausau. The directors elected the following officers: George A. Whiting, president; Walter Alexander, vice-president; G. D. Jones, secretary and treasurer.

WINNIPEG, MAN.—The City Council has granted permission to the Winnipeg Electric Company to proceed with the construction of ten additional street car lines. Address Wilford Phillips, general superintendent.

OTTAWA, ONT.—The Civic Electric Commission has ordered a 750-hp generator to be installed at the city water works as a temporary source of supply to the municipal electric plant. Arrangements have been made by the Hydro-Electric Power Commission and the Hull & [illegible] the power company made important concessions to the city, and it is expected these will be accepted by the City Council.

TORONTO, ONT.—Work has commenced in connection with the establishment of a municipal electric light plant in this city. Cecil B. Smith, of Detroit, Mich., is consulting engineer.

MOOSEJAW, SASK.—A petition is being circulated among the ratepayers [illegible]

[illegible] ago River. Mr. Gallardo owns the water and power rights on the Santiago [illegible] of the power used to operate the large irrigation pumps that will be installed there. Other transmission lines will be built to Guadalajara and nearby towns and industrial plants.

MEXICO CITY, MEX.—L. O. Harnecker, of Mexico City, is arranging to install a hydro-electric plant near Union de Tula, State of Jalisco. The water of the Ayutla River will be used.

MEXICO CITY, MEX.—A hydro-electric plant is to be installed on the Rio Atoyac, in the State of Puebla, by Luis Gomez Daza, of Mexico City. The falls in that river between the bridge of Tzicatlacoyan and the Hacienda de Coattingo will be utilized to afford the initial power for the plant.

QUERETANA, MEX.—The Compania Hydro-Electrica Queretana, of this city, has entered into a contract with the Ajuchitlan Mining Company to furnish it with electrical power to operate its mines. The mining company is installing electric motors and electrical equipment in the mines. The transmission line to the mine is about 20 miles long.

SALTILLO, MEX.—The Fuerza Electrica Mexicana, S. A., of Saltillo, has obtained the rights to a concession which was previously granted by the Federal Government to G. A. Lilliendahl, of that place, to use the waters of the Pilon River for power purposes and to install a hydro-electric plant. It is stated that the work of constructing the plant will [illegible]

Company Elections.

TURNERS FALLS, MASS.—At the annual meeting of the Franklin Electric Light Company, held July 16, the following named officers were elected: J. F. Bartlett, president; E. I. Cassidy, clerk, and W. C. D. Thomas, treasurer. The company is now at work upon a scale of prices for electricity for lighting purposes and is in hopes to have the same in effect by the first of September or October.

New Industrial Companies.

THE AURORA ELECTRIC COMPANY [illegible] incorporated to establish and equip a plant to manufacture electrical apparatus and supplies of all kinds. Charles F. Mayer, H. P. Spaeth and D. J. Hauss are the directors.

THE [illegible] COMPANY OF AMERICA [illegible] Portland, Maine, for the purpose of manufacturing and dealing in electric lamps, etc. The company has a capital stock of $300,000, and the officers are: William Sturgis, of Scranton, Pa., and Ray Phelps, of New York, N. Y., treasurer.

New Incorporations.

SAN JOSE, CAL.—[illegible] Donnels Flat Water & Power Company. The company is capitalized at $1,000,000, and the directors are William Bogen and L. E. Hanchett, of San José; F. J. Koster, W. H. Metson and L. W. Smith, of San Francisco. The company has been formed for the purpose of securing and holding water rights, and the construction and maintenance of electric railways and light and power plants.

ATLANTA, GA.—The Tennessee & Georgia Interurban Railway Com- [illegible] electric railway from Rossville through Chickamauga Park to Ringgold and Catoosa Springs, a distance of about 25 miles. The capital stock of the company is $500,000 and the incorporators are: James C. Bryan, James L. Jones, W. E. Biggers, J. T. Robinson, J. W. Clark, W. E. Mann [illegible] W. H. Paine, Jr., of Chattanooga.

GREENFIELD, ILL.—[illegible] pany has been organized with a capital stock of $7,500 by J. T. Callaway and others.

HIGHLAND, ILL.—[illegible] Company has been incorporated with a nominal stock of $25,000. The incorporators and the first board of directors are: W. P. Wall, John Bardilla, John Gehrig, John Wildi and J. L. Rhein.

LINCOLN, ILL.—Articles of incorporation have been filed for the Mt. Pulaski Independent Telephone Company, with a capital stock of $8,500, by W. E. Birks, J. M. Buckles, George T. Lucas and others.

GARY, IND.—[illegible] pose of building and operating street and interurban railroads in and connecting Gary, Tolleston, Hammond, East Chicago and Whiting. Frank N. Gavitt, C. B. Manbeck and M. N. Castleman are the directors.

PORTLAND, ME.—The Portland, Gray & Lewiston Railroad Company has been incorporated with a capital stock of $150,000 to construct an electric railway through the towns of Falmouth, Gray and New Glouces-

ter, and thence to Auburn and Lewiston. The incorporators are: Edward W. Gross, of Auburn; Charles C. Benson, of Lewiston; Lewis A. Goudy, of Portland; John D. Clifford, of Lewiston, and others.

BELGRADE, MO.—The Belgrade Telephone Company has been incorporated, with a capital stock of $1,500, by J. A. Easton and others.

BANTRY, N. D.—The Bantry Telephone Company has been incorporated, with a capital stock of $10,000, by James McIntyre and others.

FORBES, N. D.—The Forbes Rural Telephone Company has been incorporated with a capital stock of $10,000 by O. K. Schuls and others.

GLENBURN, N. D.—The Lone Star Rural Telephone Company has been incorporated, with a capital stock of $10,000, by A. Walton and others.

GRAND HARBOR, N. D.—The Grand Harbor Telephone Company has been chartered, with a capital stock of $5,000, by Simon Kingslie and others.

LISBON, N. D.—The Farmers' Southwestern Telephone Company has been chartered, with a capital stock of $10,000, by Erik Sovdo and others.

CLEVELAND, OHIO.—The Elyria Southern Railway Company has been incorporated, with a capital stock of $100,000, by W. J. Elliott, F. N. Carpenter, W. E. Moser, J. M. Storr and F. L. Sargent. The company proposes to build an electric railway between Elyria and West Salem.

QUAKER CITY, OHIO.—The Farmers' Telephone Company has been incorporated, with a capital stock of $5,000, by W. W. James and others.

UNION FURNACE, OHIO.—The New Plymouth Telephone Company has been incorporated with a capital stock of $1,000 by W. P. Miller, W. A. Horner, C. W. McClain, F. M. Ludlow and R. B. Longstreth.

CESTOS, OKLA.—The Independent Telephone Company has been incorporated with a capital stock of $25,000 by H. A. Seaton, J. W. Kerns and F. C. Hoyt.

ENID, OKLA.—The Enid, Waukomis & Oklahoma City Interurban Railway Company has been chartered for the purpose of building an electric railway 100 miles in length. R. W. Brittan, of Waukomis, is president of the company.

EL RENO, OKLA.—The Midland Telephone Company has been chartered with a capital stock of $2,500 by Elmer N. King and others.

GEARY, OKLA.—The Maple Telephone Company has been incorporated, with a capital stock of $600, by Byron Baker, A. C. Gilmore and S. S. Schmoyer.

KELL, OKLA.—The Kell Telephone Company has been incorporated with a capital stock of $5,000 by P. S. Seamans, F. J. Hansen and J. Hansen.

TRIBBY, OKLA.—The Tribby-Mardock Farmers' Union Telephone Company has been incorporated, with a capital stock of $5,000, by F. M. White and others.

FOREST GROVE, ORE.—The Haines Electric Power Company is planning to develop its water power of 500 ft. head, and installing more machinery in its power house. E. W. Haines is manager.

PITTSBURG, PA.—Articles of incorporation have been filed for the Anglo-American Light Company by Jacob Veiger, Charles Veiger, of Pittsburg, Pa.; Q. A. Stevens, of Bellevue, Pa. The company is capitalized at $100,000, and it proposes to furnish light, heat and power for commercial and manufacturing purposes.

COLLIERVILLE, TENN.—The Collierville Telephone Company has been incorporated, with a capital stock of $5,000, by Samuel Hinton and others.

MORRISTOWN, TENN.—The Home Telephone Company, of this city, has been incorporated with a capital stock of $40,000 by A. W. Letspeich, Baldwin Harle, W. W. Hobby, and others.

NASHVILLE, TENN.—The Colby Telephone Company has been incorporated, with a capital stock of $1,500, by J. L. Mackey and others.

GRAND SALINE, TEX.—The Farmers' Mutual Independent Telephone Company has been incorporated with a capital stock of $[illegible] by M. E. Davis and others.

HOUSTON, TEX.—The Houston Telephone Company has been granted a charter by the Secretary of State with a capital stock of $100,000. The incorporators are J. D. Slusher and others.

TEMPLE, TEX.—The Rogers Water & Light Company has been incorporated with a capital stock of $50,000 by John J. Cox, R. L. Brown and others.

WACO, TEX.—The Consumers' Power & Light Company has been incorporated, with a capital stock of $150,000, by Joseph Henry and others.

WINNSBORO, TEX.—The Winnsboro Telephone Company has been incorporated with a capital stock of $[illegible] by W. D. Weir, R. L. Weir and C. B. Weir.

RANDOLPH, UTAH.—The Utah & Wyoming Telephone Company has been incorporated with a capital stock of $[illegible]. The company will soon install a system to connect Randolph, Woodruff, Laketown and [illegible]. Wesley K. Walton is president, and [illegible] is managing director.

SALT LAKE CITY, UTAH.—Articles of incorporation have been filed with the Secretary of State for the Vernal Milling & Light Company with a capital stock of $50,000. S. R. Bennion is president.

TUMWATER, WASH.—Articles of incorporation have been filed for the Tumwater Light & Power Company with the Secretary of State with a capital stock of $50,000. The company is now building an electric plant and will acquire the light and water franchises already secured from the City Council by Leopold Schmidt, and supply electricity for lighting and power in the city, and also for the brewing plant. The incorporators are: Leopold Schmidt, Peter G. Schmidt, Josey R. Speckart, Frank M. Kenney and Edmund Rice.

PLYMOUTH, W. VA.—The Athens Telephone Company has been incorporated, with a capital stock of $5,000, by W. J. Ganter and others.

CLEAR LAKE, WIS.—The Clear Lake Telephone Company has been incorporated, with a capital stock of $5,000, by J. C. Saxon and J. S. Griffin.

COLUMBUS, WIS.—The Watertown Telephone Company has been organized, with a capital stock of $15,000, by Oscar Wertheimer and others.

MADISON, WIS.—The Badger Hydro-Electric Company has filed articles of incorporation with the Secretary of State for the purpose of constructing and operating dams and power plants in Wisconsin and to generate, distribute and sell electricity. The company is capitalized at $1,000,000, and the incorporators are Magmer Swenson, E. B. J. Schubring and Frank H. Hanson.

OAKLAND, WIS.—The West Oakland Telephone Company has been incorporated with a capital stock of $350 by M. C. Kravik, Andrew F. Olsen and G. C. Larson.

WATERTOWN, WIS.—The Watertown Telephone Company has been organized with a capital stock of $15,000 by Oscar C. Wertheimer, J. F. Prentiss and W. H. Woodard.

Legal.

TELEPHONE SERVICE.—At Helena, Mont., in the United States Court, Judge W. H. Hunt has rendered a decision of importance to telephone users. He held that one company could not withhold the use of its lines from another, even though it be competing. The Montana and Wyoming and the Mutual Telephone companies applied to the court for an order compelling the Rocky Mountain Bell Telephone Company to furnish connections, when desired, at reasonable compensation. This was resisted on the ground that the lines were built for its patrons and not for those of competing companies. Extended arguments were made. Judge Hunt found for the complainants, and stated that within a few days he would name a commission to fix the division of charges when such use is made of connecting lines.

EMPLOYERS' LIABILITY.—Judge Adams, in the United States Court, has handed down a decision declaring constitutional the employers' liability law, passed by Congress one year ago, which makes employers responsible for damages in cases of injury to workmen sustained through the negligence of fellow employees. This is the first decision on the statute in New York State, and was rendered in the case of Patrick Lancer, who was injured while at work on the steamship *Columbia* through a skid which he alleged was improperly placed. A similar statute has been upheld in Illinois, but has been declared unconstitutional by Federal judges in Georgia and Kentucky. The law will doubtless eventually go to the United States Supreme Court for settlement.

THE EICKEMEYER PATENT.—In the United States Circuit Court for the Northern District of New York, Judge Ray has handed down an opinion in the case of the General Electric Company vs. Wilbur F. Corliss et al., trading under the name of Corliss, Coon & Company upon Eickemeyer patent No. 677,308, granted June 25, 1901. This suit was brought by the General Electric Company to restrain Corliss, Coon & Company, Cohoes, N. Y., from further infringement of Eickemeyer patent No. 677,308 in the use of some induction motors manufactured by the Allis-Chalmers Company. The feature of these motors which formed the basis of the suit was the relation between the number of slots in the field and the number of slots in the armature whereby all dead points or locking positions are eliminated from the motor. This feature is claimed to be essential to all commercial induction motors of any size. The court holds that the patent is valid and infringed by the defendants.

THE CENTER OF A PUBLIC STREET NOT A PROPER PLACE FOR THE ERECTION OF AN ELECTRIC LIGHTING PLANT.—The municipality of Trenton, Mich., acting through its Council and Board of Water Commissioners, caused to be erected in the center of St. Joseph Avenue a building [illegible] feet, to be used for the installation and erection of an electric lighting plant. This innovation was not approved by the residents of the neighborhood, who claimed to have suffered great inconvenience and annoyance from the large volumes of smoke and soot emitted from the smokestack of the plant, and the noises of a large steam whistle blown each day. An action was brought by one of the sufferers in an attempt to bring about the removal of the obnoxious structure. It was held that the municipality had made an improper use of the street and that the building could not remain. Municipal corporations, notwithstanding their broad and comprehensive powers, have no right, unless authorized by the Legislature, to encumber their streets or devote them to any use other than the right of the general public and the abutting landowners. The municipality holds the streets and the power to regulate and control them in trust for the public and cannot put them to any use [illegible]

[illegible] streets for the erection of municipal buildings or works, and it has been held that the placing of a stand pipe in a public street, the fee of which was in the municipality, was an unlawful use of the street. McIllhinny vs. [illegible] N. W. Rep. [illegible]

LOWEST BIDDER ON CONTRACT TO FURNISH CITY WITH ELECTRIC LIGHT CANNOT COMPEL CITY TO EXECUTE AGREEMENT.—[illegible] electric light and bids have been submitted thereunder the lowest bidder cannot, as a matter of right, compel the city to enter into an agreement with him in accordance with the terms of his bid. This is a recent holding of the Supreme Court of Wisconsin. The charter of the city of Oconto provides that "all work for the city or either ward thereof shall be let by contract to the lowest responsible reasonable bidder." Pursuant to the direction of this provision, the city advertised for bids for furnishing 50 arc lights, more or less, and received responses from two parties. The plaintiff underbid the other competitor, but both bids were rejected and a new advertisement was prepared. This was repeated several times, the plaintiff each time submitting a lower bid than that of the other bidder, until the plaintiff finally instituted action to compel the city to accept its bid. The plaintiff, of course, gained no legal rights upon the submission of the lowest bid, for there could be no contract until the bid was accepted. The plaintiff contended, however, that a clear public duty was imposed by law upon the city to enter into a contract with the lowest bidder. But the court held to the contrary. The taking of bids upon a particular plan may well be merely to acquire information as to feasibility or cost of that plan as a basis for intelligent decision whether that or some other is the more desirable. The Council, having ascertained the price at which they can obtain arc lighting by contract, owes to the public the duty to consider whether some other type of illuminant may not be for the public benefit; also whether the city might not better install its own lighting plant. For these reasons it was held that there was no duty upon the city to enter into a contract with the plaintiff. People's Land & Manufacturing Company vs. Holt, Mayor, etc., 111 N. W. Rep. 1106.

INJURY TO TELEPHONE LINEMAN FROM CONTACT WITH DEFECTIVE ELECTRIC LIGHT WIRE.—The plaintiff, an employee of the New England Telephone & Telegraph Company, was injured as a result of coming in contact with a wire belonging to the defendant, the Gloucester Electric Company. The two companies maintained lines of telegraph poles along the street in Gloucester, Mass., in which the accident occurred. At the time of the injury the plaintiff was ascending one of the telephone company's poles for the purpose of assisting in the stringing of a cable. An electric wire of the lighting company passed within 4 or 5 inches of the pole upon which the plaintiff was at work. The plaintiff testified that, while climbing the pole at a point near the defendant's wire, he felt the pole sway. This was all that he remembered, but it was shown by other witnesses that the insulation of the electric light wire was worn off at the place where it passed the pole in question. The defendant claimed that the liability of electric wires to get out of repair is so well understood by experienced linemen, and the danger is so well within their knowledge, that the lineman should be held to assume the risk of the danger incident thereto, but that the doctrine of assumption of risk is applicable only as between employer and employee and the injured lineman was not in the employ of the defendant company. Another defense was that the plaintiff was guilty of contributory negligence in voluntarily bringing himself in contact with the live wire, without even the safeguard of a safety belt. But the court ruled against the defendant company on this question also. A decision in favor of the plaintiff, however, was reversed on the ground that the trial judge, in his instruction to the jury, made it possible for them to determine upon a verdict with reference to the particular plaintiff and his own situation, and not by the standard of what a man of ordinary prudence would have done under the same circumstances. Gloucester Electric Company vs. Dover, United States Circuit Court of Appeals, 153 Fed. Rep. 139.

Obituary.

MR. H. H. BARNHORN.—We regret to note advices from Cincinnati of the death of Mr. Henry H. Barnhorn, secretary of the Cincinnati Gas & Electric Company. He was a twin brother of Mr. Clement Barnhorn, the well-known sculptor. He was a graduate of St. Francis Xavier College and was connected also at the time of his death with the *Catholic Telegraph*.

MR. R. M. HOAGLAND.—The Minneapolis *Journal* of July 13 says: "R. M. Hoagland, electrical engineer, of the class of '07 at the University of Minnesota, was drowned yesterday at Canyon Ferry, Mont. News of the accident was received by his father, Roger Hoagland, of Minneapolis, last night. Mr. Hoagland left three weeks ago to take a position with the Missouri River Power Company. He was helping to place a flashboard upon the dam when a pulley on the plank on which he was standing threw him into the water. He was swept over the dam and drowned."

Personal.

MR. J. W. WHITE has been appointed superintendent of the Nevada-California Power Company at Goldfield, Nev.

MR. JOHN F. STEVENS, formerly Panama Canal engineer, has been appointed a vice-president of the New Haven Road by President Charles S. Mellen. He will have charge of all matters pertaining to the operation of the system and reports to Mr. Mellen, thus acting as his right-hand man in managing the general operative departments of the road. At present he is engaged in the revaluation of the entire property of the New Haven Road. This work will be completed by Aug. 1, when Mr. Stevens takes up his duties as a vice-president, with offices in New York City.

MR. H. GILLAM, formerly with the Westinghouse Company, has been appointed electrical superintendent of the New York, New Haven & Hartford Railroad, with headquarters at Stamford, Conn. He will have general jurisdiction over the maintenance and operation of electric transmission lines, with accessories, power houses and electric locomotives of the New York division. Mr. C. L. Peterson has been appointed chief engineer of the power station, in charge of the operation of the maintenance of station equipment, and Mr. J. C. Welch has been appointed to have charge of the maintenance and operation of electric locomotives.

Trade Publications.

H. B. CAMP COMPANY has issued a large and tasteful card folder illustrative of the use of its clay conduits at Charleroi, Belgium, on a handsome thoroughfare.

WATT-HOUR METERS.—High-tongue induction type watt-hour meters for single-phase work are fully described in Bulletin No. 4498 of the General Electric Company.

AUTOMATIC TIME SWITCH.—Leslie C. Dorland & Company, Poughkeepsie, N. Y., devote a pamphlet to a description of the Dorland automatic time switch. The switch is illustrated in detail and instructions for its operation are included.

TANTALUM LAMPS.—The tantalum lamp, having a specific power consumption of 2 watts per candle, with an average useful life of 700 hours on direct current, is described in detail in Bulletin No. 4451 of the General Electric Company.

INSULATING MATERIAL.—The Massachusetts Chemical Company has issued a loose-leaf catalogue and price list of insulating materials, including liquids and compounds, tapes and molded rubber goods. A special publication of the same company gives specific instructions for insulating armatures and field coils.

PAISTE APPLIANCES.—Bulletin No. 45 (July, 1907) of H. T. Paiste & Company, Philadelphia, contains an instructive article on electric light wiring, including hints as to the color of fittings in show windows. Elsewhere the bulletin describes and illustrates the Paiste "Pony" rosettes, panel cut-outs and entrance switches and switch-boxes.

LOCUST PINS.—The F. Bissell Company, Toledo, Ohio, has issued a circular entitled the "King Pin," which sets forth the advantages of the locust pin. A table is given of tests made by the Forest Service of the United States Department of Agriculture, showing that the locust pin is much superior in strength to oak, elm and birch pins tested in comparison.

STEAM SPECIALTIES.—In issuing a pamphlet to review briefly some of its more important lines of valves, fittings and special appliances, the Crane Company, Chicago, Ill., announces that a revised complete pocket catalogue showing its entire line of manufacture is in course of preparation and will be furnished as soon as possible after completion.

SINGLE-PHASE MOTORS.—The Advance Electric Company, St. Louis, describes in Bulletin No. 3 its new type of single-phase motor. The rotor has two sets of windings, one consisting of bare copper bars embedded in the core and short-circuited, and the other an insulated winding near the surface of the core, which is connected with a commutator which is short-circuited through a set of brushes.

DATA ON INSULATING MATERIALS.—With this title the Dielectric Manufacturing Company, of St. Louis, has issued a bulletin giving a large number of curves showing the dielectric strength of various insulating materials under normal and other conditions. The pamphlet includes a talk by Mr. J. J. Kessler to the salesmen of one of the companies handling Dielectric products which is a model of commercial exposition of a technical subject.

TUNGSTEN LAMPS.—Bulletin No. 4504 of the General Electric Company, Schenectady, N. Y., deals with the tungsten filament lamp for street lighting. The lamps are designed for either 40 or 50 cp for e. m. f.'s ranging from 7.2 to 20.25, and are intended for operation in series. The specific power consumption varies from 1.25 to 1.5 watts per candle. The life is estimated at 1000 hours, during which time the saving over a 3.5-watt carbon lamp would be 88 kw-hours per lamp.

WIRE MARKET NEWS.—The June issue of the "Wire Market News," published by the Western Wire Sales Company, of Chicago, Ill., contains several interesting articles on copper and the copper situation; statistics bearing on the copper metal supply, estimated increase in copper for 1907, etc. There are also two articles, one on "Why it costs more to roll 26-cent copper than cheaper material," and the other "Revolution in underground transmission work." The latter article fully describes the invention of Mr. Oliver T. Hungerford, to obviate conduits for underground work.

GRAPHITIZED FILAMENT LAMP.—The General Electric Company, Schenectady, N. Y., [illegible] Bulletin No. [illegible] descriptive of the Gem 50-watt, 20-cp lamp. The filament is obtained from the ordinary carbon filament by subjecting it to the intense heat of the electric [illegible]

fractory and capable of withstanding a materially higher temperature for a given life and deterioration. The higher temperature thus permitted gives increased lighting efficiency with a saving of 20 per cent in the specific power consumption over that required by the ordinary carbon filament lamps.

RAILWAY INVESTMENTS.—The Moody Corporation, which issues "Moody's Manual," has just brought out "American Railways as Investments," by Carl Snyder. This book is designed for the use of investment buyers, bankers and brokers. There is an elaborate introduction, dealing in the simplest and clearest manner with the whole subject of railway investment. The main body of the book is devoted to separate analyses of the important railway companies, including 90 per cent of the total trackage of the United States and Canada. The chapters on each railroad follow the same general scheme of analysis, so that comparisons can be made quickly and accurately. Mr. Snyder is well known as a scientific writer, and his recent book on "The World Machine," summing up present astronomy and knowledge of the physical universe, has excited a great amount of well-deserved attention and praise.

FEED WATER HEATERS.—A booklet summarizing what a Cochrane feed-water heater is and what it does, is being distributed by the Harrison Safety Boiler Works, of Philadelphia. It shows that the Cochrane open feed-water heater will often save about 16 per cent of the coal bill, one-sixth of the water bill, improve the quality of the boiler feed supply, and increase the capacity of the boilers by one-sixth and supply hot water, not only for boiler feeding, but also for other purposes about industrial plants, as washing, dyeing etc. Examples are given of applications at coal mines, paper mills, in condensing and non-condensing plants, and in steam power plants generally. The Cochrane oil separators, which make it possible to use exhaust steam for every purpose to which live steam of the same temperature could be applied, as for heating and drying, are also described and illustrated. To those who are interested, the Harrison Safety Boiler Works will supply more detailed information relating to the special conditions involved, and showing the saving to be expected in any particular plant.

RHEOSTAT SWITCHES.—Electrically operated ratchet driven rheostat switches have several advantages. In Bulletin No. 4510 recently issued by the transformer department of the General Electric Company, New York, these advantages are pointed out, and a description given of a simple, compact and efficient form of rheostat switch now being placed on the market. The switch is operated by a single-pole, double-throw knife switch on the switchboard. The switch arm is mounted on the axle of a wheel with a knurled rim and rotated by means of pawls, which engage the rim of the wheel. A core actuated by two solenoids moves the pawls to the right or left, depending upon which solenoid is energized, and the solenoids are connected directly to the double-throw knife switch on the switchboard. Means are provided to automatically make and break the circuit and thereby maintain a continuous step-by-step motion as long as the knife switch is closed, and automatic stops prevent running over after the switch arm has arrived at the end of its travel.

Business Notes.

THE ATLAS ENGINE WORKS have appointed Mr. Otto Dreckmann, Jr., as manager of their direct sales office at St. Louis, with offices in the Chemical Building.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, Pa., has changed its Chicago office and will hereafter be represented in that city by the Minerallac Company, 839 Monadnock Block.

ROTH BROTHERS & COMPANY, manufacturers of dynamos, motors and special electrical machinery, with headquarters in Chicago, have opened an office at the Electrical Exchange Building, 136 Liberty Street, New York, with Mr. George F. Schminke as manager.

THE PHOENIX GLASS COMPANY, of Pittsburg, New York and Chicago, is distributing to its friends a very attractive silver watch fob, embodying the handsome design on the one side of a Phoenix rising from the ashes and on the other side the name and address of the company.

WHITE STAR OIL FILTERS continue in brisk demand, and this fact proves to the Pittsburgh Gauge & Supply Company, Pittsburgh, Pa., that prosperity still shows no sign of a let-up. Among concerns that have purchased these filters the past month are the following: Walter Baker Company, Boston, Mass.; Union Ice Company, Quinnimont, W. Va.; Canton Home Brewing Company, Canton, Ohio; American Cast Iron Pipe Company, Birmingham, Ala.; Pittsburgh-Buffalo Company, Burgettstown, Pa.; Anniston Fertilizer Company, Anniston, Ala.; Ivanhoe Furnace Company, Ivanhoe, Va.; Atlantic Suburban Electric Company, Atlantic City, N. J.; Taunton-New Bedford Copper Company, New Bedford, Mass.; Schenley Hotel, Pittsburgh, Pa.; West Virginia Brewing Company, Central City, W. Va.; Southern Steel Company, Ensley, Ala.; Crystal Laundry Company, Cumberland, Md.; Tennessee Coal, Iron & Railroad Company, Ensley, Ala.; Columbian Canning Company, Lubec, Maine; Flynn Lumber Company, Swiss, W. Va.; McGhee Lumber Company, Dallas, Fla.; Alton Paving, B. & F. B. Company, Alton, Ill.; Evansville Brewing Association, Evansville, Ind.; Electrical Development Company, Niagara Falls, Ont.; Jond Westwick & Son, Galena, Ill.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 16, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

859,909. TELEPHONE ATTACHMENT; Arne H. Berg, Clarkfield, Minn. App. filed April 23, 1907. In a device of the character described, a telephone hook, and a mechanically operated signal, adapted to be actuated when the receiver is removed from said hook.

859,923. ELECTRIC CONDENSER; Clarence Z. Davis, Buffalo N. Y. App. filed May 13, 1907. Relates to construction of condenser having strips of tinfoil in the form of a roll and sheet metal strips forming clamps to hold the same at the ends thereof.

859,948. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 15, 1906. Relates to a form of receiver for telegraph instruments making use of a hot wire. Operates similar to what has been used in telephony. Employs a recording tape.

859,949. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 23, 1906. Provides an instrument, such as a siphon recorder, for the purpose of either receiving transmitted impulses by sound or relaying the same to other lines.

859,950. SYSTEM FOR AUTOMATIC SIGNALING; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 11, 1907. Covers improvements in systems for automatic signaling and more especially for signaling in connection with railways to enable crews of trains or cars traveling either in the same or opposite directions to readily determine the location of each other with respect to the danger zone.

860,001. SHIP'S TELEGRAPHY; Richard D. White, Washington, D. C. App. filed Aug. 2, 1906. Means whereby a single operator can telegraph to a number of gun's crews, details as to ranges and deflections, to provide for which the sights should be set, and in which the signal to each particular gun shall be repeated at a central station.

860,014. OUTLET-BOX; William H. Colgan, Newton, Mass. App. filed Jan. 26, 1907. Construction of outlet or wall box by which the conduit may be locked to the wall of the box or plate and held against rearward dislocation.

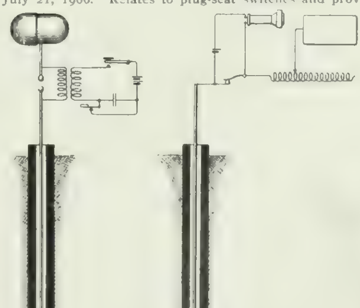
860,016. SUBSTATION PROTECTOR. A single piece of insulating material provided with a bore, an inclosed fuse carried within the said bore and provided with suitable terminals, a thermal protector and a lightning arrester inserted into the said piece of insulating material and electrically connected with one terminal of the fuse.

860,025. GUARD FOR THE MOUTHPIECES OF TELEPHONE-TRANSMITTERS; Gerhardt E. Grimm, Philadelphia, Pa. Filed May 26, 1906. A telephone guard, comprising a strip or plate bent intermediate its ends to provide a cylindrical housing at one end of the guard, the leaves of the strip or plate having registering openings, and means for securing the guard in place on the mouthpiece of a transmitter.

860,051. CONSTRUCTING ANTENNÆ OF WIRELESS TELEGRAPHY; Joseph Murgas, Wilkes-Barre, Pa. App. filed Feb. [illegible], 1906. A wireless telegraph station comprising a wave apparatus and an antenna connected to the wave apparatus between the apparatus and the earth, extending into the earth and insulated from the latter.

860,057. ELECTRIC TERMINAL; George D. Pogue, St. Louis, Mo. App. filed Nov. 22, 1906. Has clamping jaws and a terminal with a fastening device, and a plate between said jaws and provided with an opening for the passage of said fastening device, and a flange carried by said plate and closing the opening in said jaws.

860,070. PLUG-SEAT SWITCH; Ernest E. Yaxley, Chicago, Ill. App. filed July 21, 1906. Relates to plug-seat switches and provides a bell-



860,051.—Constructing Antennæ of Wireless Telegraphy.

crank lever pivoted at its elbow, one end of the lever being operated by the plug.

860,072. MEANS FOR REMOVING ICE FROM TROLLEY WIRES; Charles E. Atkinson, Richmond, Ind. App. filed Jan. 8, 1906. Mechanical construction for expeditiously removing electrical impediments from line wires employed in carrying electrical currents in the propulsion of electrical vehicles where a direct contact is necessary at all points along the line.

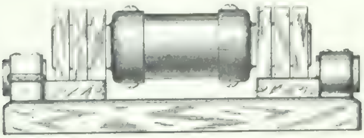
860,104. AUTOMATIC STARTER FOR ELECTRIC MOTORS; William C. O'Brien, Baltimore, Md. App. filed April 19, 1905. An au- [illegible] ated arm which trips a row of contactors into successive operation.

[illegible]. TROLLEY HARP; [illegible] filed Oct. 20, 1906. The trolley harp is made in the form of a separate section pivoted to have a vertical oscillatory movement at the upper end of the pole.

860,117. BASE-FASTENING DEVICE FOR ELECTRICAL APPARATUS; Louis Bates, Hoboken, N. J. App. filed July 9, 1906. Has means for preventing the accidental formation of an arc on the back of the non-conductive base of a switch. The cavities for the various fastening devices do not extend clear through the base.

860,124. SWITCH; Donald M. Bliss, Brookline, Mass. App. filed July 14, 1905. Relates to an induction motor of the single-phase type, in which the motor is rendered self-starting by means of phase displacement.

860,132. SIGNAL-DROP; Henry J. Heeney, Boston, Mass. App. filed Sept. 17, 1906. Relates to a signal drop of the kind commonly used



860,057.—Electric Terminal

in connection with telephone switchboards, and aims to provide a drop which cannot be accidentally operated by shocks or vibrations.

860,153. LAMP-SOCKET; Robert Rowley, New York, N. Y. App. filed April 13, 1906. Has an electromagnetically operated switch within the socket whereby the lamp may be operated from a distant point.

860,157. LIGHTNING-ARRESTING SWITCH; Washington D. Shirk, Fairfield, Iowa. App. filed Feb. 28, 1906. Form of lightning arrester switch having carbons with relatively large surfaces to afford a free escape of excessive currents and at the same time minimize the possibility of any injury being done.

860,163. SIGNAL FOR PRESSURE-GAUGES; John B. Townsend, Wellford, W. Va. App. filed Jan. 29, 1907. Details of construction of a pressure gauge switch having a contact roller engaged by an interrupted contacting roller surface.

860,175. TELEPHONE SYSTEM; David H. Wilson, Chicago, Ill. App. filed Oct. 29, 1904. A telephone system comprising a series of telephone instruments, a bridge circuit associated with each intrument and normally open when the talking circuit is completed, and means in the circuit of each telephone instrument for automatically closing the bridge circuit during the signaling operation.

860,179. ELECTRIC HEATER; Edward H. Abbott, Los Angeles, Cal. App. filed Dec. 19, 1905. Features of construction of a heater having a cylindrical casing with vertical insulating tubes spirally wrapped with resistance wire. The circulation of air through the tubes keeps the resistance element cool.

860,195. STORAGE-BATTERY ELECTRODE; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed April 28, 1905. An electrode unit for alkaline storage batteries, comprising a perforated tubular longitudinally corrugated metallic insoluble inclosing pocket, having active material therein under elastic pressure and affording the entire support for the active material, substantially as set forth.

860,206. ALARM AND SIGNAL MECHANISM; Ellsworth E. Flora and Robert J. Zorge, Chicago, Ill. App. filed Oct. 11, 1906. Provides means which will position a torpedo in the path of a train when a switch is left in improper relation.

860,229. TROLLEY STAND; James H. McPherson, Haverhill, Mass. App. filed Jan. 31, 1907. Provides a form of trolley stand in which the upward pressure caused by the lifting spring upon the trolley wheel is decreased as the pole is lowered. Has means for adjusting the leverage through which the spring acts so that it may be caused to exert its maximum effect in pressing the trolley wheel upward while in a predetermined position and to exert its minimum effect of pressing it upward in another position.

860,291. STORAGE BATTERY; William Gardiner, Chicago, Ill. App. filed May 20, 1905. Construction of storage battery plate in which the maximum area of active material is presented to the action of the battery solution without allowing the loose articles to settle into the bottom of the cell. Has U-shaped perforated lead plates bent together and filled with active material.

860,305. ELECTRIC-CURRENT REGULATOR; David R. Knapp, Philadelphia, Pa., and Howard E. Cade, Pencoyd, Pa. App. filed Nov. 24, 1905. Details of apparatus for automatically controlling and regulating the charging and discharging voltage of a storage battery.

860,362. LAMP-HOLDER; William J. Phelps, Detroit, Mich. App. filed Dec. 20, 1902. Construction of lamp-holder adapted for supporting ordinary lamps, but which is particularly adapted for use in connection with turn-down lamps in which devices for modifying the flow of current to the separate filaments of the lamp are carried by the holder itself and actuated by the ordinary switch key.

860,369. PLUG-SWITCH; Earl C. Eldredge, Springfield, Mass. App. [illegible] adapted for automobiles having a battery and magneto generator as alternative sources of current.

860,432. ELECTRIC SWITCH; Johan M. Andersen, Boston, Mass. App. filed Oct. 13, 1905. A switch having its different parts standardized so that different forms of switches may be made from the same parts at a minimum cost and without decreasing the efficiency of the switches.

[illegible]. OPERATING MECHANISM FOR ELECTRIC SWITCHES; [illegible] M. Andersen, Boston, Mass. App. filed March 30, 1907. Apparatus for operating the movable member of substantially large electric switches, such as are impelled in circuits carrying high-tension currents.

[illegible]. FIRE-ALARM; [illegible] Mass. App. filed Dec. 3, 1906. Has a spring impelled member normally restrained by a flexible strip of fusible material which melts or stretches under undue heat.

[illegible]. BRANCH-BOX; [illegible] particularly applicable [illegible]

[illegible]

[illegible]. METHOD OF AND MEANS FOR [illegible] ELECTRIC [illegible] [illegible]

[illegible]. ELECTRIC CUT-OUT; [illegible] service conductor, and means for normally maintaining said spring member to form a continuation of the service conductor.

860,482. CONTACT PLUG FOR SOCKETS FOR ELECTRIC LAMP; Frederick W. Jaeger and Gustav A. Landsee, Milwaukee, Wis. App. filed May [illegible] members provided with spring arms and means adapted to be manually actuated for spreading said plug members, and an automatically retained contact plunger co-operating with said screw-threaded members.

[illegible]. TROLLEY-WIRE HANGER; [illegible] N. Y. App. filed June 20, 1906. Covers improvements in hanging or suspending devices for overhead trolley wires, and particularly to that class known as the double-catenary suspension. Construction in which the side bars and spreader bar of the hanger are easily adjustable [illegible]

860,532. CIRCUIT-CLOSING DEVICE; Roy C. Cram, Bridgeport, and Charles L. Graves, Milford, Conn. App. filed Aug. 2, 1906. A switch having a pivoted switch arm and adapted to hang vertically and normally so held by yielding means. Has one or more switch levers weighted at one end with liquid retarding means therefor.

860,560. AUTOMATIC FIRE-EXTINGUISHER SUPERVISORY SYSTEM; James G. Nolen, Chicago, Ill. App. filed Sept. 11, 1902. Relates to automatic fire-extinguisher supervisory systems and has means whereby the supervision may be obtained from a plurality of such systems by a central station in order that they may be maintained constantly in effective condition.

[illegible]. ART OF RAILWAY SIGNALING; [illegible] ford, and Edward F. Latimer and William Grunow, Jr., Bridgeport, Conn. App. filed Aug. 2, 1906. System for effecting the movement of [illegible] opposite directions, whereby cars or trains may enter a definite section of the [illegible] ber, the first car to enter such section effecting the operation of signals at both ends of the section giving definite indication, and the suceeding cars giving additional indications to show the number thereof.

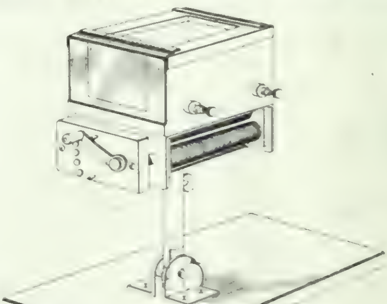
[illegible]. ELECTRIC INCANDESCENT LAMP AND CONNECTION THEREFOR; William J. Phelps, Detroit, Mich. App. filed Sept. 10, 1902. An electric incandescent lamp provided with a base having terminals for the reception of current from a suitable lamp-holder, said base having coupling devices about its outer normally projecting end, said coupling devices being electrically connected with the lamp terminals.

860,572. MEANS FOR CONTROLLING ELECTRIC-CURRENT-DISTRIBUTING SYSTEMS; Joseph L. Routin, Lyons, France. App. filed Dec. 15, 1905. A special arrangement for use in cases where a plurality of generators in parallel supply alternating currents, and by which periodical oscillations or hunting of the regulating mechanism is prevented.

860,587. ELECTRIC FURNACE; Ross C. Unger, Cleveland, Ohio. App. filed July 25, 1906. An electrical furnace comprising a casing having refractory linings and a granular resistance material located on the bottom of the furnace [illegible] retaining such resistance material in place.

860,601. ARRANGEMENT OF THE FILAMENT FOR HIGH-VOLTAGE INCANDESCENT ELECTRIC LAMPS OF HIGH EFFICIENCY; Carl Glogau, Stuttgart, Germany. App. filed May 17, 1907. Construction of support for tantalum filaments.

860,605. FIRE PROTECTION SYSTEM; James G. Nolen, Chicago, Ill. App. filed Sept. [illegible]



[illegible]

[illegible]

860,606. SAFETY-FUSE; Franz Oprendek, Vienna, Austria-Hungary. [illegible]

12,672. ELECTROLYTIC CELL; George A. Gabriel, New York, N. Y. [illegible]

Electrical World

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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During 1906 Electrical World *printed and circulated* 970,000 *copies, an average of* 18,827 *copies per week. Of this issue* 25.000 *copies are printed.*

NEW YORK, SATURDAY, AUGUST 3, 1907.

CONTENTS.

The Illuminating Engineering Convention.

The convention of the Illuminating Engineering Society, which has been held at Boston the past week, emphasizes the remarkable movement of the past 18 months. Although the society is not by any means confined to electric illumination, a very large percentage of its support is derived from electrical men and especially from those connected with central-station work. The rapid growth of this new society is one of the most remarkable episodes in the history of technical organizations. The society was started in January, 1906, and now has in the neighborhood of 1000 members. When one considers how long it took other engineering organizations in the country to get a membership of 1000, this record is somewhat startling. The fact of the matter is, the design of illumination was for a number of years previous to the organization of this society in a backward and undeveloped state. As far as electrical interests were concerned, nearly every man connected with the lighting industry assented readily to the proposition that the majority of electric light installations were wasteful, and ruinous to the eyes, and that there was chance for greater economy with a small expenditure, at this point, than anywhere else in the art of electric lighting. Nevertheless, few took it upon themselves to study the matter so as to remedy these conditions, and the amount of engineering data useful in the design of illumination was remarkably small. The sudden growth of interest in illuminating engineering among electric lighting men is due fundamentally to its importance to the industry.

We have, as our readers know, been actively stirring up interest in the matter and giving many practical and specific suggestions along these new engineering lines the past two years, and are glad to have been a factor in the promotion of this good work. The growth of the Illuminating Engineering Society would doubtless also have been much less rapid had it not been for the assistance of various companies engaged in the manufacture of illuminating appliances, the sale of which is dependent upon the dissemination of scientific knowledge in regard to illumination. This is nothing to the society's discredit, however. It has, on the contrary, been fortunate that corporations with a commercial interest at stake and with sufficient selling and publication bureaus have been able at one and the same time to further their own and those of the society by systematically doing everything possible to increase interest in scientific illumination. The transactions of the Illuminating Engineering Society even for this short period of 18 months, contain a great amount of valuable specific data on actual results obtained with various systems of lighting. This information is of the greatest service to the man who is planning new or overhauling old installations, and it is to be hoped and expected that the society will continue its services to the art along these distinctively useful lines

Growth of Electric Lighting.

Attention was recently called in these pages to the fact that the electric street railway earnings in this country are now in excess of $360,000,000; say about $1,000,000 a day. It is well known that street railways constitute by far the largest field of electrical effort, but there is reason to believe that electric lighting as an industry is growing more rapidly. The rate of increase in street railway earnings appears to be very close to 10 per cent annually. But in electric lighting, gains of 20, 25 and 30 per cent reported by central-station companies have been quite common, and they are supported by other statistics. In his recent excellent paper before the National Electrical Contractors' Association, Mr. J. R. Crouse, Jr., in speaking of the effects of the campaign of cooperative development with which his name is so worthily identified, stated that incandescent lamp sales had increased 20 per cent in 1906 over the preceding year, and so far in this year are 25 per cent over the corresponding period of 1906. Moreover, the gain of the central-station systems may easily be, and doubtless is, greater than that in lamp production, for the reason that the tendency to establish isolated plants has been definitely checked by the extension of circuits and the lower prices of electrical energy.

Narrowing these hints and suggestive data down to a practical point, we may note that our estimate at the beginning of the year of $360,000,000 street railway earnings was accompanied by one of $175,000,000 for electric lighting systems. The latter figure is probably also quite near the mark. But in view of the rate of growth being in one instance at least twice as great as in the other, it should not be many years before central stations will also be earning $360,000,000 a year. When they do that the industry will necessarily be deeply affected and modified by such a gigantic income; and we see no reason even in the use of 1-watt lamps, for apprehending any falling off in the rate at which the production of electrical energy is now gaining all over the country.

Novel Hydro-Electric Plant Construction.

The peculiar feature of the recently completed hydro-electric plant on the Patapsco River near Ilchester, Md., described elsewhere in this issue, is that the power plant is entirely submerged. At first blush, this statement appears incredible; but when cognizance is taken of the fact that the power plant is located within the dam itself, incredibility gives place to credibility, and on closer examination of details, to admiration for the masterly solution of the problem involved. The station is the first of its kind ever built, but with the rapid and extended use of reinforced concrete and the practicability of the scheme for spillways over 30 ft. high, it seems safe to predict that it will not long retain the distinction of being the only example of its kind. The advantages of the arrangement where cost and site are paramount considerations, are readily apparent. The same structure serves as dam and power house; the available fall is utilized, and with slight modifications the suction force of the spillway water as it rushes over the mouth of the tail race may be employed to increase the effective head by lowering the water level in the race well. With power houses as ordinarily constructed below the dam, the contrary effect obtains.

Abundant natural light is obtained through windows located on the down-stream side of the dam beneath the falls, and natural ventilation is also provided. The alternators when under load furnish sufficient heat to dispel any dampness that may manifest itself; and although somewhat restricted as to space, the power house is as comfortable as any other station building of like capabilities.

The structure represents the latest development in dam design. Heretofore solid masonry was considered the only safe and permanent device to impound water, reliance being placed on the enormous weight of the dam to resist the water pressure. In the dam under consideration, the water pressure is utilized to maintain its position, the up-stream side being so proportioned and shaped that the weight of the water upon it equals the horizontal pressure component. The dam is merely a shell in which the necessary rigidity and strength are secured by a very small fraction of the quantity of material needed in the former construction. The deck and apron are supported on buttresses and have a section just sufficient to resist bending under water pressure, a large factor of safety, of course, being allowed. The structure may be built in considerably less time than a solid dam, and the interior may be utilized as in the present instance for housing the electrical equipment.

The Localization of Faults in High-Tension Transmission Lines.

The localization of faults is a fine art in underground or in submarine telegraphy. There are men who are specially trained to that art. An inaccurate localization may involve much unnecessary expense. In overhead wire telegraphy, electrical localization to a lesser degree of refinement is often called for, and the same is true for underground electric light wires. In the great majority of cases of faults in electric lighting and power systems, the localization is not effected by measurements, but by switching sections of line on or off until the fault is determined within the limits of a single section, and this section is then either overhauled or removed. A paper by Mr. L. C. Nicholson, read at Niagara Falls, before the American Institute of Electrical Engineers on "Location of Broken Insulators and Other Transmission Line Troubles," deals with the localization of faults on 60,000-volt transmission circuits. In many of these faults the insulation is not found defective until the voltage rises nearly up to the normal working value, as, for example, when a broken insulator arcs over to ground, as soon as the working voltage is applied, but insulates effectively at slightly lowered voltage. The method consists essentially in using the generator switchboard connections and apparatus with the faulty line looped directly to a parallel good wire behind the generator switchboard and also at the distant end of the line. One star-branch of a three-phase group of high-tension transformers with grounded neutral point is then switched on the loop at the generator switchboard, and the readings of the ammeters on the good and faulty lines are simultaneously noted. In order to limit the current to ground through the fault, a suitable resistance has to be inserted at the switchboard.

A convenient adjustable resistance for a 60-kilovolt, 100-ampere current is not easy to construct, but the paper states that ordinary cement concrete columns, one square foot in cross section and 12 feet long, with expanded metal terminals make handy units. Four such columns, each having a cold resistance

of about 2000 ohms, are described as having been used in series-parallel combinations with advantage. It is clear, as pointed out in the paper, that if the ammeter readings on the good and faulty lines are equal, the fault is to be looked for at the distant end of the loop; while if, on the other hand, all the current is on the faulty wire, and none on the good wire, the fault may be looked for close by. In all cases, the "impedance drops" between the switchboard and fault must be equal along both wires. If the wires have the same size, and are at the same distances apart with respect to each other and to the ground, the impedance drops will be proportional to the resistance drops; otherwise corrections must be made for the differences in resistance and reactance. The advantage of this method of testing lies in the fact that it does not require special apparatus, or the loss of time necessary to run a number of testing leads. Not only is a 60-kilovolt transformer a novel kind of testing battery, but switchboard watt-hour meters are novel testing instruments.

Solar Energy and Temperature.

In the last number of the *Physical Review* Mr. W. W. Coblentz contributes an article upon solar radiation, which sums up what has recently been ascertained concerning the probable temperature of the sun and moon. It appears that the radiation power of the sun, at the surface of the earth, amounts to about 1.75 kw per square meter of perpendicularly exposed earth-surface. Of this, the books tell us about one-quarter is absorbed in the air, when the sun is at its zenith, or getting in his best work; so that what reaches the earth when the sun is overhead is, say, about 1.3 kw per square meter. In the temperate zones, where the sun is never vertically overhead, the layer of air passed through by the sun's rays is thicker and the absorption consequently greater, especially in early morning and late evening, so that a square meter of surface kept facing the sun all day long during a clear summer day might only receive an average radiation power of about 0.5 kw. Of course, the square meter would reflect away a large proportion of this power, if its surface were of polished metal, and even a dull black surface, like that of plumbago, would dissipate convectively the heat which it received, so that it is very hard to catch and utilize this radiated solar power. Nevertheless, if we could employ this power practically and conveniently, we should obtain an immense benefit. Thus, allowing that the noonday solar power on a bright day was 1 kw per square-meter of perpendicularly exposed surface, we should only have to expose a surface of 10 meters square in order to receive 100 kw; and if an efficiency of 50 per cent were imagined in the apparatus, we would be able to develop 50 kw during the brightest part of the day from a disk about 37 ft. in diameter.

The only solar engine which has yet been made successful is the waterfall. A fraction of the solar radiation energy reaching the surface of the earth is expended in converting surface ocean-water into steam or water-vapor and in raising that steam to an elevation among the clouds. Part of this energy is released in rainfall, and only an insignificantly small fraction of the rainfall occurs on elevated land in such a manner that a waterfall can be made available. There is at least one other type of solar engine possible, and that is a surface of chemical substance exposed to solar radiation and capable of being chemically transformed to a stable substance which will subsequently give up its energy for consumption. A grass meadow supporting horses is a crude form of such a machine. A small fraction of the incident solar energy is usefully absorbed by the chlorophyll in the grasses, permitting them to build up a hydrocarbon structure from an environment of gaseous water and carbon-dioxide. The horses consume and assimilate the grass, and each is capable of delivering a few kilowatt-hours a day of solar energy—an infinitesimal fraction of the total solar energy incident on the meadow. It might be possible to find a chemical substance much superior to chlorophyll as a recipient or storage material, and capable of releasing its energy in an electrical way. The paper shows that the surface temperature of the sun works out about 5980° absolute or 5707° C, each square meter of solar surface liberating apparently 67,600 kilowatts or not far from 100,000 horse-power. The effective temperature of the moon on the side facing the sun appears to be about 82° C. This shows how small a share of incident radiation energy a reflector can claim as commission for its duty. The moon is supposed to have little else to do, from a human utility standpoint, than to reflect radiation. She constantly receives a large total amount of radiation power, but is not able to raise her surface temperature thereby beyond about 100° C.

High-Tension Wires in Stations.

The question of enclosing high-tension wires in power houses and sub-stations received an interesting and at times an amusing discussion at the transmission meeting of the A. I. E. E. in Chicago. The discussion hinged on the amount of trouble and expense to which one is justified in going in enclosing high-tension wires with fire-proof barriers in stations and sub-stations. Although the consensus of opinion upheld the common practice of placing fire-proof barriers around all high-tension conductors in important power stations, there were some unorthodox views expressed as to future development, which are altogether likely to receive more consideration than they have recently, as commercial voltages keep rising and expenses of barrier protection for bus-bars in stations increase. The views expressed by Mr. P. M. Lincoln, chairman of the meeting, were to the effect that there are no satisfactory fire-proof insulating barriers for voltages of 60,000 and over, and that the tendency in the future will be to keep high-tension bus-bars, and, in fact, all high-tension apparatus except the instruments, outside of buildings as much as possible. Certain it is that at the present time the cost of high-tension bus-bar compartments in some of our highest voltage plants is running into formidable figures, and it is certainly worth while to stop and ask whether it is necessary that all of this work be kept indoors. When it comes to handling extremely high voltages, nothing is quite so good as ample air space between conductors. With ample air space in the open, the worst that can happen is a temporary arcing-across which may momentarily interrupt the service, but which is not likely to cause any such long shut-down for repairs as fireworks in enclosed bus-bar compartments where space is limited. The practice of running high-tension wires promiscuously around inside of stations and sub-stations without enclosing them is to be condemned. In large city systems where the e. m. f. is from 10,000 to 20,000 volts and employees are constantly working in the station where

room is limited, the fireproof barrier has great value simply as a mechanical protection against contact of employees with wires. The higher the voltages the less feasible it becomes to enclose them in this way, and the more important it is that plenty of room be allowed with wires and bus-bars kept entirely away from where employees are working. Such conditions are more easily obtained outdoors than indoors, and fortunately in places where extremely high voltages are used, there is usually plenty of outdoor space in which to apply the outdoor bus-bar idea.

Switchboard Practice for E. M. F.'s of 60 Kilovolts and Upwards.

It is partly in consequence of the rise in the price of copper during recent years that line voltages have steadily risen. A few years ago, 10 kilovolts was regarded as a high pressure. Then came 40 kilovolts, and 60 kilovolts. Now the pressure of 60 kilovolts has ceased to be remarkable, and we are facing the advent of 88 and 100 kilovolts. An A. I. E. E. paper by Mr. Stephen A. Hayes on the above topic illustrates the special changes which high-voltage transmission has already brought about in central-station switchboard design. The high-tension switch-room is a large hall, containing nothing but the transformers and switches. The most noticeable feature is the ample clearance between conductors, and the large number of high-tension insulators carrying cables that make as few curves as possible on their route to the overhead lines outside the building. The higher the voltage, the more elbow room and clearance. At 60 kilovolts, the floorspace in the switching room is about 1/10 square foot per kilowatt, while at 100 kilovolts, the floorspace is about ⅕ square foot per kilowatt. No one is supposed to enter the high-tension switching house while the plant is at work, and all the circuit-breakers are operated automatically from a distant switchboard. It is pointed out in the paper that it is intended to dispense with the walls of the switching house altogether in the future, where the climatic conditions will permit, and place the transformers, circuit-breakers, etc., in the open air. Since the transformers, choke-coils and circuit-breakers all operate under oil in strong metallic cases, there is no reason why these devices could not all be designed with weatherproof covers for out-of-door location. The lightning-arresters are perhaps the only devices that call for shelter, and a roomy type of sentry box could be allowed for them. The transfer of the switching plant to an out-of-door location would certainly aid in securing more room and clearance between conductors. So far as the pilot switchboard is concerned, with all its measuring instruments on the low-tension side, there is but little difference whether the line voltage be 11 kilovolts or 100 kilovolts.

The paper advocates, in general, the use of the open system of high-tension wiring, rather than the enclosed system. In the enclosed system, all of the bus-bars, leads, circuit-breakers, etc., are in separate channels or compartments of masonry, the theory being that this interposition of brick or cement tends to prevent the formation or the maintenance of a short-circuiting arc. The advocates of the open system maintain, on the other hand, that the violence of a short-circuit arc depends upon the current flow and not on the voltage, that the masonry prevents good insulation, and prevents proper inspection and repair. The [illegible] the advocates of closed and open bus-bar construction resembles that which used to exist some years ago between the advocates of insulation and non-insulation for wiring. Everyone now admits that distributing wires, in buildings or out, should be insulated, or covered, when of low voltage. The reason is that such covering as is readily applied is adequate insulation and protection. As the voltage is raised, the insulating cover is first increased, but after a certain voltage is reached, it is generally admitted that it is useless to add to the insulation, and in fact that it is worse than useless to attempt to do so, because a considerable expense is added without benefit, and a false sense of security is given by the appearance of an insulating cover. So in regard to open and enclosed bus-bars, there is no doubt an advantage in bricking in the conductors and circuit-breakers up to a certain voltage. Above that voltage it is doubtful whether the cellular structure is of any assistance, and whether it may not even be more harmful than helpful, besides adding considerably to the expense. It seems likely, therefore, that up to 30 kilovolts, we may find new plants retain the enclosed structure for their bus-bars and switches, but that for pressures of 60 kilovolts and more, the open structure of conductors may be preferred. Whichever view of the situation an engineer may take, there can be no doubt that more high-tension systems will continually make their appearance. With the high-tensions will come the necessity for simplicity in the wiring and structure. Only by simplicity can reliability and permanence be ensured. There can be no doubt that the simplest kind of structure for high-tension bus-bars and wiring is one that is in plain sight at all times.

Central Station Smoke.

Recent government statistics noted in our columns have set serious limits to the supply of anthracite coal, which will apparently be quite beyond the reach of power plants of any kind within some fifty years, because it will then be very scarce and very dear. Even now bituminous coal is the main dependence of central stations; but its use in many cities is accompanied by considerable trouble on account of the attitude of various authorities, official or self constituted, and the consequence is we see frequently mention of litigation or complaint based on the "smoke nuisance." The New York Edison Company, for example, which uses enormous quantities of coal and which has been most zealous in its efforts to minimize smoke emission, has been a target for much abuse and not a few lawsuits that might be characterized as "strikes." We understand that its more recent investigations again promise great improvement in this direction of suppressing smoke. In fact, its stacks are notable for freedom from smoke, while one of the very worst offenders is the U. S. Government itself. In fact, as a writer on smokeless cities, in *Harper's Weekly*, says this week: "Smoke-preventing devices are being used by the large plants voluntarily. The campaign against the smoke nuisance does not affect them. From an economical point of view they are doing away with belching chimneys. They know too well that great clouds of drifting smoke indicate poor economy of operation through imperfect combustion. The smokeless stack is an indication of careful firing and imperfect combustion." This is the fact, and no man is more anxious for careful firing and complete combustion than your modern, progressive central-station manager.

New Jersey Development.

One of the most interesting examples in this country of electrical consolidation is afforded by New Jersey, which contains what is probably the largest unified system of light and traction to be found anywhere in the world. The Public Service Corporation has brought under one control and management the leading utilities of a very large portion of the state, and is now working out the problems that must necessarily arise with such a unification. The lighting department, carried on separately from the traction, presents many features of interest, and these are none the less worthy of study because Mr. Dudley Farrand, the president of the National Electric Light Association, is so intimately connected with that branch of the work. We are glad, therefore, to present in this issue in our sale-of-current section an article dealing with the Public Service methods of advertising and pushing its business. Everyone knows that a large amount of energy and ability has been applied to this work, and this brief, comprehensive description will be found more than usually suggestive to those dealing with similar situations in the great field of light, power and traction.

Locking Horns with Opportunity.

During the past month the city of Philadelphia was made the rendezvous for the members of the Order of Elks, and despite the torrid rigors known to that region in July, the occasion was celebrated with astounding vim and success. The interesting part of the affair to electrical people was the brilliant illumination, which must, with all moderation, be said to have constituted one of the finest spectacles of the kind ever seen on this continent. Yet it need not have been so; it might well have been otherwise; but the Philadelphia Edison Company locked horns with the opportunity and with the Elks in a very clever manner, and the result is noted elsewhere in our pages. The advertising in preparation for the affair was skilful, liberal concessions were made with the intent to arouse the public spirit of the storekeepers and the community; and Philadelphia may be proud of the splendid crescendo attained. Probably the company gained little or nothing directly from its effort, but the public eye has been educated to a new idea of the value of light and color which will unquestionably bring a great deal of hitherto undeveloped business in the near future. Boston is enjoying at the present time the same lesson and experience in connection with the Old Home festival.

Rational Central Station Rate Systems.

The letter from Mr. Henry L. Doherty on central station rates, printed elsewhere, and the 1892 paper by the late Dr. John Hopkinson to which it refers and which we reprint in this issue bring up reflections not at all favorable to the alertness of the central station business management of this country in the past. When our central stations were casting off the flat rate system of charging and adopting, not without trepidation, the meter-rate system, the rational method of charging which only at present is attaining a solid status on this side of the water, had already forged to the front in Great Britain. When, in 1892, Dr. Hopkinson read the paper above referred to, the system he advocated had already been applied at Manchester, and shortly after was adopted in many other British stations. As modified and energetically advocated by Mr. Arthur Wright, it became more widely known, and in this country the Hopkinson-Wright system was applied by the Chicago Edison Company, a decade or more ago. Yet the Hopkinson principle was almost entirely ignored in rate-making by our central-station men, even in discussion, until Mr. Doherty when a newcomer in the field, discovered and recognized its high value and with characteristic energy, proceeded at once to apply it and strongly advocate its merits. The recent general awakening of central stations and the spirit of progressiveness which now characterizes the industry, renders it probable that in one form or other the Hopkinson method will before long receive wide extension here, and, consequently, as pointed out by Mr. Doherty, it will be well for all central station men to read the originator's classical paper on the subject, which we reprint.

The application of the Hopkinson principle may be questioned on the ground of inexpediency in particular cases, but its fundamental soundness cannot be attacked, for it is based upon the solid ground of equally fair treatment to every class of central station customer, whether large or small user. Briefly, it divides the fixed or "stand-by" or "readiness-to-serve" plant cost among all customers in the proportion that each customer makes demand on the capacity of the plant; to which sum is added the actual operating cost, plus a profit, chargeable to the manufacture and distribution of the electricity used by each customer. To determine the exact details of such an equitable arrangement is a matter not unattended with difficulties, but any of the present systems based upon the Hopkinson principle, even if open to some objection in detail, is much more rational and fair to all customers than a straight meter rate. The Wright system of basing the fixed cost charge on the maximum demand made for current during the period for which bills are rendered, is perhaps the ideal application of the Hopkinson principle, and, indeed, was pronounced by Dr. Hopkinson to be an improvement on his own method of applying it at Manchester. The method advocated by Dr. Doherty, namely fixing the "readiness-to-serve" charge by the number of lamps connected, while less exact has the advantage of no cost for instruments and minimum complication in application. An improvement has been made to this method by Mr. Doherty by removing from the operating cost the average of the cost of meter reading and similar personal services practically the same for the largest and smallest user, and making on the bill a uniform charge for such service to all customers.

When Dr. Hopkinson announced his system, central station supply was practically for lighting service alone. Since then the motor load has become a matter of importance, and also more recently the use of electricity for cooking and heating. When the demand of these services extends over the time of peak load, there may be no more reason for making concessions in "stand-by" charges than in the cases of long-hour lighting. Yet since the equipment cost of a station is fixed by the peak load, and long-hour loads employ the equipment during periods when it would otherwise be idle some modification—or rather entension—of the Hopkinson system is indicated if the principle of equity in all charges is to be maintained. To meet such cases, the two-meter system has been advocated and applied to a limited extent, but is handicapped by its cost and complication. Almost all central stations have some of special system of rates for motor loads, empirical and otherwise, and the time seems ripe for the establishment of some general principles upon which to found a rational system of charging for non-peak motor, cooking, heating and sign load.

Copper Degraded to Lithium.

Recent cable dispatches from England intimate that Sir William Ramsay has resumed or made public, researches into the transmutation of metals, by means of radium emanations. Note of this work has already been made. A special dispatch of July 26, to the New York *Sun*, says: Sir William Ramsay, the distinguished chemist, is writing the results of his researches into radium emanations for the Chemical Society and they will be published at the end of August. This highly technical statement will set forth that he has succeeded in "degrading" copper to the first member of its family, that is, lithium.

This is heralded by the *Lancet* and some other papers as being tantamount to the discovery of the philosopher's stone of the ancient alchemists, and as the realization of the transmutation of metals. It will be recalled, however, that discussion of the transmutation of elements at the meeting of the British Association last year arising from the apparent production of helium from radium led to a vigorous controversy in which Lord Kelvin and other eminent men repudiated the transmutation idea, which was as strongly supported by Sir Oliver Lodge and others.

Sir William Ramsay's latest experiments do not seem likely to have settled these differences, but rather will awaken the discussion. The eminent chemist himself modestly disclaims ability to transmute elements, but he believes that the result of his "degradation" of copper will be of far-reaching importance. He makes the following declarations among others:

"From its inactivity it is probable that the radium emanation belongs to the helium series of elements. During its spontaneous change it parts with a relatively enormous amount of energy. The direction in which that energy is expended may be modified by circumstances.

"If the emanation is alone or in contact with hydrogen and oxygen gases a portion is decomposed or disintegrated by the energy given off by the rest. The gaseous substance produced is in this case helium. If, however, the distribution of the energy is modified by the presence of water that portion of the emanation which is decomposed yields neon, and if in the presence of copper sulphate, argon.

"Similarly, copper acted upon by the emanation is degraded to the first member of its group, namely, lithium. It is impossible to prove that sodium or potassium is formed, seeing that they were constituents of the glass vessel in which the solution was contained, but from analogy in the decomposition products of the emanation they may also be products of the degradation of copper."

The Electrical Jobbers' Convention.

The Electrical Jobbers' Association, for such the electrical supply dealers of the United States have named themselves, held its annual convention at the Clifton House, Niagara Falls, Canada, July 23, 24, 25 and 26. The attendance was large, delegates coming from such distant points as San Francisco and Los Angeles. The sessions were divided, some being for members only, and some were open meetings at which the manufacturers and others present were invited to participate. This served to harmonize matters and bring the jobber and manufacturer into closer relations.

The entertainments provided were many and varied. The opening day closed with a vaudeville and smoker, which went off splendidly. On Thursday a baseball game in the morning afforded great amusement to the spectators and was an immense financial success through the efforts of W. W. Low, of Chicago. On Thursday evening a banquet was given at the hotel and was attended by upwards of 300, including members and guests.

Among the manufacturers who sent representatives to the meeting were the following: Hemingray Glass Company, D. C. Hemingray; Eastern Carbon Works, E. J. Wilson; The Dale Company, H. S. Salt; V. C. Gilpin, V. C. Gilpin; Machado & Roller, F. W. Roller; National Carbon Company, Messrs. Carrier and Cotabish; Marshall Electric Company, Norman Marshall; Brookfield Glass Company, B. M. Downs; American Circular Loom Company, Oscar Hoppe, A. T. Clark and Alex Henderson; Condit Electrical Manufacturing Company, S. B. Condit, Jr.; Hart & Hegeman Manufacturing Company, Messrs. Searing and Morris; Harvey Hubbell, H. W. Bliven; H. W. Johns-Manville Company, J. W. Perry; Franklin Electrical Manufacturing Company, Charles I. Hills and P. S. Klees; Pass & Seymour, John W. Brooks; Crouse-Hinds Electric Company, H. B. Crouse and F. M. Hawkins; Safety Armorite Conduit Company, Robert Garland and F. C. Hodkinson; Brilliant Electric Company, E. J. Kulas; E. G. Bernard Company, E. G. Bernard; National Metal Molding Company, C. E. Corrigan and H. B. Kirkland; D. & W. Fuse Company, W. S. Sisson; Chase-Shawmut Company, H. P. Moore; R. B. Corey Company, Harry Adams; New York Insulated Wire Company, P. H. Hoover; American Conduit Manufacturing Company, T. H. Bibber; Bryan Marsh Company, E. H. Haughton; Holophane Glass Company, V. R. Lansingh; Shelby Electric Company, J. C. Fish; India Rubber & Gutta Percha Insulating Company, J. B. Olson; Arrow Electric Company, E. R. Grier; T. G. Grier Company, T. G. Grier; Couch & Seeley Company, E. B. Seeley; Buckeye Electric Company, L. P. Sawyer; Western Electric Company, E. W. Rockafellow and R. Edwards, Jr.; Stuart-Howland Company, G. M. Stuart; Perkins Electric Switch Manufacturing Company, Messrs. Bryant and Burton; Phillips Insulated Wire Company, H. O. Phillips and A. N. Palmer; Safety Insulated Wire & Cable Company, A. P. Eckert; C. S. Knowles, J. H. Parker; Pettingill-Andrews Company, C. B. Price; Hart Manufacturing Company, W. P. Crockett; Edison Manufacturing Company, William Brodie.

The Montreal Electrical Show.

The Montreal Electrical Show to be held in the Drill Hall, Sept. 2 to 14, 1907, promises to be one of the best exhibitions ever held in the Dominion of Canada and the best of its kind in 17 years. Montreal has not had an electrical show since 1890, when a small but excellent exhibition was held in one of the skating rinks.

The present show will be held in the Government Drill Hall, a building with 150 ft. x 275 ft. clear floor space, and it promises to be a successful undertaking. The promoters have worked hard and have induced the Canadian Electric Light Association, the Maritime Province Electric Light Association and the Canadian Street Railway Association to hold their annual conventions in Montreal during the time of the show instead of June and July as has been the custom heretofore. This means a large attendance of buyers of electric apparatus. Eight-tenths of the floor space has been disposed of and the balance spoken for. Among the exhibitors are: Dossert Company, Fibre Conduit Company, W. J. O'Leary & Company, Wire & Cable Company, Midland Electric Company, J. A. Dawson & Company, R. E. T. Pringle Company, John Forman, Watson Jack Company, Canadian Electric Company, Canadian Westinghouse Company, Allis-Chalmers-Bullock, Packard Electric Company, Sayer Electric Company, Montreal Light, Heat & Power Company, Montreal Steel Works, Dominion Electric Company, Northern Electric & Manufacturing Company, American Conduit Company, Eug. F. Phillips Electric Works, G. M. Gest, *Electrical Review*, Electrical World, Canadian Fairbanks Company, Bell Telephone Company, Canada Electric Company, Stratton Engine Company, Economical Lamp Company, Canadian Pneumatic Tool Company, Shawinigan Water & Power Company.

The list does not show all, as some of the names mentioned on the list are companies that will have in their exhibit some 10 to 25 different exhibits. For instance, the Montreal Light, Heat & Power Company has taken a large block of space and will exhibit 13 individual devices that will consume electric energy. Nine of these devices have not yet been shown or put on sale in Montreal.

Among the attractions for the show will be a 100,000-cycle

400,000-volt display, the "dancing skeleton," wireless telegraphy, etc. Considering the size of the city of Montreal, the promoters are taking great pains to make the show a successful one. The entire management has been undertaken by Mr. R. S. Kelsch, vice-president and managing director of the Canadian Electrical Exhibition Company, Limited.

A Report Unfavorable to Municipal Ownership.

In these pages have been given recently some of the data collected and reviewed by the municipal ownership commission of the National Civic Federation. Further extracts and synopses will be given anticipatory of the publication of the full and bulky report in book form. Meantime we are able to give below the conclusions of the committee on investigation in summarizing all the results obtained. This committee, of which Melville E. Ingalls, chairman board of directors Big Four Railroad, is chairman, made a thorough investigation of municipal and private workings of gas, electric light, water and street railway plants, both in the United States and England. It is worthy of note that of the committeemen, all but one, Walton Clark, of Philadelphia, who presents a separate paper giving his views, sign the report. Charles L. Edgar, of Boston, and W. J. Clark, of New York, present a statement of minor exceptions, as noted below.

The committee is unusually representative in character, being made up of representatives of business interests, labor leaders, college professors and journalists. The conclusions reached give in detail the opinions of the committee on all the various questions connected with the public ownership problem, and present a number of practical and important recommendations on the subject.

The members of the committee who sign the report are as follows: Melville E. Ingalls, chairman; Dr. Albert Shaw, editor of the *Review of Reviews*, vice-chairman; Edward A. Moffett, secretary; Edward W. Bemis, superintendent of water works, Cleveland, Ohio; William J. Clark, general manager of the foreign department of the General Electric Company; Prof. John R. Commons, of Wisconsin University; Charles L. Edgar, president of the Edison Electric & Illuminating Company, of Boston; Walter L. Fisher, president of the Municipal Voters' League, of Chicago; Prof. Frank J. Goodnow, of Columbia University; Prof. John H. Gray, of Northwestern University, Illinois; Timothy Healy, president of the International Brotherhood of Stationary Firemen; Daniel J. Keefe, president of the International Longshoremen's Association; Milo R. Maltbie, member of the new Public Service Commission for Greater New York; H. B. F. Macfarland, president of the Board of Commissioners of the District of Columbia; Frank J. McNulty, president of the International Brotherhood of Electrical Workers, Springfield, Ill.; Prof. Frank Parsons, president of the National Public Ownership League, Boston; J. W. Sullivan, editor *Clothing Trade Bulletin*, New York; Talcott Williams, editorial writer of the *Press*, Philadelphia, and Albert E. Winchester, superintendent of the South Norwalk, Conn., Electric Works.

The report made public by Mr. Moffett, the secretary, says:

"It is difficult to give positive answers of universal application to the questions arising as to the success or failure of municipal ownership as compared with private ownership. The local conditions affecting particular plants are in many cases so peculiar as to make a satisfactory comparison impossible, and it is very difficult to estimate the allowance that should be made for these local conditions. For instance, in making deductions from the financial conditions of Wheeling, as affected by its gas plant, as compared with those of Atlanta and Norfolk with their private plants, allowance must be made for the presence of natural gas in Wheeling. Again, in comparing the public water works of Syracuse with the private water works of Indianapolis from the point of view of the success or failure of municipal operation, geographical conditions must be taken into consideration. The situation at Syracuse is extremely favorable to the establishment of an efficient plant with comparatively little effort on the part of its management. At Indianapolis the conditions are unfavorable. In Syracuse the water flows to the city by gravity; in Indianapolis it must be pumped. So we might go through the various cities here and abroad that have been visited and show that the results were affected favorably or unfavorably by special conditions applicable to each city.

"Further, the difficulty of reaching satisfactory results by the comparative method is not confined to special or local conditions. It is true, as well, of much broader questions. Thus any attempt to compare municipal with private electric light plants in the United States would be fruitless if allowance were not made for the fact that in most cases such muncipal plants are confined to street lighting and may not do commercial business. Allowance must be made also for the fact that many municipal plants have had a struggle to exist in the face of unsympathetic public opinion. Again, in England consideration must be given to the fact that the municipal electric light and street railway plants have permanent rights, while the rights of the private companies operating these particular utilities are limited as to the length of their existence, many street railway franchises expiring 21 years after they were granted.

"Finally, not only must it be borne in mind that the social and political conditions which characterize the two countries find expression in their private and public systems, but we must consider the difference in the nature of the two peoples which causes them to adopt different ideas and views as to the expediency of certain things. In other words, a measure of success in the municipal management of public utilities in England should not be regarded as necessarily indicating that the municipal management of the same utilities in this country would be followed by a like measure of success. Conditions are quite different in the two countries.

"There are some general principles which we wish to present as practically the unanimous sentiment of our committee.

"First, we wish to emphasize the fact that the public utilities studied are so constituted that it is impossible for them to be regulated by competition. Therefore, they must be controlled and regulated by the government; or they must be left to do as they please; or they must be operated by the public. There is no other course. None of us is in favor of leaving them to their own will, and the question is whether it is better to regulate or to operate.

"There are no particular reasons why the financial results from private or public operation should be different if the conditions are the same. In each case it is a question of the proper man in charge of the business and of local conditions.

"We are of the opinion that a public utility which concerns the health of the citizens should not be left to individuals, where the temptation of profit might produce disastrous results, and therefore it is our judgment that undertakings in which the sanitary motive largely enters should be operated by the public.

"We have come to the conclusion that municipal ownership of public utilities should not be extended to revenue-producing industries which do not involve the public health, the public safety, public transportation, or the permanent occupation of public streets or grounds, and that municipal operation should not be undertaken solely for profit.

"We are also of the opinion that all future grants to private companies for the construction and operation of public utilities should be terminable after a certain fixed period, and that meanwhile cities should have the right to purchase the property for operation, lease or sale, paying its fair value.

"To carry out these recommendations effectively and to protect the rights of the people, we recommend that the various states should give their municipalities the authority, upon popular vote under reasonable regulations, to build and operate public utilities, or to build and lease the same, or take over works already constructed. In no other way can the people be put upon a fair trading basis and obtain from the individual companies such rights as they ought to have. We believe that this provision will tend to make it to the enlightened self-inter-

est of the public utility companies to furnish adequate service upon fair terms, and to this extent will tend to render it unnecessary for the public to take over the existing utilities or to acquire new ones.

"Furthermore, we recommend that provision be made for a competent public authority, with power to require for all public utilities a uniform system of records and accounts, giving all financial data and all information concerning the quality of service and the cost thereof, which data shall be published and distributed to the public like other official reports; and also that no stock or bonds for public utilities shall be issued without the approval of some competent public authority. We also recommend the consideration of the 'sliding scale,' which has proved successful in some cases in England with reference to gas and has been adopted in Boston. By this plan the authorized capitalization is settled by official investigation, and a standard rate of dividend is fixed, which may be increased only when the price of gas has been reduced. The subway contracts and their operation in Boston and New York are also entitled to full consideration. In case the management of public utilities is left with private companies, the public should retain in all cases an interest in the growth and profits of the future either by a share of the profits or a reduction of the charges, the latter being preferable as it inures to the benefit of those who use the utilities, while a share of the profits benefits the taxpayers.

"Our investigations teach us that no municipal operation is likely to be highly successful that does not provide for:

"First—An executive manager with full responsibility, holding his position during good behavior.

"Second—Exclusion of political influence and personal favoritism from the management of the undertaking.

"Third—Separation of the finances of the undertaking from those of the rest of the city.

"Fourth—Exemption from the debt limit of the necessary bond issues for revenue-producing utilities, which shall be a first charge upon the property and revenues of such undertaking.

"We wish to bring to your consideration the danger here in the United States of turning over these public utilities to the present government of some of our cities. Some, we know, are well governed and the situation on the whole seems to be improving, but they are not up to the government of British cities. We found in England and Scotland a high type of municipal government, which is the result of many years of struggle and improvement. Business men seem to take a pride in serving as city councillors or aldermen, and the government of such cities as Glasgow, Manchester, Birmingham and others includes many of the best citizens of the city. These conditions are distinctly favorable to municipal operation.

"In the United States, as is well known, there are many cities not in such a favorable condition. It is charged that the political activity of public service corporations has in many instances been responsible for the unwillingness or inability of American cities to secure a higher type of public service. This charge we believe to be true. However, there seems to be an idea with many people that the mere taking by the city of all its public utilities for municipal operation will at once result in ideal municipal government through the very necessity of putting honest and competent citizens in charge. While an increase in the number and importance of municipal functions may have a tendency to induce men of a higher type to become public officials, we do not believe that this of itself will accomplish municipal reform. We are unable to recommend municipal ownership as a political panacea.

"In many cases in the United States the people have heedlessly given away their rights and reserved no sufficient power of control or regulation, and we believe that corruption of public servants has sprung, in large measure, from this condition of things. With the regulations that we have advised, with the publication of accounts and records and systematic control, the danger of the corruption of public officials is very much reduced."

The committee sums up its more important conclusions as follows:

"Public utilities, whether in public or private hands, are best conducted under a system of legalized and regulated monopoly.

"Public utilities in which the sanitary motive largely enters should be operated by the public.

"The success of municipal operation of public utilities depends upon the existence in the city of a high capacity for municipal government.

"Franchise grants to private corporations should be terminable after a fixed period and meanwhile subject to purchase at a fair value.

"Municipalities should have the power to enter the field of municipal ownership upon popular vote under reasonable regulation.

"Private companies operating public utilities should be subject to public regulation and examination under a system of uniform records and accounts and of full publicity."

On the general broad subject of municipalization, the committee reports that the general expediency of either private or public ownership is a question that must be determined by each municipality in the light of local conditions. "What may be possible in one locality may not be in another. In some cities the companies may so serve the public as to create no dissatisfaction, and nothing might be gained by experimenting with municipal ownership. Again, the government of one city may be good and capable of taking charge of these public utilities, while in another it may be the reverse. In either case the people must remember that it requires a large class of able men as city officials to look after these matters. They must also remember that municipal ownership will create a large class of employees who may have more or less political influence."

Messrs. Charles L. Edgar and William J. Clark present the following exceptions to the committee's report: "We, the undersigned, dissent from the report of the investigating committee as follows: First—The report says: 'There are no particular reasons why the financial results from private or public operation should be different if the conditions are the same. In each case it is a question of the proper man in charge of the business and of local conditions.' We dissent from the implication in this paragraph that the conditions are or are likely to be the same.

"Second—The report says: 'We are of the opinion that a public utility which concerns the health of the citizens should not be left to individuals, where the temptation of profit might produce disastrous results, and therefore it is our judgment that undertakings in which the sanitary motive largely enters should be operated by the public.' We dissent from this conclusion as having been proved by our investigations. In our opinion, privately operated water systems were, especially as regards their consideration for the public health, as properly and successfully managed as the publicly operated water systems.

"Third—The report says: 'We have come to the conclusion that municipal ownership of public utilities should not be extended to revenue-producing industries which do not involve the public health, the public safety, public transportation, or the permanent occupation of public streets or grounds, and that municipal operation should not be solely for profit.' This sentence is so drawn that to a casual reader it implies that the opposite is advisable. From this we strongly dissent.

"Fourth—The report says: 'To carry out these recommendations effectively and to protect the rights of the people, we recommend that the various states should give to their municipalities the authority, upon popular vote under reasonable regulations, etc.'

"The words 'under reasonable regulation' were put into the report at the suggestion of Charles L. Edgar, and were intended by him to mean such regulations as would compel deliberate consideration not only by the people, but by their representatives, and would consequently prevent the superficial attractiveness of the scheme from overriding the 'sober second thought' of the people. We strongly dissent from any definition of 'regulations' which does not cover these points.

"Fifth—The second and fifth conclusions in the latter part of the report, being merely repetitions of previous statements, are of course subject to the same dissents."

Walton Clark, third vice-president of the United Gas Improvement Company, in a separate paper, sets forth his agreement with the other members of the committee that "companies entrusted with franchises and charters for the operation of so-called public service industries should be subject to regulation." He dissents, however, from the statement of the committee regarding water works, saying:

"Recognizing the almost supreme importance of an adequate and cheap supply of pure water, I dissent from one of the recommendations of my associates, in effect that water works should be operated by public bodies. I dissent for the reason that my study of the report of the water works expert employed by your committee, and my personal investigations, lead me to the conclusion that the water companies have made the more intelligent efforts toward adequacy and purity of supply, and that, all conditions considered, the result of their efforts has been and is a better and cheaper water supply and service than that maintained by the municipal water works department."

Mr. Clark also dissents from the statement, speaking of politics in Glasgow, Manchester and Birmingham, that these conditions are distinctly favorable to municipal operation, if by this is meant a municipal ownership that may be favorably compared with private ownership, in the character of its results and in benefit to the city and citizens served. "My knowledge of the question," says Mr. Clark, "is had from personal investigation, and from a study of the reports of the experts employed by the commission, and of the writings of members of the commission. It leads me to the conclusion that the city and citizens of Glasgow, Manchester and Birmingham, as well as of the other municipalities investigated, are not so well served by their public service trading departments as the cities and citizens of London, Newcastle, Sheffield, Dublin and Norwich are by companies operating similar trading industries, and that there is no element of blessing in the municipalization in the former cities to compensate for the indifferent character of the service rendered."

First Annual Convention of the Illuminating Engineering Society.

The first annual convention of the Illuminating Engineering Society, in session at Boston this week, has been a pleasant surprise to the officers of the organization. While a good programme was assured by the papers promised, the probability that so many members would be present to hear and discuss them seemed too much to hope for in so young an organization. Nevertheless the registration by the close of the first day as we go to press, has reached 128, and the sessions are fully attended from beginning to end in spite of the warm weather and the many distractions offered by the "Old Home Week" in Boston. Those arriving in Boston in advance of the convention which began Tuesday, July 30, had opportunity to see the extensive decorative illumination provided for this celebration.

The electrical festivities of the week were inaugurated on Saturday evening, July 27, with the turning on of the street and park illumination which is extremely attractive and complete. Thousands of spectators examined the working of the new electric fountain in the famous Frog Pond on Boston Common, and the welcoming arches in the streets leading from the railroad and steamship terminals were placed in full service. Business houses and public parks were also illuminated with many thousands of decorative lamps. Vice-President Fairbanks was the guest of honor.

On Monday evening, July 29, a good electrical parade was held in the Back Bay and Cambridge districts. About a score of allegorical floats were in line. Col. Wm. H. Oakes was chief marshal, his chief of staff being Mr. John Campbell, chairman of the convention committee of the Illuminating Engineering Society. The route was from the Lenox Street car house of the Boston Elevated Railway Company through Columbus, Massachusetts and Huntington Avenues to the Mechanics Building, where the parade was reviewed by Mayor Fitzgerald. From this point the parade traversed Copley Square, Boylston, Charles and Cambridge Streets to Harvard Square. In Cambridge it was reviewed by the mayor, Walter C. Wardwell. From Harvard Square the floats returned to Lenox Street via Massachusetts Avenue and Harvard Bridge. the total distance traversed being about five miles.

The floats were all constructed on flat cars run on the Boston Elevated surface tracks and presented a brilliant spectacle with their many-colored lights. Among the figures presented were: "The Cradle of Liberty, Boston Tea Party, Sacred Codfish of Massachusetts, Dawn, The Flight of Time, Spring, The Wild Rose, The Lily, Summer, The Daisy, Pearl Maidens, Autumn, Golden Rod, The Fern, Winter, Wave of Happiness, Wistaria, Night, and River of Content." A considerable number of the members of the Illuminating Engineering Society were present to see the festivities.

The convention headquarters and sessions were in the new Edison Building, the illumination of which was so carefully designed by a committee of three prominent members of the society. The members of the New York section and some from further west many of them went to Boston together on the Providence line boat.

Mr. John Campbell, chairman of the convention committee, called to order and offered greeting to the first session of the convention Tuesday morning, on behalf of the New England section. He referred with pleasure to the good attendance from out of town, the convention having drawn from as far west as Denver. Dr. C. H. Sharp, president, then took the chair.

Secretary V. R. Lansingh announced that there were now 1047 names on the membership list. Besides the sections at New York, Philadelphia, Boston, Chicago and Pittsburg already established, it was expected that Los Angeles, San Francisco, St. Louis and Cleveland would soon have branches. Addresses of welcome by Governor Guild and Mayor Fitzgerald followed, the latter being one of the most amusing addresses of the kind recently delivered before an engineering society and fully repaying the convention for the hour it had waited for the mayor to appear.

Dr. Clayton H. Sharp then presented his very masterly presidential address containing some suggestions tending to simplify the calculations made by illuminating engineers. This paper was discussed by Mr. V. R. Lansingh and J. R. Cravath. Both agreed on the need and the practical utility of considering total flow or flux of light in lumens in calculating results rather than going through laborious calculations of illumination curves in large work. Mr. Lansingh condemned the rating of incandescent lamps in watts rather than in candle-power.

Dr. Edward P. Hyde read his paper on "Primary, Secondary and Working Standards of Light." Dr. Louis Bell discussing this paper said that illuminating engineers had greater difficulties to overcome in making exact measurements than any other body.

The difficulties of measuring illumination were, however, ten times those of measuring candle-power. This society was in better shape to secure the adoption of international standards than any organization representing special interests, such as gas or electricity alone. Mr. Preston S. Millar related some circumstances going to prove the constancy and excellence of incandescent lamps as secondary standards of light.

In answer to a speculative question by President Sharp, Mr. J. T. Marshall said that if all primary light standards were destroyed, incandescent lamp makers, by making several thousand lamps of a given size and resistance of filament, could probably by averaging them redetermine the standard of light.

When the convention adjourned for lunch it was taken by the local entertainment committee to Cook's restaurant near by where a very enjoyable repast was served.

Mr. Leon H. Scherck read a paper on Illuminating Engineer

ing in Central Station Practice. He favored having an illuminating engineer around the central station to stop complaints on account of excessive bills due to poorly planned installations.

A paper by Mr. C. E. Knox on the "Illumination of the Engineering Societies Building," was read by Mr. Nugent, at the conclusion of which a brief discussion was held. Mr. J. E. Wardwell inquired if any basis or calculation of the illumination was taken beforehand, such as watts per square foot or candles on a given plane. Mr. Nugent, who read the paper, stated that in a general way calculations of the number of outlets and fixtures required was made on the basis of the cubic capacity of the different rooms. The number of candle-power per cubic foot desirable under given conditions varies widely. In a hospital ward the cubic feet per 16-cp lamp may reach 1800 [illegible] cubic feet per 16-cp lamp in a library [illegible] V. R. Lansingh criticized the illumination of the under sides of the large false girders extending below the ceiling, pointing out that these are unlighted except for reflected light from the walls and floor. The contrast is too sharp between the girders and the ceiling. Mr. Nugent stated that the reason for this was because it was essential to have concealed lighting, and that in his opinion the effect was not unpleasant to the eye.

Mr. C. H. Stone, of Albany, N. Y., then read a paper upon "The Present Status of Candle-Power Standards for Gas." Discussion by Mr. Forstall favored using the best coal economically available without enrichment for gas making in most communities. High candle-power and efficiency of service are not synonymous. The main point is to give the consumer the most value for his money.

Mr. T. J. Litle, of Gloucester, N. J., read a paper entitled "The Inverted Gas Light." A brief discussion followed, in which Mr. Litle stated that the inverted gas light is now installed in some of the best stores in Philadelphia and when properly installed the results are most satisfactory. Good reflectors are as necessary here as with the tantalum and tungsten electric lamps. Mr. Lansingh stated that the amount of light delivered from an upright burner without glass shade is about 52 per cent above the horizontal and 48 per cent below. When we diffuse by a common globe the amount of light above the horizontal becomes nearly 60 per cent, with only 40 per cent below. There is a large loss at the outset, and this is even more true with an open flame burner. Here about two-thirds of the light is below the horizontal. The value of the inverted burner is plain from this.

Discussion of the paper of Mr. Nelson Goodyear, of New York, on "Acetylene Lighting" brought out a statement by Mr. Litle that he has obtained 22 candle-power on one-half cubic foot of acetylene gas in the laboratory. A result of 40.3 candle-power per cubic foot is conservative production on the 1-hour basis. Mr. Lansingh emphasized the fact that the quality of acetylene gas with respect to color is nearest to daylight. The intensity is so extreme that such lights should always be shaded when in the field of vision. Mr. Goodyear closed with the statement that the high flame temperature of acetylene gas and the impurities which occur have in the past been highly destructive of mantles, but a company in Austria has apparently overcome this difficulty, and in the near future a light production of 141 cp-hours per cubic foot of gas can be secured in regular service.

Two photometric papers by Dr. C. H. Williams, of Boston, and Mr. Preston S. Millar, of New York, were discussed simultaneously. Dr. Louis Bell emphasized the probable errors of measuring illumination, laying special stress on the great difficulties of measuring integrated light coming from many different directions at once. The substitution method should always be used on account of personal errors. The error is small if the light shall come from a single direction, but this is often impossible in commercial practice. Lambert's law of the cosine is followed fairly closely for small angles, but as the angles from the vertical increase with diffused light the error increases greatly, regardless whether the screen transmits or reflects. Integration by parts will help solve the problem. The screens of the new Williams photometer are practically free from selective absorption, and their spectrum has been photographed and examined at Harvard Observatory. Mr. G. H. Stickney stated that Ryan's photometer has recently been considerably improved and its construction corrected for variations in angles of altitude and azimuth. Readings can be taken quickly and extended easily over a prolonged time. Mr. J. T. Marshall emphasized the principal points of advantage of his photometer. It was not considered desirable to design a photometer which can be manipulated by an amateur. Dr. Williams concluded with the statement that it is impossible to get a photometer which will entirely do away with color differences. In his new instrument, which is not yet on the market but in process of test, the influence of color can be offset to a large extent by taking the mean of observations in comparing the quality of the illumination.

Mr. Preston S. Millar's paper on "The Elements of Unefficiency in Diffused Lighting Systems" was discussed by Mr. L. B. Marks. He emphasized the fact that sometimes the architect's client will select the less efficient system for other reasons than the numerical superiority of the illumination expressed in figures. We want to get away from bright light sources in the field of vision. It is a question whether we can *see* better with a direct or a diffused illuminating system. Mr. J. R. Cravath stated that his experience has been that architects and clients choose the direct instead of the diffused system.

PRESIDENTIAL ADDRESS.

The presidential address of Dr. Clayton H. Sharp dealt with the concepts and terminology of illuminating engineering, and pointed out the utility of certain ideas and names which should prove useful in the pursuit of the theory and practice of illuminating engineering. The address represented a plea for the general application of the notion of "luminous flux." The unit of luminous flux is the "lumen" which is the flux of light emitted by a 1-cp course through a unit solid angle. The use of such a unit eliminates the awkward and inappropriate term "foot-candles," which does not represent the product of the feet by the candles; it renders unnecessary the use of the corresponding misleading term, the "meter-candle," known as the "lux." Moreover, instead of the gross efficacy of an installation being expressed in "foot-candles per watt per square foot," it should be denoted by the "lumens per watt." True specific consumption would then be measured by "watts per lumen."

ACETYLENE LIGHTING.

A paper by Mr. Nelson Goodyear gave a brief historical review of the development of acetylene lighting, from the discovery of the gas by Edmund Davy, in 1836, down to the present date. The paper contained also much concrete information concerning the properties of acetylene and the results obtained from it in lighting. A pound of commercial carbide yields about 45 cu. ft. of acetylene gas, having a calorific value of 1504 B. T. U. per cubic foot. Carbide costs about $3.75 per 100 lbs., at which rate the acetylene is equivalent for lighting purposes to "20-cp" gas at about 75 cents per 1000 cu. ft.

[illegible]

The improvement of the quality of gas furnished in competition with electricity for illumination was discussed in a paper by Mr. C. H. Stone, who stated that a standard of "16 candle-power for coal gas" has been and can be obtained, but only by enrichment, and the majority of water-gas companies will have no difficulty in making "20-cp gas" throughout the year. A law demanding an increased illuminating value will prove of benefit to many companies that are struggling to compete with electric companies. The author expressed the opinion that in the not far distant future gas will be rated by its calorific value instead of its illuminating value.

[illegible]

A paper by Dr. Edward P. Hyde discussed a few practical problems in connection with the relationship of primary, secondary and working standards of light. A primary standard

was defined as one that can be set up from written specifications; a secondary standard is one which, although not reproducible, will remain constant after having once been calibrated, while a working standard is one that is used in ordinary photometric measurements.

There is no satisfactory primary standard of light, and there is an uncertainty in the ratios of the illuminating values of the different primary standards well beyond the limit of the error of measurement. With regard to secondary standards, however, it is generally conceded that the well-seasoned incandescent lamp meets every requirement.

The well-seasoned incandescent lamp is also an entirely satisfactory working standard in the photometry of electric lamps, but it is not suitable for use in gas photometry. It requires electric power to operate it and electrical measuring instruments to control it, and these are usually not available, particularly in small gas plants. But apart from its inconvenience, it is unsatisfactory. The intensity of a gas flame is a function of the atmospheric conditions, and it would not be practicable to correct all measurements to standard conditions, as that would involve determinations not only of water vapor and carbon dioxide, but also of the proportion of oxygen present in the atmosphere.

The consensus of opinion among gas engineers is certainly that the working standard for gas photometry should be a flame standard. There seems to be less unanimity, however, in regard to what flame standard should be used. Candles are still used to some extent in the United States and abroad, but recently there has been considerable advancement both in this country and in England in the adoption of the Harcourt 10-cp pentane lamp. In Germany the Hefner lamp is used now to a great extent in gas photometry, I believe, and in France the Carcel lamp continues to be used almost exclusively. In gas photometry the lamps used as working standards are ordinarily at the same time the primary standards. Now reproducibility is the chief requirement for a primary standard and constancy with burning is only a convenience; with the working standard, reproducibility is of no consequence; the lamp, however, should remain constant while burning, thus maintaining the candle-power assigned to it on calibration. If the lamp, which is the most reproducible is the most constant and convenient, then use it as a working standard, but do not confine the search for a working standard to those lamps which are reproducible. Dr. Hyde expressed the hope that not only will there be adopted an international unit of light, but there will be discovered an international standard which will take rank with the other international standards of modern physical science.

The Central Station and the Contractors.

Mr. Arthur Williams, of the New York Edison Company, contributed an interesting discussion of the above topic at the recent meeting in New York of the National Electrical Contractors' Association. Some passages follow:

"Well established is the practice of our central stations to leave to the electrical contractors the installation of interior equipment necessary to supply light, heat and power. With few exceptions, this appears to be the general rule.

"In the early days of the central station the custom was the free installation of wiring, safety devices and fixtures. This was necessary, for the possibility of the commercial distribution of electricity had not been demonstrated—at least not sufficiently to encourage any general change from the methods then in vogue. Few, relatively, considered the scheme practicable; many scientists of America and Europe denied the commercial, or even the technical, possibility of distributing electricity from a central station.

"However, the free installation of wiring and fixtures and the lending of motors, either free or on a rental basis, for the most part has been unsatisfactory. To free wiring there are many objections; customers are apt to desire a great deal more than they actually need, resulting in wasteful use of current; in dissatisfaction with the service; finally in the abandonment of a large percentage, if not all of the investment.

"With free fixtures only the most inexpensive and simple are possible, resulting in unattractive installations and, again, in dissatisfaction with the service. Likewise with motors, which, although requiring little attention, do require some—daily and methodically; motors rented or installed free of charge receive no attention from the consumer, thus causing rapid deterioration, and, again, serious dissatisfaction with the service. The field of interior equipment as a whole is one where to insure best results—satisfactory equipment on the one hand and satisfactory service on the other—the installation must be made at the expense of and be maintained by the consumer.

"Naturally, the supplying companies must grow. If the growth is not rapid enough, they may try, temporarily or permanently, various ways of securing installations. But the best way in the judgment of many is, first, for the company to do its part in cooperation with the electrical contractors to make the field profitable, and, secondly, for the contractors to do their part in securing from the public a rapid utilization of the company's supplying resources. The responsibility is mutual, and can be ignored by neither.

"One way of securing this result is to create a demand by liberal advertising. For the most part, if not entirely, this is done by the supplying companies. Is there not, however, a good field for cooperation in mutual advertising?

"The contractors should not be quick in taking offence at such installation rules as the supplying companies may feel it incumbent to adopt. They should favor rather than oppose the very limited work within building lines which most of the companies do; this is in their interest as well as in the general interest; they should favor such rules as may be formulated looking to the concentration of protective devices and of meters."

CURRENT NEWS AND NOTES.

TELEGRAMS A COMMODITY.—There seems to be some doubt even at this late date as to what a telegram actually is. Before Judge Hendrick, in the New York Supreme Court this week there was a discussion between lawyers representing the State and the Postal and Western Union Telegraph companies, as to whether or not a telegram is an article or commodity. It came about during an argument over an application of the telegraph companies to have vacated an order recently obtained by Attorney General Jackson for the appointment of a referee to take testimony in a suit to annul an alleged illegal combination said to exist between the two companies. Under the law Mr. Jackson must bring action on the ground that a telegram is an article or commodity. Judge Hendrick reserved decision. Mr. Deford appeared as Mr. Jackson's representative, while Henry D. Esterbrook represented the Western Union and William W. Cook the Postal. In reply to Mr. Deford's declaration that a telegram rightly comes under the head of commodity, Mr. Cook said: "We do not produce a telegram; the public produces it and we simply transmit it. We have a charter under the laws of the state, and it prescribes that we shall transmit telegrams in good faith. We have no authority to produce an article or commodity in common use. We cannot manufacture telegrams. If we sell the telegram we can be punished under the criminal code. A telegram company transmits information and the transmission is as old as history itself. The Greeks had fleet runners, who went from city to city. Did they produce articles of commodity? Later all governments had mails. Did they produce an article or commodity? Finally, the invention of the telegraph gave a new means of transmitting information, and intelligence involved service and labor. A telegraph company does not even buy or sell the electric current. It borrows it from nature for a brief space of time and then returns it unimpaired. It does not produce or sell anything except labor, and certainly labor is not a commodity or article."

[illegible] States Department of Agriculture, has issued a circular (No. 101) illustrating and describing an open-tank equipment for the treatment of line poles, fence posts, etc. A copy of the circular can be obtained by application to the Chief Forester.

Y. M. C. A. ENGINEERING COURSE.—The Young Men's Christian Association of New York City has for the past two years given evening instructions in steam engineering at its Twenty-Third Street building. There are about 75 men in the course, which includes arithmetic, chemistry so far as applies to combustion, purity of water, formation of scale, etc.; principles of boiler and engine construction, and of the various types of boilers, engines, condensers, valves, heaters, etc.; engine and boiler erection and practical operation.

SUBMARINE SIGNALS.—It is stated from Washington that Acting-Secretary Newberry and Rear Admiral Cowles, chief of the bureau of equipment, have arranged to install submarine signal receiving apparatus on the battleships Connecticut, Virginia, Ohio, Alabama and Maine; also on the destroyers Hopkins, Whipple, Worden, Hull and Stewart, and on the colliers Lawrence, Abarenda, Ajax, Brutus, Cæsar, Hannibal, Leonidas, Lebanon, Marcellus, Nero and Sterling. The Mayflower and Dolphin were equipped recently, and the Alabama and Maine have a temporary equipment for purposes of experiment. The War Department has equipped the transports Kilpatrick and Sumner.

MOVING PLATFORMS.—In its effort to find some remedy for the Brooklyn Bridge crush, the Public Service Commission held a public hearing on the subject last week in the Council Chamber at the City Hall. Mr. J. E. Swanstrom, ex-borough president of Brooklyn and chairman of the Citizens' Central Committee and of the Brooklyn Transit Reform League, suggested two plans. The first was the union of the Manhattan Elevated tracks with the Brooklyn Rapid Transit tracks now on the bridge, so that through cars could be run between the two boroughs. This plan, Mr. Swanstrom said, could be put in effect within a month at a cost of less than $25,000, as it was only necessary for the commission to compel a traffic agreement between the two railroads. This plan, he said, would not do away with all congestion, and so he suggested as a further relief the installation of moving platforms on the bridge. He said that these two plans would relieve all congestion.

TELEPHONY IN TURKEY.—A special cable dispatch from Constantinople of July 20, to the New York *Sun*, says: "It is barely a month since the *Sun* correspondent here reported that no telephones were tolerated in Turkey, owing to the Sultan's personal opposition on the ground that they were instruments of conspiracy. Affairs have been moving since then at the Yildiz Palace, for to-day comes the news from one or two Turkish papers at Stamboul, which are credited with possessing semi-official sources of information, that the Sublime Porte has decided to let the Ministry of Communications work out a project for supplying Constantinople with telephones. There will, of course, be no certainty that the conversations will in all cases be strictly private, but commercial circles are highly delighted and will willingly take the risk. From Salonica, too, it is announced that a private contractor has made a tender to equip the city with a local telephone system and that the chances of his securing the concession are believed to be favorable, especially as he offered 10 per cent of his prospective profits to holy work and the Pilgrims' Railway."

STATE OWNERSHIP.—At Niagara Falls, on July 29, Coroner Scott rendered a verdict in the inclined railway accident on the State reservation which cost the life of Peter Inda, of Buffalo and serious injuries to others. He found that the accident was caused by a breaking of the manila cable and subsequent breaking of the safety device attached to the front of the south car. This safety device was improperly designed and of improper material to bear the strain. No test of the safety device was ever made since its installation in 1887, and this failure, he declares, constitutes negligence on the part of everybody who has had charge of the machinery from that date to the present time. There was especial negligence on the part of those who installed the apparatus and of the State in accepting it without test. "I find," says the coroner, "that the whole inclined railway, including machinery, railway structure and buildings, was old, antiquated and dilapidated, and that the attention of the State officials and Legislature has been repeatedly called to this condition by Supt. Perry and the commissioners of the reservation." We await the outburst of indignation from the "Yellow Press," in view of the thousands of lives thus imperilled daily.

A SIX-YEAR CURRICULUM.—A class of 60 young men has been enrolled in the co-operative course of the engineering department of the University of Cincinnati for the coming year. This is the second class to be formed on this plan and it is almost twice as large as the first, showing how the plan is appreciated. Six years is required to complete the course and the students spend half the time in class and the other half in the shops. Besides a high-school education, work through the summer is necessary to matriculation in this course. The young men of the new class have shown their worth in the shops and all have been recommended as worthy of membership in the class. At a meeting held last week, Dean Hermen Schneider talked to the young men and told what the members of the Society for the Promotion of Engineering Education thought of the idea of securing a knowledge of their profession from actual work in the shops in connection with the theory taught in the schools. A number of the manufacturers who employ the youths were present and some of them talked to them and advised them regarding the work. From the experience of the engineering department with the first class, it is believed the plan will be a success. Those who complete the six-years course will be given degrees that will distinguish them from those who take the four-year course.

SAFETY SIGNAL DEVICES.—Mr. W. P. Borland, secretary of the Block Signal and Train Control Board, of the Interstate Commission is about to look into charges of trade-conspiracies to choke off safety devices. According to despatches from Washington, Mr. Borland intends to begin his investigation at the Patent Office, where he expects to find records of patents granted which will either prove or disprove the charges against the Eastern Railway Association. In speaking of his plans he said: "The board will meet soon and will doubtless take up at the very beginning an inquiry into the wreck on the Pere Marquette Road. It has already ordered me to conduct a thorough investigation at the Patent Office of all safety appliance devices on which patents have been issued, and to learn what has become of these. Some of the inventions which are unknown because suppressed are alleged to be of the very greatest utility and value, while at the same time being very cheap. So generally have these charges been made that we are going to start in right at this point, and if there is found to be merit for the charges we will insist on these suppressed inventions having a thorough test." Asked the names of concerns which have been accused of suppressing safety inventions, Mr. Borland named these: The Union Switch & Signal Company, the Hall Signal Company, the General Railway Signal Company, the Westinghouse Company. "The Eastern Railway Association," he added, "is not a corporation, but a sort of co-operative association which assumes to have as its object the protection of its members against infringement of patents on various devices. The charges against it have been made in very direct and damaging form, and without assuming to pass on their merits at this time, we do propose to know all about them. The block signal board has already been assured of the co-operation of the American Railway Association in the coming tests of all safety devices."

FIG. 1.—DAM ACROSS THE PATAPSCO RIVER NEAR ILCHESTER, MD., WITHIN WHICH THE POWER PLANT IS PLACED

Power Plant Inside of a Dam on the Patapsco River.

THE Patapsco Electric & Manufacturing Company, of Ellicott City, Md., has lately completed its new dam and power house on the Patapsco River near Ilchester, some 15 miles or more below Baltimore on the Washington Branch of the Baltimore & Ohio Railroad. The plant is unique in that it is placed within the dam and is thus completely under water. The plant also has the distinction of being the first of its kind ever built, and the cost is of course very much less than that of any other arrangement. A view of the dam within which the power plant is placed is shown in Fig. 1.

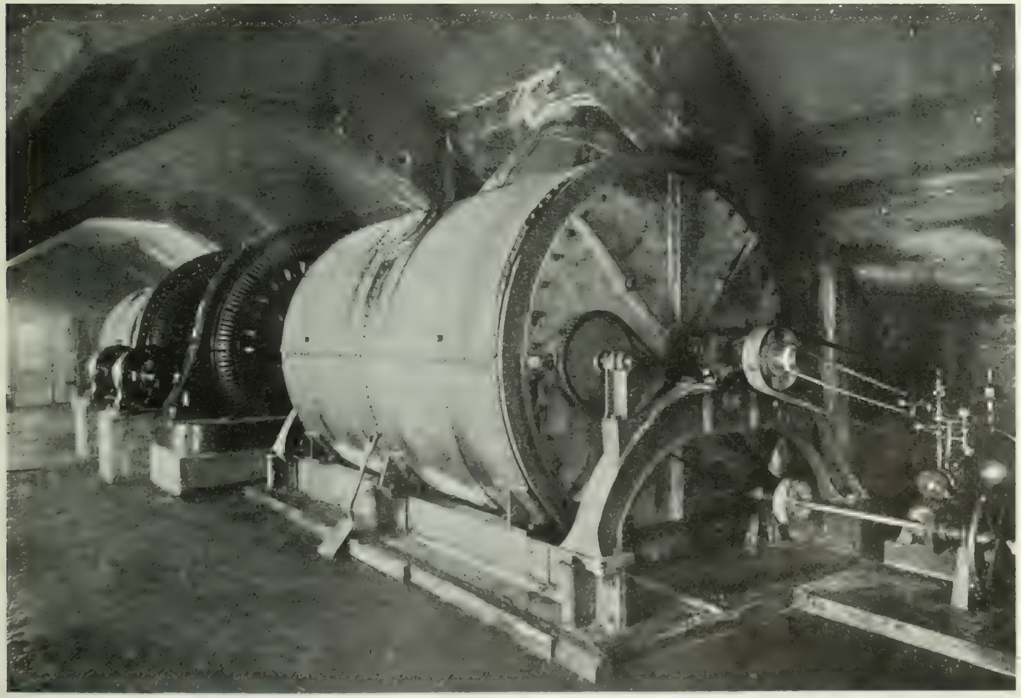
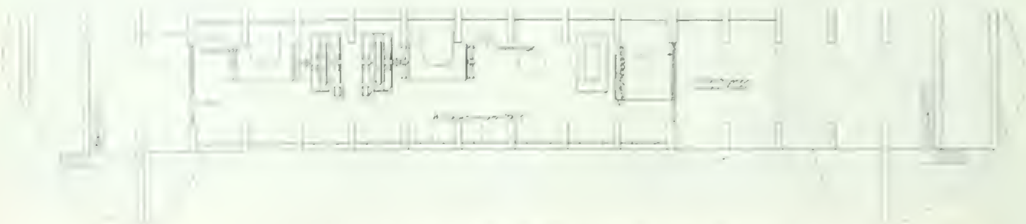


FIG. 2.—INTERIOR VIEW OF THE DAM, SHOWING THE ELECTRICAL GENERATING APPARATUS INSTALLED

THE DAM.

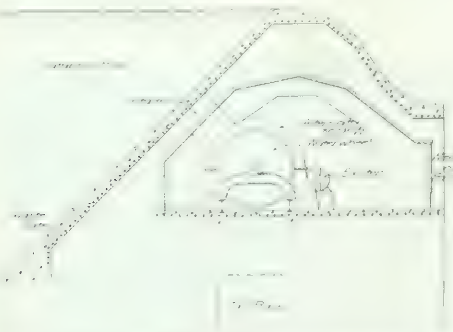
The dam has a total length of 220 ft. and is 40 ft. wide at the base. The height of the dam from normal tail water to the crest is 26½ ft. At each end the buttresses and deck of the dam rise 10 ft. above the spillway as a protection from floods and to afford convenient entrances to the interior of the dam. The spillway is 168 ft. long and is provided with anchor bolts so that if at any time it may be deemed desirable, flash boards may be bolted to them and the available head increased two feet. The back water extends ¾ of a mile with an average width of about 500 feet to the tail waters of a cotton mill located at Ilchester. The dam is built of reinforced concrete and the "deck" is supported by 19 buttresses 24 ins. thick at the bottom and 16 ins. thick at the top, which are placed 12 ft. apart. The mixture used was 1 : 3 : 6. The edges of the buttresses and of the openings are reinforced with ¾-in. corrugated iron rods in groups of three. The shell of the dam is 18 ins. thick at the bottom and tapers to 10 ins. at the top. The concrete in the deck is a 1 : 2 : 4 mixture reinforced with ¾-in. corrugated iron bars at graduated distances down to 4½-in. centers. The apron extends only half way down from the crown, the remaining down-stream portion being entirely open and provided with windows by means of which the interior is lighted. The shape of the apron is such that the water is thrown some little distance away from the windows. On a clear day the illumina-

tion is all that could be desired; while during rainy weather, at which time the water is muddy, the illumination is not quite so good. The view of the interior of the power house shows how much light is received through the windows beneath the falls.



[illegible]

At present only 108 feet of the dam is used for housing the power plant. This part of the dam is fitted with a false ceiling hung five feet from the inside of the dam so as to protect the apparatus from any water that might seep through the outer shell of the dam. The dam is built of a fine and rich mixture which was laid very wet. Aside from this no precautions were taken to eliminate water. The ceiling slopes until it reaches the vertical sides forming the power house. That portion of the dam not protected with the false ceiling is comparatively dry as very little water percolates through. What little water finds its way through the concrete trickles along the under side to the drain at the bottom. Were it not for this moisture a person within the power house would not be conscious that he was beneath the water. The waste water going over the crest of the dam is carried on the apron of the spillway to within 1[illegible] ft. of the tail water. This apron causes the water to fall about 20 ft. from the down-stream side of the dam and as the river bed is quite rocky at this point, no appreciable pitting takes pl[illegible]



[illegible] CROSS-SECTIONAL ELEVATION OF DAM

A fish ladder is placed at one side of the dam as required by law. This is 125 ft. long and has the proper slope and fins so that fish can easily go from the tail water to that above the dam. The wooden trough is shown at the entrance to one side of the dam. It might be well to state in passing that the reason for insisting on fish ways in dams is that when the fish spawn they go up stream to the head waters. To reach the waters above the dam they jump from fin to fin of the fish ladder until they reach the top.

POWER PLANT.

The power plant equipment consists of two 34-in. horizontal Leffel water-wheels fitted with Woodward governors arranged so that either governor may control both wheels when the generators are operated in parallel. Each turbine runs at a speed of 240 r. p. m. and is direct-connected to an Allis-Chalmers 300-kw. 11,000-volt, three-phase, 60-cycle alternator. Space has been provided for an additional unit of the same capacity.

Each alternator is provided with a 125-volt exciter belted to the shaft. The part of the dam used as a power house is 108 ft. long, 10 ft. high and 27 ft. wide except at the buttresses where the width is 18 ft. The arrangement of the machinery is well shown in the engravings and in the plan and cross-sectional elevation of the dam. A concrete-steel floor is placed at a proper elevation above the lower pool between buttresses, the latter being increased in section below the floor. The hollow interior structure is built upon this floor, as indicated in Fig. 4.

The water is fed to the turbines through steel pipes passing through the up-stream spillway shell and discharged by draft tubes into the base of the dam, dropping into a well sunk some three feet below the river bed. The water passes thence by way of a channel constructed in the river bed, out of the dam. The intake is 5½ ft. below the crest of the spillway so that the trash racks are kept clear of drift wood, etc. The trash rack is 10½ ft., and the flumes to the turbines 7 ft. in diameter. Two waste gates are placed near the bottom of the dam, the water from these passing under the floor. The flow through the feed pipe is controlled by a valve operated from the turbine chamber.

The mechanism for operating this valve is shown to the right in Fig 2. The advantages of such an arrangement of water-wheel and generator are readily discerned. The dam foundation and structure are the power house: the chamber is free from moisture by reason of the free circulation of air around it and the development utilizes all the available fall.

FIG. [illegible]

The entire electrical installation is compact, secure, and of the highest efficiency so far as it can be obtained from flow and fall. It will be appreciated that the water falls directly through the top of the dam into and through the wheels below, thus avoiding the friction and other losses of power resulting [illegible]

The difference between the present system and those already in vogue may be likened to direct-driven and belt-driven machinery. The actual saving in power or what amounts to the same thing, the greater efficiency of the water will be approximately equal to the difference between belt and direct-drive.

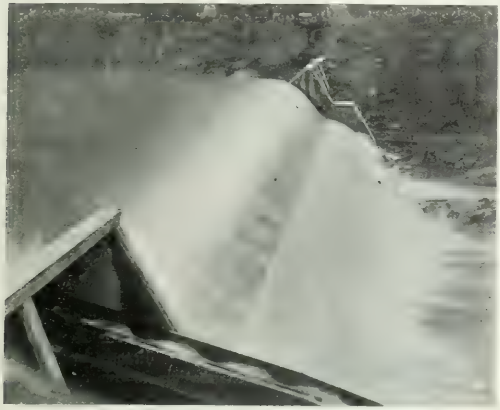


FIG. 6.—SIDE VIEW OF DAM, SHOWING THE THROW OF THE WATER FROM APRON.

The switchboard, which is located at one end of the power house, was built by the General Electric Company and is fitted with instruments, as shown in Fig. 9. As the exciters are arranged to be operated in multiple an automatic regulator is used for controlling the voltage of the generators. Polyphase indicating wattmeters have been provided, one for indicating

FIG. 7.—INTAKE FOR ADDITIONAL UNIT, SHOWING SUBMERGED RACKS IN THE UP-STREAM SIDE OF DAM.

the street service and the other the total load. A polyphase curve-drawing wattmeter is also used for recording the total output of the station.

The leads to the generators and for the commercial and street feeders are fitted with distant control, oil circuit-breakers, with disconnecting switches. The circuit-breakers for the generators have time-limit relays so that in case of trouble on the outside feeders, they will not open before the others. The switchboard is arranged so that there is no danger of shock to the operator at the board. The voltage at the board does not exceed 125 volts, as the circuit-breakers, disconnecting

FIG. 8.—INTERIOR OF DAM, SHOWING LIGHT RECEIVED THROUGH WINDOWS UNDER THE FALLS.

switches, high-tension bus-bars, transformers, etc., are placed about eight feet from the front of the board with plenty of room for persons to make the necessary repairs without danger of coming in contact with high-voltage apparatus. The transmission lines cover such a large territory, that it was decided to use 11,000 volt alternators in place of stepping up the potential by means of transformers.

When the plant is completed it will supply electricity for both lamps and motors. At present Ellicott City, Catonville, Irvington, Carroll, Halethrop, Arbutus, St. Denis, Elkridge and a part of West Baltimore are being supplied from the plant near Grays Mills. The territory covered is about six by ten miles and there is a considerable day load for that section of the country, about 250 horse-power. It is intended to extend the lines to West Arlington and Mount Washington, a distance of about 14 miles, when the new plant is delivering electricity. The old plant near Grays Mills has a capacity of 680 horse-power, of which 380 horse-power is generated by water. The

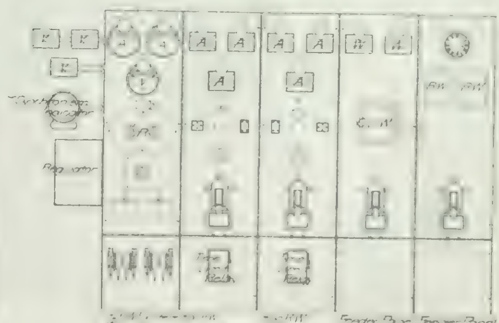


FIG. 9.—ELEVATION OF SWITCHBOARD.

electrical apparatus at this plant consists of one 240-kw Stanley generator and one 150-kw Allis-Chalmers generator. Both generators are wound for 2200-volts, two-phase, 60-cycles and transformers are used to step the potential up to 11,000 volts. At Catonsville, Wilkins Avenue and Beechfield Road, Wilkins Avenue and Roland Road and at the city limits transformer

are located for reducing the potential for distribution circuits. These are 2200-volt, single-phase lines except near the city limits, where, because of large motors installed, three-phase current is used. After the new station is in operation, it is the intention to use the old power house as a sub-station, as it is from this station that the different lines radiate.

Mr. Victor G. Bloede is president and general manager of the company and Mr. Otto Wonder is its superintendent. The designer and builder of the dam was the Ambursen Hydraulic Construction Company, of Boston, and H. von Schon, of Detroit, Mich., was the consulting hydraulic engineer. Messrs. Newton and Painter, of Baltimore, were the electrical engineers. The submerged power house was in this case the only feasible method of development on account of the available location and limitations of cost. A dam of this height is said to be the smallest that is available for a power house of this construction. At heights of from 40 ft. upwards details of submerged power houses, it is claimed, can be worked out to advantage and without the difficulty of restricted space.

Decorative Lighting in Philadelphia During the Elks' Carnival.

The annual reunion of the Elks, held in Philadelphia during the week July 15-20, was the occasion for what was probably the most elaborate civic electrical display ever made in this

FIG. 1.—COURT OF HONOR ON NORTH BROAD STREET, LOOKING TOWARDS THE CITY HALL.

country, excluding, of course, world's fairs and similar exhibitions.

The response of Philadelphia merchants to the solicitations of the Elks' special convention committee, the advertising and solicitation of the Philadelphia Electric Company, and the general all-around booming and hurrah of the Philadelphia newspapers was beyond all expectation. Philadelphia arose to the opportunity of self-advertising, and at the same time gave a display of a public and progressive spirit which has rarely been equaled upon occasions of this sort. The display of bunting, flags, emblems and other daylight effects was most elaborate and costly. The main business streets and many of the streets in the outlying districts were fairly ablaze with color, but overtopping all else was the lavish electrical display—a display which attracted scores of thousands of people to the business district every night during the week. It was an example of the efficacy, the compelling power of electrical advertising, without which no business street in a large city can ever hope to obtain its full share of trade.

It may be of interest to know just what method was pursued by the Philadelphia Electric Company to do its share toward working up public interest, in making an electrical display which resulted in such a notable exhibit. Many weeks prior to the convention the solicitors of the company were started out upon the labor of interesting its customers, particularly the retail stores and the large department stores, in the matter of individual electrical display. This work was preliminary, the idea being merely to arouse interest and not to close contracts at that time.

Three weeks prior to the convention, the columns of the daily newspapers of Philadelphia were used for a specially prepared series of advertisements bearing directly upon Elks' week. This series is reproduced elsewhere in this issue. The copy used aimed to arouse civic pride and enthusiasm in the influx of several hundred thousand visitors and the necessity for advertising Philadelphia as well as its business houses by elaborate preparations in the decorative line, and calling attention to the fact that the electrical way was the only effective way.

The interest of the newspapers was obtained and they inserted frequent notes regarding the proposed electrical features of the convention. As a result, some days before the convention, it was impossible to obtain any more electrical devices

or any more electrical letters for those people who had waited until this late date before determining to decorate their places of business. The houses that could not be induced to install special electrical decorations and who were customers of the company, were solicited persistently to at least light up their stores and show windows during the week, and to keep them lighted until a late hour. The return to the lighting company from this class of business was, of course, considerable, due to the fact that no expense was involved in the matter of meter and wiring installations, etc.

The extent of the electrical decoration during Elks' week has been variously estimated by newspaper correspondents and electricians to have amounted to from 300,000 to 500,000 lamps. The Philadelphia Electric Company, however, from its records and from the known special installation of those places that did not receive energy from the company, places the figure at between 250,000 and 300,000 incandescent lamps.

The displays were in the main artistic—in every case effective. Excursions were run every night from the outlying districts for the particular purpose of viewing the elaborate electrical effects. The Court of Honor, extending for a distance of six city blocks, divided in half by the City Hall, was worthy of an

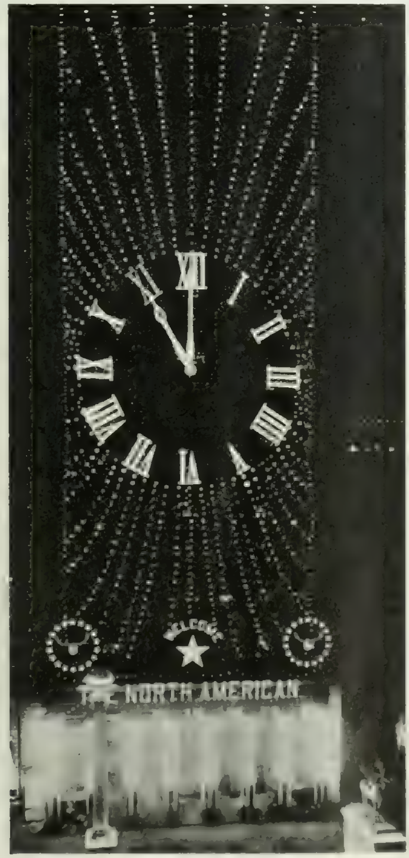


FIG. 2.—NORTH AMERICAN BUILDING.

international exhibition. It was the central point to which the masses were attracted. Market Street east of City Hall, as far as Sixth Street, was ablaze with light, the large department stores vying with each other in their exhibits. The electrical energy of more than three-fourths of the entire illumination was furnished from the mains of the Philadelphia Electric Company, and was carried practically without a hitch and with absolutely no detriment to the service rendered to the regular customers.

Owing to the immense crowds and the police regulations, it was extremely difficult to take photographs at night. The illus-

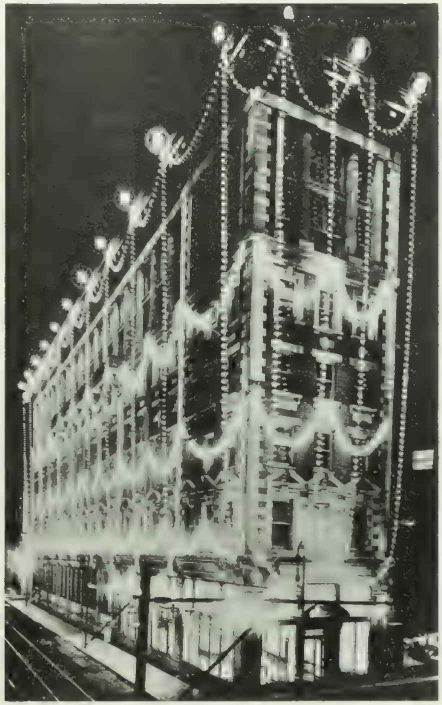


FIG. 3.—BUILDING OF THE PHILADELPHIA ELECTRIC COMPANY.

trations reproduced, however, show some of the most effective installations. Fig. 1 shows the Court of Honor on Broad Street looking towards City Hall. The illustration shows the character of the decorations on which over 13,500 incandescent lamps were employed. In the background may be seen the City Hall of the Quaker City, about which over 19,000 incandescent lamps were entwined. The North American Building, the home of one of Philadelphia's newspapers, is shown in Fig. 2. This building is one of the skyscrapers of Philadelphia, and over 16,000 incandescent lamps were employed on the exterior illumination.

The old portion of the Wanamaker department store, on Chestnut Street, was illuminated with 6000 lamps and the department store of Lit Brothers, on Market Street, was lighted by 12,000 lamps. The Philadelphia Electric Company placed 3500 lamps in circuit on its magnificent new building at the corner of Chestnut and Tenth Streets. The scheme of decoration is well shown in Fig. 3. Other large users of electricity for decorative lighting display were Strawbridge & Clothier, who employed 5000 lamps on their store building; N. Snellenburg & Company, who employed a like number of lamps; Keith's Chestnut Street Theater, on which over 1000 additional lamps were tastefully arranged; the Record Building, with 1500 lamps; the State Fencibles' Armory, with 2000 lamps, and the Elks' Lodge, with 2000 lamps. Prizes were offered by the Elks' convention committee for the best electrical displays. As was natural in the premises, these prizes were awarded not entirely for the most artistic electric display, but rather for the most extensive.

A Progressive Suburban Central Station at Revere, Mass.

[illegible] & Electric Company at Revere, Mass., affords an interesting example of a central station development under unique conditions with respect to load requirements in a suburban territory. This installation serves the town of Revere and Winthrop, including the celebrated beach resorts along the shores of the Atlantic in these communities, and it supplies light and power for both winter and summer consumers. Contrary to the usual experience of central stations, the peak load at the Revere plant occurs in the summer season, the winter output being relatively much lighter. In fact, during the cold season the plant is operated only between [illegible] being carried by the generating plant of the Malden Electric Company, some four or five miles distant. The same operating syndicate controls both companies, the offices being at 84 State Street, Boston.

The Revere station is located on Chelsea River, a salt water stream which discharges into the Atlantic ultimately, and which responds to the tidal fluctuations by a rise and fall of about 8 ft. twice each day. The plant is about a quarter of a mile south of the Revere station of the Boston and Maine Railroad.

Fig. 1.—Power House of the [illegible] Gas & Electric Company, of Revere, Mass.

Eastern Division. The station building is of the usual orthodox brick and steel construction with concrete foundations and a tar and gravel roof supported by steel trusses. It is divided by a solid fire wall into a boiler room 100 ft. x 50 ft., an engine room of the same size and a commodious 14 ft. high basement beneath the latter, which contains all the line and exhaust piping, condensing apparatus and certain auxiliary equipment. Fig. 1 is an exterior view of the station, showing the coal wharf whence the fuel is drawn, the main building, outgoing feeder circuits and the chimney, which is a brick stack 200 ft. high and 7 ft. 6 in. inside diameter.

At present the boiler room contains four 312 hp Stirling water tube boilers with space for two more of the same size. Two of the boilers are equipped with a Parsons steam jet which is used to provide forced draft at times of heavy peak loads. The air supply for these jets is drawn through galvanized iron ducts which extends from the top of the boilers on the outside, so that warm air shall be drawn downward and fed to the grates. Coal is brought by barges to the wharf adjoining the property, which belongs to [illegible] outside the boiler room, whence it is hauled into the building by hand cars over a 20 in. track in the floor, weighed and then dumped inside a wooden enclosure in front of the furnaces for hand firing. Fig. 2 is a view of the boiler room interior, showing the two batteries now installed, the space available for the [illegible]

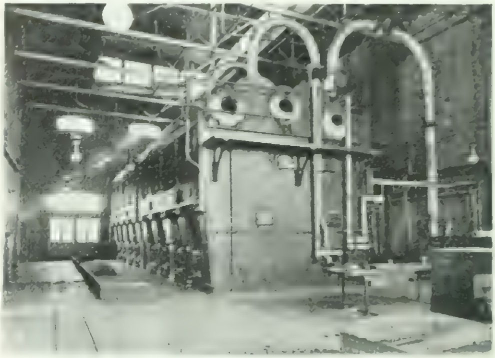


Fig. 2.—Boiler Room.

ing. The boiler room is admirably lighted by three alternating-current enclosed arc lamps in front of the batteries, a fourth at the rear, and special incandescents where necessary, a permanent 16-cp lamp being provided at the water meter, which is of National make.

City water is used for boiler feeding, the supply being brought into the boiler room by a 4-in. main. A Spencer damper regulator is in service, and Bristol records are regularly made of the temperature in the up take. Between 6 a. m. and 2 p. m. in the winter season the boilers are banked, enough steam being kept up to heat the company's local office, which is in a building near by, its stables and garage. The fuel burned averages 85 per cent. of buckwheat and 15 per cent of Cumberland coal, although in the summer season, when the load is heavy, the percentage of Cumberland is greatly increased, sometimes being nearly 50 per cent of the entire consumption. The plant contains three feed pumps, the largest being a compound duplex outfit set up in the rear of the boilers. There is nearly as much space behind the boilers as in front, the architects of the plant, Messrs. Lockwood, Greene & Company, of Boston, having made special effort [illegible]

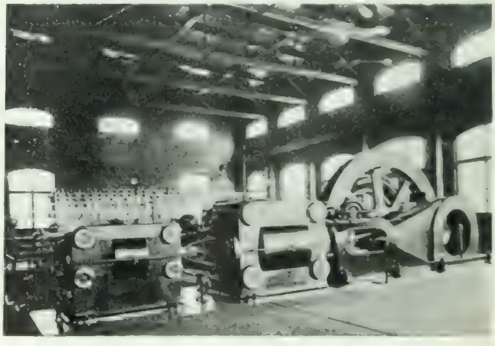


Fig. 3.—General View of Dynamo Room.

Additional pumps can be installed behind the boilers when necessary, the engine room lying at the rear. A 3-in. blow-off pipe is provided at the rear of the boilers. It connects with a tank out of doors.

The present [illegible] kw, but a 500-kw turbine will shortly be added. The engine

room is swept by a 16-ton, hand-operated crane of 50 ft. span. The switchboard is installed on a raised gallery at the end of the room, the balance of the space being left for generators and engines. Two units are now in service. The first is a 48-pole, 400-kw, 2300-volt, 60-cycle revolving field, three-phase General Electric alternator, direct-driven by a tandem compound Rice and Sargent engine making 150 r. p. m., having a 12-ton fly-wheel, 12 ft. in diameter, and exhausting into a Blake twin vertical jet condenser and air pump. The second generating unit is a 60-pole, 500-kw outfit of the same type, having a normal speed 120 r. p. m., and a 15-ton fly-wheel 16 ft. in diameter. The air pump and condenser for this unit is also a Blake outfit. Both engines are provided with reheating receivers in the basement between the high and low pressure cylinders. Both are equipped with the Monarch stop.

The turbine will be a 500-kw, 2300-volt Westinghouse-Parsons machine making 3600 r. p. m. Its condensing apparatus is already installed and consists of a complete Worthington set, including a 3000-sq. ft. surface condenser; a 10-in. centrifugal pump direct-connected to a vertical engine having a normal speed of 400 r. p. m.; a simple dry vacuum pump, and a wet vacuum pump. The turbine will occupy a floor space 21 ft. 3 in. x 7 ft.; its steam line will be 5 in. in diameter, exhaust to condenser 22 in., and 14 in. atmospheric exhaust.

Three exciters are installed in the engine room. One is a 17.5-kw, 125-volt machine belted to a Westinghouse standard engine, the speeds being 392 and 1175 r. p. m., respectively. The next is a 30-kw unit direct driven by a 40-hp. 220-volt, three-phase Westinghouse induction motor at 850 r. p. m.; and the largest set is a 50-kw generator direct-coupled to a 75-hp. 2200-volt Westinghouse induction motor, speed 690 r. p. m. The latter motor-generator set is controlled in starting by an auto-starter located in the basement and operated by a spindle and floor stand on the switchboard gallery.

The general arrangement of the piping is as follows: Each boiler delivers live steam at 150 lbs. pressure through an 8-in. riser to a 9-in. connection leading into the engine-room basement. One of these 9-in. connections is provided at each end of the boiler batteries. These supply lines terminate in separators which are cross-connected by an 8-in. main under the engine-room floor. The various engines and auxiliaries derive their steam supplies from these separators. Three separators are installed and the connecting main is valved between each pair. Circulating water for the condenser is pumped from the river and the discharge from the circulation system is provided with a branch line leading to the intake well, so that in seasons of hot weather and heavy load part of the discharge can be returned to the suction line. The relatively low temperature of the discharged circulating water permits this short cut to the supply lines being used without trouble. The larger feed pump is used only when both engines are in operation. The hot well is a tank of 600 gals. capacity located in the boiler room.

The switchboard gallery is about 4 ft. above the floor level and the board clears the edge of the gallery by about 5 ft. Behind the board is a clear space of 7 ft. to the wall. There are 14 blue Vermont marble panels in the switchboard, which is 39 ft. 4 in. long over all. The bus-bars are carried horizontally on a rack above and behind the board, and the recording wattmeters of the arc and feeder circuits are located on an additional framework behind the switchboard. The general arrangement of the panels is as follows: At the left-hand end of the board are panels devoted to commercial incandescent and power service; adjoining these are [illegible] generator, Tirrill regulator and exciter panels, and an arc lighting control section. Thomson edgewise indicating instruments are in service; automatic oil switches are in use on feeder lines and hand-operated oil switches on the generator leads. Two sets of three-phase bus-bars are installed. One panel takes care of the two-line power supply which is drawn from Malden when the Revere station is shut down.

On the power circuit which is 2300 volts, three-phase, are several motors of importance located in the various concessions at Revere and Crescent beaches. These resorts are very accessible to Boston and are visited by many thousands of patrons on Sundays, holidays and evenings in the summer season. The plant furnishes the street lighting in Revere and Winthrop and supplies the arc service along the Metropolitan Parkway which borders the beaches.

The variation in load in winter and summer on the Revere station is shown by two typical curves of average hourly output, one for July 7, 1906, Fig. 4, and the other for December 15, 1906, Fig. 5. Both of these days were Saturday. The principal data of coal consumption, output, etc., for these two days are:

	Saturday July 7	Saturday Dec. 15
Total kw-hours	5600	4800
Total coal, lbs. Cumbl'd	8870	2275
" " Buckwheat	10155	16580
Total fuel burned, lbs.	19025	18855
Lbs. coal per kw hour	3.4	3.9
Lbs. water per lb. coal	8.1	7.7
Lbs. ashes removed	3240	2340
Per cent ashes in fuel	16.5	12.4
Maximum avg. load, kw	500	1000
Minimum avg. load, kw	100	100
Average load, kw	233	200
Malden supply, hours	5	8

The difference in operating conditions is well marked by the curves. The maximum load came in the summer at from 8 to

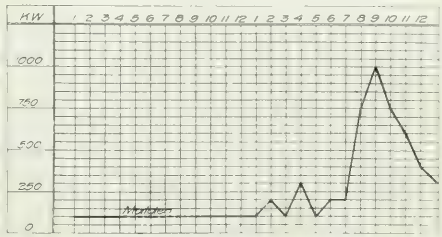


FIG. 4.—LOAD CURVE FOR JULY 7, 1906.

9 p. m. in a sharp peak of 1000 kw, whereas in the winter the peak was much broader and only half as great. The total fuel consumption of the station was much the same in both cases, and the actual total output in the 24 hours was but 16 per cent greater in the summer. The fuel economy was better and the evaporation rate higher at the time of the greater loads, even though the peaks were more pronounced than in the winter season.

The following are the results of an evaporative test made upon one of the Revere boilers equipped with the Parsons system of steam jets. The boiler has 60 sq. ft. of grate surface and was rated by the makers at 302 hp. The test lasted 10 hours and the average steam pressure at the gauge was 150 lbs. The temperature of the feed water was 209 degrees Fahrenheit. No. 3 buckwheat coal was used, the cost per ton

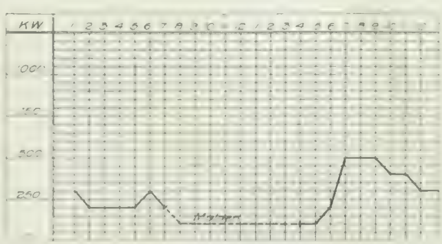


FIG. 5.—LOAD CURVE FOR DEC. 15, 1906.

of 2240 lbs. being $2.60. This coal is obtainable at the plant for about $1.90 less per ton than of the coal formerly used.

The total fuel used was 12,800 lbs. Ten per cent moisture was found in the fuel, so that the total dry fuel was 11,520 lbs. Of this, 1840 lbs. was refuse, or 15.9 per cent, leaving 9680 lbs. of combustible. The total amount of water fed

the boiler was 603,068 lbs. With a factor of evaporation of 1.052, the equivalent water evaporated from and at 212 degrees Fah. was 108,428 lbs. The chimney draft was 0.5 inch, and the temperature of the flue gases 531 degrees Fah.

The water evaporated per lb. of coal, actual conditions, was 8.05 lbs. The water evaporated per lb. of dry coal, from and at 212 degrees, was 9.41 lbs., giving 11.2 lbs. per lb. of combustible from and at 212 degrees. The horse-power developed per hour was 314.28, or 4.066 per cent above the normal rating. The fires were cleaned twice during the test; there were no clinkers. Two steam jets were used. The approximate fuel analysis showed 13,059 British thermal units per lb. Only three per cent of the boiler's output was required to produce the draft.

The officers of the Suburban Gas & Electric Company are: President, Mr. C. H. Tenney; vice-president, Mr. F. P. Royce; secretary, Mr. H. P. Wood; treasurer and manager, Mr. A. B. Tenney; electrical engineer, Mr. F. C. Sargent; local manager, Mr. C. F. Chisholm; chief engineer of power plant, Mr. A. E. Trudo.

Lightning Rods for High Chimneys.

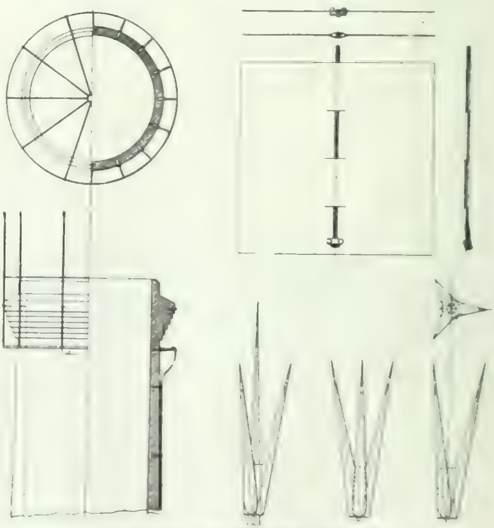
In a paper in the *Journal of the American Society of Naval Engineers,* Dr. N. Monroe Hopkins, electrical engineer for consolidated power plants, Department of the Navy, gives an account of some interesting experiments made to note the behavior and effect of high-frequency discharges upon a model chimney. A Tesla oscillator was used capable of striking through an air-gap of 4 ft., and it was estimated that the model chimney and its conductors were subjected to electrical discharges at a voltage of 1,800,000 and a frequency of 200,000 oscillations per second. The results of the experiments appeared to show that a high chimney could be adequately protected from damage by lightning by the use of several conductors from the top equally spaced, and the employment of a copper spider on the top of the chimney connected to these conductors. The object of the spider is to prevent a stroke following a current of hot air into the chimney.

The practical conclusions from the experiments follow, those relating specifically to chimneys being in the form of specifications, which have been officially approved for the installation of lightning rods on the brick power plant chimneys of the navy. The accompanying illustrations represent the top of the chimney, showing spider, and a ground plate and cast points.

For the complete protection of a central power plant, it is stated, its roof and trusses, together with all other masses of metal without and within the building should be metallically connected with chimney conductors as well as to light rods running along the top of all roofing and other prominent parts of the building. Sharp points should be placed at close intervals somewhat analogous to the protection afforded by the barbed-wire netting used in Europe about the buildings of dynamite factories. As the architecture of the building must necessarily dictate the precise arrangement of conductors, the specifications given below pertain only to the protection of the chimney which, if properly provided for, because of its towering height, affords also good protection for the building.

Chimney Protection for Power Plants.—Lightning conductors shall be laid up in the form of a seven-strand cable and each strand laid up with seven copper wires of No. 10 B. & S. gauge. For chimneys of 50 ft. and less in height, two lightning conductors shall be used. For chimneys over 50 ft. up to and including 100 ft., three conductors shall be installed. For chimneys higher than 100 ft., four conductors shall be installed. All heights to be considered from ground level. All conductors or cables shall be symmetrically arranged about the chimney with one cable on the prevailing-weather side of the chimney. Said lightning conductors or cables to be securely attached both mechanically and electrically to independent pure copper earth plates or bars. In cases where the chimney foundations have already been filled in, instead of earth plates, earth terminals may be used, composed of pure copper bars 3 ins. x ½ in. x 3 ft. In all cases the lightning-conductor terminals shall extend to the ground water level, and in no case shall they extend less than 15 ft. from the ground surface. Earth plates shall consist of pure copper 3 ft. x 3 ft. x ⅛ in.

Application of Conductors to Chimney.—Each lightning conductor shall be secured to the exterior of the chimney by means of bronze or brass anchors, without the intervention of any insulators or insulating material whatever. The brackets for attaching the ring or conductors to chimneys to be of high-grade bronze or brass, and to be fitted with approved clamps for securely gripping said conductors and making good electrical connection therewith. The tongues or shanks of the anchors or brackets shall enter the masonry of the chimney a distance of at least 6 ins., and shall be at least ⅛ in. in thickness by 1 in. wide, terminating in a suitable head or angle, to prevent the anchor from being pulled out of the masonry. Anchors to be attached to conductors at intervals of not over 10 ft., and sweated to the conductors with solder at intervals of 50 ft. Conductors to terminate within 5 ft. of the top of the chimney, and to be connected through the agency of suitable brass or bronze fitting and soldered to a 1½-in. by ½-in. ring of copper attached to the periphery of the chimney by brackets spaced not over 2 ft. apart; said brackets to enter the brickwork a distance of at least 6 ins. and to be of approved design, with a tongue at least 1½ ins. in width and ¼ in. in thickness, with a suitable angle or head to prevent pulling out. All joints in the said copper ring, as well as between the ring and conductor or conductors running down to the ground bars or plates, and including the latter, to be scraped bright and, after making a secure mechanical joint, to be "sweated with solder." Said solder shall consist of one-half lead and one-half tin. All joints when finished shall be thoroughly washed off with water to remove every trace of



LIGHTNING RODS FOR HIGH CHIMNEYS.

soldering salts, acids or other compounds used. All joints secured by bolts or screws to be locknutted. In applying conductors where the chimney is already constructed, holes shall be drilled in the brickwork and said anchor brackets and anchors grouted in, the best Portland cement being used.

Terminal Rods on Lightning Conductors.—The copper ring shall be connected through the agency of clamps, insuring a good mechanical and electrical joint, with vertically-arranged copper rods, at least [illegible] in diameter and [illegible] ft. in length,

the joints to be sweated with solder as before described. The copper rods to be placed equidistant around this ring, and supported in a rigid position vertically through the agency of additional anchors set in the masonry and a copper spider resting on chimney top. Rods to be arranged with a uniform spacing of practically 4 ft. This is taken to mean, for example, that 10 such vertical rods shall be provided for a chimney of 12 ft. outside diameter of chimney at top.

Discharge Points.—Each rod shall terminate in a 2-point aigret, each spur or point of this aigret to be at least 3¾ ins. long, the bases of which spurs shall be at least ⅜ in. in diameter, tapering to a sharp and well finished point; said aigret to be provided with approved means to secure a strong mechanical and electrical joint with the vertical rods to which it is attached. The joints shall be sweated with solder.

Chimney-Base Protection.—All lightning conductors shall be enclosed at bottom with a heavy galvanized iron pipe of 1½ ins. diameter, and extending 3 ft. into the soil and 10 ft. above. Said iron pipe to be provided with approved brackets to securely hold it to the chimney, the brackets not to be over 3 ft. apart.

Government Incandescent Lamp Specifications.

The Association of Government Electrical Engineers held a meeting in Washington recently, for the purpose of discussing and adopting standard specifications covering incandescent electric lamps required by the various departments and bureaus of the Government service. The specifications then adopted form part of the formal invitation for proposals now issued by the Government for the supply of incandescent lamps. We reprint below the main portions of these specifications as contained in a recent call for proposals for 270,000 lamps to be supplied during the present fiscal year to several branches of the Government service.

Deliveries.

All lamps must be packed in boxes, made of good sound lumber, boxes to be lined throughout with corrugated strawboard with layers of corrugated strawboard placed between layers of lamps. Each lamp to be slipped into a corrugated strawboard sleeve of proper size and sleeves to be packed so every other lamp is base down and remaining lamps base up. Not to exceed 250 16-cp lamps or equal to be placed in one package. Each delivery, or any part of any delivery, shall be subject to inspection, test and rejection by an authorized agent of the Government, with the full right to reject any or all lamps found not to comply with these specifications. The successful bidder shall furnish, for check and use in inspecting lamps, not less than four primary standard lamps. These lamps will be returned to the contractor on completion of contract.

Comparative Tests.

In determining the award of a contract bidders may be required to submit for a comparative test 500 lamps. Such test will be conducted with a procedure similar to that outlined in these specifications for inspection and tests of lamps ordered under contract, modified as follows: (*a*) Inspection of 50 per cent of each lot of 500 lamps to discover faults in construction and sorting. (*b*) A determination of the uniformity or non-uniformity of rating and the characteristics of the distribution of light of the lamp, including the measurements of about 100 lamps of each lot of 500 to determine the mean horizontal, tip and mean spherical candle-power, together with the current consumption. (*c*) Determination of mean spherical candle-power performance throughout the useful life of 25 lamps of each lot of 500 submitted, operated at voltage corresponding to an initial specific consumption of 3 watts per mean spherical candle.

General.

These specifications shall not apply to any frosted, colored, or other lamps than the usual clear-glass bulbs, unless otherwise specifically included. Frosted lamps shall be represented in initial tests, inspection and life tests by bare lamps selected from the lots before frosting.

All tests shall be made, in a competent and expert engineering manner, at the expense of the Government, excepting that when initial inspection and tests are made at the factory the contractor will be required to supply the necessary equipment, assistance, electricity and facility for making the tests The manufacturer, or his agent, shall have the privilege of witnessing and verifying all tests of his lamps made hereunder, and shall also be privileged to obtain copies of the tests of his lamps and have access to the records of such tests at all reasonable times. The Government reserves the right to modify the method of test procedure in any particular whenever such change is desirable to secure test results in a more practicable, representative or accurate manner. Such changes will be made, however, with the full knowledge and consent of contractor.

Definitions and Standards.

Unit of Candle-power.—The unit of candle-power shall be the candle as determined by the Bureau of Standards at Washington, D. C.

Photometric Measure.—The basis of comparison of all lamps shall be the mean spherical candle-power. The nominal candle-power referred to in these specifications shall be the mean horizontal candle-power of lamps having a mean spherical candle-power value of 82.5 per cent of the mean horizontal candle-power, which is the standard value for filaments of the oval anchored type.

For lamps having filaments giving a different ratio of mean spherical to mean horizontal candle-power, the horizontal candle-power measurement will be corrected by a reduction factor determined by the Bureau of Standards or other authority mutually agreed upon.

Test Quantity.—The test quantity shall consist of 10 per cent or more of any lot or package, and in no case be less than 10 lamps.

Method of Test.

From each package there will be selected at random the test quantity for the purpose of determining the mechanical and physical characteristics of the lamps, the individual limits of candle-power and watts, and finally the life and candle-power maintenance. These lamps will be known as the test lamps.

All lamps shall conform to the manufacturers' standard shapes and sizes of bulbs, and to the standard forms of filament, and the standard candle-power and watt ratings. All bulbs shall be uniform in size and shape, clear, clean and free from flaws and blemishes. All lamps, unless otherwise specified, shall be made with moisture-proof standard Edison screw bases, fitted with glass buttons. The shells of the bases shall be of good quality brass, firmly and accurately fitted to the bulb with moisture-proof cement, and in length to conform to the Electric Code of the National Board of Fire Underwriters.

The lamp filament must be symmetrically disposed in the bulb and shall not droop excessively during the life of the lamp, when the lamp is burned on test without excessive vibration and in one horizontal position at a voltage corresponding to an initial specific consumption of 3.76 watts per mean spherical candle. All filaments must be uniform and free from imperfections, spots and discolorations.

Leading-in wires must be fused into the glass with the joints between the copper and platinum wires bedded well within the glass, and must be straight, well separated, and securely soldered to the base and cap, without excess of solder. The threads of the base must be free from solder.

All lamps must have first-class vacuum, showing the characteristic glow of good vacuum when tested on an induction coil.

Rejection for Defects.

If 10 per cent of the test quantity of lamps selected from

[illegible] workmanship, good service, or with any clause of these specifications, the entire lot from which these lamps were selected may be rejected without further test when tests are made at the lamp factory. When the tests are made elsewhere, if the first test quantity proves unacceptable, 20 per cent more lamps will be selected from the package or lot of lamps, and should 10 per cent of this second lot of sample lamps be found to have any of the physical defects above mentioned, the entire lot from which these samples were selected may be rejected without further test.

When tested at rated voltage, the test lamps shall not exceed the limits given in the schedule. If 10 per cent of the test lamps from any package is found to fall beyond the limits stated, when tests are made at the lamp factory, the entire lot from which these lamps were selected may be rejected without further test. When tests are made elsewhere, if the first test quantity proves unacceptable, 20 per cent more lamps will be corrected to a basis of 3.76 watts per mean spherical candle. If desired, the life tests may be made at such other watts per candle as may be mutually agreed upon.

Readings for candle-power and wattage shall be taken during life at the marked voltage of the lamps at approximately 50 hours, and at least every 100 hours afterwards until the candle-power shall have fallen 20 per cent below the initial candle-power, or until the lamp breaks, if within that period. The number of hours the lamp burns until the candle-power has decreased to 80 per cent of its initial value, or until the lamp breaks, if within that period, is known as the useful or effective life.

The average candle-power of lamps during life shall not be less than 91 per cent of their initial candle-power. In computing the results of test of a lot of lamps the average candle-power during life shall be taken as the arithmetical mean of the values for the individual lamps of the lot tested.

Lamps selected for the life test, which for any reason [illegible]

FOR [illegible]-130 VOLT LAMPS.*

RATING.		INITIAL LIMITS.				AVERAGE PERFORMANCE.
Rated candle-power mean horizontal	Initial watts per mean horizontal candle.	Individual candlepower limits	Mean candlepower limits	Individual watt limits	Mean watt limits.	Useful or effective life in hours to [illegible] per cent drop in candlepower at [illegible] watts per candle.
[illegible]	[illegible]	[illegible] c. p. above and [illegible] c. p. below.	0.6 c. p. above and 0.6 c. p. below.	12 per cent above and [illegible] per cent below	[illegible] per cent above and 6 per cent below.	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
8	[illegible]	do	do	10 per cent above and 10 per cent. below.	[illegible] per cent above and [illegible] per cent below	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	[illegible] per cent above and $7\frac{1}{2}$ per cent below.	$2\frac{1}{2}$ per cent above and $2\frac{1}{2}$ per cent below.	$5\frac{1}{2}$ per cent above and $5\frac{1}{2}$ per cent. below	$2\frac{1}{2}$ per cent above and $2\frac{1}{2}$ per cent below	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
24	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]

*It is recommended that every effort be made to avoid ordering lamps of actual rated voltages 105 and below, 109, [illegible] and 111, [illegible] and above [illegible] from 218 to 222, inclusive

FOR 200-250 VOLTS.

RATING.		INITIAL LIMITS.				AVERAGE PERFORMANCE.
Rated candle-power mean horizontal.	Initial watts per mean horizontal candle	Individual candlepower limits.	Mean candlepower limits.	Individual watt limits	Mean watt limits.	Useful or effective life in hours to [illegible] per cent drop in candlepower at [illegible] watts per candle.
[illegible]	[illegible]	[illegible] c. p. above and [illegible] c. p. below.	[illegible] c. p. above and [illegible] c. p. below.	15 per cent above and 15 per cent below	[illegible] per cent above and $7\frac{1}{2}$ per cent. below.	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	15 per cent above and [illegible] per cent below	$7\frac{1}{2}$ per cent above and $7\frac{1}{2}$ per cent below	12 per cent. above and 12 per cent below	[illegible] per cent, above and 6 per cent below.	[illegible]
[illegible]	[illegible]	do	do	do	do.	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]
[illegible]	[illegible]	do	do	do	do	[illegible]

selected from the package or lot of lamps, and should 10 per cent of these additional lamps be found to fall beyond the limits, the entire package may be rejected without further test. [illegible]

[illegible] shall be made as follows: From each accepted package of lamps, two sample lamps shall be selected which approximate most closely to the average of the *test quantity*. One of the two lamps thus selected will be subjected to a life test and designated as the *life-test lamp*, the second or duplicate lamp being reserved to replace this *test lamp* in case of accidental breakage or damage during the life test. *The test lamps*, shall be operated for candle-power performance at constant potential, average variations of voltage not to exceed one-fourth of 1 per cent, either side.

The voltage for each lamp shall be that corresponding to an initial specific consumption of 3.76 watts per mean spherical candle, or if tested upon a different basis, the results shall be start on such test, shall be replaced by others. On all tests for determining average candle-power and life each package which will be affected by the results of test shall have at least one lamp on such test. Lamps which are accidentally broken, [illegible] the average performance. In case both test and duplicate lamps are broken or damaged before the life test is completed, the average performance of all lamps of the same class previously tested under the same contract shall be assigned to the package represented. Accurate recording voltmeter records will be obtained during the test on lamps to show the average variation [illegible] values of the lamps shall be at least as great as those given in the above tables.

[illegible]

Lamps of this type of voltage 105 and below, [illegible] above, and also 220, may have double the limits of variation

in the initial limits specified for their respective classes. For lamps between 120 and 125 volts, the useful life values shall be 95 per cent of those given in the table, and for lamps between 126 and 130 volts, the useful life values shall be 90 per cent of those given in the table. Lamps of other types of filaments shall give equivalent performances.

The individual limits for irregular types of lamps, such as round-bulb and tubular lamps, shall be twice the individual limits given in the body of the preceding schedules for regular lamps of corresponding candle-powers.

The individual limits for metallized filament and round-bulb prismo types of lamps shall be 15 per cent above and 15 per cent below the mean candle-power rating, and 15 per cent above and 15 per cent below the mean total watt rating. The candle-power ratings referred to are the mean horizontal candle-power ratings of clear lamps without reflectors.

Rejections and Penalties.

The failure of the lamps in any package to conform to the specifications as to mechanical and physical characteristics, or to initial limits, may cause the rejection of the entire package. The failure of the lamps to give within 90 per cent of the values of useful life given in the tables may cause the cancellation of the contract. Lamps which have not been used and are rejected under the terms of these specifications will be returned to the manufacturer at his expense, and no payment will be made therefor.

The Financial Side of the Central Station.

By A. D. Williams, Jr.

Progress, in engineering and other lines, is a continual elimination of the unfit, or the survival of the fittest. Any plant, even when kept in the best condition, becomes, in time, obsolete; and it will ultimately prove, not only desirable, but absolutely necessary, from economic reasons, to replace portions of the apparatus, if not the entire plant. For this purpose it is necessary to set aside each year a portion of the income, sufficient to provide the funds necessary for this purpose. In many cases this precaution is either neglected or considered unnecessary, and in others, while the necessity of such provision is admitted, the attempt is made to put it off to a later date. Such lack of foresight is ultimately bound to be a serious handicap, as the time will arrive when the concern will be forced to raise additional capital for this purpose, and owing to its false economy will have to "pay through the nose" for the accommodation required.

The annual contribution to the sinking fund is usually a percentage of the amount of outstanding bonds, the bonds in the sinking fund being included in this amount. The percentage required will depend upon the term the bonds have to run. In the case of a recent issue of 30-year, 5-per cent bonds, the sinking fund subscription was 2 per cent, the first payment being deferred for 18 months. The interest on the bonds was payable semi-annually and the sinking funds were to be invested in the bonds. This sinking fund provision makes this loan cost over 7 per cent, as the bonds were placed on the market at a price which netted the purchaser 5.06 per cent. Money for industrial corporations can rarely be obtained at prices which net the investor less than 5 per cent, and necessarily the borrower pays a higher rate as he stands all of the expenses of securing the accommodation.

The annual contribution to the replacement fund cannot be arrived at so simply. A probable useful length of life must be assumed for the various parts of the equipment, the basis for this estimate being experience with similar equipment, exposed to similar hazards of operation. At the end of its useful life the apparatus has still some value, either as scrap metal or second-hand material. The scrap metal valuation is the conservative method, and the average value of scrap metal for a term of years furnishes a good basis for this purpose. Scrap prices fluctuate over wide limits and it is not advisable to use boom prices for this purpose. As second-hand material it is difficult to arrive at satisfactory values, particularly for large units which are not easy to dispose of. Occasionally second-hand machinery comes very near the prices of new machinery, the high value being due to the fact that prompt delivery can be secured. When the endeavor is made to dispose of second-hand machinery there are few quick purchasers in the market, except at times when it is difficult to secure new machinery with any degree of promptness; in ordinary or dull times such goods get very close to scrap metal prices. With regard to the building and other structures, occasionally old buildings can be given away, the wrecker obtaining his profit by the disposal of the recovered material, but in the majority of cases the wrecker must be paid something. In some cases it is possible to reconstruct the interior of the building and adapt it to another purpose, but in special types of structures this is difficult.

The accompanying table giving the approximate term of usefulness of certain portions of the equipment of a power plant and the estimated value of the items at the end of this term is extracted from a report of Sir William Henry Preece presented to the London County Council.

	Total life in years	Probable value at end of term in per cent of cost.
Dynamos and alternators	3[illegible]	8
Motors	2[illegible]	[illegible]
Armored cables	35	15
Storage batteries	[illegible]5	1[illegible]
Arc lamps	1[illegible]	[illegible]
Lamp posts	4[illegible]	
Meters	1[illegible]	
Water tube boilers	25	5
Engines, etc.	25	6

Table II is extracted from Dawson's Pocket Book and gives the approximate length of life of various portions of a well-installed and maintained electric generating plant.

Overhead lines	10 to 20 years
Buildings, indefinite, say	50 "
Slow-speed steam engines	20 to 40 "
Boilers, pumps, piping, etc	15 " 30 "
Slow-speed dynamos of modern design	15 " 35 "
Cables	10 " 20 "
Stationary motors	10 " 35 "

Both of the foregoing tables are of interest. That of Dawson was presumably drawn from reliable sources. One of the interesting facts in connection with the machinery used in power plants lies in the fact that comparatively few plants have a long life, and in some cases the older types of apparatus are discarded long before they are worn out, to make room for later and more efficient machines. In the case of an important plant it is advisable to use conservative figures.

The repair charges are a part of the operating expenses and should be included in that portion of the estimate as they are out of place among the fixed charges. At the same time it is convenient to estimate them as a percentage upon the cost of the equipment, etc.

Taxation varies in different localities and is often lower upon personal property than it is upon real estate, as far as the rate is concerned. In making the assessments the endeavor is to fix such a value as would be realized by the disposal of the property at a forced sale, the assessment upon real estate running from 40 to 75 per cent of its value. In some states there is a tax upon dividends paid to the stockholders, increasing as the dividend increases; in addition there is a tax based upon the market value of the capital stock, etc. These taxes run from 1 to 2 per cent upon the total value of the plant, and in some localities are even higher. In some places in order to encourage the establishment of new industries, tax exemptions are granted dependant upon the employment of a certain number of men, or a certain payroll disbursement per year. In New York City heavy machinery bolted to the structure has been held to be taxable as real estate after a protracted fight in the courts. These taxes must be met during the construction period, unless exemption has been granted by a legislative body of competent jurisdiction.

Insurance against fire losses usually runs from 0.3 to 1.0 per cent, depending upon the exposure hazard from surrounding structures, the character of the building, the efficiency of the local fire department, the local water supply, and the amount

of co-insurance. In addition to fire insurance, insurance is often carried to indemnify the company against the property loss and damage caused by boiler explosions and fly-wheel accidents. If there are elevators in the plant, elevator insurance may be carried. It is also advisable to carry employer's liability insurance, the cost of this item being based upon the payroll and the hazard. This kind of insurance covers the employer in regard to personal accident claims of employees injured in the work and outside parties injured in the plant accidentally through employees, as well as the expense of settling such claims in court or outside. The premium charges for these classes of insurance is determined by a survey of the plant by the inspectors of the insurance company.

Only a portion of the expense for insurance occurs during the construction period, but it commences as soon as the first portion of the plant is turned over by the contractors. During construction the various contractors are required to carry insurance for the benefit of the company, the expense, of course, being met by them and included in their price for the work. During operation the expense for the various kinds of insurance necessary will be found to be at least 1 per cent, and may be as high as 2 per cent on the total cost.

In the foregoing has been outlined some of the elements which affect the fixed charges and operating expenses, and working from them as a basis it is proposed to compute approximately what the fixed charges would be upon an investment. For this purpose it will be assumed that a power plant is to be financed, which is to supply power to an existing corporation, it being assumed that the corporation will own all of the capital stock of the power company and will lease the plant upon completion and operate it, the rental to be paid consisting of the fixed charges and operating expenses. The lessee corporation, it is also assumed, has met all of the preliminary expenses.

It is assumed that the following apportionment will be made of each $1,000 invested in the plant, this apportionment being based upon an existing plant, located in one of the large centers, where real estate is expensive.

Real estate	$ 68.00
Building, foundations, etc	283.00
Equipment, machinery, etc	649.00
Total	$1,000.00

The construction period is assumed as two years, during which executive and engineering expenses amounting to 10 per cent on the amount invested in plant must be met. During this period at least two payments of taxes must be made upon the real estate and upon the building and its equipment, the latter payment being upon the plant completed and ready to operate, the former upon the portion of the plant completed at the time the assessment is made. For convenience the entire equipment will be rated practically the same as real estate, although in actual practice a considerable portion of the equipment will be rated as personal property, and taxed upon a different basis from the real estate. It is also assumed that only fire insurance will be carried during this portion of the time, as the other lines of insurance may be more properly classified with the operating expenses. These assumptions and those following are made with the idea of keeping this article within reasonable bounds; in actual practice much more detail is required to cover the matter properly.

It is assumed that the plant will be taxed on assessed valuation equal to 60 per cent of its cost; that at the first assessment the valuation will be on real estate plus one-third the equipment and building costs; that the second assessment will cover the plant complete; that the tax rate will be 2 per cent.

[illegible]	[illegible] × 0.6[illegible] × 0.02 =	$ 4.54
Second:	1000 × 0.60 × 0.02 =	12.00

The present worth of these two sums only is required, and it will be assumed that interest at the rate of 2 per cent can be obtained upon funds on deposit. The same assumptions will be made in regard to funds required for other purposes.

It is assumed that insurance will be carried upon the plant, the premium being 0.5 per cent, for simplicity it being assumed that the full value of the plant will be covered during the second year and one-third of its value the first year, the third premium being met by the lessee. In practice the policies are taken out from time to time to suit the values of the plant as it stands. The premiums required will be as follows:

First:	[illegible]32.00 × 0.005 × [illegible]	$1.[illegible]
Second:	[illegible].00 × 0.005	4.66

It is assumed that the premium for title insurance upon the land is 1 per cent, the premium thus being, 68.00 × 0.01 = $0.68. It is also assumed that half of the engineering and executive expenses must be disbursed during each year; that is there will be two payments of $50.00 each.

On the above basis the immediate requirements to meet these charges will be:

First:	1.55 + 50.00 + [illegible]	= $5[illegible].23
Second:	4.54 + 4.66 + 50.00 = $[illegible]	[illegible]4
Third:	12.00 ÷ 1.04 =	11.54
Total		$12[illegible]

Of the funds to be expended for real estate and plant, those required for the purchases of the land must be available at the start. For the building and equipment it is assumed that 10 per cent of this amount will be held back until six months after the completion of the plant, that 25 per cent will be disbursed in the first year, and 45 per cent in the second year, and 20 per cent upon the completion of the plant. The immediate requirements to meet these expenditures will be:

First:	68.00 + 932.00 × ¼	= $301.00
Second:	932.00 × 0.45 = $419.40 ÷ 1.02 =	411.18
Third:	932.00 × 0.20 = 186.40 ÷ 1.04 =	179.23
Fourth:	932.00 × 0.10 = 93.20 ÷ 1.05 =	8[illegible].76
Total		$[illegible],80.17

Therefore the total requirements for an investment of $1000 in plant will be: $122.16 + $980.17 = $1,101.98. A sufficient amount of bonds must be sold to secure this sum, and it will be assumed that they bear 5 per cent interest and run for 30 years, and can be drawn for purchase for the sinking fund at any interest period at 105 and accrued interest unless they can be bought in the market at a lower rate. The sinking fund requires an annual instalment to be placed to its credit equal to 2 per cent of the face of the outstanding bonds, the first payment to be made at the end of two years. This first payment must therefore be made before the plant is on an earning basis, and additional funds will be required to meet it, which must be raised by the sale of the bonds. It is also assumed that the bonds are disposed of to or underwritten by a banking house at a price of 96, the bankers paying for them in four equal instalments at intervals of 60 days, the first payment being made upon the delivery of the bonds. The present value of these payments will be, at 6 per cent interest:

First payment	$240.00
Second payment, $240.00 ÷ 1.0[illegible]	23[illegible].69
Third payment, 240.00 ÷ 1.02 =	235.29
Fourth payment, 240.00 ÷ 1.03 =	233.00
Total received from sale $1,000 par value of bonds =	$945.08

From this amount must be deducted the present worth of the first payment to the sinking fund, namely $20.00 ÷ 1.04 = $19.23, and the present worth of the four semi-annual interest payments of $25.00 each upon $1,000 worth of bonds. The amount required for interest purposes will be, $24.75 + $24.51 + $24.27 + $24.04 = $97.57. The net proceeds from the sale of $1,000 worth of bonds will therefore be $945.98 — ($19.23 + 97.57) = $829.18. Upon this sum interest must be paid amounting to $50.00 per year, making the actual rate of the interest 6.03 per cent.

The par value of bonds required to furnish a net investment of $1,000 in the plant will be, 1,101.98 ÷ 829.18 × 1000 = $1,328.88. The fixed charges will be 5 per cent for interest and 2 per cent for the sinking fund, or 7 per cent on the par value of the bonds; therefore the fixed charges on $1,000 invested in plant will be approximately at the rate of 9.30 per cent.

In addition to the above another element must be considered —the ultimate renewal or reconstruction of the entire plant when worn out. It is advisable to be liberal in setting aside money for this purpose, owing to the fact that it is often desirable to scrap old machinery or otherwise dispose of it in order to install more economical apparatus. For the purpose of arriv-

ing at the amount required for this purpose, the amount invested in plant and real estate has been apportioned in five sums as follows, this apportionment being based upon an actual plant. In order to simplify matters somewhat, the equipment has been considered in three classifications, according to its probable length of life and final value. In practice it would probably be advisable to go into this in more detail. In addition the final value of the items has been assumed as a percentage of their first cost, which for an article is more convenient than assuming a scrap value based upon the weight of the apparatus, but is not so accurate.

(1)	Real estate	$68.00
(2)	Building, foundations, etc.	$283.00
	Approximate length of life	50 yrs.
	Cost of removal, 5 per cent of cost	14.15
	Amount for which annuity must be set aside	297.15
	Annuity, 50-year term, at 3 per cent, compound interest = 297.15 × 8.87 ÷ 1000 =	2.64
(3)	Equipment, main units, etc., approximate life	25 yrs.
	First cost	$348.00
	Final value at end of term, assumed at 8 per cent	27.84
	Amount for which annuity must be set aside	320.16
	Annuity for 25-year term, 3 per cent compound interest = 320.16 × 27.43 ÷ 1000 =	8.68
(4)	Equipment, auxiliaries, etc., approximate life	20 yrs.
	First cost	$257.00
	Final value assumed at 5 per cent	12.85
	Amount for which annuity must be set aside	244.15
	Annuity for 20-year term, 3 per cent compound interest = 244.15 × 37.22 ÷ 1000 =	9.08
(5)	Equipment, minor items, etc., approximate life	12 yrs.
	First cost	$44.00
	Final value assumed at 5 per cent	2.20
	Amount for which annuity must be set aside	41.80
	Annuity for 12-year term, 3 per cent compound interest = 41.80 × 70.46 ÷ 1000 =	2.95

The total annuity required, on the foregoing basis will be:

(2)	$2.64
(3)	8.68
(4)	9.08
(5)	2.95
Total	$23.35

The fixed charges can therefore be summarized as follows:

Interest on bonds, $1,328.88 × 0.05 =	$66.44
Sinking fund instalment, $1,328.88 × 0.02 =	26.57
Annuity for replacement purposes	23.35
Taxes on equipment assumed as personal property, $649.00 × 0.025 × .60 =	9.74
Taxes on real estate and building, $351.00 × 0.02 × .60 =	4.21
Total	$130.31

It will be observed in the above no provision has been made for insurance of any kind nor for repairs, these items being more properly chargeable to operating expenses. The writer also considers the replacement annuity too low, for the reason that it will many times be found desirable to abandon equipment in favor of more economical machinery long before its useful life is past. The annuity above given is 2.34 per cent; it would be better to make it 5 per cent, for the above reasons and also because it may not be practicable to invest this fund under favorable conditions, or to obtain compound interest.

Finally it must be borne in mind that each proposition involves special considerations, and while the general principles are the same, actual facts might not agree with the values assumed here for illustrating the methods to be used.

The Cost of Electrical Supply.

In a presidential address delivered Nov. 4, 1892, before the Junior Engineering Society, Dr. John Hopkinson set forth the principles upon which the present "maximum-demand" or "readiness-to-serve" methods of central-station rates are based. Below is a reprint of this epochal paper, lacking the opening paragraphs, which are foreign to the subject, and a section showing the application of the principles to central stations where there is a large storage battery auxiliary. The paper is printed in full in THE ELECTRICAL WORLD of Dec. 3, 10 and 24, 1892.

When it has been by lot to address engineers I have usually directed attention to some scientific point which I thought would be of interest to them. This evening I should like to go to the other extreme and deal with a purely commercial question, with a matter into which no science enters, and which relates entirely to pounds, shillings, and pence.

You are all of you familiar with the fact that the expenses of an undertaking may be broadly divided into two classes. On the one hand there are expenses which are quite independent of the extent to which the undertaking is used, and on the other, expenses which are absent unless the undertaking is used, and which increase in proportion to the use. For example, the charges for interest on the construction of a bridge are the same whether that bridge is used much or little or at all, and the cost of maintaining the bridge is also practically independent of its uses. The same is true in a large measure of a harbor or a dock. Such undertakings lie at one extreme of the scale. It is less easy to find good examples at the present day of the other extreme, as nearly all undertakings with which engineers have to deal require the employment of some capital, and there will be a fixed charge for the use of that capital and for maintaining against the assaults of time the things in which the capital is embodied. But we can readily see for example in the case of a cotton mill that, if on the one hand there are expenses of interest and dilapidation which are independent of the amount of yarn actually manufactured in a given factory, there are other expenses for material and labor, and even for actual wear of machinery which will be very nearly proportional to the output. Undertakings vary enormously in the proportion of these two classes of expenses; in some the expense is quite independent of the extent of the user, in others it is for the greater part proportional to the user.

But undertakings differ from each other in another respect. In some cases the service which the undertaking is designed to render can be performed at a time selected by the undertaker; in others at a time selected by him to whom the service is rendered. In the case of most manufacturers it matters not if the thing made is made to-day or to-morrow, in the morning or the evening, for it will not be used for a month hence, perhaps; the thing can in fact be extensively stored and kept till it is wanted. Other services must be rendered at the moment the person served desires. For example, the Metropolitan District Railway must be prepared to bring in its thousands of passengers to the city at the beginning of the day and to take them back in the evening, and for the rest of the day it must be content to be comparatively idle. In this case the services cannot be stored. The line must be of a carrying capacity equal to the greatest demand, and if this be great for a very short time the total return for the day must be small in comparison with the expense of rendering the service. In such a case it would not be inappropriate to charge more for carrying a person in the busy time than in the slack time, for it really costs more to carry him.

Let us see how these considerations apply to the supply of electricity for lighting. Electrical engineers now realize that they have to provide the same plant and no more to give a steady supply day and night as to give a supply for one hour out of the 24. They also now realize that if they are to be ready to give a supply at any moment, they must burn much coal and pay much wages for however short a time the supply is actually taken. Indeed, the term "load factor," proposed by Mr. Crompton, is as constantly in the mouths of those who are interested in the supply of electricity, as volt or ampere or horse-power. The importance of the time during which a supply of electricity is used was so strongly impressed on my mind years ago that in 1883 I had introduced into the Provisional Orders, with which I had to do, a special method of charge intended to secure some approach to proportionality of charge to cost of supply. Unfortunately the orders of that day all came to naught.

A supply of electricity must be delivered at the very moment when the consumer chooses to use it, and as long as and no longer than he pleases to use it; it cannot be very readily or cheaply stored, and much of the cost of production is the fixed charge for plant and conductors. Furthermore, the provisional orders require that the supply shall be available at all hours

[illegible] supply. The cost of supplying electricity for 1000 lamps for 10 hours is very much less than 10 times the cost of supplying the same 1000 lamps for one hour, particularly if it is incumbent on the undertaker to be ready with a supply at any moment that it is required.

The actual importance of considerations of this kind can only be realized by examining figures. The figures may as well be estimated figures, because the circumstances vary from one neighborhood to another. No criticism of the details of the figures will affect the general character of the conclusion. Let us, then, imagine a station capable of supplying 40,000 16-cp lamps at one time, with mains and spare machinery enough to ensure that the supply shall not fail, and let us see what the charge for running such a station will be; first, on the hypothesis that it is always to be ready to supply the 40,000 lamps at half-an-hour's notice day or night, but that the lamps are hardly ever actually required; secondly, on the hypothesis that the 40,000 lamps are steadily and continuously supplied day and night. These are the two extreme cases possible. In the former the load factor is nil; in the latter it is 100 per cent. If the charge is by meter at 8d. per unit, in the former case the revenue will be nil; in the latter it will be [illegible]

We are going to divide the cost of supplying electricity into two parts—a part which is independent of the hours the supply is used, and a part which is directly proportional thereto, and we are going to estimate the amount of each element. It is for the purpose of ascertaining these elements that we con- [illegible] never actually occur.

[illegible] To provide the maximum of 40,000 lamps we need to deliver 2500 units per hour, and we may estimate the capital outlay as follows:

[illegible]	£[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
	£145,000

Let us deal with the annual charge for each item of capital separately on the two hypotheses. The charge for land and for buildings including repairs is clearly the same in the two cases, say at 4 per cent, £1000 for the land, and at 10 per cent, £1500 for the buildings. The boilers, engines and dynamos will have a charge for interest, and a charge for writing off or amortization as the French call it, that is, for writing off the value of the plant before the time at which it becomes antiquated—exactly the same in the two cases. The boilers, too, will require exactly the same repairs whether they are merely keeping steam or whether they are generating steam continuously; but the machinery will certainly require more for repairs and renewals if it is all running than if a part only is running without load and the rest is standing ready for a load if required. I take 4 per cent as the charge for interest; 3 per cent for amortization; 8 per cent for repairs and maintenance. Of the repairs of engines and dynamos I assume that 2 per cent will be applicable if the plant runs light, the remaining 6 per cent if it is fully and continuously loaded. The expenses connected with conductors and switchboard, etc., will be exactly the same whether the current is passing or not: these I take at 15 per cent. The rates I put down at £500 a year. The account, then, for the fixed charges already enumerated would stand as follows:

	[illegible]	[illegible]
Land	£1,000	£1,000
[illegible]	[illegible]	[illegible]
Rates	500	500
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]

W[illegible]

coal. There is no doubt that with uniform and continuous load a unit of electric energy—1⅓ horse-power for one hour—can be produced for less than 3 lbs. of coal; it is also pretty much admitted that with a load factor of about 12 per cent, but continuous maintenance of pressure, the consumption of coal in good practice is something like 7 lbs.; that is to say, to keep the boilers warm, turn round the machinery for 24 hours, and deliver full current for 24 hours, will require 72 lbs. of coal per kilowatt; whereas to keep the boilers warm, turn round the machinery, and deliver current for 3 hours will require 21 lbs. of coal. The boilers being kept warm, it will take 51 lbs. of coal to generate steam enough to give a unit per hour for 21 hours; 58 lbs. to give a unit per hour for 24 hours; subtracting this from 72 lbs., the amount required both to generate steam and keep the boiler warm, we may infer that to keep the boiler warm and merely turn the machinery in readiness to meet a demand will take about 14 lbs. of coal per day for every unit per hour the plant is capable of producing. In 1889, for the Society of Arts, tests were made of a Paxman compound engine, from which it appears that a boiler which when fully loaded consumed 40 lbs. of coal per hour, required 4 lbs. per hour to keep steam up to normal pressure when the engine was standing; that is 10 per cent of the coal used was used to maintain the steam pressure. Remembering that in addition we keep some of our machinery moving, this may be said to confirm the figures adopted. Thus, if the plant runs light all the year round 12,775,000 lbs., or, let us say 6000 tons of coal will be consumed. If the plant runs fully loaded, 65,700,000 lbs., or, let us say 30,000 tons would be consumed. If we suppose the coal to be best smokeless is might cost 20s. per ton. Next we have water, oil, and petty stores; say £600 and £3000 in the two cases. Wages will be a little less if we run light than if we run fully loaded, and, of course, will largely depend on local circumstances; let us say £5000 and £7500 in the two cases. This gives us substantially all the expenses which have to be met and our account will then stand thus:

	Running Light.	Fully Loaded.
[illegible]	£[illegible]	£[illegible]
Coal	6,000	30 000
[illegible]	[illegible]	[illegible]
Wages	5,500	7,500
	£28,010	£59,250

Thus the cost of merely being ready to supply 2500 units per hour at any moment throughout the year will be £28,010, and the cost of actually supplying 2500 units per hour for every minute in the year will be £59,250. The undertaker, therefore, who incurs the liability to supply, ought to receive £11 per annum per unit per hour from those on whose behalf he incurs the liability, and if he receives the £11 he need not charge more than ⅓d. per unit for what he actually supplies to cover his expenses. That these figures are fair approximations can be seen as follows: According to this calculation the cost of supplying 2500 units for one hour per day is £28,010 + 2500 × 365 × ⅓d. = £29,277, and the charge for the service at 8d. a unit would be £30,417; it is doubtful if such a supply would pay. On the other hand, an indicated horse-power on such a scale could certainly supplied continuously for from £12 to £14 per annum, and according to this calculation an electrical horse-power will cost just under £18 per annum. No account is taken of expenses peculiar to companies, such as directors' fees and the cost of forming the company. It will also be noted that it is assumed that accumulators are not used.

The charge for a service rendered should bear some relation to the cost of rendering it. If it is a matter of open competition the matter will settle itself, for no one will for long be able to supply some customers at a loss and recoup himself by exorbitant profits from others. If the matter be a case more or less of monopoly, the adjustment is less certain; thus, the Post Office [illegible] letter, the two costing the Post Office exactly the same. What a boon to the public it would be if the Post Office would charge more for printed trade circulars, which in nine cases out of ten [illegible]

tricity is not quite a monopoly; companies compete with each other, and there is always the competition with other methods of illumination such as gas and paraffin. It is clearly to the advantage of the undertaker to secure all those customers whom it pays best to supply, and as far as may be, to compel those who are unremunerative to adopt these other methods. The ideal method of charge, then, is a fixed charge per quarter proportioned to the greatest rate of supply the consumer will ever take, and a charge by meter for the actual consumption. Such a method I urged in 1883, and obtained the introduction into certain Provisional Orders of a clause sanctioning "a charge which is calculated partly by the quantity of energy contained in the supply and partly by a yearly or other rental depending upon the maximum strength of the current required to be supplied." In fixing the rates of fixed charges it must not be forgotten that it is improbable that all consumers will demand the maximum supply at the same moment, and consequently the fixed charge named might be reduced or some profit be obtained from it. There is no object in reducing the cost of electricity for lighting in the case of any customer much below the cost of equivalent lighting by gas, unless there are competitors in the field willing to do it, hence the current charge proportioned to the power supplied may safely be increased. In certain recent cases in which I am acting as engineer, the board of trade has sanctioned on my application, "for each unit per hour in the maximum power demanded, a charge not exceeding £3 per quarter, and in addition for each unit supplied, a charge not exceeding two pence." It is sometimes said as an objection to this method of charge, the public will object to pay a fixed charge whether it makes use of its lamps or not, and that, in fact, it will not pay it. The best answer that can be made is to give everyone the choice of being charged by the maximum simple rate provided by the Order, or by the compound rate as he prefers. What is wanted is not so much an increased charge for those consumers whose lamps are used for a short time, as such a special reduced charge for those whose lamps are used long as will induce them to use the supply.

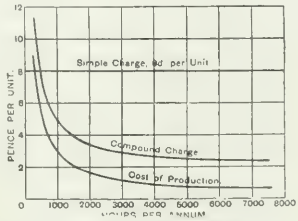
It is instructive to compare the cost to different classes of consumers of electricity and gas for lighting with 16-cp gas. Flat-flame burners must be large and of first-rate quality to give more than two candles per cubic foot of gas per hour; the large majority of burners give much less than this even at their best, and as a rule the pressure of the gas is not regulated, and much gas is wasted as far as the production of light is concerned. Incandescent lamps give about one-quarter of a candle per watt; hence a board of trade unit is equivalent to 125 cu. ft. of gas. Thus we readily arrive at the following comparative table, the charge being at the rates recently sanctioned by the board of trade:

Hours of use per annum	Load Factor	Price of Gas at which cost of lighting by electricity and those by gas are equal
480	5.5	[illegible]
960	11.0	[illegible]
1,440	16.4	[illegible]
1,920	21.9	[illegible]
2,880	32.9	2s. 0d.
3,840	43.8	[illegible]
7,680	87.6	[illegible]

In the accompanying curves are shown the cost of production and the charge per unit at the compound and simple rate. The ordinates represent pence and the abscissæ the number of hours per annum the supply is used.

It is obvious that those whose use is long will find the electric light economical to themselves and that it will be profitable to the undertaker. With a cheap light which is free from the products of combustion there will be extensions for the hours of use. Shops may find it worth while to continue the light after closing, as an advertisement.

It is possible, indeed probable, that some of my assumed figures may be shown to be too high or too low for the generality of cases. It is of no moment; let each one take any figure he pleases within reason; let him assume that the supply of electricity is made by any system he pleases, he will arrive at a result broadly similar to mine. To be ready to supply a customer with electricity at any moment he wants it will cost those giving the supply not much less than £11 per annum for every kilowatt, that is for every unit per hour, which the customer can take if he wishes; and afterwards to actually give the supply, will not cost very much more than ½d. per unit. This is the point I have been laboring to impress, for I take it it is essential to the commercial success of electric supply.



COST AND RATE CURVES

It is hopeless for electricity to compete with gas in this country all along the line if price is the only consideration. But with selected customers electricity is cheaper than gas. Surely it is the interest of those who supply electricity to secure such customers by charging them a rate having some sort of relation to the cost of supplying them.

Effect of Suggestion or Aid Received by an Inventor Upon Right to Patent.

By John Edson Brady

In an article, previously appearing in these columns, it has been mentioned that only a first and original inventor is lawfully entitled to a patent and that, if a patent is granted to a person, upon a device which did not originate with him, his letters will avail him nothing, because he cannot be regarded as the first and original inventor of the patented device. It must appear, as the basis of the patentee's rights, that his invention is new and original, for if not, it is not his invention, and he never had a right to a patent. And a patent granted in the absence of originality is clearly a nullity. Judson vs. Moore, 14 Fed. Cas. No. 7569. But inventors, like other people, are continually acquiring knowledge and information from extrinsic sources, which is not gained entirely by means of their own research and investigation, and if the rule enunciated were to be strictly applied, making it essential to the validity of a patent, that the device covered thereby should be absolutely and unconditionally the result of the labor and thought of the applicant for letters, it is probably true that very few inventors would have a legal right to the protection of the patent act. Chief Justice Taney has said, with reference to inventors, in the case of O'Reilly vs. Morse, 15 How. 62, at page 111, "It can make no difference, in this respect, whether he derives his information from books or from conversations with skilled men in the science. If it were otherwise, no patent in which a combination of elements is used could ever be obtained. For no man ever made such an invention without having first obtained this information, unless it was discovered by some fortunate accident."

If an inventor is engaged in pursuing a course of experimentation with the object of producing an improved machine or process, and has brought his machine or process to a stage at which it might be termed a near success, where he finds that some twist or touch of genius, which he cannot hit upon, is required to bring forth perfection, it is natural that he should speak of his work and the difficulties which he is trying to overcome to his friends and associates. And it is natural also, whether or not they possess inventive ability, that they should throw out such hints or suggestions as occur to them. While it is far from probable, it is possible that a suggestion made in such manner should point out to the inventor the solution of

his problem. Then, at some subsequent time, the validity of the patent may be made an issue in an action at law, and the point made that the patent is void because it purports to protect a device, which originated, not in the mind of the patentee, but of some one else. The question then presented is: Did the suggestion received and acted upon by the patentee divest him of his character of an original inventor in respect to the patent in question? And the further question suggests itself: What aid or assistance, by way of suggestion, may a patentee receive and still retain his identity as a first and original inventor?

The point has been passed upon by the Supreme Court of the United States, in the case of Agawam Company vs. Jordan, reported in 7 Wallace at page 583. The facts alleged run back to the year 1823, when an inventor, by the name of Goulding, was devoting his inventive genius to improving upon the carding machine, then in general use by manufacturers of woolen yarn. The carding machine of those days consisted of a series of five different machines and Goulding's object was to accomplish with four machines what, at and prior to the time of his experiments, required five. When Goulding had nearly completed his improved machine and while he was diligently prosecuting his experiments he exhibited the machine to one Winslow, who was in his employ, and who was a blacksmith by trade, but a very ingenious man nevertheless. Winslow, upon being requested to give his opinion, replied that the principle was good, but that the agencies employed were bad, and suggested that "a spool and drum" be substituted for certain other agencies, which were then part of the machine. The suggestion was given a trial and the trial was at first an apparent success, but the new attachment soon broke down and was about to be abandoned. Goulding, however, experimented further and made a further addition of his own to the machine, which was called the "traverser" and which, in conjunction with the parts suggested by Winslow completed the machine and made it a success. In 1826 Goulding applied for and was granted a patent upon his machine. The patented improvement soon came into universal use and worked a revolution, both here and in Europe, according to the record of the case, in the art of manufacturing fibrous yarns. The patent expired in 1849, and, through the erroneous information given him by the Commissioner of Patents, Goulding failed to apply for an extension until too late for the Commissioner to legally entertain his application. But Congress, finally, and after the persistent efforts of Goulding, passed a special act in 1862, authorizing the Commissioner to act upon the application for a renewal of the patent, as though it had been made within the time prescribed by law.

An action, to restrain an infringement of the patent, was brought in 1868 by Jordan, the assignee of Goulding's rights. One of the defenses interposed to the suit was that the machine was first invented by Winslow and that, Goulding not being the original inventor, the patent granted to him was void. So the question of the original inventorship was brought to depend upon the effect of the suggestions of Winslow. The court was of the opinion that, valuable as the suggestion was, it did not make Winslow the inventor, or deprive Goulding of any of his patent rights. Taking the strongest view in favor of the defense, the evidence showed merely this—that Winslow, after the originator of the plan had nearly completed his improvement, made a suggestion, which the inventor adopted, but to which he was compelled to add a contrivance of his own, in order to accomplish his desired result. Suggestions from another, made during the progress of experiments, in order that they may be sufficient to defeat a patent subsequently issued, must have embraced the plan of the improvement, and must have furnished such information to the person conducting the experiments that an ordinary mechanic would have been thereby enabled, without the exercise of ingenuity or special skill on his part, to construct and put the improvement into successful operation. Mere conversation about the practicability of an improvement, or suggestions as to the manner in which it might be carried out or accomplished, will not of themselves defeat the claim to originality of him who perfects the idea and secures a patent. Neither will experiments defeat, even if known to the patentee, if it appears that he prosecuted such experiments to final success. Judson vs. Moore, 14 Fed. Cas. No. 7569.

A case in which it appeared that the inventor had acted to his benefit upon a random suggestion made by his wife is that of National Feather Duster Company vs. Hibbard, 11 Bliss. 76. Hibbard, the originator of the device involved, at the time of its invention was a manufacturer of feather dusters in a small way. He conceived the idea of substituting turkey feathers for the more expensive ostrich feathers, with which the higher priced dusters were equipped, and set himself to the task of devising some means of making turkey feathers more pliable and thus overcoming the chief objection to their use. He experimented with various chemicals, but not succeeding to his satisfaction in any of his experiments, was discussing the matter with his wife on one occasion, when she suggested that he try cutting or splitting the stems of the feathers to see if that would help. Mrs. Hibbard was not experienced in the feather duster business and knew nothing of the manufacture, but her guess proved the correct one and the result was a duster of turkey feathers, pliable and limber. Hibbard obtained a patent and assigned his rights to a feather duster company. Later Mrs. Hibbard took out a patent, claiming that she, and not her husband, was the real and original inventor. For the purpose of having this later patent declared void and restraining the infringement maintained thereunder, the duster company brought suit. It was held that Hibbard was the original inventor of the new duster and rightfully entitled to a patent thereon and that the duster company might restrain any infringement on the part of Mrs. Hibbard. The patent in question did not cover split feathers as such nor the process of splitting the feathers. It covered rather a combination of split feathers with other elements which altogether constituted an improved feather duster. It was true that, while Hibbard was groping for some method of making the feathers pliable, his wife suggested what proved to be a way out of the difficulty. But although the suggestion was of great value to Hibbard in the production of the new duster, it did not, it was held, make Mrs. Hibbard the inventor.

In another action, brought to recover damages for the infringement of a patent upon an improved device in the way of fastening buttons, for use on workingmen's overalls, the evidence showed that the patentee had conversed with others about the device while making it, and they testified that they suggested the improvements, but "did not do anything about it." The persons who claimed to have made the suggestion, did not appear to have exercised any diligence in adapting the suggestion to practical form. It was held that such a suggestion was "mere information," the receiving of and acting upon which was not unjust and would not operate to deprive the patentee of his rights under the patent. Corser vs. Brattleboro Overall Co., 93 Fed. Rep. 807.

The rule that mere suggestions, made to one who has conceived the idea of an invention, or aid in construction or reducing it to practical form, will not deprive him of the right to a patent, applies with particular force where the suggestions aid or relate to ordinary mechanical details. In Fraser vs. Gates, 118 Ill. 99, decided by the Supreme Court of Illinois, in 1886, it was held that the patentee of a device known as a hard iron shoe with a soft iron stem, used for stamping and pulverizing ores, who had met with considerable difficulty in making the two metals mix, was an original inventor, notwithstanding another suggested to him: "Why not pour in the hard iron, and then pour in the soft iron, and fill up the place" for the stem, which suggestion proved successful upon trial. "The remark when made," said the court, "was not based upon actual knowledge, and was evidently intended as suggestive merely. At best, it related merely to mechanical detail by which the principle previously conceived was to be made available."

Suggestions to a patentee, assisting him in constructing or de-

vising the subject of the patent, may be so pertinent in their nature that their effect is to render the patent void. In fact, any information given to a patentee, sufficient to enable him to produce the object or the result itself, would destroy the originality of the invention and invalidate the patent. But that information must be definite and tangible; it should be sufficient of itself, without further inventive effort on the part of the patentee, to make it possible for him to bring into existence the patented device. Thus, if A had a distinct conception of an invention as patented to B, and had communicated knowledge thereof to B, so that the idea was not original with B, then A, in legal point of view, must be considered the first inventor and a patent could not rightfully be taken out by B. Judson vs. Moore, supra. This is, of course, the extreme case. The real difficulty lies in determining where to place the dividing line between the two classes of cases, the case where the patentee appears to have taken from some one else the idea upon which his claimed invention is based in its entirety, and the case where the patentee is shown to have taken the random remark or suggestion of another person and developed it until it fulfilled his requirements.

The true test, it seems, to determine whether suggestions made to an inventor should deprive him of the claim to originality, is to inquire whether enough has been communicated to enable him to apply it without the use of the faculty of invention. Watson vs. Belfield, 26 Fed. Rep. 536. In the case cited an action was brought to recover damages for an alleged infringement of a patent for an "improvement in clay presses," used in preparing clay for the manufacture of earthenware. Numerous defenses were set up and, among others, was the defense that the patentee was not the original and first inventor and that his patent was, therefore, void. Disinterested witnesses testified to the fact that drawings of an improvement similar to that which the plaintiff claimed to be the inventor of were shown to the plaintiff and that he was asked if he could not reproduce it. It was found that a general knowledge of the substance of the invention was communicated to the plaintiff prior to his production of it and it was held that his letters were, on that account, invalid.

In another infringement suit, brought by the patentee of a dredge-boat, provided with watertight compartments to make possible the settling of the boat upon an even keel, by allowing the compartments to fill, it was shown that the entire plan had been outlined to the patentee by an officer of the engineer corps of the United States before the making of the application for the patent, and that the specifications embodied merely the ideas which had thus been suggested. The patent was held void for lack of originality. Atlantic Works vs. Brady, 107 U. S. 192.

There can be no doubt that a person, to be entitled to the character of an inventor, within the meaning of the patent act, must himself have conceived the idea embodied in his improvement. It must be the product of his own mind and genius and not of another's. At the same time it is equally true that, in order to invalidate a patent on the ground that the patentee did not conceive of the idea, it must appear that the suggestions, if any, made to him by others, would furnish all the information necessary to enable him to construct the improvement. If they simply aided him in arriving at the useful result, but fell short of suggesting an arrangement that would constitute a complete device, and if, after all the suggestions, there was something still left to be planned or worked out by the patentee's own skill and ingenuity, in order to complete the arrangement, then he is, in contemplation of law, to be regarded as the first and original discoverer. On the other hand, the converse proposition is equally true. If the suggestions or communications of another go to make up a complete and perfect device, embodying all that is embraced in the patent subsequently issued to the party to whom the suggestions were made, the patent is invalid, because the real rights of discovery belong to another.

The design of the patent laws is to reward those who make some substantial discovery or invention, which adds to our knowledge and makes a step in advance in the useful arts. Such inventors are worthy of all favor. It was never the object of these laws to grant a monopoly for every trifling device, every shadow of an idea, which would naturally and spontaneously occur to any skilled mechanic or operator in the ordinary progress of manufactures. Such an indiscriminate creation of exclusive privileges tends rather to obstruct than to stimulate invention. It creates a class of speculative schemers who make it their business to watch the advancing wave of improvement and gather its foam in the form of monopolies, which enable them to lay heavy tax upon the industries of the country, without contributing anything to the real advancement of the arts. It embarrasses the honest pursuit of business with fears and apprehensions of concealed liens and unknown liabilities to lawsuits and vexatious accountings for profits made in good faith. Atlantic Works vs. Brady, supra.

Electric Dumb-Waiter Machines and Systems.

By E. L. Dunn.

Contrary to the general opinion, dumb-waiters are anything but simple affairs, and when properly designed and installed, require strictly first-class engineering.

Comparatively few people are familiar with the modern dumb-waiter machines, which in addition to their automatic features, have duties ranging from powerful freight elevators to small mail carriers. These machines did not come into any general commercial use until about ten years ago, notwithstanding the fact that there had been development along this line years before. At the start they were looked upon with suspicion and assigned a light duty, 10,000 ft. lbs. being about the limit. This duty has since been increased, until at present demand is for machines with duties ranging from 50,000 to 200,000 ft. lbs.

Few people appreciate how nicely a good dumb-waiter system operates. Everything must be "fool proof" in the fullest sense. The doors must be positively locked except where the car is at rest. Door switches are required to stop the car instantly if a door is opened, and the machine must remain inoperative while the door is open. There must be no possibility of any of the attendants getting hurt, regardless of whether they are careless or not. The car must start and automatically stop at the floor indicated by the controlling device, and must stop accurately regardless of whether the motor is working to its full capacity raising a heavy load, or whether it is being driven as a generator by a descending load. The car must also stop smoothly to avoid shaking the contents, which is often liquid in open vessels. When a push button control is used, the machine must work correctly regardless of how many buttons are pushed at the same instant, *i. e.*, it should respond to one button only. The controlling means must become instantly inoperative as the machine starts, so that the car can not be reversed or its destination changed after it has started. Thus the duties of a dumb-waiter machine are infinitely greater than those of the ordinary elevator, except in the matter of foot-pounds. A car speed of 400 ft. per minute is fast enough to insure the best service, and reduces the risk of trouble which higher speeds are likely to cause.

Trouble and confusion invariably attend the standing of a new system for a few days. The attendants do not know what to do, and besides they are sometimes inclined to be mischievous, as some of them seem to delight in putting things out of order. They sometimes allow the load to project from the car, and as a result, the load strikes a close place in the well room, and is broken or torn from the car, and sent to the bottom. Hundreds of dollars are sometimes wasted in this manner before they learn. Again they fail to close the doors, and the new operator gets bewildered and does not know why the machine will not start, or if he does know, has trouble in getting the doors closed, as he is more than likely compelled

to go directly to the door [illegible] as the attendant does not understand the signals.

Everything is subjected to the roughest usage. The attendants soon learn to [illegible] the door switches, and put the locks out of [illegible] so that they can look into the well room when they wish to see why the car does not come. As an example of this rough usage, the ordinary commercial type of push-button and door switches, which are all right for most purposes, would not last a day in dumb-waiter service. In addition to these things, a new system has what the constructors call "bugs," such as grounds or other defects likely to exist which have to be removed. The expert can locate and correct trouble very quickly, but if it occurs after the job has been turned over to the man in charge, it is liable to cause him serious trouble, as he has yet to get acquainted with everything.

Dumb-waiter doors should be of light construction, fit well, work easily, and should be provided with glass panels. The door sills should be narrow, so that the interior of the car can be reached without trouble. Door openings at both sides of the car should be avoided, as it causes trouble. Every door should be numbered to correspond with the machine so that everybody knows a certain dumb-waiter by number. Where annunciator signals are used they should be the very best, as no system can give satisfaction when crippled by poor signals.

Many different methods have been devised for controlling dumb-waiters, the simplest types being the hand rope and manually operated levers, both of which are entirely unsuitable except for very small affairs making two or three stops. The only types that have been adopted to any extent are the push button and operating box. The push-button type has the disadvantage of requiring, in addition to the regular operating magnets, a separate magnet for each floor, which necessarily means a large number of magnets and a complicity of switches. The operating-box control is a radical departure from the older, or push-button type, as it requires only the regular set of operating magnets, and can make any number of stops without complications, and being electrically connected to the machine, can be located anywhere, the same as a push-button box. It has other advantages in being so easy

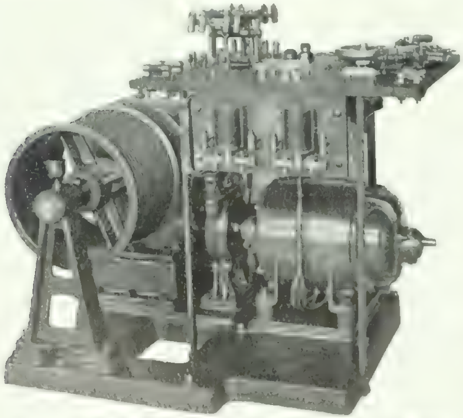


FIG. 2.—[illegible] DUMB-WAITER MACHINE FOR SHORT RUNS.

[illegible] as a push-button box, indicating the position of the car at all times, and, being really a part of the machine, the control is [illegible] and easily understood.

There is no dumb-waiter service quite as severe as that required by the large hotels, owing to the [illegible] of the loads and the consistent service demanded. The system which has just been installed by the Standard Plunger Elevator Company in the Plaza Hotel, at Fifty-Ninth Street and Fifth Avenue, New York City, is very complete. Thirteen machines of three different types, as shown in the illustrations, Figs 1, 2 and 3, are required for this building. Nine of these machines having short runs are controlled by operating push buttons at the various floors, while the four machines which have a run of 238 ft. are controlled by operating boxes, in connection with flash-light annunciator signals. The floor stops made by the machines vary from two to seventeen: the loads from 300 lbs. to 500 lbs., and the car speeds from 100 ft.

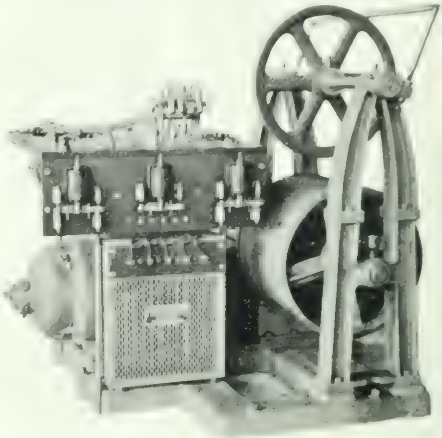


FIG. 1.—[illegible] DUMB-WAITER [illegible]

to 300 ft. per minute. All doors are equipped with automatic locks, switches and pilot lamps. The polit lamp at each door burns only when the car is at rest at that door, thus notifying the attendant that the car is waiting. Near each door, for the push-button controlled machines, is located a full set of operating push buttons, which correspond to all floors at which the car stops. This arangement permits a full control of the car from any floor.

The four well rooms for the long run [illegible] are arranged side by side. A typical landing is shown in Fig. 4.

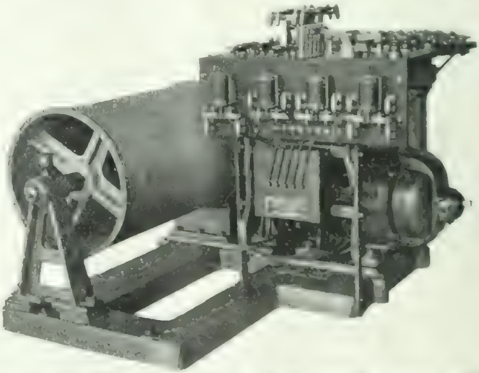


FIG. 3.—CONTROLLING BOARD AND DUMB-WAITER MACHINE FOR LONG RUN.

Directly above each door is the pilot lamp. A single push button and buzzer is provided for the four doors. In the basement the four operating boxes and flash light annunciator are grouped together upon a panel as shown in Fig. 5. Each operating box is supplied with a signal lamp by which the operator knows when the machine is running, when it is at rest and when the circuit is open, either because a door is opened or for any other reason. The four machines are con-

trolled entirely by the one operator, in response to the flash-light signals, the operation being as follows:

Assuming that the attendant at the tenth floor wants a car, he pushes the single button at that floor, the single stroke bell at the annunciator rings, and the No. 10 lamp flashes and continues to burn until extinguished by the operator by means of the bottom button. The operator knows that a car is wanted

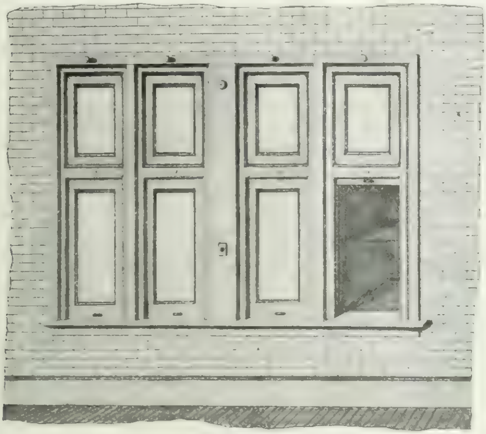


FIG. 4.—TYPICAL ARRANGEMENT OF DOORS

at the tenth floor, and accordingly starts one that is not in service, or that is the most convenient. The signal lamp at the operating box is glowing dimly, showing him that all doors are closed, and that everything is in a running condition. By means of the operating box knob he moves the pointer to No. 10 on the dial. When the pointer moves one floor space on the dial, the machine starts, the signal lamp flashes to full candle power, and continues to burn brightly until the car stops, when the light changes to a dim glow again. At the same time the pilot lamp at the tenth floor notifies the attendant at that floor that the car is there. If he does not

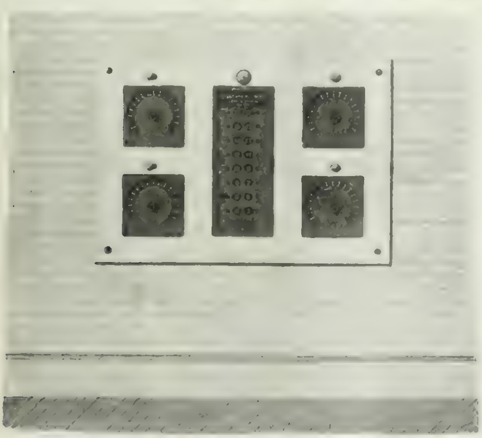


FIG. 5.—ARRANGEMENT OF OPERATING BOXES [illegible] ANNUNCIATOR

open the door promptly the operator [illegible] the signal lamp and accordingly pushes the [illegible] annunciator button, which rings the buzzer at that floor and attracts the attention of the attendant. When the door is opened the signal lamp at the operating box is extinguished, and the machine rendered inoperative. The operator now resets the annunciator signal and when the door is closed returns the car to the central station. He is not required to remember at which floor the car is at rest, as the operating box pointer indicates the position of the car. In connection with the dumb-waiter system, a pneumatic tube system is used for sending in the orders.

A new and very desirable feature is the manner in which the doors are locked and unlocked. The car is equipped with an automatic attachment, which contacts only when the car stops. As a result there is no noisy contact and it is impossible for the attendants to get the doors open as the car passes.

Another ingenious feature is the operating box. It can be seen at a glance that the car and pointer must not get out of position with each other, or in other words, that the car must always follow the pointer, and stop at the floor indicated. An arrangement is provided whereby if there is no circuit the

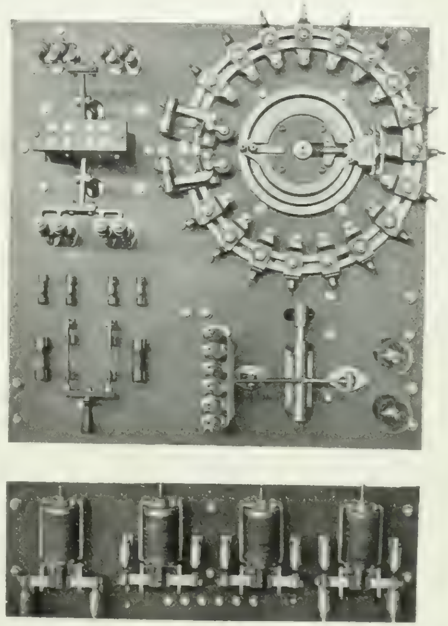


FIG. 6.—CONTROLLING DEVICES

knob which actuates the pointer is released from the pointer. The same condition exists when the machine is running. For instance, if a door is open the knob can be turned, but the pointer will not respond; or if the knob is being moved in one direction and the operator reverses the movement, the knob will reverse but not the pointer; and if he moves again in the first direction, the result is the same, i. e., the pointer will not move. In other words, if the operator reverses or lets go of the knob he can not again control the pointer until the machine stops. On the other hand, if a door should be forced open while the machine is running, the car would stop instantly, and the pointer would still be out of commission; and if the door were closed again the car would automatically resume its travel to the floor indicated by the pointer. This controlling device, shown complete in the illustration, Fig. 6, is also used on plunger and hydraulic tension machines.

Annual Convention of Municipal Electricians.

The International Association of Municipal Electricians will hold its twelfth annual convention at the City Hall, Norfolk, Va., on Aug. 7, 8 and 9. Mr. R. A. Smith, city electrician, of Norfolk, is the active local committee. The headquarters will be at the Monticello Hotel. Mr. Frank P. Foster, of Corning, N. Y., is the secretary of the association.

A Problem in Phasing.

By J. F. [illegible]

The following problem in phasing and its solution is presented as an illustration of a method by which the solution of other similar problems may be worked out more quickly than by the usual methods.

Two 60-kw, three-phase lines 50 miles long, were brought into a sub-station from the busses of another station. One line was in regular service when the second was brought in, and as carrying a load that could not be interrupted. The corresponding wires of the two lines were not known. It was necessary to find them that the two circuits could be operated in parallel.

Fig. 1 shows the wiring at the sub-station. It should be noted that the step-down transformers in banks I and II are star-

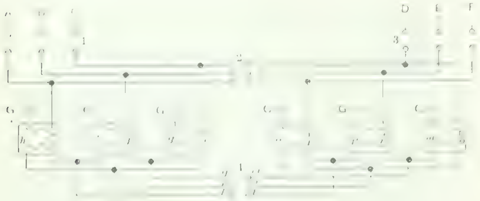
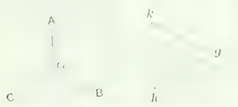


FIG. 1.—SUB-STATION CONNECTIONS.

connected on the high-tension side with grounded neutrals, and delta-connected on the low-tension side. *A, B* and *C* are the phases of the circuit first in service. *D, E* and *F* are those of the second circuit. With switch 3 open and 2 closed, 4 could be closed. This shows that banks I and II are alike in every respect.

Let Fig. 2 represent the high-tension star of bank I. Then Fig. 3 will be the corresponding low-tension delta. The meth-


FIGS. 2 AND 3.—STAR AND DELTA VOLTAGE RELATION.

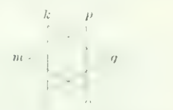
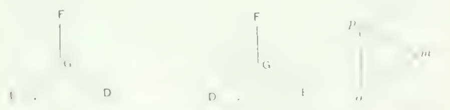


FIG. 4.—RELATIVE POSITIONS OF TWO DELTAS.

od of constructing this delta is important and is as follows: The vector of low-tension voltage of any transformer is assumed to be parallel to, and in the same direction as, the vector of high-tension voltage. Thus *kh* is parallel to *AG*, *gk* to *BG* and *hg* to *CG*. From this, Fig. 3 is drawn from Fig. 2 and Fig. 1.

Tests across switch 4 with potential transformers, when power was applied to bank II from the line *D, E, F*, showed that the


FIGS. 5, 6 AND 7.—VECTOR RELATIONS OF STAR AND DELTA VOLTAGES.

two deltas of low-tension voltage had relative positions as shown in Fig. 4. This was determined by obtaining full voltage from *p* to *h*, half voltage from *p* to *k* or *g*, and corresponding voltages from *h* and *k* to the other points of the other delta.

Now construct the high-tension star from the low tension delta *p, o, m*. The line *po* is parallel to and in the same direction as *FG* from Fig. 1. This fixes *FG* in Fig. 5. The line *mp* is parallel to and in the same direction as *EG*, and *om* as *DG*. Thus Fig. 5 is determined.

It may now be seen by comparison of Fig. 5 and Fig. 1 and Fig. 2 what must be done in order that the circuits may be paralleled. A reversal of *E* and *D* would cause the star and delta of bank II to be as shown in Fig. 6 and Fig. 7. This would permit the lines to be parallel either at switch 2 or 4 since *g* is across switch 4 from, and should be in phase with, *m*, *h* with *o*, and *k* with *p*. The change mentioned causes this to be the case. An actual test showed that this change, as deduced from the diagrams, was correct.

It is believed that a solution of many of the problems in phasing may be more quickly obtained if methods such as given above be used to indicate the necessary changes.

Hunting in Rotary Converters.

By Norman G. Meade.

In a system of electric transmission that supplies rotary converters any irregularity in the rotation of the generator will tend to cause hunting, because the inertia of the rotary converter armature prevents it from instantly following the generator and the resulting difference in the relative positions of the two armatures causes a change in the phase position of the generator e. m. f. and the converter counter e. m. f., making a difference in the instantaneous values of the two e. m. f.'s, causing so-called corrective currents to flow between the two machines. When the converter armature is behind the generator in relative position, the corrective current flows in a direction to tend to accelerate the converter armature and to retard the generator. This acceleration may be carried to such an extent that the converter armature will assume a position rela-


FIG. 1.—VECTOR REPRESENTATION OF GENERATOR AND CONVERTER E. M. F.'S.

tively ahead of the generator, causing the corrective current to flow in the opposite direction, thereby retarding the converter armature and producing hunting. Thus the hunting is due primarily to irregular rotation of the generator, and depends upon the flexible connection between generator and converter and upon the inertia of the rotary converter armature.

Hunting is almost universally caused by periodic fluctuations in the prime mover. In a steam engine, for example, the rate

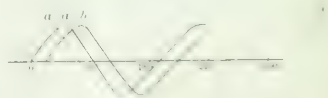


FIG. 2.—SINUSOIDAL REPRESENTATION OF GENERATOR AND CONVERTER E. M. F.'S.

of supply of energy to an alternator during the instant following the admission of steam to a cylinder is much greater than during the instant preceding admission. In gas engines the fluctuations are even more violent, because the difference in pressure just before and just after an explosion is more pronounced than in a steam engine. Since the electric circuit has no capacity for storing energy, the fluctuations must appear as changes in the output of the generator or as changes in the speed. In circuits where the power is derived from turbines, either water or steam, the rate of supply of energy is uniform and there is no tendency for hunting to begin.

Owing to the activity of the corrective currents the rotary converter automatically tends to follow changes in the rotation of the generator; how closely it follows depends upon its design. If the reactance of the armature circuit be large, the corrective current for a given difference in e. m. f. will be small and the force tending to change the relative position of the converter armature will be less able to overcome its inertia, causing a sluggish action of the armature, so that it will fall out of step with small changes in the relative positions of the two armatures. If the armature reactance be small, the force tending to change the relative position of the converter

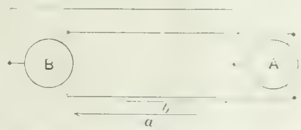


FIG. 3.—CORRECTIVE CURRENTS IN INTERCONNECTING CIRCUITS.

armature will be greater than necessary, so that the armature will be carried beyond its proper relative position, and an oscillation will be set up.

Corrective currents, which are due to a difference between the relative positions of the generator and converter armatures, increase the wattless components of the total current, and these leading or lagging currents increase or decrease the strength of the generator and converter fields due to the magnetizing effect of these currents in the armature windings. Since hunting is an oscillation in the relative position of the converter with the generator, the corrective currents in the circuit.

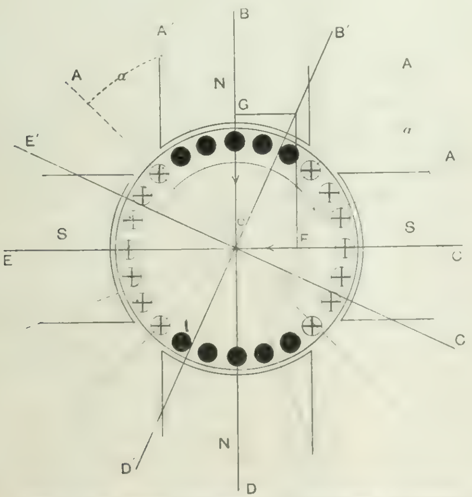


FIG. 4.—MAGNETIC RELATIONS IN A FOUR POLE CONVERTER

due to the oscillation, flow first in one direction and then in the opposite direction. The effect of this varying current is to strengthen one pole tip when flowing in one direction and to strengthen the other pole tip when flowing in the opposite direction; thus the distribution of magnetism is repeatedly changed and the magnetic flux continually shifts backward and forward across the pole face in both the rotary converter and the generator, thereby causing flashing at the direct-current brushes of the rotary converter.

To more fully illustrate the cause and effect of hunting, the phenomenon is illustrated graphically by means of diagrams. In Fig. 1, *a* represents the generator e. m. f. and *b* the rotary converter counter e. m. f., the relative positions being such that the e. m. f. of the generator is ahead of that of the converter. This condition is illustrated in Fig. 2 by means of sine curves of the e. m. f.'s. Under such conditions, the corrective currents flow in the direction of the arrow *a*, Fig. 3, in which *A* represents the generator and *B* the rotary converter. As already explained, the action of the corrective current when flowing toward the rotary converter is to accelerate its armature, which subsequently is carried beyond the instantaneous position of generator armature, changing the relative position of the e. m. f.'s, as shown by a^1 and *b* of Fig. 2, so that the rotary converter counter e. m. f. is in advance of the generator e. m. f., and reverses the corrective current and then flows toward the generator as shown by arrow *b*, Fig. 3.

To consider the effect of the reversal of the corrective currents and the consequent shifting of the magnetic flux across the poles, on the direct-current side of the rotary converter use can be made of the diagram shown in Fig. 4. For the sake of simplicity a four-pole machine is illustrated, *N, S, N, S,* representing the north and south poles, respectively. The conductors about the periphery of the armature are represented by the light and dark circles. In the conductors shown by the dark circles the current is supposed to be flowing away from the observer and in the light circles toward the observer. The flux without armature current is represented by the lines *B, C, D,* and *E,* the path being from *B* and *D* to the origin of *O,* thence to *C* and *E.* The theoretically neutral lines are shown at *A* and A^1. To show the effect of armature magnetomotive force let *F-O* represent the flux set up by the cross ampere turns of the armature, which acts at an angle with the field flux represented by *G-O.* Now, considering these two factors as forces they resolve themselves into a parallelogram and the diagonal B^1-D^1 and the line at right angles C^1-E^1 give the new path of the field flux, it having been shifted by the effect of the armature re-

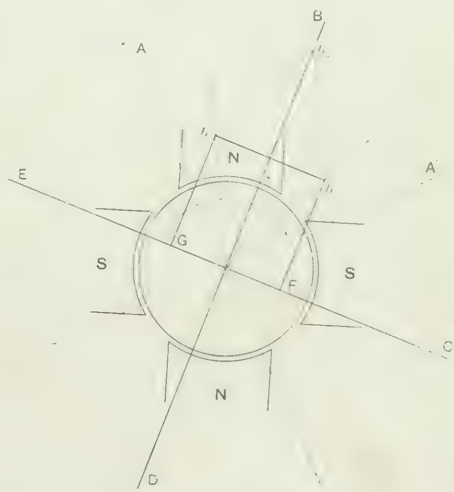


FIG. 5.—ACTION OF GRID DAMPERS.

action, causing the no-load neutral lines *A* and A^1 to shift through angle *A* or A^1 to the position of A^{11} and A^{111}.

As the factor *F-O* varies with the load and the direction of the corrective currents, the position of the neutral point is dependent upon its magnitude, and the position for sparkless commutation varies accordingly. As hunting is always accompanied by a shifting field it is possible to effectively prevent it by heavy copper grids that surround each pole and face and extend across it, imbedded in one or more slots. The function of the copper grids is to act as dampers to prevent the relative positions of the converter armature from being changed by the corrective currents more than the initial change in the generator. Assume that the generator speed momentarily increases, thereby causing a difference in the phase of the generator and converter e. m. f.'s. Under these conditions corrective currents which flow in the circuit will disturb the fields and accelerate the

converter armature. The shifting flux cuts the copper grid and generates in it eddy currents which retard the converter armature; that is to say, the secondary eddy currents have an effect the reverse of that of the primary corrective currents. The accelerating action of the corrective currents occurs as long as the converter armature is behind the generator, but the retarding action of the eddy currents lasts only while the relative positions of the converter and generator armatures are changing; that is, while the magnetic flux is moving across the pole face. The eddy currents, therefore, do not act as a constant opposing force to the corrective currents, but as a true damping force, becoming zero whenever the generator and converter armatures revolve without changing their relative positions.

Referring to Fig. 5, let *F-O* represent the corrective currents flowing toward the converter and tending to accelerate its armature with a consequent distortion of the field and a shifting of the path of the flux *B-O* toward *b-O*. Let *G-O* represent the action of the eddy currents in the grid with b^1-*O* opposing *b-O*. Now forming b^1-*O* and *b-O* into a parallelogram, *b*, b_2, b^1 and *O*, it will be seen that the resultant diagonal corresponds to the path of the flux *B-O*. This representation exaggerates the conditions, but it serves to show that the action of the grid is to prevent the rotary armature from accelerating beyond the generator armature.

Up to this time a single rotary converter and generator have been considered. When two or more converters are connected to the same generator, hunting in one converter may cause trouble with other converters connected in the same circuit if the lagging and leading currents due to hunting are large enough to produce serious pulsations in the generator voltage. Dampers on the generator field poles will help to control the corrective currents flowing between it and the hunting converter, the action being identical with those of the rotary converter. For this reason a generator designed for the operation of rotary converters is usually provided with dampers, even if it is not to be operated in parallel with other generators.

The Slide Rule as a Substitute for a Wire Table.

By Otto [illegible] Jr.

The methods which from time to time have been given for finding the diameter of wires in B & S gauge when the number is given, are more or less complicated. The principal advantage of the method here offered is in having an approximate wire table on some part of the slide rule giving the diameter in mils direct, the additional marking and figures not in any way interfering or defacing the scales on the face of the rule.

The lower half of the accompanying cut shows the front and the top shows the back of a rule which has been turned to bring the markings on it into view. It may, however, be marked on some other part and if desirable with greater accuracy than was done in this case, by placing a number on the back of the rule opposite each one-quarter of an inch on the top beveled edge. The error involved is very small and will be shown later.

The B & S sizes are marked on the back by starting with, say, No. 0 at the projection of the 8-inch division, and numbering each [illegible] numbers to No. 30, and to the right for the increasing sizes to No. 0000, bringing it at the 8¾-inch division. Then by placing the line on the glass in the runner to 460, the diameter in mils of a No. 0000 wire, on the *A* scale, and cutting a line into the top metal edge of the runner to coincide with the 8¾-inch division on the back and calling this line *N*, by moving the runner to any other size of wire and placing the mark *N* to coincide with the wire number, its diameter can be found.

For example, to find the diameter in mils of a No. 6 B & S wire, the line *N* is brought over to the No. 6 projection from the back of the slide rule, and under the line on the glass in the runner is found the diameter on the *A* scale of 162 mils.

To find the resistance per 1000 ft. of copper wire after having found the diameter in mils, a simple method may be used, proposed by Mr. Carl P. Nachod (Electrical World, Vol. 47, page 459). By placing the diameter of the wire on the *C* scale over the end of the *D* scale the resistance in ohms will be found per 100 ft. on the *A* scale over the end of the *B* scale. For any other length the resistance can be read on *A* over the given length on *B*.

The area in circular mils can be found by squaring the diameter in mils found by the above method or the nearest size of wire corresponding to a certain given area in circular mils may be found by extracting the square root. For example, to find the nearest size of wire having an area of 26,000 circular mils, extract the square root, which is 161.2, and by bringing the runner to 161, over the mark *N*, a No. 6 B & S wire is shown to be the size required.

The weight per 1000 ft. can be found approximately by taking the area in circular mils and solving in formula:

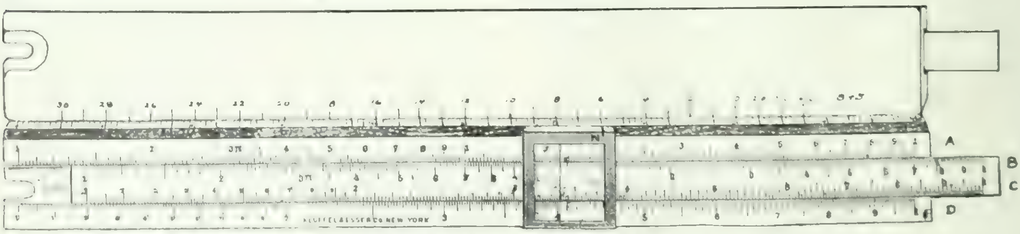
[illegible]

The proof of the assumption that each ¼ of an inch on the *A* scale of a 10-in. slide rule is approximately equal to the difference of the diameter in mils between two B & S sizes of wire can be shown by taking the formula for the diameter in mils of B & S gauge number, which is 324.86×0.890525^n, where n is number of wire, or log of the diameter in mils equals $2.5117 + \bar{1}.94964\, n$. For any size larger (in circular mils) than No. 0 wire, the formula is 289.30×1.12293^N equals diameter in mils; where N is the number of zeros.

It can easily be shown that the difference between the logs of two consecutive numbers is a constant.

For example, log of No. 1 B & S wire equals 2.461345
log of No. 2 B & S wire equals 2.410990
Difference between the logs equals .050355

From the principle that the graduations on slide rules are proportional to the logarithm of the numbers by which they are distinguished and that these divisions are on a 10-inch rule on the *A* scale for one set extends over a length of 5 inches, therefore $5 \times .050355 = .251775$, which is the distance in inches on the "*A*" scale between any two consecutive numbers of wire. On some makes of slide rules the total length of the scale varies a little, which would also have to be taken into consideration when looking for accuracy.



[illegible] DIAMETERS OF B & S [illegible]

By comparing different setting of the runner for the various sizes of wires with a wire table, the accuracy of the markings [illegible] be made more exact than shown here.

Grounding Interior Conduits.

By T. W. Poppe.

The grounding of interior conduits is a simple matter; very important, but often carelessly done. It is too often performed in a haphazard manner and seldom, if ever, executed in a first-class manner.

The conduits which enter a panel box are, as a rule, wrapped with a No. 12 or No. 14 bare copper wire and forced against the iron lining of the box by screwing a bushing on the conduit. The bushing often spreads the wire in such a manner as to leave absolutely no connection between the conduit and ground

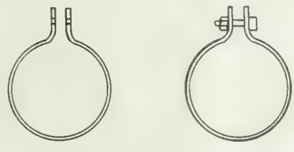


Fig. 1.—Ground Clamp for Conduit.

wire. The ground wire is wrapped around the conduit once and carried to the next conduit, and often where the wire must necessarily cross itself, the bushing, forcing the two points together, severs the wire, leaving no means of carrying a current to the ground except through the iron lining of the box. As the conduits seldom come into good electrical contact with the lining it is unwise to rely upon the possibility of any ground current finding a path through the lining of the box. It often happens that a line of conduit entering a box may be grounded at some point distant from the box by coming in contact with water, steam or sewer pipe or the steel frame of the building, but the one next to it may be perfectly clear of all grounds and a severed ground wire in the panel box may defeat the object of placing the wire there.

A way of avoiding forcing the wires apart or severing them is to put a washer under the bushing. The wide surface of the washer in either case forces the wire against the lining of the box and makes electrical connection through the washer and bushing to the conduit and a good ground connection results.

It often happens that a large number of conduits enter the box in a comparatively small space and a washer could not be used on each conduit because of the amount of room it would require. In this case a strip of thin sheet lead could be cut and fitted on the conduits and the bushings used to force the lead against the sheet iron. The lead being soft, would spread under the pressure exerted by the bushing and make an even, compact washer. Being held firmly by means of the conduits and bushings it would ground all the conduits and would be a good conductor for the ground current.

At switchboards or distributing boards where several large

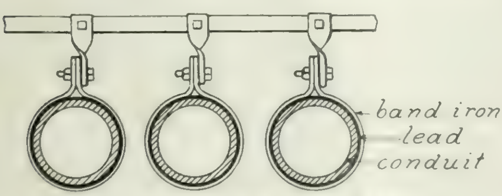


Fig. 2.—Arrangement of Grounding Clips.

conduits are placed, the above method of grounding would be impracticable. A good method of grounding is to place on each conduit a ring of band iron made to fit. Where the two ends of the ring of band iron meet they should be bent out as shown in Fig. 1 and a hole bored through both ends to allow a bolt to pass through. The conduit is scraped clean, the ring of band iron placed on the conduit with a piece of sheet lead between it and the conduit, and when the bolt is inserted and fastened the tension caused by it forces the band iron against the lead and forces the softer material into every irregular formation of the ring and conduit, thus making a perfect contact.

This is done on each conduit and each clamp is connected to one long connecting strip of band iron. This is done by drilling a sufficient number of pieces of band iron, 2 ins. long, and twisting them so the ends will be at right angles and connected by bolts as shown in Fig. 2. The band iron is then pushed over toward the conduits and when finished they present an appearance similar to Fig. 3.

From any convenient point on the band iron a ground wire can be carried to the point where the wire will be connected to the earth. Should the ground wire be connected to a water pipe it should be connected as near the source of supply as possible so in the event of alteration being made the ground connection will remain intact.

Should there be no piping to which a ground wire can be fastened, a good permanent ground can be made by perforating a piece of 1¼-in. galvanized iron pipe, into this place a ¾-in. pipe and drive both about 12 ft. or 15 ft. into the ground. Then withdraw the ¾-in. pipe and fasten the ground wire to the 1¼-in. pipe. This leaves an 1¼-in. perforated hollow tube in the ground. The ¾-in. pipe being withdrawn from the 1¼-in. pipe leaves it free from dirt. The object of the perforations in the tube is to allow the moisture to enter the pipe and to settle in the tube. Being in the tube the moisture will be more apt to reach the bottom of the tube, whereas were the pipe not perforated the moisture would be dissipated in the surrounding earth. The perforations allow a constant accumula-

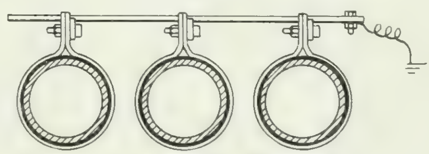


Fig. 3.—Grounding Conduit Lines.

tion of moisture which settling further from the surface of the earth is not apt to dry up and will make connection with permanently moist earth. The ground connection should be made with an insulated, copper wire not smaller than No. 4, which should preferably be sweated in a lug attached to a clamp on the pipe.

Test of a Gas-Producer Electrical Plant.

By L. J. Corbett.

One of the first plants in the Northwest to use producer gas as a source of electrical power is that of the Pasco Light & Water Company, at Pasco, Washington. The results of a test made on Thursday, April 26, 1907, were highly gratifying to the promoters of the company, the engineers and the manufacturers of the equipment, and will no doubt interest all those now investigating the economy and reliability of producer gas for electrical purposes. The fact that a Western coal was used for the test, not anthracite or coke, makes it of particular interest to Western engineers who are concerned chiefly with bituminous and lignite coals, and are far from the anthracite and coke-producing districts.

The plant is of 100 hp capacity and is to handle a pumping load of from 30 to 40 hp and a lamp and motor load which will increase with the size of the town.

The gas is generated by a Smith suction producer, and after being passed through a scrubber and a purifier, is admitted to a 100-hp Rathbun three-cylinder vertical type engine. This is belted to a General Electric three-phase, revolving-field alternator operating at 2080 to 2300 volts per phase and 60 cycles per second.

The pumping plant is located about 7400 feet from the power house and is operated by a 40-hp induction motor of the squirrel-cage type placed directly on the line at 2080 volts. The line from the power house to the pump house consists of three No.

8 hard-drawn bare copper wire spaced 14 inches between centers. The pump house is placed over a concrete well 24 feet deep in which is set a submerged triplex pump with a capacity of 400 gallons per minute. This draws water from the Columbia River 150 feet away and delivers it to a 10-inch main of wood stave pipe which leads through the town of Pasco to a tank on a hill about one mile east of the present center. This tank has a storage capacity of 100,000 gallons and gives a head of 78 feet above the grade at the Northern Pacific tracks near the present depot site. In case of fire the pump is to furnish a direct pressure of 65 pounds per square inch at the hydrants.

When the installation of the system was about completed the test was made. A non-inductive load was placed on the generator at the power house. A water rheostat consisting of three barrels connected in "Y" was rigged up with iron tie plates for terminals, the resistance being varied by the use of a little salt and by raising and lowering the terminals connected to the outer leads.

The attempt was made to carry a load on the engine of 100 hp, but such careful attention was needed to maintain the load at a certain point that it was decided to take readings and adjust the load every fifteen minutes for a portion of the time and every half-hour part of the time. Then an estimate was made of the average load carried by the engine and the horse-power hours calculated.

An interesting incident in connection with the test occurred after about three hours' run. The engine seemed unable to carry the load and maintain its speed. The speed decreased so that it was impossible to keep up the voltage, and the sky looked blue for the gas equipment. After various guesses as to the difficulty the correct remedy was applied, which consisted in turning on the water regulator on the engine, thus enriching the gas with aqueous vapor, whereupon it immediately picked up and carried the full load just as easily as it had when first starting up in the morning.

The coal had contained moisture in a sufficient quantity to yield a satisfactory gas when the load was first put on, but after the three hours' run the moisture had so far evaporated that the gas was dry and the operation of the engine was seriously hampered. The use of the water regulator is considered unnecessary by some builders, but it certainly showed its usefulness in this instance.

The rheostat load was held for another hour and then cut out and the pump load substituted. This load varied from 22.1 to 29.5 hp as the head in the pipes increased. Readings were taken every fifteen minutes.

The total duration of the test was seven hours. At the start the producer and engine had been running light for about one hour so everything was in working order. The height of the coal in the hopper was noted and the state of the fire. Coal was added as needed and the weights recorded. At the end of the test the fire was in the same condition as at the start and coal was placed in the hopper up to the same height as when the test commenced, as nearly as could be estimated.

The number of hp-hours was 512.9, the weight of coal used, 696 lbs., showing a result of 1.35 lbs. of coal per hp-hour delivered to the belt.

The coal was called a washed lignite nut, from a mine of the Wilson Coal Company at Centralia, Washington. This car load was delivered at a cost of $4.15 per ton; thus the cost of coal per horse-power hour was less than 3 cents. It was badly slacked and contained considerable impurities in the shape of earth and clay.

After the test two or three large clinkers were drawn out of the producer weighing in all 64 lbs. Pending an analysis and thorough test of the coal, it is uncertain whether it is a coking coal and not a true lignite; or perhaps the impurities consisted of siliceous ingredients or a form of fire clay, these solidifying into the clinkers mentioned.

Coal was put in twice during the test and again at the end of the [illegible] would have sufficed for the day's run, besides the hopperful to start in the morning.

The water system was laid out by Mr. Otto A. Weile, a civil engineer of Spokane, who had complete charge of the work. The writer was in charge of the electrical features.

Notes on Steam Plant Operation.

[illegible]

While it is not generally appreciated that boilers and engines in marine practice are operated much more economically than boilers and engines in land practice, such is nevertheless the case. By many this is attributed to the fact that marine practice in steam matters is far in advance of land practice, while others attribute the better efficiency to the cramped position of the apparatus in marine practice, which is claimed to be a blessing in disguise. Boilers are jammed close to engines, the length of steam pipes is reduced, complications because of the room they require are avoided and all things are conducive to economical operation.

A pound of coal is a pound of coal, however, whether it be burned on land or on sea, and the more efficient operation of marine boiler plants with their attendant disadvantages is surely a subject for investigation. At the outset it should be recognized that difficulties cannot be overcome unless they are known to be such and unless their importance is appreciated, and while it is not the purpose of this article to make any labored comparisons between marine and land practice, an endeavor will be made to point out wherein land practice may be improved without much change in equipment, by a study of marine practice.

With reference to the furnace it is recognized in both marine and land practice that sufficient air must be supplied to the furnace to insure complete combustion and that an excess is to be avoided because of the loss occasioned by the unnecessary reduction in the furnace temperature and the heat carried away by the excess air. But complete combustion is sought for more eagerly on land than on sea. Stokers, Dutch ovens, etc. and etc., are practically unknown in marine practice, where it is recognized that coal produces power so cheaply that it is quite an easy matter to save it and yet lose money. As constructed to-day boilers in which combustion is nearly perfect are really dangerous. The temperature for complete combustion must necessarily be high and this gives serious trouble either through the collapse of the furnace or through the bulging or bursting of water tubes. High temperature is an indispensable factor in securing complete combustion and high temperature means the ruin of the boiler as now constructed. The writer has seen a Dutch-oven arrangement which gave so intense a heat that the brick melted and allowed the arch of the oven to drop into the fire. Another arrangement wherein powdered coal was blown against a specially shaped bridge wall gave, without the shadow of a doubt, complete combustion, for the heat was so intense that even the best fire brick procurable melted away before the blast. This arrangement never got farther than the experimental stage, as it was considered too dangerous for practical operation.

A practical boiler maker maintains that the difficulty is that there is not sufficient grate area. With an ordinary hand-fired boiler the length of the grate is limited to about seven feet because the fireman cannot stoke more than that. It is only possible to burn a certain amount of coal per square foot and consequently for any given width of boiler the coal consumption would be very defined. Evaporation cannot be obtained without the consumption of coal and therefore the whole question resolves itself into getting sufficient grate area, and this can be gotten over to a certain extent by the installation of stokers. Marine practice shows this to be fallacious.

One point that is overlooked in land practice is the indiscriminate admission of air above the furnace, and if this were not bad enough, the air admitted is generally quite cold. In marine practice the air in the stoke hold is very warm, so that

in this alone the efficiency is increased. It is not so much a question of furnace and combustion, however, as of circulation. A kettle of water in which the water is constantly stirred will come to a boil much more rapidly than one in which the water remains quiet, the heat in each case being the same. The heat in a boiler must pass through the hot gases to the plate and from the plate into the water, and the best transmission is only obtained with very rapid circulation of water. In this respect a steam boiler does not differ from a kettle filled with water, and in this point lies the greater efficiency of the marine boiler over the land boiler. There is always more or less vibration on a boat even in still water, and in rough water the rocking and plunging of the ship serve to agitate the water in the boilers and to improve the efficiency of heat transmission. It is quite out of the question to rock boilers in land practice and until some means of improving the circulation in boilers is devised, marine practice will always be in the lead in this respect, not because of the boilers, but because of natural conditions not found on land.

The temperature of engine and boiler rooms on sea is considerably higher than on land and this is conducive to economy although not to the comfort of the firemen and engineers. For example, tests made on a large steamship recently, showed the engine room temperature at the working platform to be from 87 to 128 degrees; the temperature at the lower grating varied from 99 to 109 degrees and on the upper grating from 103 to 130 degrees. In the fire room the temperature at the working level varied from 102 to 141 degrees and at the blowers the temperature varied from 121 to 150 degrees. The temperature of the feed water varied from 174 to 204 degrees and the steam pressure was kept at approximately 250 pounds. It will be readily seen, therefore, that condensation cannot be as great in marine practice as in land practice.

Large losses are possible in the fire room and the general routine for procedure in the stoke hold which is strictly followed on sea while the ship is under way is as follows: The coal (bituminous) is thoroughly broken up and lumps no larger than the fist are put into the furnace. The furnace doors are opened just as infrequently as possible and the furnaces are fired in regular rotation and are not choked near the furnace doors. The fires are pushed well back from the doors and the dead plates are kept absolutely clear of coal. Slicing is done only when absolutely necessary to break up the clinker. When burning about 20 pounds of coal per square foot of grate per hour, the fires are usually cleaned every 24 hours. The fires are not usually carried over 7 inches thick and are usually level over the entire grate. As a guide to the firemen a mark is placed on the inside of the furnace door showing the maximum thickness of fire allowed. Just before firing the furnace, the fire is raked over with a small hoe and at the time of firing the coal is thrown evenly over the fire bed

The boilers are blown down every day and when the fires are out the boilers are blown down again and then pumped full of water to the upper gauge cock to insure the water level being above the opening of the upper tubes. When the boiler is cool, the fire sides are thoroughly cleaned of soot, the grates overhauled, leaks repaired and the boiler placed in first-class steaming condition when needed. The usual method of cleaning the fire sides is to loosen the soot with hand brushes through the cleaning doors and to haul out the accumulation of soot from above the horizontal baffle. Forced draft is then put on the boiler compartment, the ash pans and dampers opened to assist the loosening up of the soot by means of the steam lance through the dusting doors. In this way all the dirt is driven up the stack and the fire room is not dirtied to any appreciable extent. When the boilers are used for any extended period underway, the tubes are swept with the steam lance through the dusting doors at regular intervals. The keeping of the fire sides of tubes thoroughly clean is a most important item in the economical performance of boilers. The water side of the tubes also comes in for much attention. The regular surface and bottom blow off, a regular supply of soda to the feed water for keeping the oil from depositing in the tubes, and special care in maintaining clean feed water, are among the precautions taken for economy in this direction.

By keeping light, thin and regular fires and by avoiding slicing as much as possible, the coal is actually burned without much smoke. The avoidance of unnecessary smoke is important for many reasons. The smoke causes the collection of soot on the tubes and renders their heating surface less efficient; there is also a direct loss through fuel unconsumed. The use of the slice bar results in waste of fuel which drops into the ash pans, and in order to obtain economy, slicing must be avoided as much as possible.

Having obtained steam at the boilers with the least expenditure of coal, the next problem for securing economy is to handle the heat units thus secured in the most efficient manner. In marine practice steam jackets are always used on the engine cylinders and the steam in the cylinder is expanded as many times as possible. The high-pressure cut off is made as early as possible. A vacuum of 27 inches is generally maintained. The air pump is watched and kept in good condition and the exhaust lines are kept tight. By the use of trap drains, vapor from the evaporators and the heat from the auxiliary exhaust steam, a temperature of feed water reaching 200 degrees and above is usually maintained. In some instances the auxiliaries are run condensing; but the saving by heating the feed water to 200 degrees over the practice of running auxiliaries on a vacuum is about 10 per cent in actual practice.

With regard to the auxiliaries, economy is gained by running fewer feed-water pumps at nearly full capacity, rather than a greater number at lower speed. The circulating pumps which are the largest auxiliaries in use are operated with a view to economy. While it is common practice to run the circulating pumps much faster at low powers than is necessary to supply the required water, the slowing down of the pump to suit the requirements will result in the use of less steam and also in a warmer feed water.

In general it may be stated that by strict attention to every possible source of loss or possible gain, a saving results. Aside from the monetary considerations this also produces better working efficiency and freedom from repairs, and these are of immense value in marine work. That the same rules can be applied in land practice with like results in economy and efficiency is evident. There is, however, not that discipline on land that there is at sea, so that greater care must be exercised by the engineer in charge in seeing that the rules are enforced.

Cooling Spray System for Condensing Water.

At the plant of the Consolidated Power & Light Company, at Pluma, S. D., a novel cooling spray system for condensing water is in use. The main line passes under the Whitewood Creek and is carried on concrete piers along the side remote from the power station. Condensing water is taken from Whitewood Creek through a screen chamber and a 42-in. reinforced concrete conduit to the power station, where it connects with a 36-in. suction line of cast iron bell and spigot pipe, from which branches lead to the centrifugal circulating pumps. Arrangements are made whereby the discharge from the condensers can be turned down the creek through a similar 42-in. conduit through a cooling system when there is insufficient water coming down the creek to supply the needs of the station. The cooling system consists of 60 3-in. spray nozzles spaced 15 ft. on centers. Each of the spray nozzles is designed to spray 9000 gals. an hour under a pressure of 12 to 15 lbs. per square inch. Under this pressure, the water as it leaves the nozzle is broken into a fine spray and is effectively cooled by partial evaporation as it falls back into the creek to be used over. The method of support was adopted to prevent possible damage at times of exceptional high water. Valves are provided in the main line to adjust the number of nozzles in service.

LETTERS ON PRACTICAL SUBJECTS.

[illegible]

[illegible] wields the gun, there is this peculiar and significant coincidence; that when either hits the bull's-eye he always rings a bell. Therefore, I am not at all surprised that exception should be taken to my observation set forth in my recent letter published in these columns bearing the above caption. That this exception should be made by one confessing the distinction of possessing an aggregation of "elaborate tool chests," proves nothing beyond the well known fact that a man may combine ability along with a mania for tools; but the combination is rare.

Just what would be regarded as the fundamental tools required by a "jack of all trades" would, as Mr. Arnold declares, depend upon condition and environment, but the kind of mechanics I had in mind do not begin the year in a planing mill, spend their summer vacation in a textile factory, and then finish off in a type foundry. I had no reference to the "jack," who is never a good specialist, and specialization, we all know, is necessary for any one to accomplish anything worth while. No doubt the electrician referred to in my former article was of this type, and the one reason for his being permitted to work three days and complete the job was as stated, because the job was "special" and had to be gotten through with.

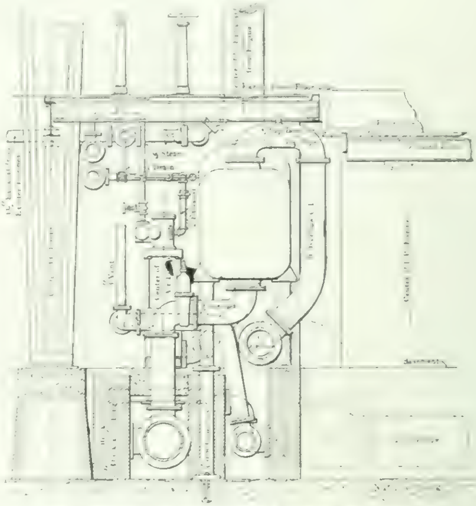
An eminently successful and practical man who began business with nothing but his ability and an article of manufacture—the proceeds from which has long since permitted him to retire in affluence—informed me that while he acted as foreman of his own shop, his first test of a new mechanic was against time; that is to say, at the end of the first day he tallied up the amount of time the newcomer spent in making adjustments, changing and dallying with tools, as against the actual time put in on the work at hand. "This and the quality of his work," my informant declared, "determined his future with me. I was thus enabled," he continued, "to pay higher wages and give better service for less money than any of my competitors, and the whole secret of my success lay in this fact, that the men at my machines were all producers and not marionettes. I was thus able to get full benefit from each moment of time which I paid my men for, and the diligent use of time is the most important thing in business. I owed it all to my system of selecting them."

I know no reason for any skilled mechanic to burden himself with an elaborate tool chest, other than the heroic never-ending attempt to appear terrifically important, or as a cheerful excuse to waste his employer's time. It is important to note that the most skilled men are bearers of but few tools. They don't have to depend on holding their jobs by the amount of furniture they bring into the factory. Their stock in trade is skill, not tools.

[illegible] CHAS. L. [illegible]

[illegible]

The fact cannot be too well realized that an increase in vacuum is a great possible gain in power, which can be obtained generally with very little expenditure of energy. Nothing has a greater effect on the economical performance of a turbine plant than the continual maintenance of the highest possible vacuum. It is fully as important to keep up the vacuum as it is to keep up the steam pressure, and it should always be remembered that every pound of vacuum obtained is a pound of steam added to the mean effective pressure of the turbine. Such being the case it is always profitable to be continually searching for and remedying the causes which tend to decrease the vacuum. With proper design and with all of the condenser apparatus [illegible] ins. to 28 ins. of mercury is maintained in practice. A loss of even a few inches, however, makes quite a difference; in fact, a larger difference than is generally imagined. In a plant where, say, a vacuum of 28 ins. is maintained, a loss of 4 ins., or, in other words, a vacuum of 24 ins., while it would not be considered excellent, would not cause the average engineer much worry. He might or might not hunt up the cause and remedy the defect. This difference of 4 lbs., however, means about 2 lbs. less in the effective pressure, and if this pressure



[illegible]

is, say, 32 lbs. in the low-pressure cylinder of a reciprocating engine and presumed to be about that in the last stage of the turbine, it is equivalent to a loss of over 6 per cent in the power developed, to regain which would mean over 6 per cent increase in the coal bill and as great a per cent of overwork on the firemen. In searching for leaks or in an endeavor to improve the efficiency of a condenser, the following points should be constantly kept in mind: It is necessary to keep all the joints in the exhaust piping tight and leakage due to holes or fractures should be immediately stopped. Inasmuch as these are low-pressure joints, this is easily done and will amply repay in increased efficiency for the little time expended on them. The slightest air leak has a great effect on the vacuum, because the air takes the place of steam which would otherwise be condensed and thus renders the space available for condensing so much less. The air pump should have its plungers and pistons properly packed, all the parts in alignment, valves in good order and clear of grease, and the springs properly set. It will pay one to give particular attention to the air pump and also to the circulating pump, as these are usually placed in such out of the way places that they do not receive ordinary attention. It would pay better to leave the brass work about the engine room go unpolished and to devote the time to these two pumps. With reference to the circulating pump, it should be watched to make certain that it is delivering a sufficient amount of water to properly condense the steam. To ascertain this it is only necessary to measure the temperature of the discharge, which for a 28-in. vacuum should be less than 100 degs. Fahrenheit. There is no advantage gained in keeping the temperature of the discharge water very much lower than this; in fact, it is detrimental, since it means in many cases cooling the feed water and useless expenditure of steam in pumping the excess condensing water. Free passage should be provided for the exhaust to the condenser. Too small exhaust pipes and sharp turns, baffling in the condenser, dirty tubes, etc., should be avoided, as this means back pressure. The exhause passages

should be of ample size, and the pipe runs should be as short as possible. In the modern vertical turbine units this is obtained by making the condenser the base of the turbine (Fig. 2); but oftentimes one sees long and crooked exhaust lines

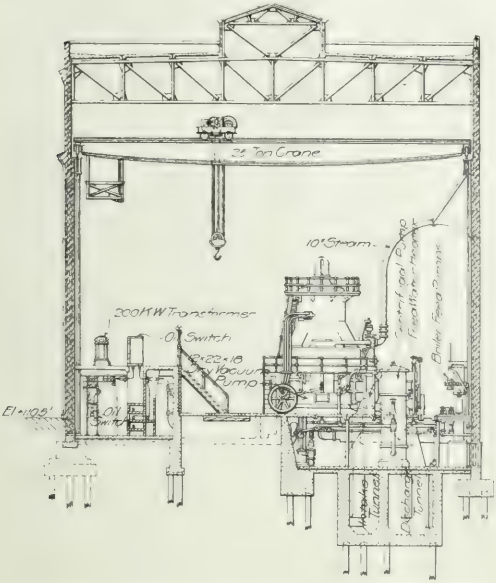


FIG. 2. MODERN CONDENSER ARRANGEMENTS FOR VERTICAL TURBINES.

filled with bends, etc., all of which obstruct the passage of the exhaust to the condenser. The condenser itself should be of proper design. In a certain plant the amount of circulating water required to maintain a vacuum of 28 ins. was 132 times the feed water, the temperature of the discharge being 88 degs. Fahrenheit. Were the condenser designed to give 28 ins. of vacuum with discharge water at 96 degs., which is not impossible for a properly designed surface condenser of suitable type, the amount of circulating water per pound of feed would be reduced to 66, or just one-half as much. Needless to say a great saving is thereby effected. The cooling surface of the condenser should be arranged to offer the greatest surface to the steam as it enters the condenser. The condenser should therefore have proper passages to permit the steam to get to the lowest tubes. Proper baffles to protect the tubes from the direct impact of the steam must, of course, be provided. Whether to admit the circulating water first at the bottom of the condenser or at the top is a question. In some instances the division plate is vertical, the water passing in on one side and back on the other. The highest possible vacuum should be obtained as near as possible to the low-pressure cylinder and this can be brought about by admitting the cooling water nearest the entrance of the exhaust steam. This will result in the exhaust being condensed as soon as possible nearest the cylinder so that back pressure in the cylinder is reduced to a minimum. To obtain good results in condenser plants, all obstructions to the flow of exhaust steam, or conditions increasing the effect of obstructions or lengthening the distance between the cylinder and the point of condensation should be avoided if it is possible to do so.

NEW YORK. EDGAR [illegible]

ELECTRIC SHOP NOTES.

Some factories are equipped with a clock device whereby bells distributed in different rooms ring at stated intervals during the day; say, at 7 and 11:30 a. m., 12 m., and 5 p. m. These contacts are often made so slipshod that they soon become loose and slip out of place, sometimes failing to make contact at all. The remedy for this condition is to solder the contacts where they belong. A case is recalled by the writer where an electrician from outside was frequently called in to make these repairs, until, after continued annoyance, the company's own electrician took it on himself to remedy the trouble as above.

Time clocks in offices are often out of repair, frequently because of weak batteries. Electric clocks are frequently out of order, either from being tampered with by an electrician who tries to repair them, or, as is usually the case, from weak batteries. Office phonographs are most often out of order because of run-down storage batteries, where portables are used. Annunciators, when in use for shop offices, are often out of order, and are frequently the source of great annoyance. Boxes thrown up on shelves, ladders rested against carelessly run wires, flapping belts tearing wires loose, and the changing of line shafts and careless workmen often cause the tearing out of great lengths of wire, and run-down batteries are frequently another cause.

As for elevator signal bells, etc., one sometimes finds the entire push pulled out and converted by some idle lad. Some

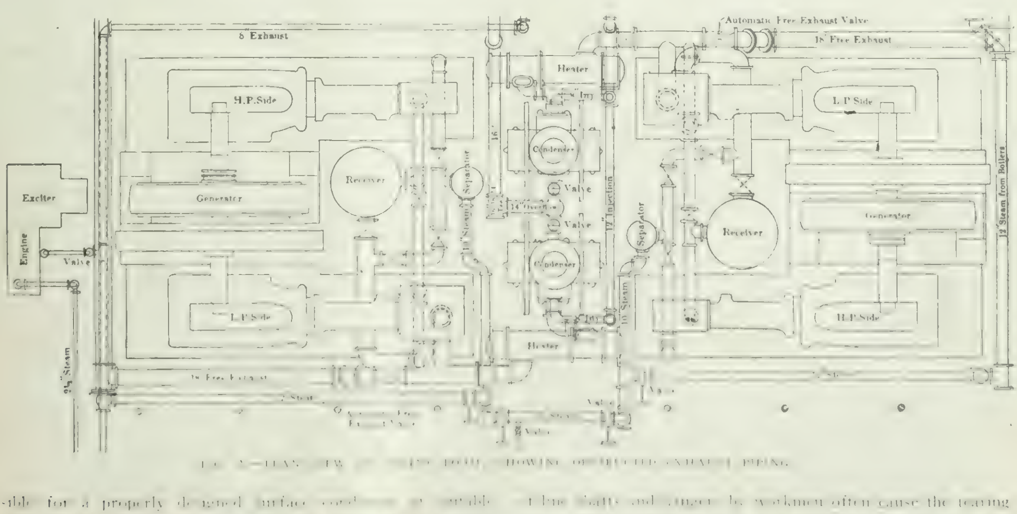


FIG. 3.—PLAN VIEW OF ENGINE ROOM, SHOWING OBSTRUCTED EXHAUST PIPING.

have lost the rubber push and the contact must be made by means of a pencil or stick. A little attention will remedy this and save annoyance.

Fire-alarm apparatus is often neglected, inspected casually but once a week, rusty, dusty and out of order; bells out of adjustment, contacts too dirty to form a circuit. As to the office fan, every one "fixes" it, and the electrician gets the blame for its not working. Poor mechanically made switches are most often the cause of their being out of service; sliding contact switches which touch only occasionally, usually oily and covered with dust, leave little to wonder at when they fail to work.

Small panel motors are often not oiled frequently enough, and fail to start finally, from too much friction; and a fuse blows. Freight elevators are not properly inspected, and are afflicted with loose, slipping belts, grounded wires, loose nuts, and motor shifted from base because of nuts worked off.

Telephones are often injured in their working by the pulling about of desks until the wires coming up from the floor are pulled loose, or jerked out bodily, or wires from condensers pulled out. Extension cords pulled out of sockets in the same way affect the lighting. The above are a few of the annoyances most common in offices and about shops in general, and form the small leaks which a little care and wise oversight can easily remedy and entirely overcome.

Chicago, Ill. James T. Arnold.

BRIDGE-WALLS FOR BOILER SETTINGS.

Will readers of the Electrical World kindly give their views concerning bridge walls? It is seldom that two settings of the same construction are found in neighboring boiler furnaces; and in different sections of the country, there is the widest range of bridge walls imaginable. The Hartford Steam Boiler Inspection & Insurance Company recommends a boiler setting which is frequently followed until it comes to the bridge wall, but there the boiler setter either goes off at a tangent or suffers from some trouble which renders him incapable of following the plans which have been furnished him.

A collection of sketches and descriptions of bridge walls from power users would be very valuable. It would be still more so if each writer would give the reasons why his particular setting seems better than others. As far as the experience of the writer goes, it seems desirable to have a bridge wall for keeping the fuel from falling off the back end of the grates. Any further use or function of the bridge wall, he has been unable to discover by observation of many thousand boilers in active operation in various parts of the country.

True, bridge walls have been made to perform other functions than those for which they were originally intended; but that was usually for convenience of construction and in no way had anything to do with the functions of the bridge wall. As an example of this kind the Jarvis furnace which was much used several years ago, and is still being used, may be cited. In this furnace, the bridge wall is also used to admit hot air above the grates. The bridge wall is made hollow and small holes communicate with the interior of the wall and permit air to be drawn into the furnace by the chimney draft.

The air which finds its way into the hollow bridge wall, becomes heated during its passage through the hollow furnace walls and through the bridge wall, and enters the furnace well heated and assists greatly in consuming the gases which arise unconsumed from the top of the fire. This is an instance when there is some reason for departing from the conventional form of bridge wall. If one knows of other equally good reasons for other forms of bridge walls, for the sake of aiding fellow workers, the writer would suggest that these persons describe their ideal of a bridge wall and tell how and why it is as good as or better than the others. For the sake of placing the matter definitely, the writer propounds this question:

What form of bridge wall do you favor, how is it constructed (illustrate with sketches) and why is it better than a narrow, plain, straight brick wall?

New York City. James Francis.

THE SMOKE NUISANCE.

The subject of smoke abatement is one of unceasing interest, especially to sanitary reformers and civic organizations. It has manifested itself again in this city to the distress of the street railway company against whom the Grand Jury has found an indictment. To one familiar with the chemistry of combustion and also with practical boiler-room operation, the remarks of well-meaning persons at such outbreaks of public indignation, display considerable ignorance of many aspects of the smoke question. Now there is no reason why every effort should not be put forth to make the atmosphere of the city as pure as possible, and improvement by reducing the volume of smoke from factory and power-house chimneys in many cases is possible and also desirable. In numerous instances smoke is due to the ignorance and the carelessness of the fireman and oftentimes to the possession of both of these qualities by the owner. The emission of smoke, however, is not attended with that waste that is popularly supposed, although it may be a nuisance. Arguments based solely on the assumption of prolific waste fail to convince users of steam whom experience has taught otherwise. A shovelfull of coal is capable of producing a vast amount of smoke and unfortunately it is difficult to avoid some smoke when boilers are overloaded and hard-fired. A certain amount of smoke is compatible with a high degree of fuel economy. The smoke nuisance can be solved by putting in additional boilers and where the nuisance is serious such a remedy could be applied and ought to be enforced. There are cases, however, and their number is legion, where the demand for steam is such that the provision of additional boilers would be a hardship. Where heavy demands for steam occur at intervals and then only for a short time, the forcing of boilers becomes inevitable, and to insist upon expensive provision in the shape of additional boilers to meet this occasional need is unfair. Such a condition, for instance, would be imposed upon an electric light company during a sudden thunderstorm. The sudden darkness would necessitate the forcing of boilers to their uttermost and the emission of smoke under such circumstances could not be avoided. The overload might continue from 10 minutes to one-half an hour, and there is no other way to meet such a sudden call for electricity in a station not provided with a storage battery, and which is being operated with any degree of economy. Bituminous coal under such conditions is bound to yield vast volumes of smoke. On the other hand there is no reason why every effort should not be made to fire all furnaces as smokelessly as possible, and the standard of skill required in firemen could no doubt be raised to advantage. Persons too often take a rather narrow view of the capabilities of firemen and of what should be expected of them. It requires very little intelligence indeed to throw coal through a furnace door; but to throw it so as to burn it economically is a different matter. The writer knows of a case in Newark, N. J., where the owner found it to his advantage to pay firemen in his employ a higher wage than they could command elsewhere, and this not because of any philanthropic spirit. Accurate records of coal consumed were kept unknown to the firmen, and by a gradual process of elimination only the best firemen were retained. It was found that these saved more than 20 times the increase in the wages given. Needless to state unnecessary smoke does not issue from the chimney connected to the boilers fired by them. The additional payment left them with the impression that they must be first-rate firemen and they endeavored to live up to the impression with plenty of encouragement from their employer. There is in one of the large cities of Germany, a society for the suppression of smoke and the promotion of fuel economy. This society is a self-supporting organization comprising about 150 firms and has about 500 boilers under its control. One of the chief duties of the society is to maintain a staff of expert engineers and firemen who take charge of boiler plants belonging to the members of the organization, and to teach the firemen in charge to perform their duties in a most efficient and economical manner. An organization of this kind is doubtless impossible at the present time in this country; but its ideas can be

carried out in many plants where a large number of men are employed. Incessant smoke is bound to create adverse public opinion and this is to be avoided, since the voice of the people is all powerful. Where smoke issues from chimneys only at rare intervals, and then because of necessity, no adverse public opinion is to be feared and where smoke ordinances are in force, no conviction is likely, when the cause is known.

Brooklyn, N. Y. Charles T. Jones.

PRODUCER GAS ENGINES AS PRIME MOVERS.

One is so often confronted with a statement that gas engines, especially those using producer gas, are so very much more economical than steam engines and electric motors as prime movers that it would appear that the statement were unqualifiedly true; whereas such is not the case. The superiority of gas engines as regards fuel economy can not be accepted without some important limitations. There can be no doubt, for instance, in the large steel mills where the gases from the blast furnace are ordinarily permitted to go to waste, that the producer gas engine has advantage over the steam engine and electric motor. There is also no doubt but what the gas engine theoretically affords the most economical way of converting heat into work; but owing to constructive defects and difficulties due to the high temperature in the engine cylinder during explosions, the gas engine has not proved reliable for use in such cases, where reliability is of the utmost importance. Nor is the economy claimed always realized. The writer has in mind a producer gas plant in the southeast where gas engines were used to drive dynamos for generating electricity. The claims were that the electrical energy could be delivered at the switchboard for four mills, and test conditions probably showed this to be nearly true. After killing one engineer, however, and placing the company to no end of trouble owing to the unreliability of the service, the owner was glad to use the energy of a local electric light company at four cents per kw-hour.

The dangers to which suction gas producers are prone, unless care is exercised in their manipulation should not be overlooked. Many attendants appear to imagine that there is no danger of explosion with such apparatus. In this connection, attention might be called to a recent explosion of a gas producer which luckily did not result in any serious injury. The incident, however, shows how a trifling neglect may easily be the cause, of outside air getting into the apparatus where the gas is stored and forming an explosive mixture with the usual results.

The arrangement of the plant is shown diagrammatically herewith. On the morning of the explosion the plant was working under normal conditions, that is to say, the cocks A, C, D, F, were shut, and the valves E, and G, were open. After a few hours' operation, the engine was stopped because of a hot bearing. The valves G, and E, were closed and the cocks D, and C, were opened to allow the gas to escape into the air. The heated brass was taken out, cooled, scraped, and refitted and the cock F, was then opened to admit gas from the city mains for starting the engine. Owing to some defect in the ignition apparatus the charge could not be fired, and after spending about 20 minutes in trying to start the engine, the receiver, a vessel about five feet in diameter by seven feet long, exploded with great violence. The cause of the explosion was the opening of the cock D. During the time which elapsed between the opening of the cocks C, and D, and the explosion, the apparatus was under the same condition as to ventilation as a coal mine having an upcast shaft with a furnace at the bottom to produce a draft and a downcast shaft in which the valve D is situated to supply fresh air. The air so supplied, of course, rendered the gas with which it mixed explosive, and as soon as the mixture reached the generator it ignited. The flame travelled backwards through the scrubber to the receiver which at once exploded. The propagation of the flame through the scrubber was sufficiently retarded by the mass of cold wet coke therein contained to prevent any explosion there. The gas in the receiver moreover was doubtless richer than that in the scrubber owing to leakage of city gas through the valve E. The leakage however would not have been a source of danger if the cock D had been kept shut;

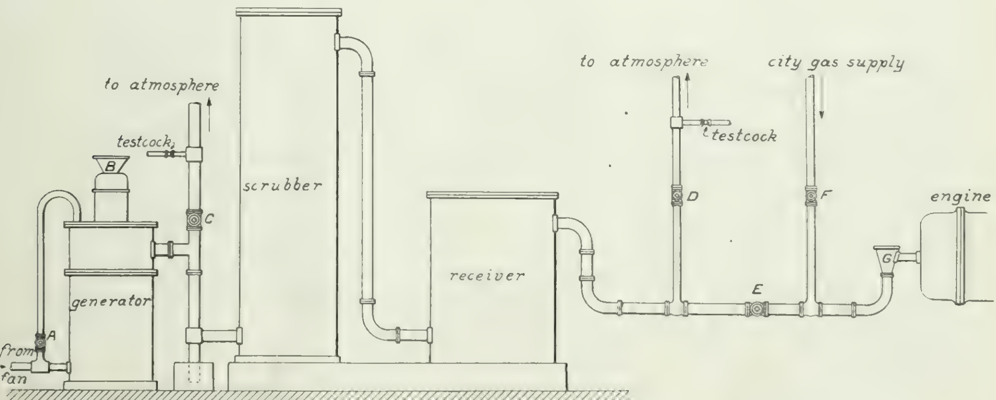


DIAGRAM OF PRODUCER GAS ENGINE CONNECTIONS.

for then the air required to make the gas explosive could not have found its way into the receiver. For so short a stoppage it was unnecessary to open the cock D, since this should only be used when starting the apparatus after a prolonged stoppage which would arrest the production of gas in the generator; and even then it should only be opened after the valve C, had been closed. While the simple cock is open there is communication between the receiver, the scrubber and the outside air and if the apparatus be left standing with the cock open, the air, as soon as the generator has become cool can pass down the pipe and mix with the contents of the scrubber and receiver. At some stage the mixture becomes explosive, and if the generator be started at this critical stage, the explosion might result. The first costs of producer gas plants should also be looked into. Usually reports omit to give this most important item.

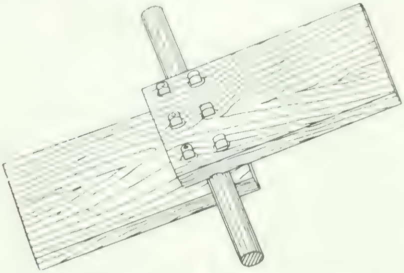
A peculiar case of a producer gas engine versus transmitted electricity is furnished by the plant of the Lackawanna Steel Company, of Buffalo, N. Y. The generating equipment at these works attracted considerable attention owing to the large sizes of the gas engines installed for utilizing the blast furnace gases. The engines were directly connected to generators installed for the purpose of supplying electric motors at various points. The latter were used for large cranes, gantries,

unloaders, conveyors, etc. The utilization of the blast furnace gases necessitated the concentration of the generating equipment at one point so that with the extension of the plant considerable losses were incurred in transmitting 250-volt direct current and 440-volt alternating current. To divide up the power plant into numerous smaller plants better situated as regards the center distribution would involve an abandonment of the gas engine, while on the other hand to avoid the losses, extensive step-up apparatus would be required, and these would entail the remodeling of the entire distribution system, so far as the alternating current was concerned. The direct-current distribution system, however, could not be remedied except by the use of converters and these would necessitate a large capital outlay. The company therefore adopted the less costly method of buying what additional energy it required from the Ontario Power Company through the Niagara, Lockport and Ontario Power Company, the distributors of electricity for the Canadian company.

PHILADELPHIA, PA. JAMES [illegible]

IMPROVISED FAN FOR SHAFT ATTACHMENT.

A very simple mechanical means of cooling a room which deserves to be more in use than it is, is shown herewith. The device consists of two pieces of board, preferably hard wood.



IMPROVISED FAN FOR SHAFT ATTACHMENT.

The fan blades or paddles, are made alike, and the two pieces are fastened together and to the shaft by means of bolts. Each fan-blade should have a narrow channel made across it where the shaft comes.

NEW YORK CITY. JOHN JACKSON.

A HEAVY, HOME-MADE ENGINE WRENCH.

The writer has had so much trouble in obtaining wrenches to fit odd and heavy nuts frequently found in power houses, that he hit upon the expedient of providing for his own use, one or

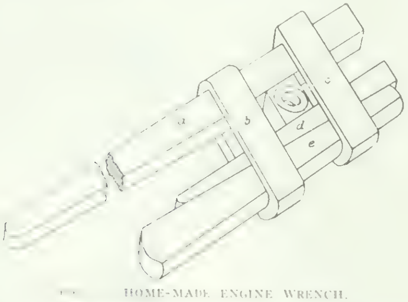


FIG. 1.—HOME-MADE ENGINE WRENCH.

more wrenches like that shown by Fig. 1, herewith. This wrench, which can be made in any smith-shop, will fit any size of nut up to four inches, and by providing a second set of straps, it will handle nuts as large as 6 inches on a side. The main bar, *a*, is made of tool steel, 3/4 in. x 3 ins., and the handle end is forged down to 1 in. wide. The bar is about 42 ins. long, and will [illegible] leverage. The straps, *b* and *c*, are also forged from tool steel. Neither bar, wedges, or straps, is hardened.

The straps were made by drilling out a slot in each of two pieces of 1½-in. x 1½-in. tool steel, which in turn was squared up by forging. One edge of the bar, *a*, also one edge of wedge *e*, was left round to fit a ¾-in. drill hole in the strap *c*. The taper of the wedges was made one inch to the foot. Several of the "e" wedges may be made to give the wrench capacity, and with the

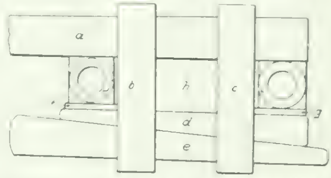


FIG. 2.—[illegible]

addition of another pair of straps, *b* and *c*, the wrench easily developed the capacity stated above.

In use, the wrench was simple clamped upon the nut as shown by the engraving, the wedges being driven to seize the nut securely. But this method of using the tool soon developed awkwardness, for it was very troublesome work to change from one nut to another and when a complete revolution could not be made with the lever bar, *a*, then there was more delay in unclamping the wrench and adjusting it again for a new pull. This inconvenience soon resulted in the additions shown by Fig. 2. Two nuts, of the size to be operated upon, were secured

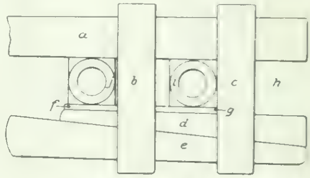


FIG. 3.—OPEN WRENCH ARRANGEMENT.

and put into the wrench as shown at *i*, *j*, and two thin pieces of metal were also put in, as at *f*, *g*. Then the wedges, *d* and *e*, were tightened, with the bar clamped tight against the nuts *i*, *j*, leaving the space *h*, a little larger than one of the nuts. This arrangement could be used as a solid end wrench for heavy nuts which were hard to remove. The pieces *f* and *g* were made of thin hoop iron.

It was not long before an open wrench became necessary to handle some nut which could not be gotten at with the wrench as shown by Fig. 2. To handle this work, the tool would be set up as shown by Fig. 3. This did not make quite as strong a combination as the last one described, but it enabled the workman to get hold of the nut he wished to grip.

In this adjustment, the nut, or distance-piece *i*, was simply

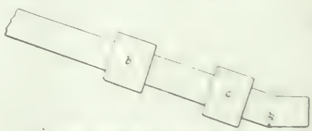


FIG. 4.—[illegible] WRENCH BAR.

moved from the end space to the center opening, and the wedges tightened as before. Soon, there was trouble in getting hold of a flat nut, on account of the strap *c*, which projected too far. To remedy this matter, the end of the main bar *a*, and the inner wedge *d*, were bent as shown by Fig. 4. The bend was such that a line drawn along the bent portion of the wrench *k* would not touch strap *c*, but would just pass by it. When the wrench is made up in this manner, sufficient thickness of liners must be put in or a wedge *e* of such width must be used that the end of this wedge shall not project beyond *k*.

[illegible], OHIO. JAMES F. [illegible]

QUESTIONS AND ANSWERS.

What effect would graphite have if poured on a hot bearing? I. B. J.

The graphite would lubricate the bearing, as it is not affected by heat.

Can alternating-current single-phase, self-starting motors be operated regularly on a three-phase system? M. F.

Yes. The motor is connected in circuit just as an incandescent lamp would be, across any two leads.

We have a $5\frac{1}{2}$ by $5\frac{1}{4}$ by 7 in. duplex pump and wish to know whether it will pump water a distance of 350 feet with a suction lift of 25 feet, the height from the pump to the tank being 20 feet? E. E. P. & T. Co.

Yes. Care should be taken to make the suction pipe air tight and a pump valve should be placed at the extreme end of it so that water will remain in the pipe at all times.

Is it possible in mills to start all the motors at once from the engine room, the supply being alternating current? J. F. D.

Yes. This is one of the advantages possessed by alternating current motors over direct-current motors. By leaving the motor switches closed and starting up and shutting down the main engine in the usual way no local attention at the motors is required. With the field of the main generator at full charge, the exciter being separately driven, the motors all gain speed with the engine, starting the mill just as though the driving were done entirely by mechanical means. This cannot be accomplished with direct-current motors excepting these were provided with separate circuits for field excitation and excepting also that there were considerable modifications of the starting arrangements as at present used.

What should cause electric wires to gather dust more so than surrounding objects, and why should the ceiling directly above studded lamps become blackened? S. C. N.

Dust collects on electric wires because of feeble electrostatic attraction due to the difference of potential between them and the earth. We have heard of a carpet sweeper designed on this principle, static electricity being used to attract the particles of dust, etc. By winding a spiral of plain wire around the conductors and grounding it, the effect may be nullified. Sometimes it is found that one wire contains more dust than the other, the one having a tendency to be grounded or on which a slight ground occurs being cleaner than the other. The blackening of the ceiling directly above the lamp may also be due to this, but more probably to the convection current of air due to the heat of the lamp. Convection currents of air are a very common cause of dirty walls immediately back of and above radiators.

I notice that in a recent issue you state that "homopolar dynamos have been built and are at present being built." I would like to know what company is making these machines and if they are at present a commercial article. Any information you can give me regarding these machines will be appreciated, as I have been working along these lines myself, but have not yet completed my machine. L. E. H.

Homopolar dynamos are being manufactured at the present time by at least two of the large manufacturers of electrical apparatus. At the January, 1905, meeting of the American Institute of Electrical Engineers, Mr. J. E. Noeggerath presented a paper giving an excellent description of a type of homopolar generator built by one of these companies. This paper can be found in the 1905 *Transactions of the A. I. E. E.* and also in the issue of the ELECTRICAL WORLD AND ENGINEER of February 4, 1905.

When calculating sizes of feeders for a direct-current [illegible] system is it advisable to allow a large drop, say 10 per cent, [illegible] feeders, and use higher voltage lamps [illegible] I. I.

There are so many considerations entering into the question of the best size of wire to employ consistent with strict economy, that the matter cannot be discussed at length here. It has been laid down as a general rule that for any given transmission, the most economical conductor is one having such a resistance that the value of the energy wasted in heat annually is equal to the interest per annum on the original outlay upon it. The question of drop increases in importance when the quantity of electricity is very large and where the price of the energy is fairly high. When the quantity of electricity is small or where the time of transmission is short and the rate is very low, the question is not important and may be ignored.

Having some poles to be cut and dropped, we would like your advice. The part in the ground has rotted and we desire to cut this off and resink the poles. How may this best be done? H. M.

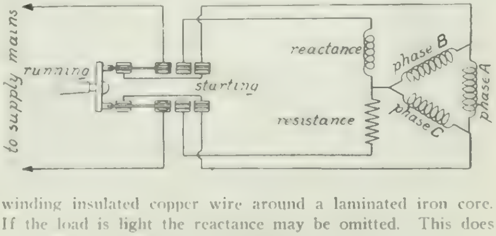
You will probably find it advantageous to provide the poles with new butts of wood or of concrete. The installation of 150 concrete bases on poles at Bakersfield, Cal., was described in the July number. The decayed base was cut out and removed and concrete bases substituted without any interruption of service. The poles may be held in position by pike poles while the butts are being sawed off and removed. When the new base is in position the pole may then be gradually dropped in position on the base and fastened to it. If the height of the pole is not of consequence, the butt may be cut off at the ground and after the end of the pole to be placed in the ground is well tarred or painted, it may be dropped into a hole alongside the old butt, or, if this has been removed, in the hole left by it.

Kindly let me know the object of the field circuit-dividing switch used on rotary converters, and also what action it effects on the operation of the converter? C. T.

Before placing a rotary converter into service, it must be brought up to synchronous speed and into step with the supply system. The application of polyphase currents directly to the stationary armature without field excitation will result in a rotating magnetic field about the armature core. The eddy currents thereby induced in the pole faces will exert a torque on the armature and cause it to tend to speed up to synchronism. Under the conditions of starting, the step-up transformer relation between the field and armature windings causes a relatively large e. m. f. to be generated in each field coil. To lessen danger from this source, the windings on the separate poles are isolated from each other so that the e. m. f. generated in the coils will not be in normal series relations and thus the total e. m. f. across any two points may be limited to that generated in one pole winding alone.

We recently purchased a three-phase motor for operating some machinery in our factory, and now find that the supply in the territory where we are situated is single-phase instead of three-phase. The electric light company operates a three-phase system; but has not as yet run its three-phase lines out as far as our works. Can we use the motor on the single-phase circuits? K. G.

If the lighting company is willing, you may operate your three-phase motor from the single-phase lines by connecting two leads from the motor directly to the supply circuit and joining the third lead from the motor to an auxiliary starting circuit formed by placing a resistance and a reactance in series across the supply circuit. A reactance coil may be made by



winding insulated copper wire around a laminated iron core. If the load is light the reactance may be omitted. This does not give e. m. f.'s in true three-phase relation; but the method is adequate for starting motors of moderate size. The permissible output, however, will only be about one-half of what it would be with the motor operating from three-phase circuits. The connections are shown herewith.

CENTRAL STATION SALE OF CURRENT

The Public Service Corporation of New Jersey.

By Carmelita Beckwith.

Some one said, long years ago, "In the midst of life we are in Jersey," and that was the tenor of facetious remarks of the hustling busy state just across the Hudson River from New York. The Jerseyites always retorted when they thought it worth while, that theirs was a proper state, for what is more renowned than Jersey justice and Jersey lightning! They pointed with pride to Salem, one of the foremost agricultural counties in the United States; in fact, the banner county in 1862. The statements of the faithful are being recognized as true by thoughtful and knowing ones. New Jersey has come into her own.

FIGS. 1 AND 2.—NEWSPAPER ADVERTISEMENTS OF THE PUBLIC SERVICE CORPORATION OF NEW JERSEY

In a great measure this forward movement in the whole state has been aided by the Public Service Corporation, which controls the gas, electric light and traction interests in a majority of the cities and towns. Through this organization, really a community of interests, improvements have steadily increased, for each of the interests concerned makes for convenience, comfort, in fact, the luxury of civilization. Under one head the smaller towns are brought into closer communication and naturally the results have been a rapid growth in everything going towards advancement.

Mr. Percy Ingalls, the commercial agent of the Corporation, said in reply to my inquiry: "It was not until about five years ago that we started an advertising and soliciting campaign. Before that we had all of the work we could take care of. But when we did start advertising, it was in a desultory, hap-hazard sort of way, each individual agent placing advertising as he saw fit in his town newspaper. About four years ago we organized an advertising department here at our main office and put Mr. C. W. Lee in charge. All advertising was placed from here, folders, circular letters and finally a bulletin, were all prepared, issued and arranged under our own supervision.

FIGS. 3 AND 4.—STREET CAR PLACARDS OF THE PUBLIC SERVICE CORPORATION OF NEW JERSEY

"When Mr. Lee severed his connection with the Public Service Corporation to start independently, he carried our advertising department with him, and now handles the matter for us.

"Of course," continued Mr. Ingalls, "ours is a campaign of publicity in a measure, and always will be, as we are interested in every phase, the railway, gas and electric light. We are

regularly using the columns of 80 newspapers in this state, in advertising the general use of gas and electricity. For developing the use of certain appliances we depend upon letters, our bulletins, *Light and Power* and *Gas News,* and specially prepared folders."

Gas News, one of the covers of which is reproduced herewith, is a 12-page booklet issued monthly, devoted exclusively to introducing the use of gas for industrial appliances of all classes and descriptions.

"Ours is the only house organ dealing absolutely and only with industrial appliances of gas," said Miss Frances Nelson, of the C. W. Lee Company, who edits *Gas News.* "In this industrial end, of which a separate record of 149 plants operated is kept at the main office, the increase in three years has aggregated something over 250,000,000 cu. ft., and it is steadily increasing. This is being accomplished by reaching manufacturers direct through *Gas News* once a month, personal letters and form reminders, showing in detail the various appliances which are operated by gas. This is a field which is almost untouched by all other companies furnishing gas, and is rich in possibilities. So thorough has been our general advertising of gas that down in one town in South Jersey every house in the village is equipped with a gas range."

FIG. 5.—COVER DESIGN.

In the advertising plan of the Corporation more newspaper space is given to the general use of gas than electricity, and in only one territory are car cards employed, and there for both gas and electricity.

Light and Power, the bulletin devoted to the electric interests of the Corporation, is regularly sent to a large list of both users and non-users, as part of a campaign of education, not with the idea of tracing direct results. Two mailings a month, personal letters and calendars are sent to power and sign prospects. A residence list is also treated in this way, but not so generally, as that is a list which is very carefully prepared and specially handled.

None of these letters, folders or booklets is ever sent out without a return postal card, and in this way not only an appointment is secured for a representative, but the right sort of audience is prepared, one with an open mind.

That portion of the business-getting covering the traction interests of the Public Service Corporation is particularly summer work, aside from the regular yearly traffic. Attractive booklets are prepared and sent, in conjunction with personal letters, to lodges, teachers and church and historical societies telling of possible trolley trips to beautiful and history laden spots all through New Jersey. These letters are sent to nearby cities in New York State and the campaign last year resulted in working all of the special cars overtime. The company had more business than it could take care of comfortably.

"As a result of this continued and consecutive policy of publicity," concluded Mr. Ingalls, "the general appearance of the Jersey towns is absolutely changed. Whereas three or four years ago one or two signs, or at the most signs on the larger establishments were seen, to-day, taking Newark as an example, and comparing the size of the town and length of the street, there are quite as many signs within a radius of eight blocks on Market Street and the same distance on Broad Street, as there are on the Great White Way in New York City. In a smaller degree, of course, this is the case right down through the state. Well-lighted stores are the rule and *not* the exception. Yes, we are pushing the sale of electric irons, putting them out to great advantage, on 30 days' trial. The motor business has had a rapid increase. Many of the largest manufacturing concerns in the state are using our energy for all purposes; in fact, I can safely say that all of the printing plants in the state of any size and consequence, are operating by Public Service energy and most of them are direct-connected installations. Our advertising has certainly paid well."

Opportunities for the Sale of Electricity for Charging Electric Automobiles.

In his paper before the National Electric Light Association, Herbert H. Rice shows what opportunities for the sale of electrical energy are available to central stations in the electric automobile.

It is surprising that central-station men, who should have been foremost in advocating and pushing the sale of electric automobiles, have been most apathetic. This has been due to the lack of appreciation of the possibilities of revenue to be obtained from the electric carriage.

The old impression that electric vehicles were no good is still held by many central-station men to-day, who continue to act on the opinion founded years ago.

The revenue to be obtained from selling electricity to charge electric automobiles is not limited by the popularity of the gasoline car, because there is no real rivalry between them. Their fields overlap slightly at times, but the gasoline car is unquestionably supreme in its field, as is the electric in its own sphere. That sphere for the electric is wider than is supposed. It used to be thought a question of mileage or speed. But any electric vehicle of to-day can go much faster than the city laws allow, and as for mileage, no lady on her errands, no busy physician or business man can use the battery charge in a day. The average run of a busy carriage in use daily is but 20 miles, and busy physicians rarely go over this amount, so that if not another mile is added to the mileage of the electric vehicle there is already sufficient mileage to satisfy all requirements of city use.

The field is what central stations make it. Thousands will buy electric carriages and, of course, energy with which to run them if given half the encouragement extended to other devices. In many instances the policy adopted by the electric-lighting companies concerning the accommodations offered for the charging of batteries is the one element that determines whether a prospective customer selects an electric or a gasoline vehicle. It is seen, therefore, that the electric-automobile industry is closely related to the electric-lighting industry. The electric carriage will use more electricity in a day than most signs in a week, a fan in a month, a hot-water bag in a year, or the curling iron in five years, and yet money is spent soliciting for and advertising these things and, with few exceptions, scarcely a cent for the electric vehicle.

Electric carriages, unlike signs, do not naturally take energy at the peak and restrictions are unnecessary in most cases. For example, in a large garage of electric carriages in Providence, some customers leave their carriages there during business hours to be charged in the daytime, while the greater part use their carriages during the day and evening and have them charged at night. Most of the charging is done from 11 o'clock on till morning. At Newport, R. I., the contract with the lighting company stipulates that no charging should be done between 6 and 11 o'clock p. m., but without such a clause 90 per cent of the charging would be done after midnight.

At Toledo very few carriages are on charge through the early evening; the bulk of them being put on charge after 10 o'clock and many not until after midnight.

Thus without contract the charging is mainly done off the peak, but if contracts are desired, they can be made with little objection. Some central stations find the moral obligations of a contract sufficient, but time switches can be used if absolutely necessary. The Edison Illuminating Company, of Detroit, Mich., furnishes electricity to private users of electric

[illegible] per cent [illegible] To public garages it makes a rate of 3 cents, in accordance with its order form. In both cases it makes the stipulation that charging shall not be done during the time of the evening peak.

The New York Edison Company has in constant use for business purposes 57 electric vehicles, and the electric light company at Hartford has for years used electric vehicles and has run its own garage as it would its own stable. The Union Electric Light & Power Company, St. Louis, Mo., began a vigorous campaign to encourage the use of electric automobiles. Up to a year ago only a few electric carriages were used in that city, where street conditions are almost ideal. A good, live agent began pushing the sale of electric carriages, when the light company saw its opportunity and rendered much assistance. This company now advertises on signs, which are illuminated at night, for the public to use electric automobiles. It has opened a garage in the residence district for electrical automobile service only, has an expert battery man, and is prepared to renew batteries. Its charges are understood to be $30 to $35 per month, which includes storing, washing and delivering. It has taken the agency for one or two makes of electric carriages, and reports indicate that it is making a satisfactory number of sales. As a result, every leading electric automobile manufacturer is represented in St. Louis, and the sale of electric automobiles is booming.

Similar reports come from other localities. The Edison Company, Rockford, Ill., has successfully handled this part of its business for the past two or three years. In that city very few electric wagons are kept in public garages, but in private garages in the residence district. The last report showed that 75 electric wagons were cared for in this way by the owners; in one instance a woman 74 years old is caring for her own carriage. A clerk in the office of that company notifies the owners of the carriages to have the batteries examined at special dates. The company's electrician makes an examination, not only of the battery, but of other parts of the carriages, and thus is the official doctor for any electric automobile in that city that the owner desires to bring there. It also has a shed adjoining the plant in which owners may charge carriages when desired, paying only for the energy consumed.

Some of the other light and power companies that have been instrumental in having electric automobiles sold in their territory are the following: The Freeport Street Railway & Power Company, Freeport, Ill.; Birmingham Railway, Light & Power Company, Birmingham, Ala.; Little Rock Street Railway, Light & Power Company, Little Rock, Ark.; Springfield Light & Power Company, Springfield, Mo.; McMeen Light & Power Company, Galesburg, Ill.; Michigan City Light & Power Company, Michigan City, Ind.; South Shore Gas & Electric Company, Hammond, Ind.

The Birmingham Railway, Light & Power Company set an example by using, whenever possible, in the conduct of its business electric automobiles; the result has been a gradual, but sure increase of the demand for electric carriages in that city.

Other central stations are being awakened to the opportunity before them. A plan is on foot at the present time, to be applied to at least a half dozen central stations in New England, wherein the lighting companies will circularize the physicians in their respective cities, notifying them that they are prepared to give them a practical demonstration of the utility of the electric vehicle in the practitioners' service and are prepared to place at their disposal an electric vehicle with driver to take them over their day's route of visits to patients; this to cover a period of half a day, or even a whole day if necessary, so that they may be satisfied of the practicability of the outfit as applied to their own use.

While the electric light companies referred to intend to start a systematic crusade among the physicians, they are not losing sight of such other applications of the electric vehicle as are called for in family use—delivery wagons, motor trucks, and so forth. Their system of working up business for the sale of electricity is the best possible one that could be adopted, and activity in this direction is the best indication of the increased popularity of electric-vehicle service. Business of this kind increases the load on the power station when it can be furnished to the best advantage. This scheme of practical demonstration is also being put in practice by the lighting company in one of our largest Western cities, where five solicitors are at work on autos alone, in addition to the demonstrators. In this instance the demonstrators are women, and they have three electric carriages for demonstrating on the street all the time.

New York City is, it is true, full of electric broughams and cabs. The city of Cleveland has over 800 electric carriages in use; Chicago, over 1000, and manufacturers in both cities do not report a decreasing demand for their product.

Miles and miles of improved streets in cities and towns enlarge the opportunities for automobiles, and especially for electric carriages. The sale of electric automobiles is not necessarily confined to level cities. Electric carriages are successfully used in hilly cities like Pittsburg, Providence, Kansas City and Cincinnati. The fact should not be overlooked that hills which are severe for automobiles are still more severe for horses.

As to rates charged, these vary with every locality, but under such conditions as described it is apparent that at least relatively low rates can be quoted with profit. Rates of 2, 2.5, 3 and 4 cents per kw-hour to garages are reported by central stations as very satisfactory to profit-showing. To individual users rates of 5 to 7 flat and 10 cents per kw-hour less quantity discounts are quoted. But in some places rates are prohibitive. Why not quote favorable rates and encourage the sale of electricity, especially off the peak, when you can spare it at almost no additional cost?

Something besides rates, however, is necessary. Some one should take a little time to find out what the carriage owner needs in order to take energy from your mains. Be prepared with the approximate cost of wiring installation, also the cost of charging rheostat for 110 volts direct current, a motor-generator set for high-voltage direct-current and a mercury arc rectifier for alternating current. Decide in advance what current you will furnish, what you will do toward installation, if nothing more than advice and oversight. Cold water could not be more chilling than the lack of a definite policy, a knowledge of what you can and will do, an idea as to the cost of apparatus for charging, if needed, and the encouragement of reasonable rates. The amount of energy required to charge a carriage varies, of course, and what interests the central station is the amount of gross income per month. At 5 cents per kw-hour, for example, individual customers average about $6 per per month, say from $50 to $75 per year, for small carriages used for pleasure or errands; trucks and commercial wagons, relatively more. Garages with 30 vehicles have bills at 3 to 4 cents per kw-hour of $200 to $300 per month.

In some cities more people charge their carriages at home than at public garages. Little mechanical or electric attention is needed on the electric carriage, but weekly inspection at the shop is advised; to oil, to keep commutator clean and cells filled with water.

The mercury arc rectifier is the simplest and cheapest device known for charging electric automobiles from alternating current mains. It is particularly well adapted for use in private garages where only a single vehicle is to be charged at a time. It has been on the market long enough to demonstrate its practicability. In Indianapolis fully 20 have been put in service within a year, and reports from their owners are favorable. The result has been a greater use of carriages by owners and consequent increase in the amount of energy consumed; and the fact that through this means of charging at home the carriage is available for any errand on short notice, adds to the daily mileage obtained. When the public is more familiar with the convenience such use of the rectifier affords, the practicability of the electric automobile will be still more appreciated.

As to electric light companies themselves, the author asks, What will you think of an electric light company that burns gas for its own lighting? How about those whose officers and managers use horses instead of electric runabouts and employ horse-drawn wagons instead of electric trucks? B[illegible]

yond all doubt the latter are cheaper and better, work for work. You will find it so if you will use them with the same degree of intelligence you do any other electrical apparatus.

You push the sale of cigar lighters and curling irons—then by your own example and encouragement push the sale of electric vehicles, and thereby increase the sale of your electricity.

Isolated Plants.

By William H. Stuart.

A great many companies have never pushed the matter of obtaining the business done by private plants. A large illuminating company after making a thorough canvass of its territory obtained information as to the why and wherefore that isolated plants were installed, the cost of installation and operation, the amount of energy produced and also noted the comments offered favorable and otherwise in regard to the plants. They then rested in the matter, doing nothing further. In the course of the year, correspondence was opened with the company by several isolated plants, asking for information as to the company's service, which finally developed on the part of a few isolated plant owners making applications for break-down service. This business was accepted only where no extension of reinforcement of the mains was needed. The rate per unit of energy was the regular one, that of 12 cents. A minimum charge of 10 cents per 16-cp equivalent of the connected load was made. This business was not desirable, as the proportion of the central station's investment that class of business took, could be used in other directions to a greater financial advantage.

But when this central station found that it could obtain all of the business in the near future, or all the additional equipment that was to be installed, the minimum charge was reduced proportionally as the nature and quantity of the prospective business warranted. No set or established charges were maintained in regard to such consumers, but the matter was left rather to the business judgment of the official having authority in the case.

In the City of New York when the legal standing of such a high rate and minimum charge was questioned, it was finally decided that such could be legally charged on account of keeping so much of the investment working at a loss.

It is in the manufacturing districts where isolated plants are to be found more frequently than elsewhere. Of course in the large cities these small plants will be often found in hotels, large apartment houses and the department stores, and they range in size from the pony generator driven with the small sputtering gas engine to that of a central station. Every manufacturer has got to have motive power and his whole thought in the matter is how cheap he can procure it. He does not care if the prime movers are in his building, owned and operated by him or whether a mile away in a central station. What determines where and what they shall be is the expense account in his ledgers.

I once asked a large manufacturer why he had installed a plant of his own and he told me that all things considered he could produce electricity cheaper than he could buy it. He was afterwards shown items he had not considered and starting with a break-down connection, his plant was finally sold as scrap and central station service installed. He did not require steam in his factory for any purpose save for running his engines, and this fact made the case easier for the new-business department. The auxiliary use of steam plays an important part in isolated plants. In fact, it is a big obstacle to be overcome when opposing the installation of and arguing for the abandonment of isolated plants.

The policy of the illuminating company has a great effect upon this side of the "new business" situation. If it is broad minded, progressive and aggressive, it extends every possible advantage for business to be obtained. It is [illegible] open helping hand policy that tells. It has been found that [illegible] seeking from the owners correct and authentic inform[illegible] concerning the various items and costs of isolated plants with a view to a comparison, the success lay, despite what the representative said, with the impression that was held of the policy of the company by the private plant owners.

In one case where a manufacturer was approached by a representative of a lighting company, he refused to discuss the matter in any form whatsoever. His impressions were that the company having a monopoly of the field, was only trying to throttle all the small plants and was making overtures to obtain information to inveigle him into giving up his plant and then treat him as it saw fit. What was done with this concern was to change his impressions by presenting to him in every way possible instances showing the error of his views.

In the same city within a stone's throw of this concern, lay the plant of another manufacturer, who was approached on the same day. While he had never had any dealings with the central station he stated that he was open to receive any proposition to purchase energy providing he could do so as cheaply as he made it. He stated in regard to his feeling towards the company that he believed it was anxious to increase its business in every way, honestly and fairly. This he judged from the statements published in the newspapers during a publicity campaign.

Many a plant has been installed through misunderstanding, petty squabbling, obstinacy and disagreements which, had they been set aside, would have prevented such installations. The location and capacity of the mains prevent, sometimes, business of any size being connected, although when any return on the investment can be made it would prove perhaps good business to make extensions or reinforcements.

When figuring the cost of operating an isolated plant a great many items are overlooked or do not receive their proper value and sometimes none at all. The items given to me as those which the owners figured as constituting the operating expenses of a plant of some proportion, were labor, coal, water, oils, removals of ashes, repairs and sundries. When the actual cost of these items was computed, it was found that the plant was a money saver, the cost per unit of energy being about one-half that of the figure submitted by the central station. No price at all, however, was placed upon the rate of depreciation, nothing for insurance, no interest upon the investment was computed, the time and bother due from break downs and the constant thought and worry for its smooth operation were never assessed. When a fair value was placed upon those items and the whole used as a cost basis, the result proved to come to considerable over the illuminating company's figure.

One of the large trunk line railroads at its eastern terminal was allowed a certain figure to operate its own electric light system. This covered its terminal shed, office building, yards and piers. To keep within its appropriation and light the premises it was found that they had to produce energy for about 3½ cents per kw-hour. With the big advantage of obtaining supplies, namely, coal, water, oil, etc., at a very low figure, it was found that they exceeded their yearly appropriation. This was allowed to go on for several years when a halt was called. Application was made to the illuminating company for service and a flat rate of 6 cents per kw-hour was given, doing away with the plant. This brought the lighting account to a little below the allowance with no other expense and perfect service.

A plant is like any other article purchased, the more that can be got out of it, the greater the value. If it is made to run generators, heat buildings, do compression work and any number of various things in the different industries its usefulness is more apparent. It is the side uses apart from generating motive power and light that make it very hard to have an isolated plant replaced by central station service. If the plant as a whole or the electrical portion of it is discarded, the reasons which have brought about the change would be found most likely to be that the uncertain costs have proved to amount to more than they should. That is, the responsibility, losses through break-downs, etc., have proved to cost more in the end than the actual savings in dollars shows on the ledgers.

Electric Power Experience in Detroit.

In a paper presented at the Washington convention of the National Electric Light Association, Miss Sarah M. Sheridan gave details of the successful work of the Detroit Edison Company in building up a power load. In little over two years the commercial power load was increased by 5965 horse-power in alternating-current motors and 3862 horse-power in direct-current motors. During the past 12 months the day load has been increased 50 per cent.

The practice was followed of loaning and renting motors for trial installations, to do which it was necessary to carry a stock of motors that reached a value of $46,000 during the year 1906, when the average monthly gain in motor connections was 450 horse-power.

When the electric motor business showed decided and permanent growth, several of the local construction companies put in motor stocks and adopted the plan of trial on loan for 30 or 60 days, renting the motors for longer periods if purchase seemed likely in the future. This movement by the contractors is gradually relieving the central station of the necessity for carrying a stock of motors.

The rental charge, after the loan period, was 25 per cent per annum on the net price of the motor. The company has always taken care of emergency cases, due to fires or breakdowns, or isolated plants at a minimum rate, which custom has frequently led to permanent business. There is also considerable business with contractors on construction work; and while this occasionally requires extensions of lines this can be afforded considering the advertising given to electric power among contractors.

Observations taken in 100 factories at odd times show that on an average only 50 per cent of all the machines will be loaded at any one time, because operators are preparing work, adjusting machines, are idle, or for the moment away from the machines. This fact is considered by the selling force when specifying motors required and in estimating probable costs; and the saving of expense with metered central-station electric drive against other power, due to this condition, is a good selling point.

Individual motors are not recommended unless a saving in energy consumption equal to 20 per cent per annum on increased investment will be effected, except where the individual drive is desired for special convenience. In wood-working shops individual motors displacing one large unit have shown considerable saving.

A shop operating a twenty horse-power motor, with average monthly bill of $40, installed nine motors aggregating 42.5 horse-power, and reduced its average monthly bill to $32, in addition to providing for increased output. In another shop a 10-hp motor was replaced by nine motors aggregating 28 horse-power, effecting a reduction of 20 per cent in the customer's bills, with the same work.

Customers should be influenced to use roller bearings on the shafts, which bearings in some cases reduce the friction load of the shafting by 20 to 25 per cent as compared with good babbitt bearings; also to install shafts in separate short lengths where practicable, which is a decided advantage if a part of the shop is run overtime or at times when the shop is operating only in part.

With large blowers it is frequently found that the fan is delivering more air than is actually required. In displacing a steam installation recently it was found that two ounces less pressure was sufficient for the work, and by reducing the fan speed the customer's bill was cut down by about $15 per month. This brought the cost of electric energy low enough to compete successfully with steam. In another instance the pressure at the blower was reduced one ounce by moving it so as to shorten the length of the pipe by 100 ft., thus reducing the load by 6 horse-power.

In another motor-driven blower installation of the same kind, four horse-power was saved by straightening several sharp curves on the blower pipe. The use of motors made these changes simple and cheap. Such experiences have led to caution with respect to fans, blowers, air-compressors and centrifugal pumps. The power required by these devices varies so rapidly with variation of speed that it pays to investigate every such machine in an installation and to make certain that it is not being run at a higher speed than is necessary to deliver the proper pressure. To run blowers needlessly fast is a very common fault.

In a small machine shop the friction loss was reduced by changing the location and piping of an air-compressor, so that an intermittent small loss in an air pipe was substituted for a constant considerable loss in friction of a shaft. The electric drive was entitled to no credit for this, but got it just the same. In the same shop a portable desk fan, playing directly on tanks to be cooled, was substituted for a wooden-blade fan that was bolted on each side of end of line shaft. These changes effected a reduction of 15 per cent in energy consumption.

A shop manufacturing steel products asked for a 50-hp motor for three months, to take care of part of its plant while rebuilding boilers. This gave an opportunity of studying its conditions and before the three months were up the following recommendations were made: To install a motor-driven air-compressor to supply air instead of steam to oil burners of forges, which change saved the cost of energy in the saving of oil; to arrange the work so that the big grindstones were operated off the peak, thus giving the limited service rate for that service; and to do all work requiring high-pressure steam on two days a week instead of each day, which change greatly reduced the standby charges for steam and dispensing with the services of one man; also to install a governor on the air-compressor to close the inlet valve and allow the compressor to coast until the tank pressure fell to the line pressure. With these economies and the usual cutting out of shafting, the cost of operating the shop by electricity was reduced below the steam cost. The company finally equipped its shop with motors and at present has an installation of 150 horse-power with a monthly bill averaging $250.

By changing tight cross-belts to wide slack open belts on a shaft driving 20 machine tools, the power required was reduced by three horse-power. In a polishing-room where 10 double heads in one row with one exhaust fan at each end were operated, the machines were placed in two rows with one fan between the rows, which effected a saving of 8 horse-power. In endeavoring to deliver the required power at a machine driven by a countershaft, the 12-in. pulleys on the main and countershafts were changed to 24-in. pulleys with the desired result and incidentally reduced the load two horse-power. By reducing the speed of the line shaft in a large machine room from 220 to 190 r. p. m. a saving of eight horse-power was effected without decreasing the output, as the speed of the tools was taken care of by cones.

A motor in replacing a gas engine, operating automatic machines, by the improved speed regulation increased the output of the machines 10 per cent—the constant turning moment permitting a heavier feed to the cutting tools. In the foregoing case the output of the shop was increased because the steady motion given by a motor allowed a heavier cut to be taken than when the tools were driven by a gas engine. In other cases the cutting speed was increased to a point higher than was possible with the unsteady drive resulting from the use of the gas engine.

In one small factory the energy consumption was 25 per cent higher than the estimate, and upon testing it was found that the bearings in the air-compressor were running on the iron of the boxes. Proper babbitting of the machines reduced the customer's demand 2 kilowatts, and the business was retained.

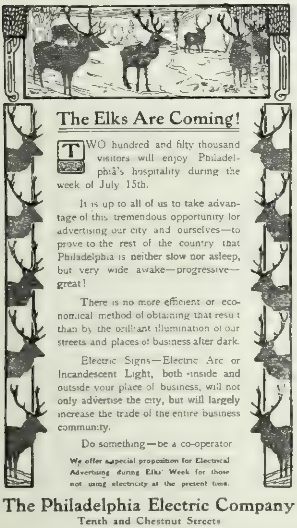
In factory lighting, customers are advised to do their general floor lighting with gas-arcs, but to install individual incandescent lamps at the machines. Since adopting this policy the office has been relieved of many complaints on lighting bills.

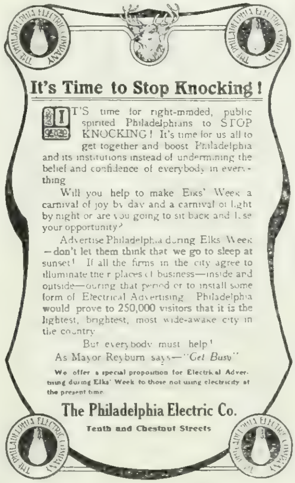
The rate system used makes a high price per kw-hour for lamps operated for only a few hours annually, while the gas company makes no difference between short-hour and long-hour customers, so all parties are satisfied by this division of service. This practice of retaining the power business and willingly letting short-hour factory lighting go to the gas company is unusual. The power business, which is much wanted, is secured by adopting this method; while by insisting on getting the evening lighting the combined cost would be prohibitive. Other respects in which Detroit power practice is unusual are that special pains are taken to assist customers in keeping down constant losses, such as friction and windage, and a reduction of the standing-charge item is regularly offered in consideration of a customer undertaking to refrain from using specified parts of his equipment during the hours of the winter lighting peak.

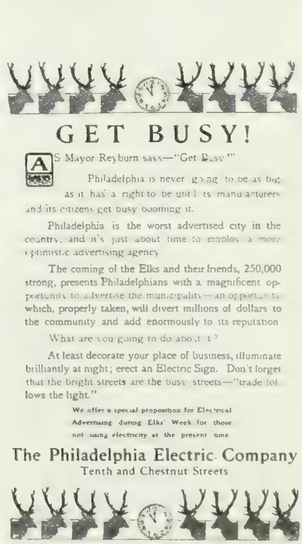
Philadelphia Electric Company's Advertising Preparatory to the Elks' Carnival.

Elsewhere in this issue is published an account of the special lighting in Philadelphia during the Elks' Carnival week. A few weeks before the Elks' convention, the Philadelphia Electric Company, through its advertising manager, Mr. Howard K. Mohr, prepared a series of advertisements bearing directly upon Elks' week.

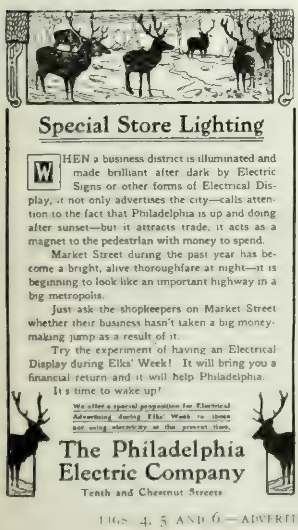
These differently worded advertisements, which are reproduced herewith in the order of their appearance, were of sufficient size, 7 ins. deep by two columns wide, to attract attention. A series of specially-designed borders were used calling attention to the fact that the advertisements had a particular bearing upon the Elks' convention. The advertisements speak for

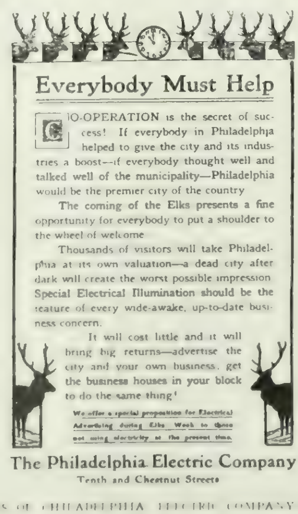


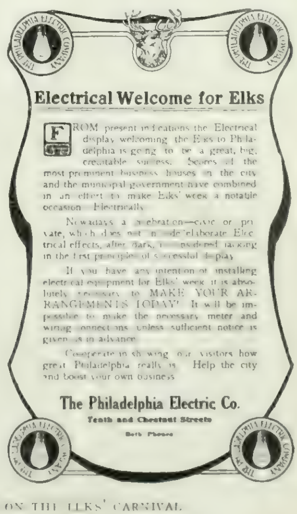




FIGS. 1, 2 AND 3.—PHILADELPHIA ELECTRIC COMPANY ADVERTISEMENTS PRIOR TO ELKS' CARNIVAL.







FIGS. 4, 5 AND 6.—ADVERTISEMENTS OF PHILADELPHIA ELECTRIC COMPANY BEARING ON THE ELKS' CARNIVAL.

themselves. They were afterwards reprinted as they appeared in the different newspaers, upon mailing cards and sent to the principal retail stores in the city. Solicitors of the company were then sent to follow up this double advertising and to secure the business. Judging from the results, the advertising must have been very effective, although the solicitors and the occasion also contributed not a little to that end. An otherwise staid and quiet city was thus transformed for a week

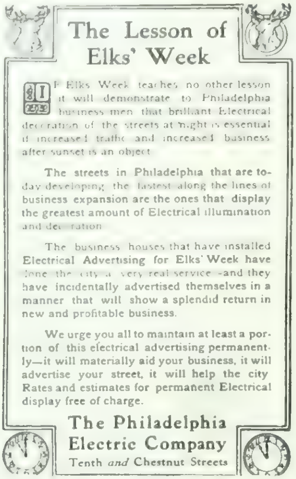


FIG. 7.—FINAL ADVERTISEMENT OF THE SERIES

into a city of jollification, the gloom of night being dispelled by myriad electric lamps. The electric light company deserves great credit for the part it played in this transformation. As is generally the case, however, with public service corporations this is often not forthcoming, so that the company must be content with the consciousness of having done its part well.

Public Service Diplomacy.

The following from *Stone & Webster Public Service Journal* is addressed by the "The Retired Manager" to an up-to-date successor worried at the introduction before a council, by an Alderman Peterson, of a resolution asking for a municipal inspector of meters. After sketching the beginning of the company when the officers knew all of its patrons "well enough to eat in the kitchen with the family" and when the "'Employees,' as you call them, were our neighbors," he proceeds as follows:

"Now, as I view it, a conductor while on duty is no longer a citizen; he is clothed with a uniform, given a book containing more rules than I should care to count on a hot day, and turned loose on the public, an integral part of a corporation that knows nobody nor frequents the kitchens of the lowly. When this individual tells a person to 'step lively' or directs him to the 'next car' with his eyes fixed as though he saw two dollars in the distance, that person takes a dislike to the terms of the franchise. These haughty ways and the habit of calmly ignoring a patron's existence are sure to culminate some day. Perhaps the motorman is so busy with another corporation atom that the citizen is left standing on the corner, with another car due in 37 minutes, if it is on time. He is now due to drop in on you, in order to express to you how pleased he feels over the incident. Do you tell him to come right in, shake him by the hand, and listen as though you are interested? Not on your life, you don't, my boy. You keep him cooling his heels, and heating his insides, while you figure out how many ohms resistance there are in 396 feet of trolley wire, and when he does get in you assume a judicial air that would leave a Chief Justice of the United States Supreme Court in the backstretch. You are going to decide which is right, the employee or the patron—it stands out all over your visage like the horn on a rhinoceros. When this man leaves your managerial presence, he has taken his first degree in political economy, and has more ideas on the subject of municipal ownership than William J. Bryan. I saw the other day that Marshall Field said his success was due to one rule—'Always start with the premise that a complaining customer is right.' You see, he had been watching his diplomatic department.

"You say that you don't know what ails Alderman Peterson; well, I do. Peterson came from down in Acton County; started here as a carpenter, working at his trade. He got a little money together, and borrowed more from Samuel Fuller to start in for himself. Naturally, Peterson was more or less friendly with the Fuller family. Old Samuel Fuller died leaving nothing, on account of bad investments. His son George went to work as a clerk, and is living in a rented house over in the Third Ward. Right here is where your municipal meter inspector comes in. George has to be somewhat economical and somewhat minute in his financial estimates, and it is probably this that led him to the conclusion that his meter was a trifle nimble as it were. He brought this to the attention of your minions down stairs, and after listening to a series of conversations that resembled that machine that was used by the telephone company a while, and which told you in perfectly respectable, but exasperating language, 'The line is busy, please ring off,' he got peevish and refused to pay his bill, his lights were then shut out and he has now enlisted Peterson on his side.

"Now if your diplomatic department had been as well developed as your administrative department, George would have been advertising the company at no salary.

"I tell you, Jim, you can't operate a company as we old fellows used to; you would be ashamed to; nor can you deal with the public with the nonchalance of twenty years ago. You have solved the operating problem to the queen's taste, and the diplomatic department is now up to you good and hard, and the beginning is to surround yourself with the right men. There are some drawbacks to this plan, in that a manager has to scratch gravel to hold his job. These capable subordinates crowd toward the front office pretty hard."

Letter to the Editors.

Charging for Electricity.

To the Editors of Electrical World:

SIRS:—As you know, I am greatly interested in the problem of charging for electricity, and believe that this is one of the most important considerations in the development of the central-station business.

When I devised the system of charging which is known either by my name or as the "readiness-to-serve" method, I knew nothing of Hopkinson's work. In fact, little was known by any one in this country of Hopkinson's methods, as evidenced by the fact that two years after the presentation of my paper we were unable to secure a correct explanation of the Hopkinson method from the more than 200 central station men in the convention hall at Cincinnati in May, 1902.

Through the kindness of Messrs. J. S. Codman and W. H. Gardiner I was given a copy of this paper during the last winter, and after another recent reading of this paper I am so favorably impressed with Hopkinson's method of stating his case that I am prompted to ask your journal to republish this paper, believing that it is the best paper on the theory of charging which I have ever seen. I also think that Dr. Hopkinson is entitled to be universally acknowledged as the Dean of the School of Rate Making, and deserves more credit for his work than has ever been given him. Some of the important principles of rate making, which are not yet fully recognized in this country, were succinctly stated by him so long before there is

any record of recognition by others, that it leaves little chance for doubt but that he was the original pioneer.

While I freely admit, since having Dr. Hopkinson's work called to my attention, that much of the system evolved by me was not new, yet on proper study it can readily be seen that the two systems are far from being identical, as has been frequently, but erroneously stated. The only difference of importance is my additional "consumer charge," which I believe constitutes a difference under conditions prevailing in this country fully as important as the "demand charge," of which Hopkinson is undoubtedly the inventor.

My original system was much more refined and discriminating than outlined in my paper before the Chicago convention in May, 1900, but in the interest of simplicity I eliminated every factor possible which did not greatly contribute to reasonably exact equity.

The difference in expense between the large and the small consumer cannot, I believe, be equitably arranged except by the use of a fixed consumer charge.

In fixing the division between the "consumer expense" and the "demand expense" there is no well defined line of demarcation to be found. If we assume that each consumer should pay a fixed uniform charge to the extent of the company's expense to provide minimum service to each consumer, and that the demand charge shall only apply to that expense occasioned the company to supply excess demand, then the bulk of all the fixed charges fall to the consumer charge.

In dividing between consumer charges and demand charges I adopt that division which will yield greatest commercial flexibility—in other words, the greatest scope of application.

This explanation of the difference in the two systems is perhaps unnecessary, but made to explain the position which I have been forced to take by insisting that for universal application the consumer charge is necessary.

However, in asking for the republication of the Hopkinson paper, I do so because it treats the rate problem in a more masterly manner than any other paper I have seen, and because I would like to see Dr. Hopkinson receive full credit in this country for the important principles he so early recognized and announced.

NEW YORK. HENRY L. DOHERTY.

[That portion of Dr. Hopkinson's presidential address of 1892 which relates specifically to the subject of rates is reprinted on page 219.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Mercury-Vapor Rectifier.—J. POLAK.—Tests of a mercury-vapor rectifier of the General Electric Company. A number of oscillographic curves are given, and the chief results of the measurements are plotted in diagrams and also given in tables. As a practical disadvantage of the mercury-vapor rectifier it is mentioned that it will not operate below a certain minimum current. It, therefore, does not run "unloaded." But this disadvantage is compensated for to some extent by the fact that the rectifier is very easily started and assumes its stationary condition in a few minutes. The minimum current at which it operates depends upon the distance of the electrodes, on the conditions of cooling of the tube and the values of the inductances used. The numerical values of the minimum current for different conditions are calculated and given in tables. In all other respects the apparatus is said to have been absolutely satisfactory and stable during a fortnight's tests. It started immediately after lighting the auxiliary arc.—*Elek. und Masch.*, June 2.

Lamps and Lighting.

Testing of Street Lamps.—K. EDGECOMBE.—An article in which the author deals with the anomalies which have hitherto existed in the methods commonly employed for the comparison of different forms of street lighting, and emphasizes the importance of taking actual tests in situ, from which can be deduced a "figure of merit" for the particular conditions under which each is being used. A large number of actual illumination curves taken in London streets, railway stations, etc., are given and form interesting comparisons between gas and electric public lighting and figures are worked out for the total cost per "candle-foot-yard" for various forms of gas and electric lighting. Incidentally it is mentioned in this article that one of the most up to date municipal councils in London lets its lighting contracts on terms which require the contractors to furnish lamps giving a minimum of 900 candle-power, "as measured by the Council's traveling photometer." The "traveling photometer" consists of two screens, one of which is illuminated by the standard lamp, and the other by the lamp under test. The whole thing is moved to and fro along the streets until the screens appear equally illuminated, the candle-power being then calculated in the ordinary way. The point of balance may thus occur at almost any angle, but still the 900 candle-power has to be furnished. A. P. Trotter's old suggestion to measure the candle-feet is the only proper one, but the question has been much discussed as to whether the illumination should be measured at a horizontal surface or at any other angle, and at what height from the ground. There is much to be said in favor of illuminations measured at 45 degs., inasmuch as they represent, as it were, a compromise between the horizontal and the vertical, but the drawback that no one screen can face all the lamps at once, prevents its being adopted as a really universal method of comparison. The horizontal surface will, therefore, be the ideal surface and it has become usual to make measurements at a height of from 3 ft. 6 in. to 4 ft. The author has made extended tests in various streets in London using the method of comparing the average candle feet per yard of street and employing the Trotter photometer which has been recently described in the Digest. It had the distinct advantage, for the particular purpose in hand, of enabling the lowest illuminations to be accurately measured, and this, moreover, independently of the color of the light tested (which ranged from that of the mercury-vapor lamp to that of the flame arc). Two other essentials were that both the illumination and the candle power should be measured at will, and that the instrument should be easily carried from place to place. An interesting incidental remark concerning the real and nominal candle-power of gas lamps refers to the fact that the candle-power found by H. T. Harrison for a three-burner high-pressure gas lamp (nominal 1000 candle-power) in Kingsway, was 515 candle-power, and by S. L. Pearce for a similar lamp measured in Manchester, 525 candle-power, while Bradley, in Westminster, found 573 candle-power. In the present tests it averages about 550 candle-power, which shows a very satisfactory agreement among four independent observers making tests on similar lamps at different times. The results of the tests are given in numerous diagrams and tables and the relative cost under working conditions was found to be as follows:

Nature of lamp	Relative cost of electricity or gas
Bastian mercury vapor	1.0
Tantalum lamp in Reason fitting	1.2
Low pressure gas	1.35
Osram lamp in Reason fitting	1.55
Nernst lamp in holophane globe	1.6
Kern high pressure gas	1.6
High pressure gas	1.9
Tantalum lamp in Lotto lantern	2.3

The question of color is an important one. The general public claims that the color of an ordinary arc is either too white or too blue. Trotter attributes this to the fact that, after dark, the eye becomes accustomed to a yellow light, and is dissatis-

fied with any other. As a "cheerful" light the flame arc seems to be the foremost. The author finally states that the object of his paper was to show what an extremely simple thing it is to obtain a thoroughly systematic survey of the illumination in a given street, and that those engineers who covet a street lighting load may be induced to avail themselves of it.—Lond. *Elec. Eng'ing*, July 4.

Photometry.—R. McCourt.—A paper read before the (British) Municipal Electrical Association. All the incandescent lamps used in the Harrogate supply system are previously tested and the methods of testing introduced by Wilkinson for this purpose and including wattage tests and candle-power tests are described. For a 16-cp lamp the limits within which the candle-power may vary are from 14 to 18. That the systematical tests have brought good results is evidenced by the fact that the number of lamps rejected in January, 1906, was 14.3 per cent and in January, 1907, it was only 8.7 per cent.—Lond. *Elec. Eng'ing*, July 4.

Efficiency of Lamps.—H. Lux.—The first parts of a serial on extended tests carried out in the author's laboratory on the exact determination of the ratio of the heat rays to the light rays from various commercial lamps. W. Wedding has devised an extremely simple method of separating the heat rays from the light rays and for determining the ratio of their energies. The method is based on the use of the Lummer-Kurlbaum bolometer. The present author has found, however, that the numerical values obtained by Wedding are quite wrong. Several examples are given showing that the figures of Wedding cannot be right. The author then describes the bolometric methods of measurement and the arrangements of Kurlbaum, of Paalzow and Rubens, of Wedding's modification of the latter, of the modification of the Paalzow-Rubens system for direct readings, and finally an arrangement according to the compensation method. In the present installments no final results are yet given. The serial is to be continued.—*Zeit. f. Beleucht.*, June 10, 20, 30.

Electric Lighting Effects in Theatre.—An article on some new electrical effects at the Alhambra Theatre in London. In a ballet the dancers carry miniature colored electric lamps, which are switched off and on frequently by a rotary switch driven by a small clockwork motor fixed in the bodice. The motor runs at constant speed for 25 minutes and weighs only a few ounces. The small accumulators are also carried by the dancers in thin india-rubber bags. On another occasion so many lamps are carried by each individual that the electricity is to be supplied through flexible cables from a special switchboard to each performer. Nearly every costume is connected to at least 16 separate circuits. The switchboard is highly complicated.—Lond. *Elec. Eng'ing*, July 4.

Power.

Cheap Energy Supply from Municipal Stations.—C. E. C. Shawfield.—A paper read before the (British) Municipal Association. The author first speaks of the Wright maximum demand system of charging for electricity. He thinks this is unfair. More inducements must be made to get motor customers. It would appear to be almost a settled principle that new business rates should be based on existing cost sheets, with the result that the possibilities of the future are largely discounted by the accidents of the past. The author believes this principle to be fundamentally wrong, and would substitute therefore a maxim which may be briefly expressed as follows: "Adjust the tariff to suit the competition and the cost of production will adjust itself to the tariff." That the maximum demand system is thought to be unfair to motor users is explained by the fact that during the months of November, December, January and February the lamp and the motor loads overlap, with the result that additional plant is required to meet the short peak which usually occurs between 4 and 6 p. m. in those months. One result of this condition of affairs is that the motor user is debited with a considerable proportion of those standing charges which properly belong to the lamp user. The author believes that a solution of the difficulty is to be found by regarding lamps and motors as two separate and distinct classes of supply, each of which should bear only those charges directly incurred by it, and if this principle be adopted it will be found that in practice it will often pay to instal different types of plant for their respective requirements. He emphasizes that the motor load and the lamp load should be kept strictly separate.—Lond. *Elec. Eng'ing*, July 4.—Some critical remarks on the subject; it is stated that the above maxim of energizing the tariff has already been adopted at some places; "we have yet to learn the ultimate financial result, but we fear disaster."—Lond. *Elec. Rev.*, July 5.

Electric Motors in Collieries.—An illustrated description of the electric equipment of the Cambrian collieries in South Wales where a few years ago nothing but steam equipment was used. The power plant contains now two 1000-kilovolt-ampere generating sets to supply alternating current to induction motors for a great variety of purposes in all parts of the mine. There are at present some 21 induction motors in use, ranging in rating from 220 to 3 horse-power, the total horse-power of motors being 1890. Motors on the surface are supplied with three-phase currents at low tension, the e. m. f. being transformed for this purpose by static transformers from 2200 volts, the voltage produced by the alternators in the power house, to 400 volts. The bulk of the supply, however, is conveyed in cables at an e. m. f. of from 2000 to 2200 volts down the pits, and distributed to the various motors at this pressure.—Lond. *Elec. Eng'ing*, July 4.

Electric Motors in Textile Factories.—Cramer-Chape.—An illustrated article on the use of electric motors in textile factories. Induction motors with short-circuited secondaries are specially suitable on account of the risk of fire in such plants. In the electric equipment of a new plant the machines should be provided with individual motors, but the author shows that even in the case of a plant using the group system of driving, the cost of operation can be reduced by installing the individual-motor system. In the works tested by the author, in which only two-thirds of all weaving machinery is in operation at the same time, in one large room the no-load loss was 44 per cent, in a second room 58 per cent of the power consumed.—*Elek. Zeit.*, July 4.

Electric Driving of Spinning Machines.—K. Schnetzler.—A paper about the best methods of electric driving of certain cotton spinning machines. It is shown that a variable-speed motor is most useful for this purpose. Either a direct-current shunt motor should be used or a variable-speed alternating-current motor. A repulsion motor designed by Deri and stated to be specially useful for this purpose is described.—*Elek. Kraft u. Bahnen*, July 4.

Electricity in Mines.—C. P. Sparks.—A paper read before the Engineering Conference of the (British) Institution of Civil Engineers discussing in a general way the economies which result from the use of electricity, the special advantages for underground work and the applications of electric winding, hauling and pumping.—Lond. *Elec.*, June 23.

Power Plant.—An illustrated description of the Frindsbury plant of the Kent Electric Power Company. The turbo-generating plant installed consists of two 1500-kw units delivering three-phase currents at 11,000 volts pressure and 50 cycles, also a smaller two-pole, 500-kw unit of similar frequency, supplying 2500-volt, three-phase currents.—Lond. *Elec. Rev.*, June 21.

Pumping Station.—P. Frenz.—An illustrated description of the pumping station of the city of Moedling. The springs are at a distance of 17 km from the city and the small waterfalls which furnish the power for operating the pumps are at a distance of 3 km from the pumping station. Three-phase currents are transmitted to the station and operate two 65-hp, three-phase motors, which drive the pumps.—*Elek. u. Masch.*, June 9.

Power Plant.—An illustrated description of the power plant of the Norfolk & Portsmouth Traction Company, which furnishes energy to operate the railways in Norfolk and Portsmouth, Va., motors and lamps for the Jamestown Exposition,

and similar service for several towns along the Atlantic seaboard.—*St. R'y Jour.*, July 13.

Traction.

Swedish Railways.—R. DAHLANDER.—An illustrated paper (an abstract of which has already been printed in the Digest) on electric traction on the Swedish State Railways. After the preliminary trials have been concluded the regular passenger service by means of electric trains was started on Feb. 23 on the trial road from Järfva to Stockholm, which is 7 km long. A passenger train consists of two motor cars, each equipped with two 120-hp compensated repulsion motors of the Allgem. Elek. Ges., and of two other cars, the total weight being 144 tons unloaded at a maximum speed of 50 km and about 160 tons with passengers; each motor must, therefore, haul 40 tons. One motor car is also able to haul the whole train, so that one motor must haul 80 tons. The second passenger train consists of a locomotive of 22.6 tons with two 150-hp compensated series motors of the Westinghouse Company. This locomotive hauls seven cars with a total weight of 93 tons unloaded without locomotive. The train loaded with locomotive weighs about 130 tons, so that each motor must haul about 65 tons at a maximum speed of 50 km. Recently a part of the line was equipped with the trolley wire system of the Oerlikon Company. On a part of the line a three-axle locomotive of the Siemens-Schuckert Company hauls freight trains with a maximum weight of 450 tons so that each motor must haul about 150 tons at 20 km speed. Three water falls have recently been purchased by the Government, one yielding 9000 horse-power, the second 12,000 horse-power and the third 36,000 horse-power at the turbine shafts. The Government also owns two powerful water falls in southern Sweden. It is proposed to electrify the state railways of southern Sweden 2086 km in length. Electric power will be furnished by five hydro-electric stations. Two estimates of the cost are based on the traffic in the year 1905 and on the assumption of the traffic being 60 per cent higher in 1920. Electric power will be transmitted at 50,000 volts to 37 transformer sub-stations, where the voltage is reduced to 15,000, which is the tension on the trolley wire. Since the electric power is cheap, heating of all cars will be done electrically. On the basis of the traffic of 1905 it is estimated that the first cost of the power plants will be about $6.000,000, the cost of transmission lines and sub-stations about $9,000,000, hence the total cost $15,000,000. For a traffic, 60 per cent greater, the estimated cost of the power stations is $7,000,000, the cost of transmission lines and sub-stations $12,000,000, hence the total cost $19,000,000. For the latter traffic the water powers which are owned now by the Government would not be sufficient and for this reason two power plants, operated by peat as fuel, have been included in the estimate. It is estimated that the net yearly saving, due to the introduction of electric traction will be about $10,000 with the traffic of 1905 and $370,000 for the larger traffic.—*Elek. Kraft u. Bahnen*, June 14.

Interpole Motor for Traction.—The interpole motor has found a large field of usefulness in stationary, variable-speed motors, and is now entering the traction field. It would seem to be useful especially for high voltages. since it is easier to build a compact high-voltage motor with commutating poles than without them. The coming of a practical and reliable railway motor for from 1500 to 2000 volts would put a new phase upon the heavier railway work. A three-wire system worked on a four-motor equipment arranged in pairs with from 3000 to 4000 volts between the outside wires would be an important addition to the means of heavy traction. With 5000 volts between the outside wires the gain in distribution would be so great as to push alternating-current operation hard, especially if it be considered necessary to drop the frequency to about 15 cycles to get the best operating conditions.—*St. R'y Jour.*, July 6.

Transmission Line in Interurban Traction.—E. R. CUNNINGHAM.—An illustrated article on the effect of the transmission line upon the reliability and efficiency of electric interurban service. Among the points discussed are the methods of connecting the transformers and starting the sub-station rotaries so that the accidental disconnection of one or even two of the transmission wires will not interrupt the service.—*St. R'y Jour.*, July 6.

Electric Traction on Main Railways.—PH. N. PFORR.—The conclusion of his long article in which he discussed the general problem of using electric motors on main railways. From his figures he concludes that recent achievements in electric engineering make electric traction an equivalent competitor to steam traction in a commercial respect. This does not mean that electric traction should replace steam traction in every instance. On railways with light traffic it would not do to increase the first cost by electric equipment, but if such railways are excluded the results become even more favorable to the electric system than is apparent from the figures in the article which are average figures. In other words, "It is certain that in the Prussian Street Railway network there are lines on which the introduction of electric traction would represent a commercial success."—*Elek. Kraft. u. Bahnen*, June 22.

Boston.—A long, illustrated account of the plants of the Boston & Eastern Electric Railroad which is now endeavoring to secure permission to build a high-speed electric railway between Boston, Lynn, Salem and other points. Abstracts are presented of the hearings before the Massachusetts Railroad Commissioners of the relative merits of the present steam and proposed electric service. A detailed estimate of the probable cost of the line is included.—*St. R'y Jour.*, July 13.

Alternating-Current Traction.—J. R. HEWITT.—A description of the Illinois Traction System, with an account of the single-phase work now being carried out on certain lines operated by this syndicate.—*St. R'y Jour.*, July 6.

Braking.—W. KUMMER.—A description of a series of tests on employing alternating-current series motors as generators to produce a braking effect.—*Elek. Kraft. u. Bahnen*, July 4.

Installations, Systems and Appliances.

Extension of Electricity Supply to Outlying Districts.—R. L. ACLAND.—A paper read before the annual convention of the (British) Municipal Electric Association in which the author discusses the extension of an electricity supply to outlying districts, taking as an example the case of Chesterfield, where the lighting supply to an outlying suburb is taken from the traction mains and the voltage regulator of Tirrill is used to steady the pressure. The operation of the regulator can be traced by reference to Fig. 1. When starting up, the voltage of the generator is raised by hand rheostat to about 210 volts (the supply being at 240), and the regulator is then switched in. It immediately short circuits all the shunt resistance that has been left in, by the spring pulling against the solenoid and

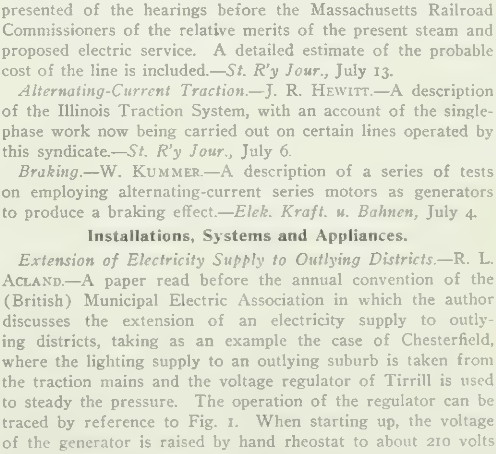


FIG. 1.—DIAGRAM OF SUPPLY SYSTEM WITH REGULATOR.

closing the contacts, and the voltage commences to rise to the maximum of 300 at the machine. On reaching the pressure for which the main control coil has been set, however, the solenoid overcomes the spring tension, and the resistance is again inserted as the contacts open and the voltage tends to fall to 200. This operation is repeated at high frequency, and the resultant, on the recording chart of a voltmeter with the dashpot taken off, is practically a straight line at any predetermined pressure for which the spring tension on the main coil has been set. The only things that require attention are the contacts, and neglect of these will cause trouble, and

[illegible] made up for by [illegible] apart, about 1/16 in. The silver must not be burnt completely off, and dirt or dust must be kept off the contacts. The sparking on the relay contacts is taken up largely by condensers placed in multiple with them, but these must be assisted by cutting out with the hand rheostat as much of the shunt as possible consistent with the regulator having control of the maximum rise in voltage, for by this means the burning of the contacts will be reduced as will also any chance of a flicker on the lamps with a small load on the generator.—Lond. *Elec. Eng'ing*, June 27.

Cost of Electricity and Tariff.—R. H. Burnett.—A paper read before the British Municipal Electrical Association. The author first discusses the necessity of keeping exact records of the cost of electricity supply, and gives the law for the costs of supply for instance in somewhat like the following way: Total costs equal 13.48 cents per kw-day (standing charges) plus 1.20 cents per kw-hour. He then discusses how to use such information for fixing the tariff. His recommendations are as follows:

Supply for Lamps.

(1) A maximum demand rate so arranged that the price charged to a consumer using the supply for two hours per day, is from 10 per cent to 15 per cent in excess of the ascertained cost of the supply.

(2) (*a*) An optional flat rate for any consumer based upon two hours' daily use of the supply on scale (1).

(2) (*b*) Optional flat rate for particular classes of consumers, such as hotels, clubs, public houses, and dwelling houses, based upon scale (1), the rate being fixed according to the ascertained average daily use of the supply by these consumers.

Supply for Motors and Heaters:

(3) A maximum demand rate in which the initial and final prices are each one-half of the prices charged on scale (1).

(4) An optional flat rate for all consumers based upon two hours' daily use of the supply on scale (3).

Supply to Special Consumers:

(5) The price charged to be the ascertained cost of supply plus 10 per cent to 15 per cent for profit.

Restricted-hour or Two-rate Supply:

(6) The price to be based upon the ascertained "running costs" of supply plus 50 per cent for the proportion of standing costs, use of plant, and profit. Any supply taken between sunset and 12, midnight, to be charged at the maximum price on scale (1). In the long discussion which followed J. F. C. Snell and W. W. Lackie, among others took up a strong position in favor of the maximum demand system.—Lond. *Elec. Eng'ing*, July 4.

Power Factor.—A. J. Cridge.—In a paper read before the (British) Municipal Electrical Association, the author discusses the means which are being adopted at Sheffield for the improvement of the power factor of the system in view of the large alternating motor load. A single instance is described as follows: A motor-generator used to furnish the direct current supply in the center of Sheffield has a rating of 120 hp, but it is not loaded to more than 40 hp as a rule. Fig. 2 shows

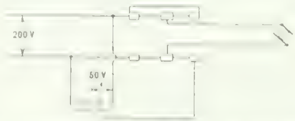


Fig. 2.—Connections of One Phase.

the connections of one phase of the motor. In order to obtain some comparisons, a wattmeter, ammeters, and voltmeter were introduced into both phases, and readings were taken with the machine running at 200 volts in the ordinary way. The instruments were allowed to remain in the 200-volt circuit, and the machine was switched over on to the 50-volt winding of an auto-coil used for starting it. The conditions were thereby greatly improved, the power factor which at 200 volts with 0.35 became 0.9 at 50 volts. The author then shows how to improve the power factor of a system by installing a synchronous motor capable of dealing with the wattless current; some means must be provided of altering the field strength so as to diminish or increase its condenser effect according to the amount of wattless current flowing. A scheme based on this principle and to be introduced in Sheffield is then described.—Lond. *Elec. Eng'ing*, July 4.

Electrical Industry in Italy.—E. Jona and M. Bonghi.—Abstracts of two papers presented before the congress of Italian Electrical Societies. In Jona's paper on the development of electrical engineering in Italy during the last ten years, statistical data are given on the manufacture of various electrical machinery in Italy. In 1905 electric motors of an aggregate rating of 32,000 kw were installed (against 16,000 kw in 1898). The total rating of the 12,000 electric motors which are now in use in Italy (excluding traction motors) is 100,000 kw. During 1905 about 650,000 incandescent lamps of 13,000,000 cp were in use, while in 1906 there were used about 3,000,000 (lamps?). Since there are only two lamp factories in Italy many of the lamps are imported. The paper of Bonghi refers to electrical industries in the 17 provinces of Southern Italy. With a population of 9,000,000 inhabitants there are 145 central stations for public lamp and motor purposes and 274 isolated plants. The annual increase since 1903 is about 10 per cent. Two hundred and five stations use steam power, 106 water power and 70 gas engines. Three hundred and five stations use the direct-current system, 80 the alternating-current system and 7 a mixed system.—*L'Ind. Elec.*, June 25.

British Central Station Accounts.—An account of the annual report of the electric station of Poplar. The total kw-rating of the station is now 3400 kw and the maximum demand was 1980 kw, while the output was 4,208,302 units, so that the load factor works out at 24.26 per cent. The lamp connections for private lighting represented 64,493 lamps of 8 cp, equal to 2063.7 kw, and the 332 motors connected are equivalent to 4710 hp or 3768 kw. The public lighting connections are equivalent to 6037 kw. The number of kw-hours generated was 5,321,383. The total works cost per kw-hour sold was 1.218 cents, the total cost excluding capital charges was 1.824 cents and the total costs including capital charges 3.516 cents.—Lond. *Elec. Eng'ing*, July 4.

Depreciation and Reserves.—C. H. Yeaman.—A paper read before the (British) Municipal Electrical Association. He took up the attitude that, in addition to setting aside in municipal electrical undertakings an adequate sum for sinking fund purposes, a further full amount should be provided for depreciation. Most of the speakers in the discussion, among whom were R. Hammond and Pearson, took up a somewhat different view, and considered that municipal undertakings would be unfairly hampered if required to set aside a sum for depreciation on the scale recommended by the author of the paper.—Lond. *Elec. Eng'ing*, July 4.

Wires, Wiring and Conduits.

Energy Loss in Dielectrics of Condensers and Cables.—B. Monasch.—After dealing with the subject historically the author describes a method of measuring dielectric losses, and

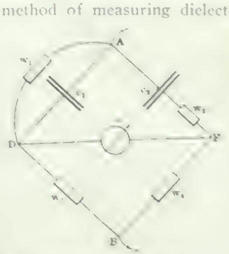


Fig. 3.—Bridge Arrangement.

discusses the sources of error. The method involves the producing of a balance in the bridge arrangement shown in Fig. 3 [illegible] used for capacity measurements. In this case the

four arms of the bridge have the following meanings: Arm AD contains the condenser, the loss of which is to be determined. Without making any supposition as to the nature of the loss, it is permissible to assume the condenser in the bridge to be replaced by a perfect condenser (without any loss) of capacity c_1 shunted by a pure resistance w_1 free from capacity and inductance. In the arm AF there is a perfect condenser of capacity c_2 in series with a pure resistance w_2; in the arms BD and BF pure resistances w_3 and w_4 are inserted. The author then discusses the two conditions which must be fulfilled for the vanishing of the current in the cross-connection and deduces several conclusions from these equations. One is that if the loss in the condenser tested is exactly proportional to the square of the voltage, this method will quickly show it. If the law is exactly obeyed, the instrument in the cross-connection will, after the bridge is once balanced, indicate no current, also when the voltage is varied. The author also discusses the proportionality of the loss to the capacity and the influence of the wave form of voltage, and then discusses various causes of error which must be avoided in the practical use of this method. Serious difficulties were encountered in the construction of the high-voltage condensers. The author finally succeeded in building an air-condenser which acted satisfactorily up to 11,000 volts (effective value). It consisted (Fig. 4) of two brass tubes, 1 m and 95 cm respectively in

FIG. 4.—AIR CONDENSER.

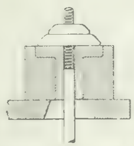


FIG. 5.—DETAIL OF TUBE SUSPENSION.

length, outside diameter 110 mm and 85 mm respectively, and 1 mm in thickness. One end of the outer tube was closed by a hemispherical bottom, and then surrounded with a paraffin block 20 cm in height and 13 cm in diameter. The inner tube was closed by hemispheres on both ends, and at one end a brass rod, 1 cm thick and 24 cm long, was soldered, provided with a screw-thread at its free end for fastening the tube. Fig. 5 shows how it was suspended. There were two nuts on the thread, the upper one of which served for attaching the lead, while the lower one and the inner tube with it rested upon a wooden socket fixed in the paraffin block 5 cm in height. This latter was supported by a wooded board fastened on the table of a wooden stand by wooden clamps. Any edges were carefully avoided in the construction of the apparatus, as may be seen, for instance, at the nuts in the latter figure. The capacity of this air condenser, amounting to 0.00023 mfd. as a maximum, could be varied in a continuous way. The author then gives the results of his measurements describing first the comparative measurements with voltages of different wave form and tension tests.—Lond. *Elec.*, June 28 and July 5.

Electrophysics and Magnetism.

Photo Electricity.—R. A. M[illegible] and G. W[illegible].—An investigation of the influence of temperature upon photo electric effects in a very high vacuum and the order of the photo-electric sensitiveness of the metals. The chief results are as follows: The photo-electric discharge from metals is a phenomenon which, like radio-activity, is completely independent of temperature. The escaping electrons are therefore not the free electrons of the metal, but are rather electrons which become detached from the [illegible] coincidence of their own natural periods with the periods of the impressed æther-waves. The positive potentials acquired by different metals under the influence of ultra-violet light are wholly independent of temperature, and hence temperature changes produce no change in the velocity of the electron within the atom, a result which is in accord with the known thermal properties of monatomic gases. The order in which metals in a vacuum exhibit photo-electric sensitiveness bears no relation whatever to the Volta contact series. The relation between this series and the order in which the metals exhibit photo-electric sensitiveness in air is probably due to the masking of the true photo-electric effect by the effect of the double-layer formed between the oxygen and the metal. The order in which the metals arrange themselves with respect to the positive potentials assumed in vacuum under the influence of ultra-violet light bears no relation to the Volta contact series. Clean, unpolished metals exhibit in a vacuum, under the influence of a given source, perfectly definite and constant discharge rates. If fatigue effects occur at all, the recovery from them is complete in the course of a few minutes.—*Phil. Mag.*, July.

Magnetic Compounds of Manganese with Boron, Antimony and Phosphorus.—WADEKIND.—Until a few years ago the only magnetic metallic substances known were iron, nickel and cobalt. Then several alloys of non-magnetic constituents were found to be strongly magnetic, all of which contained manganese, viz., manganese-tin, manganese-aluminum and manganese-aluminum-copper. It appears, however, that Wöhler had noticed nearly 50 years ago the first case of a magnetic compound of non-magnetic elements in the oxide of chromium Cr_6O_9. The present author has recently found that the boride of manganese, MnB, has remarkably strong magnetic properties, probably one-quarter to one-half as great as soft iron, while the compound MnB_2 appears not to be magnetic at all. The antimonide, MnSb, seems to be about twice as strongly magnetic as the boride, while the phosphide Mn_3P_2 shows this property to a much slighter extent.—From *Berichte*, Vol. 40, p. 1259, abstracted in *Am. Jour of Science*, July.

Electrochemistry and Batteries.

Electro-Metallurgy.—B. BLOUNT.—A paper read before the Engineering Conference of the (British) Institute of Civil Engineers. The author gives a sketch of what he calls the principal electro-metallurgical industries, namely, refining of copper, manufacture of aluminum and the manufacture of sodium; but "the largest of all electro-metallurgical industries will be the manufacture of steel." Zinc is a metal not at present smelted electrically, but which for chemical and physical reasons is excellently fitted for production in that manner. There is much the same reason to replace the present furnaces with their numberless small and costly retorts by a furnace internally heated by electricity as there was to supersede the older mode of making phosphorus and carbon bisulphide by the electrical methods now in operation.—Lond. *Elec.*, June 28.

Units, Measurements and Instruments.

Three-voltmeter Method for Determining the Iron Losses.—H. ZIPP.—The author first gives the simple diagram by means of which the three-voltmeter method enables one to find all relations of current, phase-difference, and power consumption in inductive circuits, if the inductances contain no iron. He then shows how the diagram is to be altered if the inductances contain iron and also shows that the three-voltmeter method enables one to determine the iron losses by a second measurement. Moreover, this method has certain advantages over the use of the wattmeter.—*Elek. und Masch.*, June 30.

Telegraphy, Telephony and Signals.

[illegible] W. DAWSON.—A paper read before the Engineering Conference of the (British) Institute of Civil Engineers, describing a system which has been in use for the past 15 months on a section of the Great Western Railway. The parts consist of a slightly arched piece of timber from 40 ft. to 60 ft. long, bolted to the sleepers midway between the two running rails, on top of [illegible] bolted a [illegible] suitably mounted and insulated, the bar being

electrically connected by means of a length of telegraph wire to a switch at the signal-box. This bar is electrified by pulling a lever when it is desired to give the "all right" signal. There is no moving part in this ground apparatus. This fixed, non-movable sloping bar also serves the purpose of lifting a rod connected with a mechanical device fixed beneath the engine of a standardized design to fit any engine. The lifting of this rod opens a small steam-whistle fixed in the cab of the engine when it is desired to give the "danger" signal. To give the "all right" signal, the action set up by the electrified bar on the ground apparatus restrains the whistle from blowing, but rings a bell. When the whistle or the bell sounds, it continues to do so until the driver shuts it off, and without any further action on his part it is ready to produce the same signal again at the next station. Neither frost nor snow prevents the operation of the "danger" signal. Seeing that the device is available at all times and in all states of the weather, it follows that fixed distant semaphores are not needed, and their cost and maintenance and lighting need not be incurred. The Great Western Railway Company has removed them altogether on the single branch line referred to.—Lond *Elec.*, June 28.

Miscellaneous.

Welding of Structural Materials In Place.—H. A. Ruck-Keene.—A paper read before the Engineering Conference of the (British) Institute of Civil Engineers. After a description of the Thomson process of electric welding he describes the Benardos system of electric welding in which an arc is employed. The articles to be welded are placed in position and are connected by a cable to the positive pole of the dynamo, and the negative pole is connected to a carbon pencil. On the pencil being brought into contact with the article to be dealt with and then withdrawn a short distance, an electric arc is formed which rapidly heats the part in close proximity to the arc. When the surface of this part is fused a small piece of metal is added, and this becomes fused and attaches itself to the fused surface; this process is continued until sufficient metal has been added and fused to fill the space between the parts to be united. Great care must be taken to ensure that each and every one of the small pieces of the metal added becomes firmly attached before adding more metal to it. Many successful repairs have been carried out by this process, more especially to steel castings, etc., and it is generally considered necessary to anneal the parts dealt with, after the operation, to relieve the contraction strains set up by the intense local heat. In another system, instead of the carbon pencil, a small rod of specially prepared iron is used; this itself becomes fused in the arc and forms the metal which builds up the so-called welded joint. The use of the oxy-acetylene and oxy-hydrogen flame for welding and of the aluminothermic process for welding are also dealt with.—Lond. *Elec.*, June 28.

Workingmen's Compensation and Insurance.—J. J. H. Stansfield.—The author deals with the effect of the new (British) Employers' Liability Act upon the position of the manufacturer, and shows that in some ways the Act is obscure, besides adding materially to the employer's liability.—Lond. *Elec.*, June 28.

Sales Contracts.—B. A. Brennan.—A second article on the subject discussing different kinds of sales contracts. The author first deals with simple sales contracts, and then with conditional sales and discusses patent clauses and terms of payment.—*Elec. Jour.*, July.

BOOK REVIEWS.

A Practical Guide for Authors. By William Stone Booth. Boston: Houghton, Mifflin & Company. 180 pages. Price 50 cents.

This useful little volume will be of assistance to any one who writes even infrequently for print. The opening section deals with the preparation of manuscript, in which advice is given as to its material form, with reference to size of sheet, spacing, notes, illustrations, etc. We are glad to see stress laid on uniformity of size of sheet, forwarding copy unrolled or unfolded and unbound. Following sections are devoted to marketing copy and relations with publishers. Then come sections on proofreading, signs used in proofreading and types. The remainder of the book, or about two-thirds of the contents, is devoted to rules for spelling, punctuation, capitals, etc., including sections on French and German spelling. Lists are given of words spelled differently by different authorities, but so-called "simplified spelling" is not recognized. Sections that will be found particularly useful are those on compounds, division of words, capitals and miscellaneous points of style.

A German Science Reader. With Notes and Vocabulary. By William H. Wait. New York: The Macmillan Company. 321 pages.

The object of this "reader" is commendable, aiming as it does to provide suitable selections in German scientific literature for the growing body of college and university students who need them. The subjects treated are limited to physics, chemistry, astronomy, geology and mineralogy; and any student who covers 100 of the 180 pages of reading matter best suited to the nature of his studies will have gained such acquaintance with style and terminology that will enable him to read without much labor the technical works and periodicals that are of greatest use to him. The extracts are followed by notes, verbal and grammatical, on each of the six subjects treated; and the last 100 pages of the reader are given over to a vocabulary which will prove to be a great economizer of time over the use of the cumbersome lexicon.

Electric and Magnetic Measurements and Measuring Instruments. By Frank W. Roller, M. E. New York: McGraw Publishing Company. 404 pages, 312 illustrations. Price, $3.50.

The title of this book is somewhat misleading, as the work is principally devoted to the instruments and devices in general use for measuring electric and magnetic phenomena, their construction and method of use being fully treated.

The book is a timely one and it contains much information necessary to the electrical profession, which has hitherto been available only in a scattered and disconnected form. It covers its field broadly. Instruments and standards of nearly every known kind, both commercial and laboratory, are here given a place, their construction shown and described, their possible errors, defects or advantages pointed out, and directions for their manipulation set forth. Many practical suggestions—the result of the author's long and varied experience in this branch of the art—are given in connection with the setting, care and operation of the various devices described. Probably the most complete exposition of the Wheatstone bridge in its many variants ever written, is in this work.

The opening chapter defines the electric units. The second chapter covers the standards of measurement, voltage, resistance, inductance and capacity, with brief references to the potentiometer, tangent galvanometer, ampere balance and electrostatic voltmeter—a somewhat heterogeneous group. Chapter III, "Galvanometers" covers the reflecting, hot-wire and D'Arsonval types. It is regrettable that ballistic and tangent galvanometers are not here mentioned, and nowhere in the work is the general equation of the latter derived, while the former receives but scant consideration in the chapter on "Capacity." Chapter IV on "Potentiometers" is admirably complete. In Chapters V, VI, VII, VIII, IX and X entitled, "The measurement of Resistance," measurement of current, potential, power, capacity and inductance, respectively, the instruments required and the methods of using, are described. Chapter XI takes up "Miscellaneous Determinations," such as wave form, frequency, phase relation, speed variation, and transformer testing. Chapter XII is on "Location of Faults." In Part II, Chapter I covers recording instruments; Chapter II, integrating meters, and Chapter III maximum demand meters.

Part III is devoted to magnetic measurements, Chapter I

taking up the magnetic units. Chapter II is on measurement of field strength, and Chapter III on measurement of permeability, and Chapter IV on measurement of hysteresis.

In such a complete manual it is unfortunate that more careful proofreading was not done and the errors which have crept in eliminated. For instance, on page 67 the equation for the Ayrton and Mather universal galvanometer shunt is incorrect in that R should be the resistance of the shunt, plus that of the galvanometer, while it is given as the resistance of the shunt alone. Also on page 235 the numerical illustration of the decrement of a ballistic galvanometer is given as 1.04, and it should be 1.11. The names Thompson, Thomson and Kelvin are hopelessly mixed and occasionally the symbol C for capacity replaces I for current. These matters are, however, trivial compared with the large amount of good and helpful information in the book, and a proper errata sheet should clear these minor errors.

New Motor Rheostats.

The National Board of Fire Underwriters proposed recently a rule bearing on the vital part of a motor-starter, the resistance, which has aroused general interest. This rule stated that the resistance conductor should possess a low or negligible temperature coefficient. One of the arguments against the proposed rule was to the effect that resistance material of low temperature coefficient cost so much that motor-starting rheostats would have to be built with less material. This, it was stated, would require that the resistance material be imbedded close to a heat absorbing mass and such construction would interfere with the rapid cooling of the rheostat. In the light of this discussion, the new motor starting rheostats (Fig. 1) just placed on the market by the General Electric Company have special interest. This line of rheostats with no-voltage release, and with no-voltage and overload release, is constructed with a new resistance unit not only having a negligible temperature coefficient, but also permitting a ventilated construction of the rheostat.

The new resistance consists of a low-temperature resistance material wound on a tube which is ventilated inside and out. The whole is covered on both surfaces with a special compound, which protects the wire effectively and holds it in position. The unit so formed is absolutely fire and moisture proof, and, if accidentally raised to such a degree of heat as to melt the wire, will open the circuit without appreciable arcing. The design of the unit, furthermore, increases the starting capacity of the rheostat from a duty of 30 seconds to a duty of one minute without increasing the dimensions.

In addition to these excellent electrical characteristics, the new unit permits many improvements in detailed mechanical

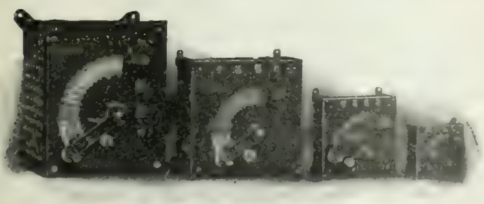


Fig. 1.—Motor Starting Rheostats.

construction. Because of the reduced space which the unit occupies, not only is the space required per horse-power much less, but more room is available in which to make internal connections. This, together with the fact that all leads are insulated with glass beads, eliminates danger from grounds or short circuits caused by crowded leads. The glass beads are excellent insulators and are also absolutely fireproof. In rheostats of two horse-power and larger, the resistance units are fastened to supports independent of the iron cover, these supports being fastened to the slate top of the rheostat. (See Fig. 2.) This allows the unit to be removed for inspection or repairs without disturbing other units or connections. In larger rheostats the iron-grid type of resistance is used, the grids being treated with a compound which prevents rusting.

The mechanical features of the new rheostats have also received thorough consideration. Necessarily subjected to hard service, the switch arms, contact shoes, segments and connections are all designed to meet such conditions. The arms of the dial switches are of rugged construction and will undergo heavy handling without injuring the contact between the sliding brushes and the segments. The springs which pull the arms to the "off" position, encircle the pivot stud and are positive in

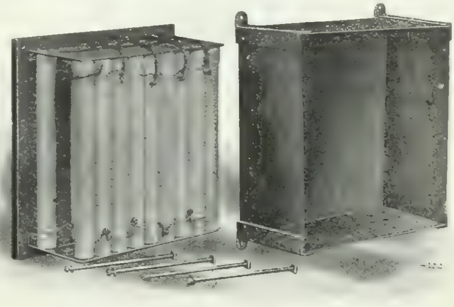


Fig. 2.—Motor Starting Rheostats.

action. The arms may be easily removed by slipping out a cotter-pin. The dead segments on the starters have been made of ample proportions to ensure the proper breaking of the current when the switch arm flies to the "off" position.

In the smaller sizes, the sliding contacts consist of copper shoes held down firmly on the segments by springs. Above 7½-hp, 110 volts; 10-hp, 220 volts, and 15-hp, 550 volts, brass blocks are provided with carbon protecting blocks which precede the brass blocks while starting, this prevents pitting. The contact blocks, in all sizes, are self-aligning, and can be renewed readily without removing the switch arm from the slate. Care has also been taken with the stationary contact segments. These on smaller sizes are of brass, while on larger sizes all are made of copper and are renewable from the front. Rheostats in the larger sizes also have the initial contact point protected by an auxiliary button, which may be removed and renewed from the front.

The motor shunt-field circuit is made and broken on the first live segment of the starting switch. When the starting arm passes to the "off" position the field is discharged through the motor armature and the starting resistance. This resistance, however, is not in series with the field in the "running position."

All of the rheostats are fire and moisture proof and are built to withstand the hardest service. They are suitable for starting direct-current motors ranging in capacity from ⅛ horse-power to 35 horse-power at 110 volts, and from ⅛ horse-power to 50 horse-power at 220 volts and at 550 volts.

Stamped Steel Loud-Ringing Polarized Bell.

The accompanying illustrations show a new loud-ringing polarized bell which has just been developed and placed upon the market by the Holtzer-Cabot Electric Company, of Brookline, Mass., and Chicago, Ill. A distinctive feature of the bell is that the frame and case enclosing the mechanism are made from stamped steel, which gives rigidity to the bell and at the same time makes it much lighter in weight than the old cast-iron or wood base types. The stamped steel case is practically dust and moisture proof, thus enclosing the operating parts in a waterproof chamber. The frame and case are thoroughly japanned.

The bell is particularly adapted for use on telephone lines as loud ringing extension bells and on alternating current power

[illegible]
The current consumption is stated to be extremely low.

There are provisions in the base for a condenser when re- [illegible]

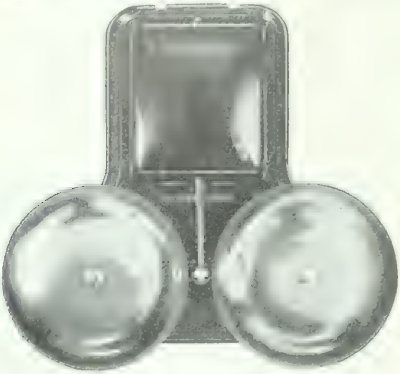


FIG. 1.—BELL COMPLETE.

lated, and the magnets and armature are of the highest grade of special iron. The terminal blocks are of solid hard rubber and all connections are so located as to be readily accessible. The

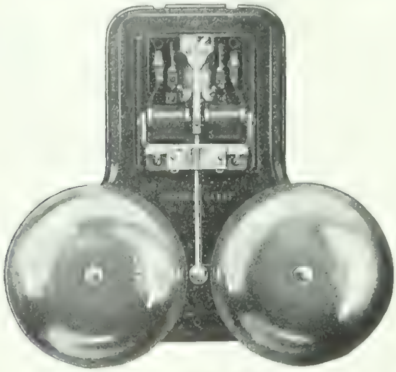


FIG. 2.—CASING REMOVED.

gongs are heavily nickel plated over copper plate, thus insuring long wear and preventing corrosion.

Concrete Poles.

The American Concrete Pole Company, of Richmond, Ind., has been organized for the manufacture of concrete poles for line work, involving the principles of construction of armored or re-inforced concrete work.

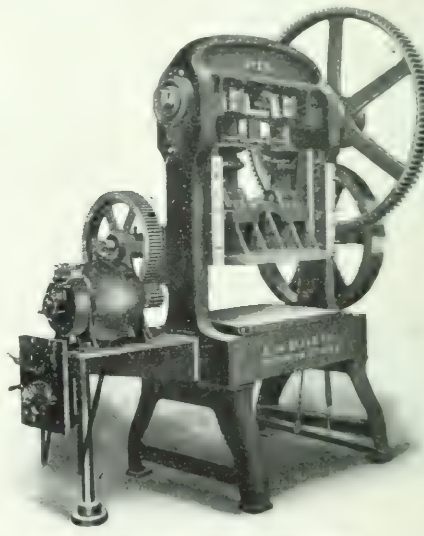
A series of continuous rods of twisted carbon-steel especially prepared for the purpose are held in position and bound together by a spiral steel wire from the apex to the base of the pole, and the poles are moulded in adjustable forms. All large poles or poles over 35 ft. will be constructed in the holes by upright forms. Gains for cross-arms, holes for bolts and steps are easily provided for while the concrete is plastic. A 30-ft. pole of octagonal section constructed a year ago in a horizontal position, hauled nine squares and set up with cross-arms in the rear of the new building of the Richmond, Ind., Home Telephone Company, subjected to two summers and a winter with wires attached, is stated to show no perceptible wear or injury from use or the elements. The company is now constructing a line of 45 and 50 and 55-ft. poles in an upright position across the White Water River bottom at Richmond, Ind., to convey the cables of the Home Telephone Company from the east side to its west side automatic sub-station. A self supporting stub has also been erected and in use for some time at the end of a strong lead without showing any apparent yielding.

Some severe tests made with poles constructed in this manner show that though very hard and durable and apparently rigid, a surprising elasticity is displayed. For instance, a pole 30 ft. in length when subjected to a strain of 3100 pounds at the top deflected from a straight line 30 inches before cracking the cement. A cedar pole of like dimensions broke at 2200 pounds, thus showing a power to resist strain in the concrete pole of about one-third over that of wood. Even the cracking of the cement did not apparently weaken the strength of the concrete pole, since the re-inforcement then becomes active and takes the entire strain. In addition to the great strength imparted to the cement shaft by the carbon-steel twisted rods, the spiral coil binds the body of the concrete and at the same time imparts additional strength both horizontally and longitudinally.

Accurate accounts of all expenditures for labor and material in the construction of these poles are stated to show that under average conditions the first cost of these reinforced concrete poles is about equal to or slightly in excess of the cost of cedar poles set in the ground. With reinforced concrete poles the renewal cost incident to the use of wooden poles is entirely removed as the former are absolutely indestructible.

Motor-Driven Presses.

As an indication of the increasing recognition by manufacturers of the advantageous features of electric motors for driving machine tools may be mentioned the fact that the E. W. Bliss Company, maker of machine tools, has arranged each of its standard machines for independent motor drive. A double-crank press with electric motor attached is shown in



DOUBLE CRANK PRESS, MOTOR DRIVEN.

the accompanying illustration, the motor starting rheostat and controlling devices being within convenient reach of the operator. When motor-drive is used it is unnecessary to waste power in running long line of shafting when one wishes to operate a certain machine or department after the regular working hours for the whole shop. Moreover, in event of the demand for a small amount of power, the manufacturer can obtain a supply from the local electric company and thus avoid the loss incident to running large engines at light loads.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The weather was seasonable and trade in general was thereby favorably affected. The high temperatures stimulated crop development and helped retail trade in light summer goods. There was a lull in the industries, notably in iron and steel in their cruder forms, and lumber is quiet, especially at the South where production is being curtailed, and prices are easier as a whole. Coal is active at the West, where a general stocking-up is reported. As to the crops, the present outlook is favorable for heavy yields of corn and cotton, but wheat estimates do not tend to enlarge materially. There was a slight improvement in the demand for pig iron, but the markets are still dull, and some fair-sized orders were placed for structural material. Orders for about 5000 box cars were placed during the week, which will require a heavy tonnage of plates. New domestic business in steel rails was light, but several good-sized foreign orders were received, including some from Japan, Mexico and Australia. Old material was quiet and prices continued to decline. Collections were a little better than they have been lately, owing largely to the steady outgo of seasonable supplies in all parts of the country. In copper, the business of the week was moderate, but this may be said to be due to the readjustment of conditions. While prices have not changed in any material way, there has been a nominal range only. The closing quotations are: 21½ cents for lake; 21¾ cents for electrolytic, and 20⅛ cents for casting stock. The number of business failures during the week ending July 25, as reported by *Bradstreet's*, was 155, against 177 in the week previous and 171 in the corresponding week last year.

BELL TELEPHONE INSTRUMENTS.—The statement for June showed a net output of only 17,678 instruments, and the inference naturally is that this represents the new net business of the licensee companies for that period. The truth of the matter, it is stated from Boston, is that the number of new stations or new subscribers during June amounted to 32,400, against 37,100 in June, 1906, and President Vail gives it as his opinion that by reason of the recent efforts of the company to secure a higher class of business, there is more net money by at least $1 per month to the Bell companies on the basis of the June, 1907, business than was secured from that booked in June, 1906. The Bell companies have laid off at least 50 per cent of their canvassers, and at the present time there is no active solicitation for business. In other words, the company is devoting its energies to securing higher grade and more permanent business in contrast with efforts a year ago to increase solely the number of subscribers whether or not they were transient or permanent. At the beginning of the year the Bell companies had a surplus supply of at least 600,000 instruments, and they to-day have in stock a sufficient number of instruments to last them for at least six months on the basis of new business during the last six months of 1906. The American Telephone & Telegraph instrument statement for the month of June and six months ended June 30, compares as follows:

June.

	[illegible]	[illegible]	[illegible]	[illegible]
Gross output	[illegible]	[illegible]	[illegible]	[illegible]
Returned	[illegible]	[illegible]	[illegible]	[illegible]
Net output	[illegible]	[illegible]	[illegible]	[illegible]
Since Dec. 31, 1906.				
Gross output	[illegible]	[illegible]	[illegible]	[illegible]
Returned	[illegible]	[illegible]	[illegible]	[illegible]
Net output	[illegible]	[illegible]	[illegible]	[illegible]
Total outstanding	[illegible]	[illegible]	[illegible]	[illegible]

THE COPPER SITUATION.—Discussing the situation, the *Copper Gossip* of the National Conduit & Cable Company [illegible]: "There is probably considerable copper in the hands of consumers carried over from old contracts, and the apathy of some of the prominent manufacturers would seem to confirm the belief that supplies of raw material are by no means exhausted. The effect of the recent reduction in prices has served to encourage outside offers in this country and [illegible] below the official price lately announced. These cheap offers lead buyers to adhere to the hand-to-mouth policy of buying, and tend to still further confuse the minds of the trade. The situation is not without its bright features, notwithstanding the presence of certain conditions which have a tendency to rein in enterprise for the time being. Business is getting down on a more normal plane, and the disposition to embark upon rash ventures has received a wholesome check. The ideas of the financial and industrial world are not quite so inflated as they were, and people are beginning to realize that there is a limit to expansion methods. The kernel of the situation, as we understand it, lies in the present unsatisfactory condition of the money and bond markets. No permanent improvement can be looked for until it becomes possible to finance new enterprise with greater facility than can be done at present. The trouble is not with the price of copper per se, but the root of the difficulty is traceable to the inability of various utility corporations to secure the necessary funds against bonds whereby the money can be raised for executing contemplated improvements. A curtailment of business would send money into other channels, and investment funds would gradually become available for purchase of bonds, and with a ready market for the latter work already mapped out could be taken up and carried through successfully."

BIDS WANTED FOR HYDROELECTRIC DEVELOPMENT IN NORTH CAROLINA.—The Water-Power Electric Company, of Hickory, N. C., is soliciting bids for the construction and installation of a hydroelectric power plant on the Catawba River three miles from Hickory. The development is to consist of a concrete dam 18 feet high above normal low water level and 400 feet long including the power house and penstocks. Two vertical shaft water-wheels of 1000 hp each will be required and bidders are requested to furnish blue prints in detail of the installation they intend to furnish before they sum up the bid. The electrical equipment is to consist of three 600-kw, three-phase, 60-cycle, generators to be either moderate-speed, rope-driven, or slow-speed, direct-connected or driven from horizontal line bevel gears to water wheels. Bids will be received for both kinds of drive with exciters, switchboards and appliances necessary for the successful operation of the equipment. Detailed plans and descriptions of the generators, etc., are requested a reasonable time in advance of bids. The bids are to be opened at Hickory, N. C., on August 10 and should be addressed to Col. M. E. Thornton, Hickory, N. C. Bids for the transmission line and supplies will be considered later; but will be received at the time specified for 3½ miles to 12 miles inclusive. Copies of the report, surveys, plans and specifications, blue prints of drawings in detail, may be had on application. C. S. Wenger is the engineer.

CHICAGO ELEVATED PLANT.—After nine and a half years of service, running 20 hours a day and 80 revolutions per minute, Sundays included, a recent annual inspection of the engines installed at the power house of the South Side Elevated Railway Company, of Chicago, indicated that the amount of wear in the 54-in. low-pressure cylinders of the 26-in. and 54-in. x 48-in. Allis-Chalmers cross compound machines constituting this equipment measured the thickness of one paper sideways and two papers top and bottom, using paper of from .010 to .011 of an inch thickness. The measurements were taken on the No. 2 engine, which is one of four units first installed in the power house. The cylinder was opened under the direction of Chief Engineer Hadin, for the regular annual inspection. The same steel gauge was used which was made when the engines were first erected. The original bull rings and packing rings are still in use in this cylinder. Current has never been off the bus-bars at this station since it was first put into operation. This station now contains four Allis-Chalmers 26-in. and 54-in. x 48-in. horizontal cross compound direct connected engines, two units of the same type, 34 in. and 70 in. x 54 in., and two vertical cross compound engines with cylinders 38 in. and 80 in. x 60-in. stroke.

SEASONING POLES.—The Forest Service of the U. S. Department of Agriculture has just issued in circular 103 a very interesting report on the seasoning of telegraph and telephone poles conducted with the cooperation of the American Telephone and Telegraph Company. The report is by Mr. Henry Grinnell, forest inspector. The scarcity of timber suitable for telephone and telegraph poles has of late assumed serious proportions. To users of poles, therefore, the question of how best to meet this situation is of first importance. Latest reports of the Census Office show that there were in operation in 1902 approximately 700,000 miles of pole line. Subsequent additions, however, together with certain railroad pole lines not reported, would enlarge this figure. It is safe to assume that there are in operation at present fully 800,000 miles of line. The average line contains about 40 poles per mile, so that there are approximately 32,000,000 poles in use. Assuming that the average life of a pole is twelve years, it follows that for the maintenance of the lines now in operation there are needed each year more than 2,650,000 poles. Such an enormous demand must soon deplete the available supply. This is fully recognized by the different companies. A good deal of useful information is given in the report. It appears that winter-cut wood seasons more regularly than that cut at other seasons, but does not, for many months, at least, reach as low weight as spring-cut wood seasoned equally long. In timber of approximately the same age and growth that cut in winter will have the greatest specific gravity, and that cut in autumn the least. The shrinkage of round timbers in air seasoning is very slight and may be disregarded. If poles are carefully cut, checking during air seasoning is comparatively slight. If split or shaken in felling, however, serious checking may result. From the standpoint of seasoning, spring and winter are the best times for cutting. Other considerations, such as custom, availability of labor, and susceptibility to decay, make winter cutting preferable.

CITY GAS ENGINE PLANT.—The city of Edmonton, situated in the central northern portion of the province of Alberta, Canada, has grown in recent years to a population of approximately 16,000 and become an important station among the coal producing centers of Western Canada. Three railroads offer good shipping and transportation facilities, and at the present time real estate is high and conditions are very prosperous. In the expansion which has taken place there the municipal lighting and power plant for Edmonton has been outgrown and the initial equipment, which comprises Allis-Chalmers electric generators driven from high-speed engines, will soon be supplemented by a new plant in which gas power will be used, the first installation consisting of one 700-kw gas engine and alternator, the former to operate on producer gas. The engine is of the standard horizontal twin tandem type built by the Allis-Chalmers Company and consequently it has all the refinements of the latest practice in gas engine design. The speed is 150 r. p. m. The piston rods are water cooled, water being introduced at the center slide, with a discharge in the crosshead for the front piston and a discharge in the tail guide for the rear piston, each piston having its separate supply. The unit has four cylinders 24 in. in diameter by 32 in. stroke and uses gas of 130 effective B. T. U. In the air starting system provided for the engine, air will be admitted to each cylinder, in turn, at what would be the explosion stroke. The high compression carried prevents the engine from stopping on dead center, which arrangement insures proper starting of the engine from any position, without the use of a barring gear. The motor-driven air compressor, also furnished by Allis-Chalmers Company, has a capacity of 36 cu. ft. of free air per minute, compressing to 200 pounds per sq. inch into two air tanks. The generator, which follows the well known Allis-Chalmers design, is rated at 700 kw and wound for 2300 volts, 60 cycle, 3-phase. The generator is excited by means of a 50-kw gas engine driven unit.

NEW YORK TELEPHONY has been made the subject of a special report by an aldermanic committee, which says with regard to the New York Telephone Company: "Your committee demand rigid investigation for the protection of the city's rights, which have been too frequently disregarded in the past, a condition which should no longer prevail. This does not involve impairing the usefulness of companies legally exercising privileges in the streets of the city, but does involve a recognition by them of the city's rights with respect to such privileges. Your committee, therefore, recommends to the Board of Estimate and Apportionment that these questions be thoroughly examined, with the view to determine whether or not the present operating telephone companies should be required to obtain the consent of said board in order to continue such operation, and as to its power to impose conditions therefor, including the compensation to be paid the city for such privileges. The committee finds that the reduction of rates at pay stations promulgated by the company has not generally benefited the public. Such reduction has affected only a limited number of such stations. The situation in this respect has not met public expectations, justified by the assurance of the company. Your committee appreciates that complaint as to the present telephone service may be in some instances exaggerated, and also that the difficulties attending such service in a large city are not easily overcome, but the committee is satisfied that there is some just ground for complaint, and that service open to such fair criticism is a natural outgrowth of an unrestricted and uncontrolled monopoly of the business."

NEW YORK CENTRAL FIGURES.—Some interesting figures are given out as to the use of electric traction on the New York Central system. On July 1 the New York Central began the operation of electric trains into the Grand Central Station. The mileage of the electric system amounts to 19.5 miles. The main line from the Grand Central Station to High Bridge is eight miles in length and the Harlem division to Wakefield is 11.5 miles. The following is the official status of the electric operations per day of the New York Central trains of date July 1: Total number of multiple unit trains in operation, 123; there are 114 motor cars and 46 trailers in service at the present time; total number of cars on hand for service is 124 motor cars and 54 trailers; number of miles covered by multiple unit trains, 1232; number of trains hauled by electric locomotives, 124; miles covered by electric locomotives in passenger train service, 1080; number of electric locomotives required to cover through train service, 17; locomotives in shop service, 8; locomotives in switching service, 3; miles covered electrically by shop train schedules, approximate, 350; miles covered by electric locomotives in switching service, 360; number of electric locomotives required to cover shop train service when in full operation, 12; number of miles covered when shop train service is operated electrically, 530; grand total miles covered by electric locomotive trains in passenger, shop and yard service, 1790; grand total number of miles covered by multiple unit trains, 1232; grand total number of miles covered by all electric trains, 3022.

GENERAL ELECTRIC ERIE PLANT.—It is stated that the officials of the General Electric Company are seriously considering the abandonment of their plans to build a big plant at Erie, Pa. The company has become disgusted with what it considers a hold-up on the part of a local promoter who has launched a company for the ostensible purpose of building a railroad which will encircle and cut into the General Electric property in Erie in such a way as to greatly impair its advantages. Some months ago the General Electric Company announced that it had bought several hundred acres of land west of Erie, in Mill Creek Township, and had options on enough to bring the total up to 1000 acres. On this site the company intended to erect a plant that would ultimately employ probably 7500 persons, and call for the building of thousands of homes. Immediately after the company's plans became known an Erie promoter formed the Merchants' Terminal Railway Company, with a capital of $200,000, to build a belt line road which would encircle the proposed site of the General Electric's plant, and the company now has pending applications for permission to condemn a right of way that would cross the Pennsylvania Railroad Company's tracks and bisect the General Electric Company's land. To carry out the plan that the Merchants' Company announces would cost several million dollars. The General Electric officials view the whole affair with suspicion.

TELEPHONE SUPPLIES.—U. S. Consul-General John P. Bray, of Melbourne, Australia, reports that the Postmaster-General of Australia is about to call for bids for the supply of a large amount of material. This will include six or seven hundred miles of copper wire for an additional telegraph line between Sydney and Melbourne, 3000 telephones, 20 tons of copper wire, 7000 insulators, etc., for use in the State of South Australia.

TROLLEY CAR EXPORTS.—Note is made of the shipment from the Brill works in Philadelphia of trolley cars for Lisbon, Portugal; Buenos Ayres, Argentine Republic; and Kingston, Jamaica, W. I. The semi-convertible type is used for the two former cities. The semi-convertible type is well suited to the climate conditions of Lisbon, for the winters are mild, with many warm days, and during the summer the evenings are invariably cool. The large window openings and low window sills of this car give it the airiness of the open summer car. Another reason why the semi-convertible type is especially desirable for use in Lisbon, is the extremely narrow gauge of track which is necessary because of peculiar local conditions. The track gauge is but 2 feet 11½ inches, limiting the extreme width of the car body to 7 feet eight inches. It would be impracticable to provide a transverse seating arrangement within these limitations in a car having window pockets in the side walls; the absence of the side wall pockets in the car increases the available space for seats and aisle, 7½ inches wide, permitting the seats to be 35 inches long and the aisles 17½ inches wide. The semi-convertible cars measure 28 feet over the end panels and 38 feet over the vestibules. The second-class cars are 25 feet over the bodies and 38 feet over the vestibules. Both types of cars are constructed chiefly of teak, as other kinds of wood are subject to the inroads of white ants. On account of the heavy grades encountered on the Lisbon system, independent air, hand and track brakes are used on both types of trucks. A large shipment of semi-convertible cars recently left Philadelphia for Buenos Aires, Argentina. The order consisted of 75 single-truck grooveless post semi-convertible cars and ten double-truck cars having the same window system. A novel feature is the installation of two electric fans at diagonally opposite corners of the car for service during the hot summer months. Another innovation is a metal pocket into which is slipped the conductor's badge. This receptacle is so located as to be easily seen by passengers entering and leaving the car. The pocket allows the number of the badge to be clearly read, the presence of the badge indicating, of course, that if the conductor does not properly perform his duties, passengers will have the means of reporting the delinquent at headquarters.

GENERAL TRADE PROSPECTS have been made the subject of a special investigation by the *New York Times,* which gives the results considerable space in its issue of July 29. All the authorities quoted are prominent in their lines of industry. Summing up, the *Times* says: Is the volume of commerce on the decrease? Are the manufacturing interests showing any signs of decadence? Is the demand for labor less than it was a year ago? The answers to these queries are to be found in the actual conditions which prevail to-day in the trades and industries of the United States. To ascertain these conditions and to derive from them something upon which to base a conservative estimate of the country's immediate industrial future, the *Times* has asked for an expression of fact and opinion from leading authorities in the world of trade. The result of this canvass, as here given, is gratifying in every sense of the word. With scarcely an exception, each line of industrial activity that has been consulted shows an encouraging degree of progress, and in no case is there a forecast of the future colored by pessimistic forebodings. These trade authorities, arguing from present conditions and tendencies, see in the outlook a continuation, and even an increase, in the prosperity which the country is at present enjoying. It is pointed out, as the one negative feature in the situation, that there is a scarcity of money in the markets; but this very lack of money is quoted as an evidence of business activity. For the moment, it is believed, this stringency may act as a check to the development of new enterprises. But in the end, it is argued, whatever force this money scarcity may exert, will be counteracted by the uniform stability of the country's crops and the disinclination on the part of business to decline from its present standard of activity. Thus, on all sides, America's business future is deemed to be built on a solid basis, and there is no room given by these experts in trade conditions to the belief that the threat of coming hard times is visible on the country's horizon."

DECLINE IN COPPER.—A further decline in copper prices occurred this week. On Monday, according to the quotations of the Metal Exchange and in independent trade circles, electrolytic copper was quoted at 20 cents a pound, and a range for this brand was made in the open market from 20 to 20½ cents. Lake was quoted anywhere from 20½ to 21½ cents a pound. These prices compare with 22 cents a pound for electrolytic brands made some weeks ago by Phelps, Dodge & Company and the United Metals Selling Company, while the Calumet and Hecla quoted its famous lake brand at 23 cents a pound. The decline in the metal was ascribed to selling by the smaller trade producers, who are not anxious to hold their copper. Some sympathetic effect was also created by the decline of the metal in London. Here the Metal Exchange committee reduced quotations one-half a cent a pound. The same conditions in the trade now exist as have prevailed for several weeks. The producers, controlling the great supplies are desirous of holding prices at what they consider an equitable figure. Consumers are buying in small quantities, awaiting more decisive developments in the trade outlook. Neither interest is willing to give way until these trade conditions are definitely formulated.

MILWAUKEE NORTHERN RAILWAY.—The line of the Milwaukee Northern Railway, between Milwaukee and Port Washington, will probably be ready for operation early in September, and all work is being pushed as rapidly as possible to that end. From a point a little over two miles north of Milwaukee to the town of Grafton, a short distance from Port Washington, tracks are laid. All grading between these points has been practically completed. The force of men engaged in this work will shortly be put on the work between Port Washington and Sheboygan, where another gang of workmen has been clearing the right of way. The Allis-Chalmers gas engines are being erected in the main power house at Port Washington. The complete power equipment was built by the Allis-Chalmers Company, Milwaukee. Three-phase alternating current will be generated in the power house at 405 volts by three direct-connected Allis-Chalmers alternators each of 1000 kilowatts normal capacity, driven at 107 r. p. m. by twin tandem gas engines, each with a rated capacity of 1500 horse-power. This equipment, when in operation, will constitute the largest installation in America of gas engine-driven electric generating units used for traction purposes.

NEW YORK WATER POWERS.—According to the Troy, N. Y., *Press,* the announcement that the state administration is opposed to granting power privileges on streams running through state land will not affect power companies now in operation. Neither will it prevent the Hudson River Power Company from proceeding with its project to dam the Sacandaga River and create a power plant of double the capacity of the Spier Falls plant. The decision affects only the concerns that desired to build dams and flood state lands. The plea of such concerns was that the dams would make storage reservoirs and thus equalize the flow of the Hudson, but the Governor is in favor of the state receiving revenue from its power producing streams.

MECHANICAL DRAFT APPARATUS is to be furnished by the B. F. Sturtevant Company, of Boston, Mass., for boilers in the following power plants: Pittsburg, Ft. Wayne & Chicago Ry., Allegheny, Pa.; Acushnet Mills, New Bedford, Mass.; State Hospital for the Insane, Howard, R. I.; Syracuse Malleable Iron Works, Syracuse, N. Y.; Union Light, Heat & Power Company, Fargo, N. D.; the Fisheries Company, Fall River, Mass.; Wood Worsted Mills, Lawrence, Mass.; El Paso Elec. Ry. Company, El Paso, Tex.; Russia Cement Company, Ana Cortes, Wash., and Hazard Mfg. Company, Wilkes-Barre, Pa.

THE TESLA TOWER for wireless power transmission at Wardencliffe, Long Island, has passed back into Mr. Nikola Tesla's possession. It was to have gone under the sheriff's hammer this week. Mr. Tesla owed Dr. James S. Warden, the founder of Wardencliffe, $1,108. Dr. Warden sued, got judgment, and placed the judgment in the hands of Sheriff Wells for collection. Mr. Tesla has paid the money, and the sale is off. It is hoped that some definite experiments and data may now soon be recorded.

ELECTRIC CRANES.—The Atlantic Coast Line Railway Company has installed at its South Rocky Mount plant, a 5-ton, 3-motor electric Northern traveling crane, span about 72 ft. This crane was furnished by the Northern Engineering Works, Detroit, Mich.

ESTIMATES ON COAL HANDLING PLANT.—The Concord municipal light plant, Concord, Mass., desires estimates on the cost of installing a complete coal handling plant. Information may be obtained from A. W. Lee, manager, Concord, Mass.

Financial Intelligence.

[illegible] more active and there was evidence of greater public participation. Southern Pacific was the principal feature, having a substantial advance on the report that its dividend rate is to be increased to 6 per cent. United States Steel was depressed early in the week on the strike of miners in the Minnesota iron regions, but the stock rallied with some vigor when the strike collapsed and it became generally understood that the statement of earnings for the quarter ended June 30 would show the largest net earnings ever exhibited by the company for any quarter in its history. The conflict between the State and Federal courts over the new passenger rate law passed by the Legislature of North Carolina became a factor to which holders of the stocks of railroads operating in that section of the South were forced to give consideration toward the end of the week; and the decline in Southern Railway preferred indicated what a serious matter the enforcement of the law might become. Brooklyn Rapid Transit was active and showed strength, while, on the other hand, the Interborough-Metropolitan stocks were decidedly weak as the result of fears regarding the contemplated investigation by the Public Utilities Commission. Some of the neglected specialties were also strong, among them General Electric, and New York Air Brake had another of its spectacular rises, advancing over 20 points, to 124⅞, on statements that certain interests were endeavoring to secure options at 150 on a majority of the stock. The curb market showed some improvement early in the week, but eased off later. Following are the closing quotations of July 30:

NEW YORK.

	July 23	July 30		July 23	July 30
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	[illegible]	[illegible]
Allis-Chalmers pfd.		[illegible]	Hudson River Tel.		
Am. Dist. Tel.			Interborough Met. com.	[illegible]	[illegible]
American Locomotive	[illegible]	[illegible]	Interborough Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	[illegible]	[illegible]	Mackay Cos.		[illegible]
American Tel. & Cable		[illegible]	Mackay Cos. pfd.		[illegible]
American Tel. & Tel.		[illegible]	Marconi Tel.		
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.		[illegible]
Electric Boat	[illegible]		N. Y. & N. J. Tel.		
Electric Boat pfd.	[illegible]	80	Western Union Tel....	79	77
Electric Vehicle.......	—		Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd.			Westinghouse pfd.		[illegible]

BOSTON.

	July 23	July 30		July 23	July 30
American Tel. & Tel..	108	107¼	Mass. Elec. Ry pfd.		[illegible]
Cumberland Telephone.	—	103¼	Mexican Telephone....	2	2
Edison Elec. Illum.	[illegible]	[illegible]	New England Telp.	[illegible]	[illegible]
General Electric		139	Western Tel. & Tel.		[illegible]
Mass. Elec. Ry.	[illegible]	[illegible]	West. Tel. & Tel. pfd.		[illegible]

PHILADELPHIA.

	July 23	July 30		July 23	July 30
American Railways	48	48	Phila. Electric.......	[illegible]	[illegible]
Elec. Co. of America	[illegible]	[illegible]	Phila. Rapid Transit...	22½	20¾
Elec. Storage Battery		[illegible]	Phila. Traction	[illegible]	[illegible]
Elec. Stor. Battery pfd.					

CHICAGO.

	July 23	July 30		July 23	July 30
Chicago City Ry.	[illegible]	[illegible]	National Carbon..	[illegible]	[illegible]
Chicago Edison	[illegible]	[illegible]	National Carbon pfd.		[illegible]
Chicago Subway			Union Traction		
Chicago Tel. Co.	[illegible]	[illegible]	Union Traction pfd....	—	
Metropolitan Elec. com.	[illegible]	[illegible]			

*Asked.

WESTINGHOUSE ABROAD.—In the annual report of the Westinghouse Electric & Manufacturing Company, Mr. G. Westinghouse says: "Under the management of Newcomb Carlton, the business of the British Westinghouse Company is being established upon a sound and profitable basis. The orders received for its fiscal year to end July 31, will exceed $6,000,000. The operations of the Societe Anonyme Westinghouse (the French Westinghouse Company) under the able management of F. E. Drake, director general, have during the past year assumed very substantial importance, especially by reason of contracts entered into with the Italian government for the installation of electric apparatus for the operation of one of the Italian state railways. This contract has required the organization by the French Westinghouse Company of an Italian company (the Societa Italiana Westinghouse) and the establishment of works at Vado, near Genoa, Italy, which are now so far advanced that manufacturing operations have been inaugurated under the direction of a competent staff of officials. The Societe Electrique Westinghouse De Russie is a French company organized for the purpose of carrying on business in Russia, for which purpose it has been granted a license by the Russian Government. This company is now completing the execution of a contract amounting to nearly $5,000,000, covering the electrification of a part of the tramway system of St. Petersburg and is also carrying on a growing manufacturing business in its works at Moscow. The Westinghouse Metallfaden Gluhlampen-fabrik G. m. c. H. has recently been organized and works have been erected near Vienna, Austria, for the manufacture of tungsten incandescent lamps. The operations of these several companies are on a more satisfactory basis than heretofore with indications that the returns to your company will, in the not distant future, fully justify the expenditures which have been made. The Canadian Westinghouse Company, Limited, is doing a large and constantly increasing business and its prosperity is indicated by the payment of regular quarterly dividends of 1½ per cent and the accumulation of a substantial surplus."

NEW YORK UTILITIES.—The up-State Public Utilities Commission gave a hearing this week to the Newburgh Light, Heat & Power Company, which seeks consent to issue $250,000 additional capital stock, making a total issue of $750,000, and to classify the same as $500,000 common and $250,000 8 per cent, preferred cumulative stocks. The company claims that since 1900 it has expended $300,000 in extensive improvements, which expense has been thus far met by the stockholders. John L. Wilkie, of New York, appeared as attorney and said the company's earnings for 1906 were more than sufficient to pay the dividends on the additional preferred stock. There was no opposition. The village of Sherburne was heard by the commission on the application to establish a municipal electric lighting plant and to furnish lights for other than municipal purposes. The Sherburne Gas Company, which was incorporated in January last and is operating a gasoline plant, also put in an application for authority to transact business and issue $10,000 capital stock. Decisions on the applications were reserved.

PACIFIC LIGHT AND POWER.—It is authoritatively reported in Los Angeles that the Pacific Light & Power Company, the Huntington corporation which supplies power to the electric railways in Southern California, has completed the financing of its large new steam power plant at Redondo, through a deal recently consummated with the banking house of N. W. Halsey & Company. It is said to involve approximately $1,000,000, secured by first mortgage bonds of the Pacific Light & Power Company, guaranteed by the Los Angeles Railway Company. The Redondo plant provided for is an oil-burning steam plant, and one of the largest of its kind in the country. It will furnish the major part of the power required for handling the load of the Los Angeles Railway Company, the Pacific Electric Railway Company, the Interurban Railway Company and the various other Huntington lines which gridiron Southern California. Work on this plant was commenced in the early part of 1906, and is now nearing completion.

BIRMINGHAM, ALA., CHANGES.—It is stated that the Birmingham Railway, Light & Power Company is to have a new management. President Robert Jemison, who has been at the head of the company for twenty years, resigned some time ago, to take effect Sept. 1, and General Manager J. A. Emery, who has conducted the $3,000,000 of improvements made the past few years, is understood to have resigned also. Mr. A. H. Ford, of the firm of Ford, Bacon & Davis, who have had charge of the construction work for the Newman syndicate of southern street railway systems, takes Mr. Jemison's place. Mr. Jemison was first mentioned for chairman of the board of directors, but it is now stated that he will retire altogether.

DIVIDENDS.—Directors of the New England Telephone Company have declared the regular quarterly dividend of 1½ per cent, payable Aug. 15. The Western Telephone & Telegraph Company has declared the regular semi-annual dividend of 2½ per cent on its preferred stock, payable Aug. 1. Directors of the Chattanooga Railways Company have declared the regular 1¼ per cent dividend on the preferred stock, payable Sept. 1. Directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Aug. 15. The Chicago Edison Company has declared a quarterly dividend of 2 per cent, payable Aug. 1.

THE WHITNEY ESTATE.—The details of the estate of the late W. C. Whitney have been made public the past week in the accounts of H. P. Whitney as executor. The value is shown to be $25,000,000. The list includes $1,283,250 worth of Electric Storage Battery Company stock, $4,051,284 worth of Guggenheim Exploration Company stock, $91,227 worth of National Lead common and $75,397 of National Lead preferred, $38,250 of Electric Vehicle preferred, $70,000 worth of Nassau Light and Power Company stock, 9,900 shares of New York Transportation Company stock, valued at $58,781.

THE LOCKPORT TANGLE.—As is well known serious and determined efforts have been made to reconcile the various lighting interests at Lockport, N. Y., where competition has been carried to disastrous lengths. There is still opposition, however. At Lockport on July 25, Public Utilities Commissioner Keep held a hearing in the city building on the application of the Lockport Gas and Electric Light Company and the Economy Light, Fuel and Power Company to merge into the Lockport Light, Heat and Power Company, recently organized as a subsidiary of the United Gas and Electric Company of New York. The city of Lockport and the Attorney-General's office opposed the merger. Attorney Abner Hopkins for the citizens' committee held that it would destroy competition, create a monopoly, place the people at the mercy of one company, and if the application of the company was granted would permit such an overcapitalization, judging from the present values of the two plants, that higher rates or poorer service would result in order to pay dividends to the stock and bond holders. The marked feature of the session was the refusal of the officials of the two companies, on request of the citizens' attorney, to produce books of rates to various consumers to support the citizens' argument that on streets where both companies operate steam heating, power and lighting are lower in price than on others. Further surprise was occasioned by the fact that Commissioner Keep sustained the companies, holding that the commission could examine the books privately and thereby not reveal the trade secrets of one company to another, as would be the situation if the books were produced in open hearing. Commissioner Keep closed the session by giving both sides two weeks in which to file briefs before the commission. Norman D. Fish appeared for the Attorney-General's office, which will oppose the merger on the ground that it violates the anti-trust laws.

MILWAUKEE CAPITALIZATION.—In anticipation of the enactment into law of the Hagemeister bill requiring public service corporations to get permission from the state railroad commission before issuing any stock or bonds and prohibiting them from selling stock for less than its par value or bonds for less than 75 per cent of their par value, three of the large Milwaukee public service corporations in Milwaukee have filed in the office of the secretary of state amendments to their articles of incorporation increasing their capital stock. Several millions are added to the authorized capital of each of the three companies as follows: The Milwaukee Light, Heat and Traction Company increase in capital stock $1,000,000 to $30,000,000; net increase, $29,000,000. The Milwaukee Electric Railway and Light Company from $19,500,000 to $24,500,000; net increase in stock, $5,000,000; increase in shares, 195,000 to 245,000; common stock, 200,000 shares; preferred stock, 45,000 shares, bearing 6 per cent dividend. The Milwaukee Gas Light Company increase in capital stock $1,500,000 to $5,000,000; net increase in stock, $4,000,000; increase in shares, 30,000 to 110,000 at $50 a share.

CUMBERLAND TELEPHONE.—President Caldwell, of the Cumberland Telephone & Telegraph Company, has called a special meeting of the stockholders to be held at Hopkinsville, Ky., Aug. 6, to consider an increase in the authorized capital stock from $20,000,000 to $20,200,000, and a change in the legal domicile from Hopkinsville to Louisville, Ky. There is no intention of issuing any additional stock beyond that subscribed on Feb. 1, 1907, but by reason of the fact that that issue was subscribed for in full, it exceeds the present authorized capital by about $200,000, which will be due and payable on Oct. 1, 1907. Therefore, it became necessary to increase the authorized capital by that amount, so that the company will be in position to issue the additional stock when the subscriptions therefor mature.

UNITED RAILWAYS INVESTMENT.—At a meeting of the stockholders of the United Railways Investment Company the proposal of the directors to issue $3,000,000 three-year 6 per cent collateral trust notes was approved by the stockholders without opposition. Of these notes, $1,300,000 have been sold. The remaining $1,700,000, it is understood, will not be sold for the present. The proceeds of these $1,300,000 notes will be used for the acquisition of outstanding securities of the United Railroads of San Francisco and for other corporate purposes, including making provision for additional cars for use in the city.

IOWA TROLLEY CAPITAL.—The capital stock of the Fort Dodge, Des Moines & Southern Railway has been increased from $2,500,000 to $6,700,000. The road's authorized capital now consists of $1,200,000 preferred stock and $5,500,000 common stock. In addition there have been authorized $3,500,000 of first mortgage bonds and $6,500,000 of refunding mortgage bonds. Of the latter, $3,500,000 are reserved to retire the first mortgage. The Fort Dodge Road has acquired control of the Newtown & Northwestern. It is expected that the company's high-speed electric line between Fort Dodge and Des Moines will be ready for operation about Sept. 1.

U. S. TELEPHONE REORGANIZATION.—A special dispatch of July 24 from Rochester, N. Y., states that the reorganization plan of the United States Independent Telephone Company was approved by the committee of bondholders of the United States Company on the previous day. The plan contemplates the appointment of a reorganization committee and the foreclosure of the mortgages of the United States Company and the Independent Telephone Securities Company. It is recommended that a new company be organized, with a capital of $6,000,000, and to which shall immediately be transferred all securities bought in by the reorganization committee.

OHIO HOLDING COMPANIES.—The announcement of Attorney-General Wade Ellis that a foreign corporation can not legally hold all the stock of an Ohio corporation and control it by voting the stock, has caused some speculation among those who are interested in holding companies of this kind. In the case of the Columbia Gas & Electric Company, an Ohio company has been formed to take over the stock of the companies that have passed to it under lease and it is possible that the law may be complied with in this respect and yet allow the owners to control the corporations owning property which they have purchased.

OKLAHOMA TELEPHONE.—The balance sheet of May 31 of the Pioneer Telephone & Telegraph Company, of Oklahoma City, shows a capital stock of $2,473,200. The exchanges and toll lines are valued at $3,461,397. The results for the first five months of this year showed a large improvement over the corresponding period last year, and as the heaviest volume of business is done during the last half of the year the management expects a still better showing in 1907 than in 1906.

SAFETY CAR HEATING AND LIGHTING.—The increase in the capital stock of the Safety Car Heating & Lighting Company, from $5,000,000 to $10,000,000 is to more nearly equalize the valuation of the plants and the capital stock, the value being much in excess of the capitalization of $5,000,000. The directors, therefore have decided to increase the capital stock to be in a position to effect a more equitable distribution of the benefits to the stockholders.

WESTERN ELECTRIC EARNINGS.—The gross business of the Western Electric Company for the first six months of 1907 was as large as for the same period of the preceding year. In the fiscal year ended Dec. 31, 1906, the company did a gross business of $69,245,963, or approximately $5,800,000 a month. The gross earnings were heavier in the last half than in the first, the average being about $5,000,000 up to June 30 and $6,500,000 for the remaining six months of the year.

GENERAL ELECTRIC BONDS.—The General Electric Company announces that the entire issue of $13,000,000 5 per cent ten year convertible bonds the first payment on which fell due last Saturday, has been subscribed for. The second payment of 50 per cent falls due January 20, 1908. The new bond issue will give the General Electric Company between $7,000,000 and $8,000,000 available cash for construction and other purposes immediately.

NO AIR BRAKE DEAL.—It is officially stated that the Westinghouse Electric & Manufacturing Company has made no offer for the stock of the New York Air Brake Company. There are no negotiations under way for control of the New York company by the Westinghouse Company. A controlling interest in the New York Air Brake Company was offered to Westinghouse interests in January of this year, but the offer was declined.

WEST PENN RAILWAYS.—It is stated that an arrangement has been made by which the West Penn Railways Company has purchased a controlling interest in the Pittsburg, McKeesport & Greensburg Traction Company, terminating a bitter fight between the two companies along the main line of the Pennsylvania Railroad between Pittsburg and Greensburg and other points in Westmoreland county.

GENERAL NEWS

Construction News.

[illegible] has decided to increase the capacity [illegible] plant and has purchased a [illegible]-kw generator from the Westinghouse Electric & Manufacturing Company. The new machine will be installed as soon as possible, and the entire lighting system of the city will be changed. A new engine will also be installed in the plant.

CITRONELLE, ALA.—The Council has granted [illegible] to the Citronelle Light & Power Company to erect and operate an electric lighting plant in this place.

BOTHAN, ALA.—William Crawford has applied to the City Council for a franchise to operate a street car line on Main Street. Mr. Crawford proposes to build a park about three miles out of the city and is [illegible] park.

HEBER, ARK.—W. H. Horton has secured a franchise for an electric [illegible] Heber.

BERKELEY, CAL.—The Home Telephone Company has purchased a lot on the corner of Allston Way and Milvia Street for its Berkeley office. The company will shortly commence the erection of a two-story building and basement at a cost of $60,000.

EUREKA, CAL.—The North Mountain Power Company will soon install a 1000-kw frequency charger at the auxiliary station in Eureka. When the new machine is installed the company will transmit 2400 kilowatts over the transmission line from Trinity, about double the quantity that is now being received. H. L. Jackman is manager.

FRESNO, CAL.—The Chinese Electric Light Company has petitioned the Board of City Trustees for a franchise to operate an electric light plant in the city.

LOS ANGELES, CAL.—The Hueneme, Malibu & Port Angeles Railway is planning to build between five and six miles of track within the next [illegible] months. Work [illegible] portion of the road. [illegible] Darlington is manager.

NAPA, CAL.—The Board of Supervisors of Napa County has granted a franchise to D. L. Beard to maintain and erect poles and wires over the county for the transmission of electricity for lighting and power purposes.

OROVILLE, CAL.—Owing to the increased demand for electricity for power purposes the Oroville Light & Power Company has recently installed an additional 255-hp generator in its plant, making the present capacity of the plant 500 horse-power.

PALO ALTO, CAL.—The City Trustees have granted the California Gas & Electric Company permission to erect poles and wires on Hawthorne Street from its main line on Middlefield road to the power house [illegible] railway on High Street.

REDDING, CAL.—The stockholders of the Pacific Power Company have voted to appropriate $30,000 for the completion of work and line into Red Bluff.

SAN FRANCISCO, CAL.—Bids will be received until Aug. 29 by James Knox Taylor, supervising architect, Washington, D. C., for furnishing motors, rheostats, chain drives, air compressors, circuit breakers, conduit wire, etc., at the United States post office and custom house, San Francisco, Cal.

SAN FRANCISCO, CAL.—Several important improvements are being planned by the Pacific Gas & Electric Company, which will benefit the service materially. Preparations are being made to install at Station A, in the Potrero, an additional 5000-kw, 11,000-volt turbo-generator set. A 1500-kw generating set is to be removed from the same station to [illegible] kw, direct-current generating sets from the old Jessie Street station is being installed in the Mutual Electric Light Company's plant at Spear and Folsom streets, which is now under the control of the San Francisco Gas & Electric Company. A small storage battery is to be installed in Station A in place of the large one that was destroyed by fire.

SAN JOSE, CAL.—J. A. Belloli has applied to the Board of County Supervisors for a franchise to erect poles and wires along the county roads for the transmission of electricity. Mr. Belloli proposes to purchase electricity from the United Gas & Electric Company and to distribute in the territory from Milipitas to Alviso.

SAN JUAN, CAL.—The Board of Town Trustees is considering an [illegible] the purpose of furnishing the town with electricity.

SANTA ROSA, CAL.—[illegible] Company is planning to extend its railway from Sebastopol to Lake Jonive, about a mile north of that town.

WILLOWS, CAL.—[illegible] to erect transmission lines for the distribution of electricity throughout the county. The price paid for the franchise was $250.

BRIDGEPORT, CONN.—[illegible] with the hotel building at Main and Chapel Streets, owned by Samuel H. Wheeler. The plant [illegible] buildings in the vicinity owned by Mr. Wheeler, and also to run the elevators.

HARTFORD, CONN.—The House has passed over the veto of Governor Woodruff the resolution incorporating the Danbury & Northern Electric Railway Company.

HARTFORD, CONN.—The State Legislature has passed the bill permitting independent telephone companies to incorporate under the general law permitting them to do business after securing a finding of public necessity and convenience from a judge of the Superior Court.

NORWICH, CONN.—The Uncas Power Company has given a deed of all its property to the Federal Trust Company, of Boston, Mass., to secure an issue of $150,000 in bonds, the proceeds to be used for the purpose of completing and improving the construction of its power plant.

STRATFORD, CONN.—At a special town meeting held recently the citizens voted to appoint a committee to lay out a plan for a lighting district, to be reported to the Selectmen, who will then call a special meeting to decide whether the district shall be laid or not.

THOMPSONVILLE, CONN.—The electric lighting station here is being dismantled and electricity for operating the system will soon be furnished from the new plant at Windsor Locks.

WILMINGTON, DEL.—The Wilmington City Electric Company is building a transmission line from this city to Newport for the purpose of furnishing electricity for lighting and power in the town of Newport, and also to parties along the line between the two places. The company has contracted with a number of manufacturing concerns in Newport to furnish electricity for power purposes, and also proposes to light Richardson Park, which is located between the two cities.

WASHINGTON, D. C.—Bids [illegible] Supplies and Accounts, Navy Department, Washington, D. C., until Aug. 6, to furnish at the navy yards and naval stations naval supplies as follows: Boston, Mass., schedule 121—electric operating equipment. Charleston, S. C., schedule 121—motor drives. Portsmouth, N. H., schedule 118—cells, iron wire, electro-mechanical gongs; schedule 150—motor. New York, N. Y., schedule 117—searchlight projectors, generating sets, incandescent lamps, portable testing sets, testing generators, keyboards, Gonda cells, dynamotors, interior fittings and fixtures, branch boxes, etc., switch handles, steel and brass enameled conduit and fittings, conductors, etc. League Island, Pa., schedule 151—incandescent lamps, arc-lamp globes and parts, switches, rubber-covered wire, electrical supplies, etc. Washington, D. C., schedule 148—air drills, sheet copper, and lead; schedule 151—incandescent globes, and repair parts for arc lamps, switches, flexible steel conduit, electrical supplies. Charleston, S. C., schedule 149—motors. Applications for proposals should designate the schedule desired by number. E. B. Rogers, Paymaster General, U. S. N.

LAKE CITY, FLA.—John D. Carley is preparing to develop the water power of Suwanee River near Lake City.

FITZGERALD, GA.—Application has been made to the City Council by S. T. Holtzendorf, W. T. Whitney and B. K. Waldridge of New York, N. Y., and T. M. Parsons and C. A. Holtzendorf of this city for a 40-year franchise to operate an electric railway within Fitzgerald and to suburban points.

GRIFFIN, GA.—Application has been filed for the incorporation of the Middle Georgia Interurban Railway by Charles F. Howe, Milledgeville; William F. Smith, Robert F. Smith, Samuel P. Smith, Flovilla; Stephen J. Smith, of Jackson, and others. The company is capitalized at $200,000, [illegible] will be about 70 miles long.

SAVANNAH, GA.—At a meeting of the City Council held July 17, it was decided to secure the services of an electrical engineer to prepare specifications for the new contract for city lighting, which will go [illegible]

KANSAS, ILL.—[illegible] ing a new boiler and engine in the municipal electric lighting plant. Frank [illegible]

MARSEILLES, ILL.—[illegible] transmission line along the tow path of the Illionis and Michigan canal from Marseilles to Joliet. Mr. Boyce is planning to build a large power plant in this town and supply Ottawa, Morris and intervening towns with electricity.

TAYLORVILLE, ILL.—[illegible] fall.

WESTERN SPRINGS, ILL.—The question of installing two new boilers in the municipal electric lighting plant is under consideration. Albert Erickson is manager.

SOUTH BEND, IND.—The South Bend Home Telephone Company has increased its capital stock from $200,000 to $400,000.

RED FORK, I. T.—Steps are being taken toward making a cut off of the Arkansas River north of this place, for the purpose of developing water power for factory uses. The project embraces a canal three miles long, which will take water from the Arkansas River, two miles west of Red Fork. The estimated cost of the work, including dam, is placed at $700,000. J. A. Mackin and Dr. C. H. Bland are interested in the enterprise.

SOUTH McALESTER, I. T.—The power house of the Choctaw Railway & Electric Company was wrecked recently by the bursting of a flywheel. The damage to the plant is estimated at $15,000.

DES MOINES, IA.—The capital stock of the Mutual Telephone Company has been increased from $450,000 to $1,600,000. The issue is for the purpose of taking over and consolidating five outlying companies.

GALENA, KAN.—Plans are being made to change the present system of the Galena Light & Power Company to 60-cycle, alternating current. When improvements are completed a 24-hour service will be established. J. A. Gadwood is superintendent.

PADUCAH, KY.—The Paducah Traction & Light Company is contemplating building an extension into Mechanicsburg.

VERSAILLES, KY.—The Versailles Electric Light Company is contemplating extending its lines to Midway, several miles distant. Harry Reid is president and manager.

CARROLLTON, LA.—The entire building and plant of the Carrollton Electric Light & Power Company has been destroyed by fire.

EASTON, MD.—The Easton Fuel & Light Company is installing arc lamps. Addison W. Porter is superintendent.

HAGERSTOWN, MD.—At an election held recently the citizens voted to establish a municipal electric lighting plant.

ATTLEBORO, MASS.—The Attleboro Steam & Electric Company has applied to the Board of Electric Light & Gas Commission for permission to increase its capital stock by $75,000.

BOSTON, MASS.—The Stone & Webster Engineering Corporation reports that work is progressing rapidly on the Boston Elevated Railway Company's power stations at Charlestown, Lincoln Wharf and Cambridge. The Charlestown power station is an extension of the present station with room for two 2700-kw vertical engine driven units, and eight 600-hp boilers. Only half of the equipment is being put in at present. It is planned to have this station in operation about Nov. 1. The extension to the Lincoln Station will have a capacity of 5400 kilowatts, consisting of two units of 2700 kw each. The engines are of the vertical Corliss type, made by the William Tod Company, of Youngstown, Ohio. Eight 600-hp Babcock & Wilcox boilers will be installed in the new extension of the station. It is expected to have the addition to the Harvard Square station ready for installing the machinery about Aug. 15. In addition to this work the Stone & Webster Corporation is building a wharf and 5000-ton elevated coal pocket with tracks, conveyors, etc., for the Boston Elevated Railway Company.

BROCKTON, MASS.—The Edison Electric Illuminating Company has applied for a permit to enlarge its power plant buildings on School Street, to cost $10,000. Westinghouse, Church, Kerr & Company are the contractors.

EAST HAMPTON, MASS.—At the annual meeting of the Easthampton Gas Company the directors voted to petition the State Commission of Gas and Electricity for permission to increase its capital stock from $30[illegible] to $[illegible]. The increase is needed for the development of the electrical end of the business. A new engine will soon be installed in the plant. The officers were elected as follows: H. L. Clark, president; John N. Lyman, secretary; G. L. Manchester, treasurer.

MILFORD, MASS.—Bids will be received until Aug. [illegible] at the Town Hall Milford for furnishing and erecting a small electric pumping plant, consisting of motors and directly connected centrifugal pumps. Specifications may be obtained from Joseph [illegible] Hickey, Milford, Mass., and plans may be seen at Milford, or at the office of [illegible] A. [illegible], engineer, Boston, Mass. James [illegible] Walker [illegible] chairman of committee.

PITTSFIELD, MASS.—Ley & Company, of Springfield, have secured the contract to build a subway from the [illegible] power [illegible] on the east shore of Silver Lake to the Morningside and lower East Street shops. The subway, which is to be of concrete, will be [illegible] feet high and 6½ feet wide and [illegible] mile in length, and will be used as a conduit for steam pipes and electric power and lighting wires. All wires now above ground will be placed in the conduit as soon as it is ready. The cost of the subway work is estimated at about $[illegible].

READING, MASS.—The committee in charge of the rebuilding of the municipal electric lighting plant has awarded contracts for machinery for the plant as follows: To the Hodge Boiler Works, for boiler, $[illegible]; to the Ridgway Dynamo & Engine Company, engine, for $[illegible]; to Western Electric Company, for two new generators, one to be direct connected to the new engine and the other to be belted to the old engine, $[illegible]. Work on the power station and rebuilding the lines will be taken up at once.

SPRINGFIELD, MASS.—The United Electric Company is planning to build a condenser as an adjunct to its power plant.

SALEM, MASS.—The Salem Electric Lighting Company has awarded a contract for the construction of an addition to its power house on Peabody Street. The company will install two boilers of 350 horse-power each.

UXBRIDGE, MASS.—The State Railroad Commission has approved of an issue of $40,000 in bonds by the Uxbridge & Blackstone Railway Company.

JACKSON, MICH.—The Michigan Power Company is contemplating erecting a transmission line to Charlotte for the purpose of furnishing electricity for street lighting.

PONTIAC, MICH.—Plans are being prepared by E. C. Betchel, consulting engineer, for remodeling the plant of the Pontiac Lighting Company. The new equipment will include engines, boilers and generators. T. J. Weber is superintendent.

BOVEY, MINN.—Frank McCormick, of Duluth, has been granted a franchise to operate an electric lighting plant in this place.

CARROLLTON, MISS.—The building and plant of the Carrollton Electric Light & Power Company was recently destroyed by fire. The loss is estimated at $10,000, and the insurance was $6,000. The plant was owned and operated by the city.

BILLINGS, MONT.—Yegen Brothers have applied to the City Council asking that a special election be held for the purpose of submitting to the voters the proposition of granting the applicants a franchise for the construction of a street railway. Yegen Brothers have recently completed an electric plant on the banks of the Yellowstone River.

HARLOWTON, MONT.—John L. Bright, of Lewiston is interested in the construction of an electric light plant in this place.

FALLS CITY, NEB.—John R. Crook, city engineer, writes that the citizens on July 16 voted to issue $10,000 for electric lighting and $25,000 in bonds for water works.

FREMONT, NEB.—The City Council is said to be considering the question of reconstructing or building an entirely new municipal water and light station.

STANTON, NEB.—The City Council has advertised for bids for installing a gas producer engine to run the electric light plant and water system.

STANTON, NEB.—The citizens on July 16 voted in favor of issuing bonds for a municipal electric light plant. The local electric light plant, owned by F. L. Sanders & Company, will be taken over by the city, according to an agreement made recently, on condition that the citizens voted to issue bonds.

ASBURY PARK, N. J.—The City Council has granted a franchise to Messrs. Clarkson and Moore to construct and operate an electric lighting plant in this city.

BROOKLYN, N. Y.—Bids will be received until Aug. 5, by C. B. J. Snyder, superintendent school buildings, New York City, for installing electric equipment in addition to and alterations in School 129, borough of Brooklyn.

CARTHAGE, N. Y.—The Carthage Electric Light & Power Company is making extensive improvements and extensions to its plant. Details of this work appeared in our issue of July 27, by mistake, under Carthage, Mo.

GLENS FALLS, N. Y.—The Kinser Construction Company, of Chicago, Ill., which has the contract for the barge canal work between Dunham's Basin and Fort Edward, will soon commence work on the erection of an electric light plant a few miles south of Dunham's Basin. The company's contract calls for the completion of its section in three years, which will require the work to be carried on night and day. The electric plant will furnish electricity to light the grounds so the men can work 24 hours a day.

NEW YORK, N. Y.—Contracts for installing electric equipment in schools in Manhattan Borough have been awarded by C. B. J. Snyder, superintendent school buildings, as follows: School 14, to Spiro Company, for $4,875, and School 29, to Reis & O'Donovan, Inc., for $4,740.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, New York City, until Aug. 15, for all materials and labor required for the complete conduiting, electric wiring, and all other work in connection with the installation of a complete electric lighting and power system for all the buildings and grounds under the jurisdiction of the Department of Public Charities and comprising the City Hospital District, Blackwell's Island, borough of Manhattan. Robert W. Hebberd is commissioner.

PATCHOGUE, N. Y.—The Suffolk Syndicate Company has filed a mortgage for $200,000 to the Long Island Trust Company, of Brooklyn, to secure a bond issue. It is said that the company is contemplating building an electric railway from Patchogue along the south shore of Long Island.

ROCHESTER, N. Y.—The Rochester Railway & Light Company is building a substation at Elmwood Avenue and the Lehigh Valley Railroad. It is expected to have the building completed in September and the machinery installed in October.

[illegible]

[illegible]

[illegible]

[illegible] ton, for constructing a concrete rock reinforced dam with power house, across the Catawba River, at Hickory, and installing 3000-hp turbine water wheels, electrical apparatus and transmission lines for lighting and power purposes.

WINSTON-SALEM, N. C.—Work will soon commence on the East Winston extension of the Fries Manufacturing & Power Company traction system. It is expected to have the line completed by next fall.

[illegible] contemplating rebuilding its toll in this section of the state.

GRAFTON, N. D.—McKay Brothers have secured the contract for installing a 150-hp boiler in the municipal electric light plant.

JAMESTOWN, N. D.—The Western Electric Company is making extensive improvements and extensions to its plant, which includes the installation of a 150-kw generator and an engine of 320 horse-power.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has notified the Board of Public Service that 400 new lamps will be in- [illegible]

BUCYRUS, OHIO.—The City Council has appropriated $250 for preliminary plans for a municipal electric lighting plant.

CINCINNATI, OHIO.—The Interurban Railway & Terminal Company has been granted permission to increase its capital stock [illegible] to $3,600,000.

CLEVELAND, OHIO.—The stockholders of the Cuyahoga Telephone Company have voted to increase the capital stock from $3,000,000 to $3,500,000.

COLUMBUS, OHIO.—The Jeffrey Manufacturing Company, of this city, has secured a contract for a number of electric locomotives to be used in the work of making extensions to the subways and tunnels of the Illinois Tunnel Company.

FOREST GROVE, OHIO.—The Hames Electric Power Company is considering the question of developing a water power, with 500 ft. head, and installing more machinery.

FREMONT, OHIO.—The Fremont Power & Light Company has announced that plans have been completed for utilizing the Sandusky River at this place for power purposes, and erecting a power plant to cost $100,000. The plant will have a capacity of 2000 horse-power.

HAMILTON, OHIO.—Bids will be received by the Board of Public Service until Aug. 13 for driving driven wells; pumping pit and house for centrifugal pumps, two 4,000,000 gallon duty centrifugal or turbine pumps to work against 70-ft. head, and water connections; two 100-hp alternating-current electric motors and starting devices, and 1000 feet electric pole line, etc. John W. Hill, Cincinnati, is engineer.

NEW LEXINGTON, OHIO.—The capital stock of the Perry County Telephone Company has been increased from $50,000 to $75,000.

COQUILLE, ORE.—The Coquille River Electric Company will install a 150-kw, 3-phase, 2300-volt General Electric alternator in its plant about Oct. 1.

COTTAGE GROVE, ORE.—It is reported that the electric plant owned by the Willamette Valley Company was recently destroyed by fire.

EUGENE, ORE.—Russell Welch, manager of the Willamette Valley Power Company, has appropriated 80,000 inches of water under 6-inch pressure on the north bank of the McKenzie River. A flume 40 feet wide and 20 feet deep is to be built and known as the Eugene and Eastern Canal, and the power is to be used for general developing purposes, including the operation of the proposed railway from Eugene up the McKenzie River.

CANONSBURG, PA.—A mortgage has been given by the Pittsburg, Canonsburg & Washington Railway Company to the Safe Deposit Trust Company, of Pittsburg, to secure construction bonds to the amount of $750,000. This mortgage, together with an agreement of lease between the Pittsburg, Canonsburg & Washington Railway Company and the Washington & Canonsburg Railway Company has been filed in the Recorder's office in Pittsburg. Work will soon be started on the proposed railway between Washington, Pa., and Pittsburg via Canonsburg, and the Pittsburg and Charleroi line.

NEW WILMINGTON, PA.—The New Wilmington Telephone Company is making arrangements to install a new terminal and protective equipment, and is in the market for material for the above work.

PHILADELPHIA, PA.—[illegible] Arch Street for the Philadelphia Electric Company, to cost about $85,000.

[illegible]

PITTSBURG, PA.—[illegible] the Tri-State Telephone Company, which operates through Fayette, Washington and other counties in eastern Pennsylvania.

[illegible]

AIKEN, S. C.—The Carolina Light & Power Company has purchased the Anderson Shoals water power on Little Creek and will develop the same, with a view of erecting a plant there. Harry Sudlow is manager.

ANDERSON, S. C.—Arrangements are being made by the Anderson Street Railway Company to complete the line from Belton to Greenville. Work will commence about Sept. 1.

ABERDEEN, S. D.—C. T. Freehauf, of Cresco, Iowa, is seeking a franchise for an electric light plant in this place.

DEADWOOD, S. D.—The Red Water Traction Company has completed a large hydro-electric plant near Spearfish, which is to furnish electricity for operating the mines of the Black Hills, and for an electric railway system between Spearfish and the Northern Hill towns.

GARY, S. D.—T. M. Antony, town clerk, writes that it is proposed to construct an electric light plant at a cost of about $5,000

LA FOLLETTE, TENN.—The La Follette Coal, Iron & Railway Company has contracted with the Morgan-Gardner Electric Company, of Chicago, Ill., for a full electric equipment for its Gem mines at Peabody. The entire plant is to be installed by October 15, 1907.

BRYAN, TEX.—The Bryan Water, Light & Power Company has awarded the contract for the construction of its new power house to Wheelock & Allen, of this city. The new building will be large enough to accommodate duplicate machinery. T. J. Preston is vice-president and manager.

DALLAS, TEX.—The Martin Telephone Company has filed amendments to its charter increasing its capital stock from $20,000 to $40,000.

DENTON, TEX.—Plans have been practically completed for an interurban line from Fort Worth to Denton, and from Denton to Gainesville via Slidell. It is reported that Stone & Webster are interested in the project.

ROCKDALE, TEX.—A syndicate of electrical interests, represented by Joseph J. Henry, of Denver, Col., is arranging to invest not less than $3,000,000 in the installation of a power plant here and the building of transmission lines to cities and towns in adjacent territory. It is proposed to use the lignite for fuel, and, as a preliminary move options have been obtained upon a number of the principal mines in this territory by Mr. Henry and associates. Power and lighting contracts are now being made with towns and industrial concerns in the territory to be reached by the proposed system.

TEMPLE, TEX.—The Rogers Water & Light Company, recently incorporated, will commence the construction of its plant at once. Part of the machinery is on the ground, and a modern water works system will be installed in Rogers. The company has purchased the old lighting plant in that place, which will be enlarged and improved. The officers of the company are: John J. Coe, president; R. L. Brown, vice-president; Thomas G. Binkley, secretary, and I. W. Arnold, treasurer. The principal office will be in Temple.

WACO, TEX.—Joseph J. Henry, of Denver, Col., is contemplating erecting a power plant in the lignite fields of Central Texas for the purpose of furnishing electricity to all towns from Waco to Houston.

BELLOWS FALLS, VT.—[illegible] to be built by the Bellows Falls Canal Company across the Connecticut River at Sumner's Falls, 31 miles north of Bellows Falls. The dam when completed will develop 7,000 horse-power. The company is now building a new line to Charlestown, and electricity for lighting will be supplied from the Bellows Falls plant. The line will be built to transmit 5,000 or more horse-power, and will be part of the main line when the dam is completed. When connections are made the company's steam plant will be increased to correspond with the increased water power.

BETHEL, VT.—[illegible] power at Gaysville and proposes to construct a power plant for generating electricity. Mr. Cushing has purchased the property of the Bethel Electric Light & Power Company and the J. E. Safford Lumber Company. Included in the purchase is the electric lighting system in the village of Gaysville, owned by J. E. Safford. An auxiliary steam plant will also be installed by Mr. Cushing to be used in time of low water and in case of break down. Mr. Cushing is now negotiating with the Woodbury Granite Company to furnish electricity for operating the machinery at its quarries.

BRANDON, VT.—The Neshobe Electric Company is building an addition to its power station.

ESSEX JUNCTION, VT.—The absorption of the People's Electric Light & Power Company of this village by the Burlington Light & Power Company, which included the purchase of the property along the Winooski River at this point, for the purpose of building a large dam for water

power, has resulted in the abandonment of the plant of the People's Electric Light & Power Company. The transmission line has been completed from the plant of the Burlington Light & Power Company at "the gorge" and electricity for operating the local system will be furnished from the above plant. Meters have been installed, flat rates being abolished.

MORETOWN, VT.—Messrs. Moody & Almon are planning to extend their lines to this place from the power plant located near Middlesex Village, and will furnish electricity for lighting and power purposes. Later the lines will be extended to Waitsfield.

RUTLAND, VT.—The Rutland Railway, Light & Power Company is installing a 750-kw frequency changer in its sub-station at Cleveland Avenue. When this machine is put in operation the entire system will be operated by water power, and the Post Street plant will be held for auxiliary use.

LEAVENWORTH, WASH.—Work has commenced on the construction of the power plant of the Great Northern Railroad Company, which is to furnish electricity for operating the trains through the tunnel. J. A. Coughren & Son, of Sauk Center, Minn., have secured the contract for excavating for the pipe line. Robert Herzog, assistant engineer for the Great Northern Railway Company, will be located here to supervise the work.

WENATCHEE, WASH.—Work has commenced on the construction of the new electric plant of the Wenatchee Electric Company. As it is not possible to get more power from the stream which operates the present plant of the company the new plant will be operated by steam. It is the intention of the company to put in a large water power plant later, but owing to the immediate need of increase of power the company has decided to install a steam plant.

WHEELING, W. VA.—The Wheeling Traction Company is planning to commence work on the St. Clairsville extension within a short time.

NEENAH, WIS.—Announcement has been made that the Wisconsin Light, Heat & Power Company has purchased the electric railway from Neenah to Oshkosh, which gives the company a through line from Kaukauna to Neenah. The price paid for the road was $250,000. N. A. Freeman is manager.

VANCOUVER, B. C.—The British Columbia Electric Railway is contemplating the extension of its system at Fort Langley. R. H. Sperling is manager.

CAMPBELLFORD, ONT.—Bids will be received until Aug. 15 by Mayor W. J. Doxsee for concrete work, turbine wheels, generators and about 2¼ miles of transmission line for power development at Middle Falls on the Trent River. John S. Fielding, Toronto, Ont., is consulting engineer.

OTTAWA, ONT.—It is reported that the city is considering the question of taking over the Ottawa Electric Company's plant and system and operating them in connection with the municipal electric lighting plant.

Company Elections.

GARDNER, MASS.—At the annual meeting of the Gardner Electric Light Company held recently the following officers were elected for the ensuing year: Arthur P. Derby, president; Thatcher B. Dunn, vice-president, and Francis S. Whittemore, secretary and treasurer.

KANSAS CITY, MO.—At the annual meeting of the Kansas City Railway & Light Company held July 22, all the officers were re-elected for the ensuing year. The officers are Bernard Carrigan, president; C. M. Black, vice-president; W. E. Kirkpatrick, secretary and treasurer, and J. A. Harder, assistant secretary and assistant treasurer.

NEWARK, OHIO.—At the annual meeting of the stockholders of the Licking County Light & Power Company held recently all the directors were re-elected, and they in turn re-elected the officers who served last year. [illegible]

New Industrial Companies.

THE DOERR MITCHELL ELECTRIC COMPANY [illegible] near future.

THE MASTERSON ELECTRIC COMPANY [illegible] Frank L. Masterson, [illegible]

THE DAVID H. WILSON ELECTRIC COMPANY [illegible] has been incorporated with a capital stock of $10,000 for the purpose of [illegible]

New Incorporations.

OAKLAND, CAL.—[illegible]

BOULDER, COL.—The Perfect Light Company has been incorporated with a capital stock of $50,000 by C. W. Sanborn, W. L. Seely and others.

GRAND JUNCTION, COL.—The Colorado Mining, Land & Power Company has been incorporated with a capital stock of $100,000 for the purpose of developing a general electrical business throughout the state.

WATERBURY, CONN.—The Waterbury & Milldale Tramway Company has been organized and the following officers elected: Charles H. Clark, president; John H. Cassidy, secretary, and Edwin S. Todd, treasurer.

WILMINGTON, DEL.—The Newton Telephone Company has filed articles of incorporation with a capital stock of $50,000 and has been authorized to operate in Newton, Ill., with a capital stock of $10,000.

ALPHA, ILL.—The Tri-City Light & Power Company has been incorporated with a capital stock of $20,000 by R. L. Malone and others.

AURORA, ILL.—The Aurora Electric Company has been incorporated with a capital stock of $15,000. The directors are C. F. Mayer and others.

MT. PULASKI, ILL.—The Mt. Pulaski Independent Telephone Company has been incorporated with a capital stock of $8,500.

GARY, IND.—The Gary & Eastern Traction Company has filed articles of incorporation with the Secretary of State. The capital stock is $25,000. The declared object of the company is to construct, equip and operate an electric street and interurban railway system between and connecting the towns of Gary, New Chicago, Hobart, Wheeler and Valparaiso. A. R. Fipo, John Frier and Gustan Lukas are the directors.

CHICKASHA, I. T.—The Chickasha Electrical Supply Company, of El Reno and Chickasha, I. T., has been incorporated with $20,000 capital stock. The incorporators are: E. P. Holmes, of Lincoln, Neb., H. B. Low and C. O. Blake, of El Reno.

RED FORK, I. T.—The Midcontinent Traction Company has filed articles of incorporation for the purpose of constructing an electric railway connecting Red Fork, Tulsa, Sapulpa and Glenn Pool oil fields, a distance of 20 miles.

OAKLAND, IA.—The [illegible] Valley Farmers' & Merchants' Mutual Telephone Company has been incorporated with a capital stock of $15,000.

WASHINGTON, ME.—The Washington Telephone Company has been incorporated with a capital stock of $100,000. C. A. Hatch is president.

VINELAND, N. J.—Articles of incorporation have been filed with the Secretary of State for the McArthur Electric Manufacturing Company. The company is capitalized at $200,000 and the incorporators are Alexander McArthur, Luke J. Le Roole and Edward J. McMullin.

NEW YORK, N. Y.—The Pneu L. Electric Company has filed articles of incorporation with the Secretary of State with a capital stock of $200,000. The incorporators are: C. Burton, R. C. McDonald, of Brooklyn, and A. J. Myers, of New York.

WALLACE, N. C.—The Wallace Telephone Company has been incorporated with a capital stock of $3,000 by R. B. Cowell and others.

CLEVELAND, OHIO.—The Standard Electric Company has been incorporated with a capital stock of $10,000 by T. J. Ross, Fred T. Klingman and others.

DEFIANCE, OHIO.—The Defiance, Paulding & Fort Wayne Railway Company has been organized to build an electric railway from Defiance to Fort Wayne, following the bed of the old Wabash and Erie Canal. A spur will be built from Tate's Landing to Paulding, and a number of extensions will be built if the present plans are carried out. H. F. Schnelker and W. S. Rogers have purchased the right of way for the company.

POMEROY, OHIO.—The Pomeroy & Middleport Telephone Company has been incorporated with a capital stock of $10,000 by W. M. Gray and others.

EL RENO, OKLA.—The El Reno Railway Company has been chartered with a capital stock of $100,000 to build an electric or steam railway from Oklahoma City via El Reno to Geary, a distance of 60 miles. The incorporators are J. W. Maney, Oklahoma City; John Maney, Henry Shafer, H. K. Schafer and Herman Mittner, all of this city.

VERNAL, UTAH.—The Vernal Milling & Light Company has been incorporated with a capital stock of $50,000. The company will operate a flour mill at Vernal and also maintain a power plant. S. R. Bennion is president and R. S. Collett, secretary.

SEATTLE, WASH.—Articles of incorporation have been filed for the Priest Rapids Railway Company by W. R. Rust, of Tacoma, H. K. [illegible] $1,000,000, and proposes to build an electric railway 90 miles long in Douglas County.

WATERVILLE, WASH.—Articles of incorporation have been filed for the Northern & Southern Railway Company by A. L. Rogers, M. B. Howe, I. W. Matthews and A. E. Chase. The capital stock of the company is $7,000,000. The company proposes to build a railroad to be operated by steam or electricity from the city of Waterville to Pasco, a [illegible]

Legal.

[illegible] injunction was issued on July 15 by the United States Circuit Court for the South- [illegible] Westinghouse Electric & Manufacturing Company versus the Wagner Electric Manufacturing Company for infringement of Stanley patent No. 469,809, granted March 1, 1892. Under this decision the Wagner Electric Manufacturing Company, of St. Louis, Mo., is forbidden to make, use or sell self-regulating transformers, which infringe this patent, anywhere in the United States.

[illegible] Vice-Chancellor Stevens, in the Court of Chancery in Newark, N. J., handed down a decision to the effect that a man's face is his own property as well as his name. The Vice-Chancellor made this decision in injunction proceedings brought by Thomas A. Edison against the Edison Polyform & Manufacturing Company enjoining the latter company from publishing on its products a picture of the complainant, accompanied by a certificate purporting to be signed by him and recommending the use of the compound. The material in question is a neuralgia cure. "If a man's name," said the Vice-Chancellor, "be his own property, as no less an authority than the United States Supreme Court says, it is difficult to understand why the peculiar cast of one's features is not also one's property, and why its pecuniary value, if it has one, does not belong to its owner rather than the person seeking to make an unauthorized use of it. If the mere exhibition of one's face to one's friends and to others on the public streets be a publication for all purposes, then that line of cases of which Pollard versus Photographic Company is an example was wrongly decided, for there could be no implied contract or confidence to keep that private which was already public property. Mr. Edison early in his career compounded a medicinal preparation intended to relieve neuralgia pains by external application. In 1879 a Mr. Lewis and a Mr. Jacobs visited Mr. Edison's laboratory in Menlo Park and he told them he had made a preparation which he had called Polyform and had found it to be a good pain killer. Lewis and Jacobs were so impressed with its merits that they bought Mr. Edison's rights for $5,000. Mr. Edison made a written assignment of his rights Sept. 2, 1879, and the same year a company called the Menlo Park Manufacturing Company was organized to sell the preparation. The company failed after several years and was succeeded by a Maine corporation. This company, too, met with little success and was succeeded by a New York company, which did nothing. Finally the present defendant corporation was organized by several men living in Chicago, where it is now manufacturing the compound. This contains all but one of the drugs, morphine, mentioned in Mr. Edison's formula."

Educational.

BROTHER POTAMIAN, of Manhattan College, New York, is delivering a series of lectures at the Summer School of St. Mary's College, Oakland, Cal. Among the subjects are "The Mariner's Compass, Historically and Practically," and "Submarine Cables; How Made and How Laid." Brother Potamian has compiled the bibliographic notes of the Wheeler Gift in the library of the American Institute, the MS. of which is now with the printer.

Obituary.

CAPT. B. E. LINEHAN.—The death is announced at Memphis, Tenn., of Capt. Bart E. Linehan, capitalist and promoter, who succumbed to the excessive heat. He resided at Dubuque, Iowa, and was president of the Dubuque Light & Gas Company, the Linehan Transfer Co. and the R. R. Linehan Company.

MR. S. McC. HAMILL.—We note with deepest regret the death at Schenectady, N. Y., on July 29, from typhoid fever, of Mr. Samuel McClintock Hamill, an officer of the General Electric Company, with which he became connected by reason of his position as manager of the merged Brush Electric Company of Cleveland. He was born in Lawrenceville, N. J., March 27, 1858, and was the son of the Rev. Samuel M. Hamill. After attending the Lawrenceville school until 1876, he went to Princeton University, where he was graduated with the degrees of A.B. and A.M. in 1880. He married Miss Maria Woodward Baldwin, of Baltimore, on Nov. 27, 1900. Having held the position of master in the Lawrenceville school, Mr. Hamill worked for the Chicago, Burlington & Quincy Railroad. He was in the second vice-president's office three years. Then he became manager of the Brush Electric Company. Since that concern's absorption he had been connected with the General Electric's lighting department and with the various companies controlled by it. He was a vice-president of the Sprague Electric Company of New York and the Stanley Electric Company of Pittsfield, Mass., and an officer and director of several other similar corporations, as well as president of the Schenectady Trust Company. In politics he was a Republican. His clubs were the Country of Schenectady, the University and Princeton of New York City, the Country of Trenton, N. J., and the Ivy, Golf and Nassau of Princeton. [illegible] Church and a trustee of the Ellis Hospital, Old Ladies' Home and Young Men's Christian Association, he was well known in Schenectady's charitable circles. Quite recently Mr. Hamill had undertaken the construction of a beautiful home close to the Schenectady golf links. The funeral services were held at the First Presbyterian Church, of which Mr. Hamill was a member, on Tuesday afternoon. The funeral party left immediately for Lawrenceville, N. J., where interment was made in the Hamill family plot. The honorary pallbearers were: C. A. Coffin, president General Electric Company; F. P. Fish, of the American Telegraph & Telephone Company, Boston; A. Butler Duncan, New York City; D. Smith, Schenectady; General Robert Z. Emmett, New Rochelle, N. Y.; W. P. Hanson, Schenectady; Blair Lee, Washington, D. C.; J. R. Lovejoy and E. W. Rice, Jr., General Electric Company, Schenectady; the Hon. Myron Herrick, ex-Governor of the State of Ohio; Robert McA. Lloyd, of the General Vehicle Company, New York, and Rudolph F. Chirmer, of New York.

Personal.

MR. W. McCONWAY [illegible] inghouse Electric & Manufacturing Company, to fill the vacancy caused by the death of Mr. P. [illegible]

MR. [illegible] been spending the summer there with friends.

MR. C. R. BEEBE, manager of the Bell telephone district in Logansport, Ind., has been appointed manager of the Peru district, which includes control of the Peru, Wabash, Bunkerhill and Logansport territory.

MR. BAYARD S. STEWART [illegible] Barstow & Company, engineers, and will be attached to the New York office.

MR. L. H. CONKLIN has been appointed general superintendent of the West Penn Railways Company and the West Penn Electric Company. Previously Mr. Conklin had been superintendent of lighting of the latter company.

MR. THEODORE N. VAIL, president of the American Telephone & Telegraph Company, and residing at Lyndon, Vt., was married on Saturday, July 27, at the home of the bride's mother, Brookline, Mass., to Miss Mabel Rutledge Sanderson.

MR. L. E. HOLDERMAN has been appointed superintendent of the Terre Haute, Indianapolis & Eastern Traction Company. Mr. Holderman was formerly superintendent of the electrical department of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis.

MR. N. F. BRADY, treasurer of the New York Edison Company, accompanied by his wife, sailed for a two months' trip in Europe on the *Kaiser Wilhelm der Grosse* on July 30. His father, Mr. Anthony N. Brady, is also on the other side at the present time. A large number of friends went to the steamer to see Mr. and Mrs. Brady off.

MR. C. W. HUMPHREYS has taken quarters in The Rookery, Chicago, and will practice as consulting and designing engineer. Mr. Humphreys, who is a graduate of the University of Wisconsin, when connected with the Denver Gas & Electric Company, presented several valuable papers before electrical associations, giving accounts of some of the methods which have rendered the Denver plant perhaps the most notable in this country.

MR. FRANK J. SPRAGUE celebrated his fiftieth birthday last week with a house party at his new country residence on one of the most beautiful hilltops at Sharon, Conn. Letters and telegrams of congratulations were received from all over the county. The anniversary found Mr. Sprague in full health and spirits, and about to follow up his important share in the electrification of the New York Central system by other kindred work of equal magnitude and interest.

MR. W. CORIN, C. E., E. E., the city electrical engineer of Launceston, Tasmania, for the past eleven years, has resigned in order to devote time to his growing private practice. He has made a marked success of the Launceston three-phase plant and general system, which he leaves in a high state of efficiency. He has lately been consulted by the Queensland and [illegible]

MR. WILL M. DIXON [illegible] Jamestown Exposition, has been appointed assistant director-general of the Exposition. Mr. [illegible] position, having planned and executed the exceptional illumination of the buildings and grounds, and while still retaining his position as chief of the Department of Electricity, will also have a hand in the active management of the Exposition [illegible] ability is well merited.

DR. DAVID T. DAY, for many years chief of the division of mining and mineral resources of the United States Geological Survey, has been relieved from duty at his own request, in order to be able to devote himself wholly to the preparation of the report on the petroleum resources of the country for the United States Government. This is a gigantic task requiring ability and experience [illegible] succeeded by Mr. E. W. Parker, the well-known mining statistician, expert and journalist, who was a member of the Anthracite Coal Strike Commission appointed by President Roosevelt, and who had served under Dr. Day for the past sixteen years.

Trade Publications.

BELT-DRIVEN ALTERNATORS of the revolving field type are treated at length in Bulletin No. 4394B of the General Electric Company.

ALTERNATING CURRENT GENERATORS of the water-wheel type are described in detail and well illustrated in Bulletin No. 1050 of the Allis-Chalmers Company, Milwaukee, Wis.

ELECTRICAL CONSTRUCTION SUPPLIES.—The Fletcher Manufacturing Company, Dayton, Ohio, has issued Catalogue No. 562, giving a complete price list of electrical construction supplies.

LIGHTNING ARRESTERS.—Low-voltage and high-voltage lightning arrester of the 1907 type, disconnecting switches and choke coils are dealt with in Bulletin No. 4511 of the General Electric Company.

LAMP SOCKETS.—Security lamp sockets, which are assembled by simply pushing the shell into the cap and turning it until it locks into position, are listed and described in Bulletin No. 4497 of the General Electric Company.

ELECTRIC GAS LIGHTERS.—Bulletin No. 154 of the Holtzer-Cabot Electric Company, Boston, Mass., describes automatic electric gas lighting apparatus, spark coils, tell-tale short-circuit alarm bells and automatic sectional cut-out.

TRAIN LIGHTING SYSTEM.—The Consolidated Railway Electric Lighting & Equipment Company, New York, has issued bulletin No. 5, dealing with an axle-driven generator and storage battery equipment for lighting railroad postal cars.

ELECTRIC RAILWAY.—Bulletin No. 1058 of the Allis-Chalmers Company gives a complete illustrated technical description of the Winona Interurban Railway for which the Allis-Chalmers Company supplied the electrical and steam equipments.

GRAPHITIZED FILAMENT LAMPS equipped with bowl holophanes are treated at length in Bulletin No. 4494 of the General Electric Company. These lamps are rated at from 100 to 250 watts, the specific illumination in each case being .4 cp per watt.

RICHMOND INDUCTION MOTORS.—The Richmond Electric Company, Richmond, Va., in Bulletins Nos. 8 and 9, describes and gives dimensions of its line of two and three-phase motors. These range from ¼ to 50 hp and are made for from 25 to 60 cycles.

SPRAGUE ELECTRIC COMPANY has issued a new edition of its book of instructions for the proper installation of Greenfield flexible steel conduit and flexible steel armored conductors. It is in handy vest pocket form and embraces all the details of this class of material.

DIRECT-CURRENT DYNAMOS.—The Allis-Chalmers Company has issued bulletin No. 1057, descriptive of type K direct-current motors and generators. These machines are built in ratings varying from 5 hp to 100 hp in motors and from 3 kw to 85 kw in generators.

ELECTRIC SIGNS.—Bulletin No. 116, of the Electric Motor & Equipment Company, Newark, N. J., gives numerous views of exceedingly attractive electric signs designed and installed by the company, including the "pioneer" electric sign, and the "largest electric sign in the world."

FLEXIBLE ARMS FOR ELECTRIC LAMPS are illustrated in a convincing manner in the 1907 catalogue of the J. R. Almond Manufacturing Company, Brooklyn, N. Y. These arms are made of tempered steel and copper wire, and their flexibility is claimed not to be affected by frequent bending.

CONTROLLERS.—Repair parts for type R controllers are listed in bulletin No. 4493 of the General Electric Company, which is a publication containing a total of 76 pages. Auxiliary contractor equipments for cylinder controllers are illustrated and described in bulletin No. 4514 of the same company.

END-CELL SWITCH CONTROLLER.—The Electric Storage Battery Company, Philadelphia, Pa., has issued bulletin No. 102 dealing with high-speed magnetic controller for end-cell switches, which is moved through a spiral gearing by means of a shunt-wound motor whose control switches are operated magnetically.

GENERAL ELECTRIC SUPPLIES.—The General Electric Company has issued in the form of a large quarto, 430-page, cloth-bound volume, a catalogue of smaller apparatus and miscellaneous supplies. The volume supersedes the 1904 supply catalogue. Railway supplies are not included, there being a separate volume for these.

STREET LIGHTING TRANSFORMER PANELS.—The General Electric Company has issued Bulletin No. 4500, devoted to constant current transformer panels for series arc and series incandescent lighting systems. Watt-hour meters for showing the total input of energy to the transformer are mounted on a special sub-base, when desired.

ELECTRIC PYROMETER.—[illegible] bulletin No. 25, devoted to electric pyrometers. All that goes into the [illegible] amount of rough handling. One element of the thermocouple is a closed [e]nd tube containing pure iron, an insulated rod being used as the other [illegible]

FAN MOTORS.—[illegible] motors differ from the earlier forms, principally in that they are pro[illegible] instantly transformed into one of the wall bracket type, or vice versa

TESTING MAGNETOES.—The Holtzer-Cabot Electric Company, Boston, Mass., has issued bulletin No. 153-A dealing with testing magnetoes for determining the continuity of electrical circuits. The magnetoes are rated according to the resistance in which a ringing current may be produced. The ratings vary from 10,000 to 100,000 ohms. Portable testing sets especially designed for telephone linemen are treated in bulletin No. 204.

VISES.—A unique and original catalogue has just been issued by the Pittsburg Automatic Vise & Tool Company, general offices, Pittsburg, Pa., illustrating its special automobile and motor boat vise. The entire book is black and white, and in spite of its artistic nature, each subject is plainly and concisely deal with. Due to the special class of people it is intended for, as little description matter as possible is given, everything being fully described in effective cuts.

WESTINGHOUSE STORAGE BATTERIES.—The Westinghouse Machine Company announces in handsome pamphlet form a line of storage batteries being placed on the market by its storage battery department. It is stated that contracts will be taken for complete storage battery installations for any class of service. The pamphlet is profusely illustrated, showing details of plates and complete cells for all classes of service from portable cells to types for central stations and car lighting.

STRAIGHT FILAMENT LAMPS.—The O'Brien Electric Light Company, 1710 Market Street, Philadelphia, has issued a series of leaflets dealing with its straight filament lamp which, when used with a trough reflector, is well adapted for many specific purposes. Since the filament parallels the sides of the reflector, the lamp equipment sends a large part of the light in the useful direction. It is claimed that the lamp produces more useful light for the same specific power consumption than any other style of lamp.

ELECTRICAL MEASURING INSTRUMENTS.—The 1907 catalogue of the Leeds & Northrup Company, Philadelphia, Pa., is a neatly prepared 125-page publication, giving not only excellent illustrated descriptions of its various lines of instruments, but also an outline of the factory in which the instruments are built and tested. The catalogue contains much valuable information concerning the operating characteristics and the relative advantages and disadvantages of the numerous testing instruments for certain duties.

C. S. KNOWLES, 7 Arch Street, Boston, has recently issued two new catalogues on insulators; one (Catalogue No. 50), covering standard glass insulators and porcelain wiring knobs, cleats, etc., of interest to telephone and electric light companies; the other (Catalogue No. 51), covering glass and porcelain insulators for high-voltage work, and also insulator pins and pole hardware in general. Catalogue No. 51 shows porcelain insulators for voltages from 4000 to 75,000. Either or both catalogues will be sent on request.

KNIFE-BLADE SWITCHES.—Bulletin No. 4502 of the General Electric Company deals with type L, form D-12 knife-blade lever switches. These switches are built without fuse connections for from 30 to 6000 amperes, with link fuses up to 800 amperes, and with enclosed fuses up to 600 amperes. The bulletin contains complete diagrams showing the principal dimensions of all of the switches. It is instructive to note that the 6000-amp. switch for 250 volts direct current or 500 volts alternating current is 5 11/32-in. in width and is built up of five blades.

ARC LAMPS.—A convincing bit of advertising matter has been issued by the Excello Arc Lamp Company, 24 East 21st Street, New York, in the form of a list comprising a few of the names of representative business houses, theatres, parks, etc., that have adopted Excello luminous arc lamps. The reader is assured that a letter addressed to any of the firms mentioned will bring confirmation of each claim made for the lamps. A complete description of these lamps with full instructions regarding their care and maintenance has been issued by the same company.

MOTOR CONTROLLER.—A series of catalogues issued by the Electrical Apparatus Company, Claxton House, Westminster, London, is devoted to motor starters, controllers and protective devices. Catalogue D deals with the Sundh type of automatic motor starter, while catalogue H describes open type semi-enclosed and totally-enclosed hand-operated motor starters, motor starting panels, circuit breakers and switches. Catalogue C discusses "Korlarh" enclosed and open fuses. The Barrett controller regulator for electric railways is treated at length in catalogue G.

STROMBERG-CARLSON.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has just received the revised issue of its Bridging Telephone Bulletin No. 19. This edition is rearranged and includes descriptions and half-tone illustrations of its popular central energy style dry battery wall telephone. There are some fifty pages of illustrations, circuit diagrams and other data of value included. The switch 12, 10, 8 and 6 point type used for the text and the John Hancock style type for the display make a pleasing contrast in two-color ink that is a notable feature of this issue. Copies will be mailed [illegible]

DRYING MATERIALS IN INDUSTRIAL PLANTS is the title of a pamphlet just issued by the Green Fuel Economizer Company, of Matteawan, N. Y., which takes up the drying of various materials, as fabrics, clothes, malt, lumber, baking powder, paper, paper pulp, sugar, etc. Besides describing and illustrating the fans, blowers, steam coils, etc., manufactured by this company for use in drying plants, an inter[illegible]

[illegible]

[illegible] has brought out an octavo paper covered catalogue of its instruments, which are illustrated and quite fully described therein. This range of apparatus includes direct current, permanent magnet instruments, portable instruments for direct current, shunts for portable ammeters, Jewell laboratory standard meters for direct current, switchboard instruments, illuminated dial types of voltmeters and ammeters, "baby" switchboard meters, round pattern types and theraupeutic shunt milliammeters. Details are also given very fully of the new Jewell precision indicating instruments for both kinds of current. The catalogue includes also detail parts and accessories. The cover is handsomely designed in gold and white.

BRYANT & PERKINS.—The Bryant Electric Company of Bridgeport, Conn., has just issued a new edition of its catalogue of Bryant & Perkins goods and detail apparatus. It is oblong, 3½ by 6 inches, with stiff cloth cover, and the paging is heavy black numerals at the middle of the side margin. All the goods are carefully shown and identified in the first part of the catalogue; and in the second part is given the price list No. 204 with approximate weights of package and standard contents in number of pieces. This second portion is simply pinned in, and is therefore readily detachable when later price lists are issued. The whole thing is admirably arranged and worked out most thoughtfully and systematically. The typography also is excellent and the cuts made direct from photographs are very clear.

GAS PRODUCERS.—The Westinghouse Machine Company, East Pitts- [illegible] non-bituminous fuels which it has developed for the market. The producer consists in general of a pair of vertical steel shells, one of which is the gas generator proper, lined with a superior quality of fire brick and tile, while the other is the combination scrubber-dryer from which the gas is led to the engines or the point of use, without the intervention of gas holder or any storage apparatus whatsoever. The apparatus is entirely self-contained; the two principal elements, generator and scrubber, are connected by a substantial cast-iron gas main fitted with a water sealed cut-out and stack valve, which, by a single movement, opens communication to the purge stack and simultaneously seals the main to the scrubber, or vice versa. The automatic pressure controlling apparatus is mounted securely on the main producer shell. On account of the automatic balanced blast of the producer, the amount of gas generated is controlled entirely by the demand for gas, and, therefore, no gas holder is required regardless of whether the gas is used in engines or for heating purposes.

Business Notes.

THE [illegible] N. Y., has recently opened a machine shop for repair work and will make a specialty of repairs to multiple-unit control apparatus, refilling of en- [illegible] also manufacture armatures, field coils, commutator controller fingers, and also engage in all classes of electric railway repair work. Mr. Cross [illegible] and will take charge of the power station work.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutical Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, fourth Friday of each month.

American Street and Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Detroit, Mich., third Wednesday, September, 1907.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, Atlantic City, N. J., October 14-18, 1907.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Montreal, September, 1907.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, Sep- [illegible]

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 1537 Old Colony Building, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November [illegible], 1907.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting, October, 1907.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, Dr. Arthur H. Elliot, 4 Irving Place, New York. Meetings in New York, second Friday of each month.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

International Independent Telephone Association. Secretary, Charles West.

Iowa Electrical Association. Secretary, L. B. Spinney, Iowa State College, Ames, Ia.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., Oct. 16, 1907.

Kentucky Independent Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Battle Creek, Mich., August 21-23, 1907.

Missouri Independent Telephone Association. Secretary, Houck McHenry, Jefferson City, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting, New York City, July 17, 18 and 19, 1907.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

National Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

[illegible]

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, August 20 and 22, 1907.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Charles W. Ford, Oklahoma City, Okla.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., 1907.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

PUBLIC UTILITIES ASSOCIATION OF INDIANA. Secretary J. A. Shunk, Peru, Ind. Regular meetings second Thursday in May and December.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 23, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

860,657. CATHODE; Henry S. Hatfield, Brighton, England. App. filed Aug. 20, 1906. The combination of an electrolyte containing mercuric salts in solution and a cathode of the iridium group.

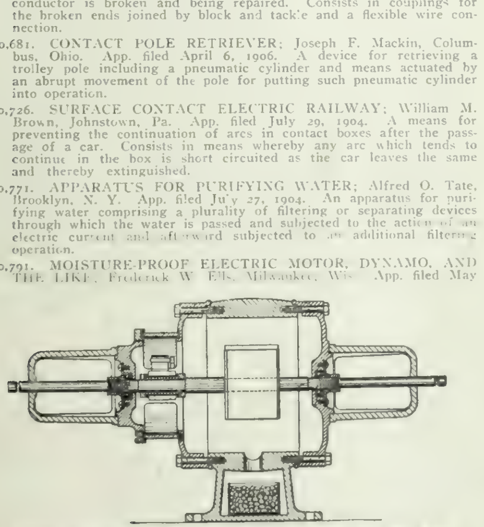
860,665. ELECTRICAL CONNECTION; Paul Horan, Toledo, Ohio. App. filed May 21, 1906. A device whereby a telegraph, telephone or other electric circuit may be maintained while the permanent conductor is broken and being repaired. Consists in couplings for the broken ends joined by block and tackle and a flexible wire connection.

860,681. CONTACT POLE RETRIEVER; Joseph F. Mackin, Columbus, Ohio. App. filed April 6, 1906. A device for retrieving a trolley pole including a pneumatic cylinder and means actuated by an abrupt movement of the pole for putting such pneumatic cylinder into operation.

860,726. SURFACE CONTACT ELECTRIC RAILWAY; William M. Brown, Johnstown, Pa. App. filed July 29, 1904. A means for preventing the continuation of arcs in contact boxes after the passage of a car. Consists in means whereby any arc which tends to continue in the box is short circuited as the car leaves the same and thereby extinguished.

860,771. APPARATUS FOR PURIFYING WATER; Alfred O. Tate, Brooklyn, N. Y. App. filed July 27, 1904. An apparatus for purifying water comprising a plurality of filtering or separating devices through which the water is passed and subjected to the action of an electric current and afterward subjected to an additional filtering operation.

860,791. MOISTURE-PROOF ELECTRIC MOTOR, DYNAMO, AND THE LIKE; Frederick W. Ellis, Milwaukee, Wis. App. filed May



860,791.—Moisture-Proof Electric Motor, Dynamo and the Like.

2, 1906. The motor is hermetically encased in a casing having a transparent side portion and a material is placed within the casing which has an affinity for moisture so as to keep the interior dry.

860,813. DYNAMO CONSTRUCTION; Henry [illegible], [illegible], England. App. filed Aug. 9, 190[illegible]. Relates to means for regulating direct current dynamos so as to render their output constant within certain limits of speed or any variation of the speed at which they may be driven.

860,866. MULTIPLE STATION TELEPHONE [illegible]; [illegible] Farmer, Detroit, Mich. App. filed Feb. 4, 1902. In a telephone exchange system, the combination with [illegible] line, switching apparatus of means [illegible] in the said circuit [illegible] current over both the line conductors [illegible] applying relay apparatus [illegible] line thereto, and means controlled by the [illegible] plug for restoring said relay apparatus to normal condition, substantially as set forth.

860,861. TELEPHONE CABLE TERMINAL; Edward C. F[illegible], Santa Barbara, Cal. App. filed Aug. 28, 1906. Details of distributing box for cables.

860,867. ELECTRIC LAMP SOCKET; Thomas H. Hill, Philadelphia, Pa. App. filed Aug. 31, 1906. Consists in features of a lamp socket having a depending chain connection from a ratchet part whereby the lamp is turned on and off by successive pulls on the chain.

860,874. RINGING AND LISTENING KEY; Herbert L. Knight, Cleveland, Ohio. App. filed Jan. 10, 1906. Construction of ringing and listening key for operator's use upon telephone switch boards. Designed to simplify the construction and render it more compact.

860,889. METHOD OF MAKING ELECTRICAL LUGS; George A. Fower, Richmond, Va. App. filed Sept. 13, 1906. A method of forging or stamping sheet metal so as to produce a circuit terminal lug or connection piece duly recessed and socketed for use.

860,902. TELEPHONE-EXCHANGE SYSTEM; E. E. Clement, Washington, D. C. App. filed Nov. 11, 1905. In a telephone system, a line circuit, a secondary battery supply, and controlling means for current in the circuit, a translating device between the controlling means and the battery, a charging generator, and means to connect the same during conversation between the controlling means and the translating device, substantially as described.

860,907. AUTOMATIC CUT-OUT; George Eastman, Chicago, Ill. App. filed June 2, 1906. Relates to improvements in automatic cut-outs and particularly to devices for establishing a storage battery circuit during the charging action of the dynamo and for breaking said circuit when the operation of the dynamo ceases.

860,920. LOCK-OUT DEVICE FOR TELEPHONES; D. W. Kneisly, Dayton, Ohio. App. filed July 12, 1906. In a device of the character described, the combination, with a lock-out mechanism and a selector comprising a sliding plate having a series of recesses therein of different depths, a movable bar extending substantially parallel to said selectors and having a tooth adapted to enter the recesses of different depths in said selector, thereby controlling the position of said bar, and means for operating said selector, substantially as described.

860,945. APPARATUS FOR RAILWAY SIGNALING; Henry W. Spang, New York, N. Y. App. filed Sept. 22, 1902. Covers means for controlling the action of an electromagnet by the moving of the rolling equipment of a railway. Provides means whereby the current from sectionally energized track rails may be caused to flow in different directions through a polarized relay in the locomotive, thereby giving different signals.

860,953. DYNAMO ELECTRIC MACHINE; Robert B. Williamson, Norwood, Ohio. App. filed Sept. 5, 1905. Arrangement for supporting the brushes of a continuous current generator.

860,961. METER; David Broido and Walter H. Lubach, Berlin, Germany. App. filed May 4, 1905. An integrating electric meter having a damping plate with armature coils directly supported thereby and moving in a single magnetic field.

860,9[illegible]. APPARATUS FOR CONTROLLING THE MOTOR AND DRIVING MECHANISM OF SELF-PROPELLED VEHICLES; [illegible], Hempstead, N. Y. App. filed Sept. [illegible], 190[illegible]. A transmission gear for automobiles including various speed change gears with magnetic clutches by which they are successively put in operation.

860,976. SYSTEM OF CONTROL; George H. Hill, Schenectady, N. Y. App. filed Nov. 14, 1905. Relates to apparatus for controlling the operation of motors from a distant point and more particularly systems wherein a plurality of motors or groups of motors are controlled from a single station.

[illegible]. DYNAMO ELECTRIC MACHINE; Arthur C. [illegible], [illegible], Wis. App. filed Dec. [illegible]. [illegible] pole piece [illegible] connected [illegible].

[illegible]. ALTERNATING CURRENT MACHINE; M[illegible] C. A. [illegible], Paris, France. App. filed Jan. [illegible], 190[illegible]. An alternating current

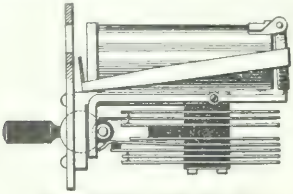
[illegible] windings each distributed around said core, a many-part commutator having successive segments connected to the several armature windings, brushes bearing on said commutator of a width insufficient to bridge two segments connected to the same winding, and means for shifting a portion of said brushes relatively to the rest.

860,987. ELECTRIC METER; William J. Mowbray, Brooklyn, N. Y. App. filed July 20, 1905. A portable watt-hour meter for testing meters installed in customer's premises.

[illegible] LIGHTNING-ARRESTER; C. P. Steinmetz, Schenectady, N. Y. App. filed Dec. 28, 1900. A resistance stick or mass composed of a mixture of oxids of iron having different electrical conductivities.

860,998. CONTROLLING-ALTERNATING CURRENT MOTORS; C. P. Steinmetz, Schenectady, N. Y. App. filed Jan. 25, 1904. In combination, a plurality of repulsion motors, means for varying the series-parallel relation of said motors, and means for varying the relative angular displacement between the line of the primary field and the line of the short-circuiting brushes on the secondary member.

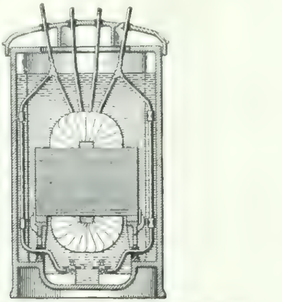
861,001. VISUAL SIGNAL AND KEY; Kelley M. Turner, New York, [illegible]



[illegible] Visual Signal and Key.

adapted to retain the [illegible] ringing or talking circuits as desired.

[illegible] PROTECTIVE DEVICE FOR TRANSFORMERS; [illegible] the protection of transformers and electrical apparatus employing oil as an insulating medium and means to prevent burn-out due to



[illegible] Protective Device for Transformers.

the presence of water in the oil, has a spark gap submerged in the oil near the bottom of the casing and connected to a source of electric potential.

[illegible] DIAL SWITCH FOR REGULATING TRANSFORMERS; Herbert I. Washburn, Overbrook, N. J. App. filed Nov. 14, 1905. Relates to switches for use in connection with transformers where it is necessary to widely vary the voltage supplied to the distributing main. Has means for moving the switch blade from one contact to the other with an abrupt movement.

861,012. ALTERNATING CURRENT MOTOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Dec. 10, 1906. An alternating current motor of the commutating type having high resistance leads for the purpose of improving commutation. Has means for dissipating the heat in the leads.

861,015. BLOCK SIGNAL SYSTEM; Elmer F. Bliss, Schenectady, N. Y. [illegible] sectional track rails energized by an alternating voltage and connected by inductive bonds. Has protective devices adapted to reduce the current in case of abnormal flow.

861,018. SWITCHING MECHANISM FOR ELECTRIC RAILWAYS; Ed W. Clark, Coalton, Ohio. App. filed March 26, 1907. Features of improvement in the switching mechanism of electric railways. Has means whereby a motorman may control a switch from a dis- [illegible]

Has a special trolley co-operating with a suspended contact plate in the overhead system.

[illegible] THERAPEUTIC LAMP; Harley E. Coger, Minneapolis, Minn. [illegible] ical casing is arranged with [illegible] to focus the light rays through an opening at the apex of one of the cones.

861,029. TRANSFORMER CORE; Walter A. Hall, Lynn, Mass. App. filed Sept. 24, 1904. A built-up transformer core having separate branches in the form of a cross with meeting edges which intermesh to form a substantially solid leg.

[illegible] ELECTRIC [illegible] FURNACE; [illegible] England. App. filed Jan. 24, 1907. Furnace is operated by means of polyphase current for which purpose the heating element is ar- [illegible]

861,061. INSULATOR AND SUPPORT FOR ELECTRIC LINES; Theodore Varney, [illegible] metal frame [illegible] suspension wires by a steel plate collar.

[illegible] STRAIN INSULATOR; [illegible] Pittsburg, and Christian Aalborg, Wilkinsburg, Pa. App. filed June [illegible] Has a metallic cylindrical core on which is placed an insulating tube which in turn supports an eye ring or bolt.

861,071. STRAIN INSULATOR; Christian Aalborg, Wilkinsburg, Pa. App. filed May 2, 1906. Provides an insulator having an insulating body with tapered holes containing plugs which are threaded to engage the ends of a U-shaped bolt or staple.

861,072. DYNAMO ELECTRIC MACHINE; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 12, 1907. Relates to dynamo electric machines of the commutator type and provides a novel arrangement of commutator coils and leads such that better commutation can be secured in a machine having more than two coils per slot than hitherto obtainable.

861,073. TRANSFORMER; Claxton E. Allen, Lynn, Mass. App. filed April 18, 1905. Relates to modifications of No. 861,029.

861,094. STRAIN INSULATOR; Harry P. Davis, Pittsburg, Pa. App. filed June 4, 1906. A strain insulator comprising a metal tube with a rod projecting therein and having an enlargement located substantially at the middle of the tube, and insulating tubes interposed between the end walls of the metal tube and the ends of such enlargement.

861,100. ELECTRIC CONDUCTOR; Charles E. Eveleth, Schenectady, N. Y. App. filed July 28, 1905. A terminal clamp for electric cables having two halves which are bolted on a single conducting rod and each of which is socketed for a separate cable connection.

861,117. ELECTROGALVANIC APPARATUS; Frederick F. Hespe, West Hoboken, N. J. App. filed July 13, 1906. A therapeutic device comprising a link belt, the ends of which are made the terminals of a battery.

861,125. SIMULTANEOUS TRANSMISSION OF TELEGRAPHIC AND TELEPHONIC IMPULSES; Isidor Kitsee, Philadelphia, Pa. App. filed Sept. 22, 1906. Relates to the simultaneous transmission of telephonic and telegraphic impulses designed to eliminate the influence of the telegraphic impulses on the telephone receivers.

861,126. TRANSMISSION OF INDUCED IMPULSES; Isidor Kitsee, Philadelphia, Pa. App. filed Oct. 11, 1906. The method of electrical signaling which consists in producing a sharp electrical impulse and converting such impulse into a line impulse of relatively great duration. Has an induction coil with a key in its primary and a condenser bridged across the secondary circuit.

861,135. ELECTRIC ANNEALING FURNACE; Albert L. Marsh, Lake Bluff, Ill. App. filed Feb. 18, 1907. A metallic frame has a flat insulating block supported thereby with a spiral groove in its upper face in which is received a resistance element.

861,149. STRAIN INSULATOR FOR ELECTRIC LINES; Theodore Varney, Pittsburg, Pa. App. filed June 4, 1906. A strain insulator having a ribbed insulating body with metallic rings molded therein and which support threaded bolts projecting from the ends of the insulating body.

861,155. SYSTEM OF ELECTRICAL DISTRIBUTION; John W. Achard, Philadelphia, Pa. App. filed April 15, 1905. Provides means for keeping the floating voltage of a battery substantially the same as the average voltage of the line on which it is floated.

861,159. SURGICAL NEEDLE; William R. Burch, Chicago, Ill. App. filed March 3, 1906. Construction of needle projecting through an insulating sleeve or guard.

861,162. ELECTRIC BELL; Charles C. Cadden, Cleveland, Ohio. App. filed Dec. 1, 1904. An electric bell having a vertical magnet coil which vibrates between the poles of a permanent magnet between which it is pivoted.

861,192. UNIPOLAR DYNAMO; W. Mathiesen, Leipzig, Germany. App. filed Jan. 25, 1907. A unipolar electrical machine comprising a shaft, means through which said shaft is mounted, constructed to permit said shaft to oscillate about a center, an armature carried by the shaft, and a spherical brush-contact surface having its center substantially coincident with the center of oscillation of the shaft.

861,197. SYSTEM OF MOTOR CONTROL; August Sundh, Yonkers, N. Y. App. filed Dec. 27, 1904. A system of motor control designed to produce the sudden reversing of an electric motor.

861,212. CALIBRATING DEVICE; Charles H. Hill, Schenectady, N. Y. App. filed April 28, 1904. A calibrating device for an automatic circuit breaker having an adjustable stop to receive the impact of the core when released and an adjusting device to regulate the stop and independently supported so as to be practically free from such impact.

861,224. PROCESS OF PRODUCING FERROSILICON; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. Process employing a substantially similar apparatus except that two electrodes project into an insulating cup.

861,225. PROCESS OF PRODUCING SILICOSPIEGEL; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. The material is treated in a carbon cup with an electrolyte projecting therein and forming an electric arc therewith.

861,226. ELECTROLYSIS; Giovanni Rambaldini, Grosseto, Italy. App. filed Dec. 28, 1904. An apparatus for effecting electrolysis while keeping two liquids of different natures separate from one another.

861,233. AUTOMATIC TROLLEY POLE; Hugh W. Fellows, Cahuegua, and Ira A. Cammett, Hollywood, Cal. App. filed July 16, 1906. The pole is impelled upward by a spring connection which is automatically tripped or released in case of a too abrupt movement of the pole occurring when the pole leaves the trolley conductor.

861,238. ATACHMENT PLUG; William C. Tregoning, Cleveland, Ohio. App. filed Jan. 9, 1907. Relates to improvements in attachment plugs and has for its object the provision of an appliance of this character in which the insulating properties of the contacts are contained at the highest efficiency. Relates to details of construction.

861,239. CONTROLLING SWITCH; Harold E. White, Schenectady, N. Y. App. filed May 12, 1904. A rotary controlling switch adapted to be moved in either direction from its off position two sets of substantially diametrically opposite contacts, and contacts relatively movable thereto and adapted to be engaged serially and alternately by said two sets when the switch is moved in either direction from its off position.

[illegible]0,627. SECTIONAL INCANDESCENT LAMP; Gorge E. Bill and Albert D. Redman, Sr., Harrisburg, Pa. App. filed Jan. 30, 1906. [illegible] as to vary the intensity of the illumination.

Electrical World

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NEW YORK, SATURDAY, AUGUST 10, 1907.

CONTENTS.

EXPORTS IN 1906-7.

The figures of exports for the last fiscal year ending June 30 are now available, and we are very glad to note the excellent manner in which electrical exports have held up, and increased over 1905-6. A month ago we estimated in this column that they would reach $17,000,000. The returns of the bureau of statistics of the Department of Commerce and Labor, show the exact figure to be $17,268,406, agreeing closely with the estimate. This total, moreover, is a gain of not less than $2,528,169 in 1906-7, or nearly 20 per cent, which is in close accord with the general run of increases the past year in the electrical field. The gain was shown in both classes of electrical goods; in fact it was pretty evenly divided between instruments and heavy machinery. During 1905-6 the exports of electrical instruments were $7,809,137 as compared with $9,005,766; while the exports of heavy machinery were $6,931,100 as compared with $8,262,640. While this holds true for the year, as a matter of fact the machinery class has lately been making heavy gains, while the smaller wares have fallen off for two or three months. Thus in June, machinery jumped from $639,561 to $1,080,960, while instruments declined from $815,846 to $754,276. There does not appear, however, to be any particular reason, as gains and losses are fairly well distributed.

By this time our leading customers for electrical goods are reasonably known, subject to fluctuations, such as the equipping of new systems in Brazil, lately, which will, of course, increase sales in that quarter. Moreover, every American plant once installed in a non-mechanical country should mean a steady market afterwards for supplies, material and new apparatus for extensions or repairs. Meanwhile, England and her colonies take a large share of the goods; Mexico is an excellent customer, and our progressive friends the Japanese show an increasing partiality for both instruments and machinery—a partiality we would be very sorry to see turned aside by any narrow prejudice or wild jingoism. Cuba is quite disappointing, for instead of increasing her orders, this past year she took only $92,079 of electrical machinery, as compared with $528,565 in 1905-6, and instead of half a million for instruments she spent nearly $50,000 less. Yet the island would seem to present widespread opportunity for electricity in its cigar factories, tobacco fields, sugar plantations, iron and copper mines, and fruit industries. There as elsewhere in tropic and sub-tropic regions large markets can be built up by intelligent and persistent endeavor.

THE FUNCTION OF THE ILLUMINATING ENGINEER.

The recent convention of the Illuminating Engineering Society is ample evidence that the illuminating engineer has found a permanent and useful place in the economy of society. But his work is so recent that it is not easy to limit and define. One of the speakers at the convention made a witty but blundering attempt to define him as "an electrical engineer with horse sense."

[illegible] electrical prejudices, and in the second place his special qualification is not "horse sense," valuable as that is, but something that horse sense can never replace— to wit, a wide and precise knowledge of several branches of arts and sciences of which the ordinary electrical engineer is woefully ignorant. The business of the illuminating engineer is to utilize light in the most effective way possible whatever the source. He may have to deal with gas or with electricity, oil or acetylene, and know how to make the best of any or all of them, although his usual work will commonly be in a single line.

As a profession, illuminating engineering is in the formative stage. It is being built up from men trained in other lines for the simple and obvious reason that there is no such thing as a special course of training yet available. Courses in electric lighting given as parts of electrical engineering courses are entirely one-sided and are merely useful stepping stones. The fact is that illuminating engineering bears somewhat the same relation to the older profession that sanitary engineering does to civil engineering. It may in general start along the same line as electrical engineering, but it must diverge from it almost from the start. The well trained illuminating engineer must have a fair working knowledge of the practical use of all kinds of illuminants, a sound grounding in physics and chemistry and some knowledge of physiological optics. He should have a training in photometry that is seldom given and something of the artistic training of the architect. On the other hand at least one-half of the ordinary course in electrical engineering is for him simply a waste of time and energy. For some years to come, at least, no proper training will be available, and the field must be filled by men who are self-trained in some of these lines. It is not likely that illuminating engineering will ever become a great independent profession any more than has sanitary engineering, but it will be a well recognized branch in which there will be an opportunity for admirable work. The large central station whether for gas or electricity will find the services of a first-class man quite necessary, and it will find too that he has to be something besides a slick salesman with "horse sense" and a smattering of technical knowledge. His work is very varied and cannot always show immediate results in fat contracts, but it is the capacity for giving the best service that counts in the long run in the prosperity of the station. It is the business of the illuminating engineer to determine the usefulness of the station output so far as lighting is concerned, and to give the consumer the best value possible per watt or per cubic foot. This is not a task to be passed over lightly.

Primary and Secondary Standards of Light.

The paper by Dr. Edward P. Hyde, of the U. S. Bureau of Standards, on primary and secondary and working standards of light which was read before the recent Illuminating Engineering Society convention and published in abstract in our issue of August 3, last, contains some very clean-cut definitions of the things which must be expected of primary and secondary standards. As Dr. Hyde points out, the important thing in a primary standard is the possibility of reproducing it exactly from [illegible] and working standards, the possibility of exact reproduction [illegible] desired is constancy after a calibration and comparison with the primary standards. There is no reason whatever why primary and working standards should be the same, as the things required of them are so different. As a matter of fact, we are in a very much better condition to-day as regards the reliability of secondary and working standards than as to primary standards. The electric incandescent lamp when properly seasoned and calibrated, and when used in connection with reliable voltmeters and ammeters, is very satisfactory as to constancy. In fact we are much more sure of the constancy of such standards than of the ability to reproduce the various primary flame standards in use. The principal laboratories of the world are now working with secondary standards which were derived from primary standards many years ago, and by checking back and forth between the different laboratories of these secondary standards a much closer degree of accuracy is obtained than if attempts were made to reproduce any of the various primary flame standards for units of reference.

For all practical purposes, at the present time, therefore, in electrical work the standards are secondary ones derived from comparison of incandescent lamps. So far has this matter gone that it is a question whether the adoption of any primary flame standard of light will change the situation. It is, nevertheless, desirable if an exactly reproducible primary standard can be found, that it be adopted for purpose of reference. It is not, however, desirable to cling to flame standards that may involve considerable errors in reproduction. If the standard of light could by agreement be made the average of several hundred incandescent electric lamps carefully selected and kept by the principal standard bureaus of the world, the chances of error in the course of years would be much smaller than they are now with flame standards. We do not at the present day calibrate units of length by comparison with a fraction of the earth's quadrant, the original standard, but by comparison with certain bars kept at national laboratories. Likewise there should be no reason for comparing our present secondary light standards with the original candle or hefner even if that were possible. Less error is involved by comparing it with the more definite and less elusive incandescent lamp secondary standards in the principal national laboratories of the world.

Municipal Ownership in Paris.

In Paris, the electric lighting franchises were originally so drawn up by the city that at the end of a certain period the system of conducting mains in the streets reverted to the city, without further compensation or purchase. That period is already at hand, and the electric-lighting companies found themselves still possessed of their stations and plants, but facing the loss of ownership in the conducting and distributing mains. This naturally gave to the city a great advantage in its negotiations for lighting contracts; since if the terms were unsatisfactory, the city could take the position of desiring to construct its own power houses. In order to meet the situation, a new company has been formed, taking over the old power houses of the original companies and supplying power [illegible] lasting for a fixed number of years. At the end of that period, the city will take over the entire plant, power-houses and all, without further compensation. In the meantime, the [illegible]

contract for lamps and motor operation, as well as the discount which is made for lighting the municipal offices and the streets. Since the new company contemplates building at least one new power-house, besides installing additional mains, and has to recoup itself completely within the fixed period of about thirty years, it is clear that the arrangement is not best adapted to meet the public need. Of course, to the socialistic mind it sounds well that after the termination of the contract the city will get the entire lighting plant for nothing.

In theory, perhaps, all that the municipality will have to do at the end of the contract will be to appoint its own employees, and proceed to operate the system for the public benefit at rates that can be theoretically reduced, because no dividend will have to be earned on invested capital. But it is unreasonable to expect that the company will expend money towards the close of its contract for the purpose of renewing or developing the plant. It could not do so in justice to its stockholders, when no return is expected for such expenditure at the termination of the contract. It is only reasonable to suppose that the plant will ultimately be operated with the greatest immediate economy, which is necessarily inconsistent with the greatest ultimate economy. Large expenditures for upkeep, repairs, renewals and betterments are then to be expected when the city finally takes over the system, and this expense will have to be made good by taxation. Meanwhile, towards the close of the contract, extensions of the plant will be commercially impossible, and the public will be prevented from securing increased electric lighting; while they will have to pay for energy more than would be necessary, if the company did not have to realize on its capital within the contract period. The advocates of municipal ownership of all possible public services often ignore the fact that the highest public welfare can only be secured by promoting within reasonable limits the private welfare of those citizens who advance capital for the public service. The socialistic doctrines recognize the power of capital, but commonly ignore the power of management and of trained intelligence in the direction of affairs. The popular impression too often is that because a city owns a large public machine, such as an electric lighting system, it can operate the system as efficiently as the owner whose funds are at stake therein.

New Incandescent Lamps Abroad.

Only a few years ago it seemed as though the carbon-filament incandescent lamp was destined to light the civilized world for an indefinite period. Such evolution as had taken place in the filament of the incandescent lamp, since the production of the 100-volt high-resistance lamp, had been in improving the quality of the carbon with respect to uniformity, longevity and cheapness. It was the discovery of the osmium filament which, at one blow, imperilled the prestige of the carbon filament. The tantalum lamp next arrived on the scene, and again damaged the prospects of the survival of the incandescent lamp. Finally the tungsten lamp came to predict the ultimate disappearance of the carbon filament. As the matter stands to-day, it really seems doubtful whether carbon-filament lamps will be found 50 years hence, except in historical museums. In England and France, the tungsten lamp has as yet scarcely made its presence felt; but the tantalum lamp has come into fairly extended use, especially in France. In England, the public electric lighting conducting networks are nearly all three-wire systems with about 430 volts between the outers and 215 volts on each side of the neutral, the standard incandescent lamp being a 215-volt 8-cp carbon-filament lamp. In France, the three-wire system with 220 volts between outers is in general use. Consequently, the new metallic-filament incandescent lamps are handicapped and retarded in England, by comparison with America and the continent of Europe. It is well known that it is fairly easy to produce 55-volt, 16-cp tungsten filaments, very hard to produce them for 110 volts and 16 candle-power, and practically impossible at present to produce them for 220 volts and 16 candle-power, so that it is at present a fortiori commercially impossible to the second power to produce them for 220 volts and 8 candle-power.

The reason for the 220-volt incandescent lamp habit in Great Britain seems to be attributable to original legislation. The original lighting systems in England were 220-volt three-wire systems with 110 volts on each side, feeding 110-volt lamps. The framers of the early electric lighting laws, by which companies were permitted to lay down lighting mains in city streets, apparently assumed that if the companies were allowed to sell the lamps exclusively to their customers in addition to selling them the electrical energy for operating the lamps, the country would go to the dogs, and life in Great Britain would be intolerable. Just why, or how, the companies would have been able to crush the public, their own customers, if they had been allowed to supply the lamps, as in America, it is now difficult to see in the light of experience; but the effect of the legislation was, as intended, namely, to divorce the business of lamp supply from the business of energy supply. Consequently, all that the regular central-station manager had to think about was how to supply killowatt-hours through his customers' meters in any manner that the customers would accept, and so long as the customer was content to take energy, he had no concern with the incandescent lamps used, or with the manner of using them. Naturally, he preferred to supply the energy at 440 volts between outers, rather than at 220 volts between outers, because the former involved one-fourth as much copper in the conducting network as the latter, for the same area of district and number of lamps suppplied. The motors on the system were readily capable of being supplied from the outers with 440 volts, and as for the lamps, they could be obtained for 220 volts, although they could not be obtained for 220 volts of the same quality as for 110 volts at the same price. The public, not being experts, did not usually inquire into the relative merits of 110-volt and 220-volt incandescent lamps for eight candle-power. They bought reasonably operating lamps at the lowest offered price, and the law prevented the electric lighting station manager from interfering.

The result of the original paternal legislation, together with open competion in the sale of incandescent lamps to a non-expert public, has been to reduce the selling price of a kilowatt-hour at customers' meters to a relatively low value; *i. e.*, to make electric energy relatively cheap in Great Britain; and to make lamps nominally cheap, but actually expensive in operation. So low was the average efficiency, and so high the average consumption in watts per candle actually delivered, that the general reputation of electric lighting in England suffered. Efforts have recently been made, however, to improve the standard of incandescent lamps on the market, and many central-station managers have felt that their efforts in this direction were well repaid.

A Lively Discussion on the Atom.

[illegible] sions over the latest theories and investigations as to radium, the nature of the atom, and the transmutation of the metals. A special dispatch of August 2 says:

A battle royal was waged at to-day's meeting of the British Association at Leicester between the chemists and the electricians. The fight was around the atom, and at the close of a three hours' contest Sir William Ramsay, as the representative of the chemists, announced the results of his recent experiments with radium emanations. It is impossible to exaggerate the sensation made upon the meeting by Sir William's paper or the possible effects of his experiments on the future of chemical science.

The discussion gave a remarkable picture of the way in which modern science works. Helium was first discovered in the sun by the spectroscope. Thanks to the hint from the sun, Lord Rayleigh's son, the Hon. R. J. Strutt, among others, discovered helium in almost every mineral experimented on, and perhaps the crucial secret lies in the fact, discovered quite recently, that helium is an emanation given off by radium and two other substances. This is said to prove that a change of matter into another form is possible.

Hence one party has come to believe that there is no such thing as matter; that matter is a shape assumed by electricity; that an atom is not a permanent thing, but a sphere enmeshing little units of electricity, now called electrons. The whole atom, Sir Oliver Lodge says, squirms with electricity, and when it escapes, as in radium, the atom will at a certain point change into something else.

The chemists, and especially Mr. Soddy, one of the youngest and most brilliant investigators of the present time, regard this school as drunk on radium rays, and Lord Kelvin, who finished the debate to-day, came out heavily on their side. He spoke with wonderful fire and imagination of the infinite possibilities to which radium had opened scientists' eyes, but he declined absolutely to believe that matter is a form of motion, and that the atom is merely whirls of electrons that may escape and break down bits of matter that have existed unchanged since the earth was nebulous.

When Lord Kelvin had ended Sir William Ramsay announced the results of his recent experiments with radium emanations, which have already been given. Experiments are now in progress with gold and other substances, and may furnish proof of Sir William's belief in the transmutation of elements and of the theory of decomposition. In any case, these wonderful results of Sir William go far to strengthen these theories.

Brooklyn Co-operation in Business Getting.

The Edison Electric Illuminating Company, of Brooklyn, N. Y., on Tuesday, July 30, entertained the electrical contractors of Brooklyn at the Brighton Beach Hotel, Coney Island. Upon arriving at their destination, whither they were transported in chartered trolley cars, a group photograph was taken on the steps of the hotel. Immediately thereafter a banquet was served.

When the cigars were lit, W. W. Freeman, vice-president and general manager of the company, arose and congratulated the electrical contractors of Brooklyn upon their growth in numbers and prosperity as unmistakably evidenced by the company present. He dwelt upon the mutual advantages to be obtained by co-operation between the contractors and the electric lighting company, and cited figures to show that expenditure of money and effort on business-getting methods, such as advertising and soliciting, have proven exceedingly profitable to the company, and would doubtless prove equally profitable to the contractors. He urged them to increase their efficiency as business-getters.

Mr. James R. Strong, president of the National Contractors' Association, was the next speaker, and he also dwelt upon the necessity for co-operation between contractors and company, and also upon the advisability of co-operation among the contractors themselves. Mr. E. J. Theimer, president of the Long Island Contractors' Association, and Mr. C. A. Christensen, president of the Independent Contractors' Association, also spoke, while Mr. W. F. Wells, operating superintendent, and Mr. P. R. Atkinson, treasurer, of the Edison Company, spoke briefly on matters of mutual and technical interest.

Mr. J. C. Forsythe, chief inspector of the New York Board of Fire Underwriters, delivered an excellent address on the importance to the electrical interests of the body he represented, and urged upon the contractors, for their own sakes, as well as for the welfare of the community, the necessity for doing their work in the best and most thorough manner possible. Mr. T. Beran spoke for the General Electric Company, which he was present to represent. After the speechmaking, the guests were given their choice of an evening at Luna Park or at the Brighton Beach Music Hall. The party divided about evenly on this issue, and the rest of the time was spent in enjoying vaudeville and spectacle.

Empire State Gas & Electric Association.

Since the June convention of the Empire State Gas & Electric Association at Lake Champlain, N. Y., the executive committee acting under the instructions given it at this meeting has appointed the three committees authorized as follows: Public Utilities Commission—W. W. Freeman, vice-president, Edison Electric Illuminating Company, of Brooklyn; M. J. Brayton, general manager, Utica Gas & Electric Company; Chas. R. Huntley, vice-president, Buffalo General Electric Company. Accounting Committee—R. A. Carter, secretary, Westchester Lighting Company; A. S. Cooke, auditor, United Gas & Electric Company; G. W. Curran, assistant general agent United Gas Improvement Company. Insurance Committee—E. A. Davidson, president, Hudson Counties Gas & Electric Company; T. O. Horton, secretary, New York & Richmond Gas Company; L. W. Emerick, vice-president, Fulton Light, Heat & Power Company. The Public Utilities Committee is sending out a circular letter to all gas and electric companies in the state asking them to send to the secretary notice of all applications made to the Commissions and any information in reference to them. Data will be collected with reference to each of these applications, as to the time required by the commissions, the rulings of the commissions and the reason for these rulings. This data will, of course, be available to all members and should be found very useful.

It is hoped that in this way any defects in the law will be discovered and such evidence collected as will make it possible to secure reasonable changes. In order that this may be accomplished it is essential that the companies should cooperate with the committee to the extent of furnishing the desired information.

There is no doubt but that a uniform system of classifying accounts will be established under the utilities law and a committee has been appointed to investigate this subject with the idea that it is possible to have a classification adopted which, while furnishing all the information desired by the authorities will also be satisfactory to the companies. It is a large and very important matter and it will take time to arrive at any final conclusions, but the work is being gotten under way in such an energetic manner that some beneficial results, at least, are already assured.

The discrepancy in fire insurance rates for similar risks was shown very clearly in Mr. Davidson's paper at the convention and it was felt that something could be done towards obtaining a more uniform basis or some scheme of mutual insurance could be devised. A committee was therefore appointed to investigate this subject. Unfortunately this committee has not as yet been able to have a meeting but expect to organize and start the investigations this week.

Production of Copper and Brass.

In its report just made public for the year 1905, the Census Bureau at Washington shows that in that 12 months period the value of the product refined and smelted in New Jersey—$62,795,613—was 26.1 per cent of the entire valuation of the industry of the country—$240,780,216. The growth of the industry in five years and the percentage which the states most actively engaged in smelting and refining copper is shown best in the following tabulation:

	[illegible]	[illegible]	Per Cent. [illegible]	Total. [illegible]
United States	$24[illegible]	$[illegible]	[illegible]	[illegible]
New Jersey	62,[illegible],613	[illegible]	[illegible]	[illegible]
Arizona	[illegible]	[illegible]	[illegible]	[illegible]
Michigan	[illegible]	[illegible]	[illegible]	[illegible]
California	[illegible]	[illegible]	[illegible]	2
Other States	[illegible]	[illegible]	[illegible]	[illegible]

The value of the brass and copper wire industry in 1905 was $19,657,743, against $4,278,635 in 1900. In 1905 a total of 1406 short tons of copper rods were manufactured, valued at $463,057. In the same time 25,966 short tons of copper wire were turned out having a value of $7,252,917. The value of brass and bronze manufactures and rolled copper for three different years compares as follows:

	1905	[illegible]	[illegible]
Brass	$[illegible]	$[illegible]	$[illegible]
Brass and rolled copper	51,912,853	44,309,829	8,381,472
Brass castings	[illegible]	[illegible]	[illegible]
Bronze castings	2,622,[illegible]	2,229,[illegible]	[illegible]
Total brass (not including wire mentioned above)	$102,407,104	$88,653,987	$50,656,101

Liability for Electric Light Fires.

Mr. W. H. Blood, Jr., the insurance expert of the National Electric Light Association, has recently addressed to the members a very interesting communication in regard to recent litigation in New York, over electric light fires. We present the document below, as it is of more than usual interest, and is particularly important to central station companies:

There recently appeared in the *New York Herald* an article, evidently inspired by an attorney representing some insurance companies, which was largely exaggerated and contained a certain amount of misinformation. As this matter is liable to come to your attention in some way or other, later on, it seemed advisable that you should know the true facts in the case.

The Appellate Division of the Supreme Court affirmed the judgment of the trial term in the case of the Continental Insurance Company against the New York Gas, Electric Light, Heat & Power Company and others (The New York Edison Company). The case was tried before Mr. Justice Truax in December, 1906. It was claimed by the plaintiff that the building was destroyed by a fire which was started by the contact of a secondary wire upon a tin roof, or cornice, the wires having sagged on account of the negligence of the electric light company.

At a former trial, the plaintiff attempted to prove that the transformer was faulty, but it was shown, and later on admitted, that it was in perfect order and no trouble could have resulted on account of its condition. The plaintiff brought out the evidence in its case through a policeman and a fireman. No evidence was introduced to show that more than one wire touched the roof, or in what condition the secondary wires were elsewhere. On the other hand, the claim of the electric light company was that only one wire touched the tin cornice and that under such conditions no fire could have resulted; that the cornice was considerably rusted and that the fire burned outward rather than inward.

The testimony of experts for the National Electric Light Association was that an arc would not have lasted long enough to burn a hole in the tin and set fire to the wood, because the fuses in the transformer would have melted. Inspectors from the Board of Fire Underwriters and city inspectors testified that the wiring was in good condition when installed and was put up in the proper manner. Various employees of the company showed that when the wires were first installed, and several times previous to the fire, they were all in good condition.

The real question which came before the jury was as to whether or not the company had been negligent in allowing its wires to sag and rest uninsulated upon the tin cornice. The jury in this particular case decided that the company was negligent, which, of course, was a question of fact upon which juries might differ.

The newspaper clipping above referred to stated that insurance companies pay an average of $25,000,000 per year for such losses, and that this decision makes it possible for them to get back most of their money and at the same time enforce perfect wiring of buildings.

As there are in all a very few similar cases to the writer's knowledge pending against the total number of companies which are represented in the National Electric Light Association, this statement is not only misleading but gross misrepresentation. No such conclusion, therefore, can rightfully be drawn from the decision in the case above referred to.

The Licensing of Electrical Contractors.

At the recent convention of the National Electrical Contractors' Association, in New York, an interesting paper was presented by Prof. G. F. Sever, on municipal relations with the contractor. He discussed the general situation, and in regard to one or two points of special interest said:

"There has been, up to within a short period, another authority whose inspection it was necessary to secure before an installation was placed in service. I refer to a local lighting or power company which does not care to have the wiring, which a contractor places in a house or factory, connected to its mains to cause trouble, even though it has passed the inspection departments of the underwriters, or the municipal inspector, if there be one. In many localities this inspection by the lighting company has been abandoned and dependence placed upon the certificates of inspection of the underwriters and the municipal department and also the standing of the contractor. This latter recognition is, I feel, one of the important steps in the direction of doing away with the multiplicity of control and inspections which has caused so much annoyance and disfavor in the past, and which is present even now where the underwriters and the municipality make either joint or separate inspections. In isolated plants, or where power is not taken from the mains of a power company, one inspection should govern, and if the municipal organization could so arrange, it might be well to recognize the standing of the best electrical contractors and omit the detailed inspection of their work.

"Bearing immediately upon this subject is the question of the control over the additions and alterations made to existing installations by the men in responsible charge of the isolated or other equipment. Much work of this character is done and some is done in execrable fashion and against all the rules of the National Electrical Code and the locality. How should these be handled? The municipal inspector cannot go over every installation each year or in any regular manner. An insurance inspector may not be called upon for some years to go over his former inspection and thereby find some changed conditions; and the owner of the building does not have his attention drawn to the fact that there have been changes which he should have called to the attention of the authorities. It is well recognized that any one with some skill and a few appliances can put up electrical devices and wiring, but in so doing may wholly fail to comply with those rules intended to safeguard that portion of an electrical installation which gives most of the trouble—the wire. It is for this reason that the situation is a difficult one to cope with and to solve equitably. If licensing is really the only cure, I fear that it will never be looked upon with favor by the community, as the public would not consider the danger sufficiently great to warrant shutting out workmen from small undertakings which may have but a small risk in them. And furthermore I do not believe in issu

[illegible] of control under the suggested conditions which I have observed and studied. State licensing is that which I have in mind and the conditions surrounding the equable adjustment of the regulations, and the carrying out of examinations are not such as in my mind would warrant its establishment."

Electrical Opportunities in India.

Some data with regard to Indian electrical development have been forwarded to the State Department by U. S. Consul-General W. H. Michael, of Calcutta.

The little city of Poona is situated 45 miles from Bombay at an elevation of 1800 feet above sea level. It is a week-end resort for many of the well-to-do citizens of Bombay, who have fine cottage homes there, or have reserved suites of rooms at the hotels and boarding houses. It is rather a fashionable hill suburb of Bombay. It has all sorts of accommodations for sports and a race course that is considered equal to any in India, which boasts of many of the finest mile courses in the world.

The latest improvement at Poona is an extensive electric car system. A Bombay firm has made a start with a scheme to provide Poona with electric energy for lamps, motors and cars. The supply, at first, is to be confined to the municipal limits of Poona, and this area enlarged as the demand requires. It is proposed to supply the energy from a central station, and to lay underground mains, or to erect overhead wires, as may be approved by the local government. All the streets to be supplied are under control of the municipal government, but it is already understood that there will be no opposition by government to the proposed scheme.

No country stands as well in India as America in regard to all kinds of electrical machinery and supplies, as well as to methods in the use of them. American electrical engineers are considered the best in the world, and it is suggested that they pay some attention to the Poona proposition.

The extensive electrical works in Kashmir, under the direction of American electrical engineers, are making rapid progress toward completion. The power is derived from the Jhelum River, below Baramulla. The big flume, capable of carrying [illegible] horse-power is completed and the turbines [illegible] 5000 horse-power are being installed. Electrical energy for mills and other purposes will be conveyed to Serinagur, many miles away. The scheme is a large one, and great commercial results are confidently expected. The comfort and convenience that will necessarily follow to a large territory occupied by millions of people would be hard to describe. The items of lighting and operating electric fans alone are worth the expenditure on this great enterprise.

Expert Investigations in Municipal Ownership—III.

In our issues for July 20 and 27, have been given abstracts of the reports of the Municipal Ownership Commission of the National Civic Federation, taking up the investigations in this country and in England. In the last named issue were presented some of the data as to Great Britain, on electric lighting, with the comments in favor of municipal plants and the adverse remarks of Messrs. Edgar and Clark, which are now resumed and are continued below:

The examination of the electric lighting systems of Great Britain, both municipal and private, shows, according to Mr. Edgar and Mr. Clark, that municipalities in England, though said to be much better governed than are those in the United States [illegible] tion of an electric lighting plant as are private companies controlled by men of average honesty and ability whose training and initiative are given full scope. "It appears," they add, "that so far as the prices charged are concerned the system of municipal ownership and operation of electric undertakings in England has given its advocates no reason for feeling ashamed or elated, but that so far as extending the benefits of electric light and power and so far as progressiveness in developing the industry so as to give the best possible service are concerned, it has shown itself to be entirely outclassed by the system of private operation."

Messrs. Edgar and Clark in closing their review summarize their opinions as follows: "The efforts of the National Civic Federation have resulted in a commission of Americans whose first interest in this investigation, as in all else, is to do what they may to preserve and continue the American idea and American institutions, believing that the high state of civilization and of prosperity in America justify the American idea and the American method, and place the burden of proof heavily upon those who would say another idea and another method would result in improvement in the condition of the people. Believing this to be the thought and intent of the membership of the commission and of the committee subordinate to it, we still believe that there are ills in the American body politic that may be remedied or cured. We believe that the remedy should be applied and the cure effected without any unnecessary departure from the American idea and the American system. We believe that the framework upon which may be built purity of administration and the highest possible good of the citizens is in existence with us, and that it is not necessary, in the effort to cure the ills from which the body politic may be suffering, to destroy that body. We submit that, living in a land where peace and prosperity are the common lot, we must be very cautious of change. This does not mean that where abuses are found to exist they should not be promptly and mercilessly eradicated, but it does mean that changes in system should be undertaken only after conclusive proof that such changes will result in bettering the condition of the individual. We had better bear the relatively few ills we have than subject ourselves to unknown conditions that may bring in their train greater ills of which we do not know.

"Our investigation has determined with certainty many heretofore mooted questions. It indicates the probably correct answers to other mooted questions. Where the facts are clear and the conclusion evident our task has been to summarize and indicate. Where there is remaining uncertainty as to facts, and conclusions are not evident, we have made an effort to determine the probabilities. This has resulted in arguments based on such facts as our investigators have recorded, and on our own experience as operators and observers. We believe no intelligent reader of the voluminous record of this Commission's work will fail to conclude that it clearly proves municipal ownership to be productive of many and serious ills, with little or no compensating good.

"The writers of these chapters, agreeing we believe with the other members of the committee of 21, that public service companies should reasonably be regulated and afforded the protection that comes with regulation, and appreciating that the committee was not appointed or constituted to consider methods of regulation, nevertheless desire to record their opinion, that some form of regulation of private companies should be adopted in each of the United States. What that form should be this commission is not prepared, by any investigation or any study it has made, to suggest.

"Finally, we who stand in opposition to municipal ownership, speaking, we believe, for all individualists, arraign the arrogance of many of its advocates [illegible] clusively occupy the field of reform in dealing with the problems concerned, and that they are the sole promoters of measures of economic improvement in municipal affairs. We assert that the opponents of municipal ownership and operation, firm and consistent supporters of justice, are the class seeking the public welfare intelligently and in accordance with American prin

ciples. On this point we do not yield to any body of men. We seek, as a first principle, to insure to every man his own. In doing so, and in endeavoring to protect the public against oppression and error, we find it our duty to demonstrate the errors in the schemes of municipalizers and Socialists and to warn against the oppression that they threaten. We are resisting efforts to put burdens on the backs of the American people. We cannot and will not remain silent while the attempt is made to thrust costly and impracticable projects upon customers of public service corporations and upon the public at large. We know the truth will out. We are confident that ultimately the American people must appreciate at their value the unsoundness of the arguments of the municipal socialists. We shall aid in hastening the day when our fellow citizens will know through discussion what the public of London have been taught by bitter experience. London has awakened to the perils of municipalization, as is evidenced by its verdict in the recent borough and county elections. In that great city the municipalizers have led their fellow citizens astray, and their dupes, finding it out, have administered to their false guides an overwhelming rebuke.

"We individualists are not seeking to lead the people in strange paths; our aim is to keep them in the paths they have heretofore trod; paths well known, along which the American people have marched to heights of prosperity and civic development not known heretofore to the civilized world. Along these paths have been stumbling blocks. Our opponents are endeavoring to persuade us the sole responsibility for these stumbling blocks rests upon our public service system, to be remedied only by a change of system. This we deny. We are patiently studying the ways of justice; municipalizers advocate experimenting, at enormous cost, with public funds, with the principles of liberty and with the institutions of our country. In this we stoutly refuse to take part. We are conservatives in believing that it is better to adhere to old and tried methods based on our accepted national principles; but radicals in the determination to discover and to sternly rebuke and rectify any injustice which may have been developed by the present system. As it has always been the function and duty of government to insure that individuals shall deal justly with their fellows, it is now the function and duty of government to protect the governed against injustice on the part of these associations of individuals working under the name of public service corporations. Any government that is too feeble or corrupt to control with justice the conduct of a public service corporation has little prospect of being able itself to supply such public service with efficiency and justice. Our duty is to elect to office men who have the intelligence and integrity to govern efficiently, honestly and justly; men who can and will curb the unjust aggressiveness of the individual, or of the voluntary association of individuals, and who can and will compel each to bear its share of the burdens of government, and give in price, service or otherwise a proper consideration for special privileges enjoyed. Our nation is what she is industrially and commercially and in world politics because of the American character, developed by the most absolute individualism, and because of the American corporation, developed under a government that governed but did not trade. Our duty is to conserve the human agencies that have made our country what it is—the adventurous individual and voluntary association—but not to let them be our masters. This is the confession of faith of the anti-municipalizer—the anti-socialist."

Electric Lighting in Germany.

In a paper prepared for the National Electric Light Association, but received too late for the Washington meeting, Prof. Dr. Phil. G. Klingenberg, of Berlin, Germany, describes the electric light conditions in that country: The author points out the advantages possessed by electricity over gas for illuminating purposes and also wherein the high price for electricity forms a hindrance to its rapid introduction. It is [illegible] quite general to divide the annual cost of the generation of electricity into constant expense and variable expense. On this basis the constant expense with modern steam central stations of average size is between \$20 and \$32.50 per kw per year. The variable expense is between 0.6 cent and 1.25 cents per kw-hour. From these figures the author shows that the extra cost per kw-hour incurred through an increase in consumption, the capacity of the plant remaining the same, is very slight. The tendency of consumers on the other hand is to reduce their expense for lighting by burning lamps as little as possible. On this account central stations have charged special rates to long consumers by introducing tariffs with a certain fixed rate of charge calculated on the maximum power demanded and an additional price per kw-hour shown on the meter. To charge a consumer the same rate for a lamp which does not burn often as for another lamp which is lighted is no doubt a hindrance to the introduction of electricity. The double tariff extensively applied in Germany overcomes this difficulty. A normal charge is made for electricity during the time of greatest consumption, but at other times the price is very much lower. An advantage resulting from this system is that the motor load and the lamp load do not overlap to the same extent as they do where the single tariff or a maximum tariff are in use.

The author then considers the influence of potential on electric lighting. Contrary to American practice preference has been given on the continent to a circuit pressure of 2 x 220 volts, on the assumption that a loss of 10 per cent to 12 per cent in the economy of high tension carbon filament lamps is more than balanced by a saving in interest and depreciation in the network. A reasonable tariff and low initial expenditure with the accompanying low rates lead to a general introduction of electricity and help to overcome the competition of gas. The price of electricity is, however, still higher than that of gas and were it not for certain improvements in incandescent electric lamps, the development of gas lighting and the introduction of inverted gas burners might have seriously hampered the further introduction of the carbon filament lamp.

Dr. Klingenberg here notes the improvements made in Nernst and in incandescent lamps and shows their superiority over the older lamps. He draws attention to the fact that the high efficiency lamps are at present only made for 110-volt circuits and states that replies to a circular inquiry addressed to managers of central stations in Germany show that a large proportion of the engineers are in favor of a potential of 110 volts, the present standard being 220 volts. The author is of opinion that the introduction of 220 volts during the time when no other than carbon filament lamps existed was a mistake, so far as lighting circuits were concerned, since the cost of electricity was increased because of the fact that the 220-volt lamp was not as efficient as the 110-volt lamp.

Engineers now consider it absolutely necessary to return to 110 volts whenever possible and to stop carrying out new installations for 220 volts. The author is of opinion that eventually a high-efficiency, 220-volt lamp will be forthcoming, although a less sanguine manufacturer states that it will not be possible to make 220-volt, high-efficiency lamps on a large scale until the process of manufacturing 110-volt lamps has reached a very high state of perfection and the price of the lamps has come down in consequence. It is evident that lamps for 220-volt circuits must have very long filaments and the natural result will be a very high percentage of breakage during manufacture, in transit and in use. Dr. Klingenberg is not to be weaned, however, from the 220-volt system and maintains that new schemes should be based on a supply of 2 x 220 volts as heretofore in spite of the contrary opinions expressed.

With reference to arc lamps, the author believes that the smaller sizes of arc lamps consuming two amperes at 110 volts must give place to the high-efficiency, incandescent lamp. He considers the 500-cp arc lamp the smallest that it is worth while to make, and states that the arc lamp industry is already preparing to meet a future demand for more light out of doors. Units giving 5000 candle-power are not beyond practical requirements in roads and places where traffic is congested [illegible]

proved by the lighting of the Potsdam Platz in Berlin with eight flaming arc lamps each consuming 20 amperes. The lamps are mounted on two high posts so that the burning point is fixed at a height of 18 meters above the level of the road. By this means, the source of illumination is not disagreeable to the eye and the lighting of the square is as uniform as possible, the total light given by the lamps approximating 40,000 candle-power. The author points out the disadvantages of the luminous arc, such as the color and flicker in the light itself, the expense of trimming, cleaning, etc. Brief mention is made of the advantages of the mercury vapor lamp.

CURRENT NEWS AND NOTES.

METER INSPECTION.—The New York State Civil Service Commission will hold examinations on Aug. 24 for a number of positions, including an inspector of electric meters under the Public Utilities Commission. The salary is not stated. Information can be obtained from Mr. C. S. Fowler, chief examiner, Albany, N. Y.

BUSINESS EDUCATION.—In a recent paper on the technical press, read before the National Electrical Contractors' Association, Mr. T. C. Martin said: "To-day nearly nine per cent of the graduates from the Sibley College of Engineering at Cornell University are 'sales engineers,' a somewhat larger per centage are directly engaged in manufacturing, and about 4½ per cent are employed in the superintendence of manufacturing and construction. We have therefore obviously reached a period when technical education and training are vital qualifications for business life; and of all the weapons for success in the struggle, none is quite so ready to hand as, none has a keener edge than, the press of any given art or industry. It is no wonder then that, speaking at the same University, Mr. Andrew Carnegie should have emphasized this very fact."

RESISTING A BOYCOTT.—At Helena, Mont., on August 3, the Rocky Mountain Bell Telephone Company filed suit in the Federal Court against the Montana Federation of Labor, the Livingston Trade and Labor Council, Telephone Operators' Union No. 42, Alex. Fairgrieves, H. O. Smith, L. W. Thorpe, Almodose Grenier, and Effie Le Fevre to secure an order restraining the respondents from interfering with or molesting in any way the business of the company, and to shut off the boycott, which the complainant says has been in force since March 14 last. An order to show cause why the application for the injunction should not be granted was made by Judge Hunt, returnable September 16. The trouble is caused by the strike of the linemen in Utah, Idaho, Wyoming, and Montana, the Montana federation having ordered the Rocky Mountain Company, declared unfair in all Montana cities, and ordering out all switchboard operators.

TELEGRAPH IN MANCHURIA.—U. S. Consul-General J. W. Ragsdale, of Tientsin, advises that according to Chinese reports the Government has paid $160,000 for the telegraph lines erected in Manchuria, and Russia has abandoned her plan to construct a service along the Sungari. Mr. Ragsdale adds: Certain sections of the line attached to the railway will be available for China's use free, and all Russian messages passing over Chinese lines will be accepted at 20 per cent less than the public rates. The new president of the Board of Communication proposes to establish wireless telegraphy in Mongolia. It will be much cheaper, as no guards will be required to protect the service except at the operating stations. The proposal is generally approved, and steps are now being taken to ascertain the opinion of the officials on the spot. No particular system of wireless telegraphy is mentioned, but the Marconi system is the one likely to be selected.

CODE OF ETHICS.—[illegible] the recent A. I. E. E. meeting at Niagara Falls, [illegible] of the proposed code of ethics back to the council for repairs before adoption, the *Electrical Times* of London says: "This is the first instance in America of an engineering society laying down a formal code of conduct for its members. The nature of the new code was the subject of notice here a fortnight ago. It is drafted in very choice American (thus electrical engineers are not paid for their work but receive 'compensation' and so on), and it is obviously the result of a well intentioned compromise. Thus rule 5 is that 'The electrical engineer should incline towards standards of all kinds' for the good of the industry, but rule 7 is that the electrical engineer should consider his clients' interests before everything. The 'standards' clause was in fact a little too much for the ELECTRICAL WORLD, which characterized it as entirely out of place, but the Convention adopted it with the rest. As a matter of fact it is next door to an impossibility to draft a code of professional (or any other) ethics that will satisfy everybody and yet be so categorical and explicit than one cannot dodge or disregard it."

UNIFYING LONDON.—One of the difficulties in giving London a unified electrical energy supply has been the number and diversity of its present sources and authorities. A special committee of the House of Commons is now sitting to consider the city of London union of parishes bill. The city corporation is promoting the bill, the object of which is the unification of the 114 parishes which now compose the city into one parish for civic purposes under the control of the city corporation. As it is now each parish independently fixes its own taxes and controls its own affairs. Rates vary 50 per cent, which one ratepayer whose business house stood in three parishes found extremely complicating, as he had to pay three different rates on three different scales. Within the city's square mile of area there are no fewer than 750 properties which stand in two or more parishes. This causes the greatest confusion in deciding how much is due each parish. This system necessitates the maintenance of 114 different sets of books and officers and has resulted in doubling the officers' salaries between 1891 and 1905. The bill seeks to make the common council overseers of a parish of London which shall have one uniform rate and one rule of authority.

CHINESE TELEGRAPHS.—[illegible] of the Imperial Telegraph Administration, prepared by Mr. F. D. Cloud, student interpreter of the Shanghai consulate-general, contains some interesting items: Originally this system of telegraphs was a private concern organized by wealthy Chinese officials and gentry, but some eight or nine years ago the Central Government took over control of the company, allowing certain merchants to retain their shares, increased the capital, and secured a monopoly of the business throughout the Empire. Under Government management the system is approaching a tolerable degree of completeness and usefulness. Of late years, also, it has been paying fairly good dividends, amounting to 10 per cent in 1906, and this, too, in the face of rather large extensions of the system. The total receipts of the system for the year were $1,597,176 United States gold, made up of the following items: From commercial business, $879,994; official business, $98,058; from general business, $619,124. The total expenditures for the same period were $951,639, as follows: For the maintenance of the superintendent-general's office, $34,252; maintenance of general office, $37,108; running expenses of the various stations, $429,888; expense in connection with official business, $20,910; all other expenses, $429,391. According to the showing the gross profits for the year were [illegible] And after paying the Government royalty of $129,807 the administration was still able to pay the private shareholders a dividend of 10 per cent; all of which goes to show that the telegraph, like the railways, has come to be regarded by the Chinese as a public necessity, and likewise the telegraph, like the railway, has a great future in China.

LIGHTING RATES IN CHICAGO.—The central-station companies of Chicago reduced electric lighting rates on August 1 by making the rate on all electricity used in excess of the equivalent of 30 hours' use of the maximum demand per month at the rate of 8 cents per kw-hour instead of 9 cents, as formerly. The rate on the first 30 hours' use is 14 cents, as before.

NEW COLON CABLE.—The recently laid cable of the Central & South American Telegraph Company, direct to Colon, Panama, was opened last week without ceremony. The cable begins at the Morris Building, Broad and Beaver Streets. Commercial telegrams were started over the cable wires shortly before noon on Aug. 1, and a great amount of work was transmitted in a few hours.

LONG-DISTANCE PHOTOGRAPHY.—A special cable dispatch from Berlin, Germany, of July 31, says: "Most successful experiments in long-distance photo-telegraphy from Munich to Berlin (about 320 miles) were carried out to-night by Prof. Stern. For the purpose the Government had loaned a direct wire. The apparatus was operated without a hitch. Photographs of Emperor William, the Crown Prince, and Prof. Stern were received here over the wire, faultlessly developed. The experiments will be continued next week from Berlin to Munich."

CUTTING METALS.—"The Art of Cutting Metals," by Frederick W. Taylor, M.E., Sc.D., which was the admirable presidential address presented at the last annual meeting of the American Society of Mechanical Engineers, have been reprinted and bound in cloth by the society; price, $3. This or any other publication of the society may be had by addressing the secretary, 29 West Thirty-ninth Street, New York. It is not necessary to send orders through members. None of the publications of the American Society of Mechanical Engineers are copyrighted.

NAMES AND ADDRESSES.—Mr. John T. Huntington, superintendent of the Topeka, Kan., Edison Company, writes us as follows: "Having used and been familiar with your excellent 'Central Station List and Electric Railway Directory' for years, I have cause to wonder why so many business houses use old and out-of-date mailing lists. Officials of companies are constantly changing, and the names of the companies themselves are often changed, yet some concerns keep on using names and addresses that often are several years old and mean nothing. If you called attention to this I think it would help."

RHINE REMAINS UNEXPLOITED.—A cable dispatch from Schaffhausen, Germany, says: "The romantic Rhine Falls, near this city, have been rescued by the local council from the industrial exploiters by whom they were threatened. The majority of the councilors have refused to permit the erection of new water power works for the supply of electricity to the surrounding district. Their reply to the application of the exploitation company was decisive: 'The council is of opinion that, not only should the falls not be further enchained, but an effort should be made to prevent an extension of the concession already granted at its expiry, in 1928.'"

CANADIAN WIRELESS.—It is stated that the installation of the Marconi apparatus in the stations through the Gulf of St. Lawrence is now approaching completion. The Government steamer *Montreal* has landed the operators and their instruments at every station as far up as Point Amour, and has started from there for the uttermost post, the Belle Isle Station, 60 miles away. The opening of these signal stations is causing satisfaction among the shipping men. There is a constant procession of vessels through the Straits of Belle Isle, and it is therefore of the utmost importance to them that they should be kept advised of weather conditions and of the progress of their vessels.

OSTWALD ON TRANSMUTATION.—A special cable dispatch from Berlin, of August 3, says: "Prof. Wilhelm Ostwald, the distinguished chemist of Leipzig, University, was interviewed this week on Sir William Ramsay's discovery that elements hitherto regarded as primary and unchangeable are capable of transmutation. He calls it 'the greatest scientific achievement since the discovery of the practicability of applying the electric dynamo to mechanics.' After describing the processes by which Sir William converts radium into helium and produces also neon, krypton. lithium, and natrium, Prof. Ostwald said: 'When I visited Sir William Ramsay in London he demonstrated to me that he could produce lithium from copper by the action on a solution of copper sulphate of the emenetions of radium. After the copper had been extracted by means of sulphurated hydrogen from the solution which had been in contact with the emanations a residue of lithium remained. Since then, as I have seen from the proofs of an article which Sir William is about to publish, he has not only confirmed the discovery, but has added to it.'"

ELECTRICITY FOR ST. PAUL RAILROAD.—It is announced from Spokane, Wash., that the Chicago, Milwaukee & St. Paul Railway Company is planning to install a series of hydroelectric power plants on the St. Joe River, in northern Idaho, east of Spokane, for operating the railroad across the Bitter Root Divide, and also for operating several sawmills and other plants. The work will cover 35 miles of the St. Joe River and it is stated that 180,000 horse-power can be developed. Three years will be necessary to complete the work, which will cost $9,000,000. If the trial is successful, electricity will probably be used on the entire line between Missoula, Mont., and Puget Sound, a distance of nearly 600 miles. Three dams are to be constructed at once and others later. One dam 86 feet high will be built at Little Falls, three miles above St. Joe, to develop 5000 horse-power. Another will be constructed at Cottonwood Island, ten miles up the river. The power will also be used extensively in developing the resources of the tributary country, especially in the operation of sawmills, as the St. Paul railroad interests control large timber lands in Idaho. The developments are in charge of Mr. C. B. Price, hydraulic engineer, and are said to have received the sanction of Mr. A. J. Earling, president of the railway company.

EDISON CONVENTION.—Announcement has been issued by Mr. Alex. Dow, of Detroit, president of the Association of Edison Illuminating Companies, in regard to the twenty-third annual convention at Hot Springs, Va., the date for which has now been fixed as September 10,, 11 and 12. The Homestead Hotel will be headquarters. The place is on the Warm Springs Valley branch of the Chesapeake & Ohio Railroad. An interesting programme of work and entertainment has been provided. It is apparent that the committee reports to be presented and discussed will be of exceptional value. The report of the lamp committee will deal, in addition to the current business of the committee, with the new developments in metallic filament lamps and with other recent improvements in lamps. The reports of the committees on steam turbines, on storage batteries and on meters will likewise be of special interest. Among the subjects on which papers and discussions are already promised are, sales of industrial energy; costs and results of a district steam heating system in combination with electric lighting; technical papers on smokeless furnaces, on rotary condensers, on periodical testing of high tension lines and apparatus; a description of a large system covering city and suburban areas; and a presentation of the legal and equitable rights of the wholesale consumer.

[illegible] company, [illegible] recently in starting up a new generator owing to some internal defect. An expert force was detailed to repair the machine and put it in operation. Some time was thus consumed, but to prevent public dissatisfaction over poor service for which it was in no wise to blame, the local company took the public into its confidence and explained the whole matter in the daily papers. We do not know of any similar procedure, but it is certainly to be commended and recommended. There are daily events in central station life that make excellent "copy," and help to cultivate friendly relations with the consumer.

MUNICIPAL ELECTRICIANS.—As already announced, the International Association of Municipal Electricians holds its annual convention this week at Norfolk, Va., Hotel Monticello, August 7, 8 and 9. A good social programme has been provided including the Jamestown Exposition, and there will be several papers read. They include: "Electrical Inspections and Records," "Modern Application of Storage Batteries," "The Value of Volt and Ammeter Tests for Insulation," "A Modern Fire Alarm Central Office," and "Operation of a Municipal Electric Light Plant." The familiar "Question Box" is expected to furnish many suggestions. Mr. T. C. O'Hearn, of Cambridge, Mass, is president, and Mr. F. P. Foster, of Corning, N. Y., secretary.

LIGHT FOR OCULISTS.—A cable dispatch from Paris of July 30 says: "A new contrivance, likely to be of great service in eye diagnosis, is reported by the Academy of Science. Dr. Forlin has discovered that the light from a mercury vapor lamp, passing through two sheets of blue glass and reflected into the eye by a large lens, reveals the internal condition infinitely better than the ordinary white light. By placing a screen with a pinhole between the light and the eye a magnified image of the vessels at the back of the retina, which have been hitherto almost invisible, has been obtained. The capillary veins, the diameter of which is only two-thousandths of a millimeter, are seen to distend with each heartbeat, and it is even possible to count the blood globules." A trial will be made of the device in this country, where the mercury vapor lamp has already been well worked out for industrial purposes.

FATAL TAPE CONTACT.—An unusual kind of fatal accident is reported from Mineola, L. I., where on Aug. 1 George Wesener, employed by the New York & New Jersey Telephone Company, was killed instantly. The case was remarkable in that the current was carried to him by a measuring tape made of linen or cotton and coated with a sort of shellac. There was no metal on the tape. Wesener was assisting a man who was making some measurements in connection with alterations in a pole line. He had one end of the tape, and a man ascended the pole with the other. When the measurements had been taken, the man aloft let go of the tape and it struck the high-tension wires used to carry energy to the Glen Crove trolley line at 12,000 volts. Wesener was in the act of winding up the tape, and as the other end of the line slid along the wire he stiffened out and fell. He was dead when a physician arrived from the Nassau Hospital. Probably the tape was quite wet.

THE HUDSON CLUB.—Arrangements have been completed and a temporary organization effected for a lunch club to be known as the Hudson Club, with quarters in the new West Street Building, New York City. A large number of men prominent in the coal, machinery, electrical and contracting business are interested in the organization; the membership will be limited and it is expected that the list will be filled within a few days, as the club will open early in September. Situated directly on the water front, with an unobstructed view of the bay, the location is one of the most attractive for club purposes in the city. Dues have been fixed at $50 per annum. The entire twenty-second floor will be devoted to the Hudson Club, and Mr. Cass Gilbert, the architect of the building, is at present engaged in designing the decorations and furniture, which will be especially made to harmonize with the general color scheme and style of the different rooms. Mr. F. R. Eden, 134 Cedar Street, is the temporary secretary.

THE ELECTRICAL SHOW.—The management of the Electrical Show, to be held in Madison Square Garden, New York City, Sept. 30 to Oct. 9, 1907, makes the following offer to its exhibitors. With the desire of sharing any profit that may be made, it is proposed to share with the exhibitors (in proportion to the payments made for space) the receipts from the sale of tickets and of admissions at the box office. With this end in view, 50 per cent of these receipts will be returned to the exhibitors and they may take such steps as may seem desirable to them to verify the records. Tickets will be distributed on the following basis: Each exhibitor will be entitled to one ticket of admission for each dollar of rental paid for space; additional tickets may be purchased in lots of one hundred at 12½ cents each; as half of this will be returned to the exhibitors in proportion to their rental, the net price thereupon becomes 6¼ cents each. It is believed that this plan will have the effect of increasing the attendance to a marked degree thus being of double benefit to the exhibitor.

SMALL TELEPHONES.—Swedish newspapers [illegible] miniature telephone, invented by the chief of the Government telephone bureau. U. S. Consul R. S. S. Bergh, of Gothenburg, describes it as follows: "In front of the diaphragm of this miniature telephone, the dimensions of which are 12 mm. and 16 mm. (0.472 in. and 0.630 in.) is screwed a cover with an elongation of hard rubber suitable to insert into the ear. When in use, this receiver is put into the auditory passage of the ear, and the connection consists of fine cord resting on or behind the ear in the same way as pencils or eyeglass cords are sometimes carried, and no helmet or extra fixtures are needed. It is suggested that this small telephone can be very useful to persons with dull hearing. It is claimed that the microphone, nicely mounted, could be carried in the shirt front, that the receiver can hardly be noticed when carried inserted in the ear, and that both can be connected to a dry-cell battery and an induction coil carried in the pocket. In case extra strengthening of the sound is needed, a receiver can be carried in each ear."

NICKEL ALLOYS.—A brief item in our issue of July 20 called attention to a patent granted recently to Mr. A. L. Marsh, electrical engineer of the Hoskins Company, of Chicago, who is good enough to send us a little fuller data on the subject. He says: "The patent covers broadly the addition of a metal having a refractory oxide, such as aluminum, to nickel, or the similar metal cobalt, and their alloys with metals of the chromium group, for the purpose of producing from the alloy a protecting film of oxide when employed at high temperatures, and also for the increased electrical resistance. The composition of an alloy as given in the note (88 parts nickel, 8 parts chromium and 4 parts aluminum) shows the property of producing from itself a protecting film of oxide in a marked degree. The addition of 4 per cent of aluminum to pure nickel doubles the electrical resistance, but does not increase the resistance of a nickel-chromium alloy (which is already high) to the same extent. The specific resistance of the alloy composed of 88 parts nickel, 8 parts chromium and 4 parts aluminum, not that of the oxide, is about 50 times that of copper. The resistance of the oxide is, of course, much greater. This alloy in the form of wire is being used as the resistor in electric furnaces in sizes up to three kilowatts with very satisfactory results. A temperature above the melting point of gold may be reached with safety."

Kern River No. 1 Power Plant of the Edison Electric Company, Los Angeles—I.

THE Pacific Coast, California in particular, has won a goodly amount of renown in engineering circles because of its many noteworthy hydroelectric power plants and long-distance transmission systems. Harking back 14 years to the noted historical work at Redlands and Pomona, practically all the improvements in hydraulic design in connection with high-head plants that have stood the test of time and which mark the best practice of to-day have been evolved in connection with the California water-power plants. Substantially the same may be said regarding transmission work; and, although the record for highest voltage has been surpassed quite recently in Michigan, the Golden State still operates successfully the longest lines on the continent.

With this excellent record of pioneer work, and with many modern efficient plants now in continuous operation, it is interesting to note the improvements or innovations incorporated in the design of any new plant.

The Edison Electric Company, of Los Angeles, has just completed and placed in operation a power plant on Kern River, which, while not surpassing any previous records of high heads utilized or length of transmission, does embody in its construction many distinguishing features, some of which are pronounced departures from previous practice.

In capacity, the Kern River No. 1 power plant equals the rated capacity, 20,000 kilowatts, of the largest impulse-wheel plant previously in operation, and in overload capacity surpasses it. Its gravity conduit, constructed almost entirely of tunnels excavated through the mountains, is the most permanent and costly hydraulic waterway in the country. The pressure main, driven in the form of a tunnel, down the mountain slope is probably the most unique feature of the installation and is a decided innovation in power-plant construction. The water wheels embody new features in the design of buckets, nozzles and governors. In the electrical details of the station is incorporated the most modern apparatus. The transmission line is at present operating at 60,000 volts, which will later be raised to 75,000 volts. The length of transmission, 117 miles, is exceeded in only a few instances. Moreover, the steel towers and insulators are of special design.

Considered in entirety, or as to its several conspicuous component parts individually, the Kern River No. 1 station of the Edison Electric Company typifies the latest modern practice in hydroelectric power plant design and makes timely the following descriptive data. General descriptions of this plant as under construction at that time, as well as the other power plants and general transmission and distribution system of the Edison Electric Company in southern California, were given in the ELECTRICAL WORLD AND ENGINEER of Feb. 25, March 4, 11 and 25, and April 8, 1905. The present article is intended to supplement and bring those descriptions up to date.

GENERAL DESCRIPTION.

The Kern River is the southernmost large tributary of the San Joaquin River, and has its head in the snow-covered slopes of Mt. Whitney and neighboring peaks in the Sierra Nevada Mountains.

Water for the Kern River No. 1 plant is diverted at a point about one-half mile below Democrat Spring, in Kern County, and about 14 miles up the river from the mouth of the canyon. A hydraulic conduit, consisting almost entirely of a series of tunnels, approximately nine miles in length, conveys the water through the mountains on the south side of the river to a forebay at a point about 900 feet above the river, and about two miles from the mouth of the canyon, where the plant of the Power Transit & Light Company, of Bakersfield, is located.

From the forebay the force main continues down to the power house in an inclined tunnel. The power house is located on the bank of the river directly opposite the intake of the Bakersfield plant, and at an elevation of about 20 ft. above the ordinary high-water level of the stream at that point. The tail race of the station is designed so as to deliver the water to the river immediately above the diversion point of the Bakersfield plant.

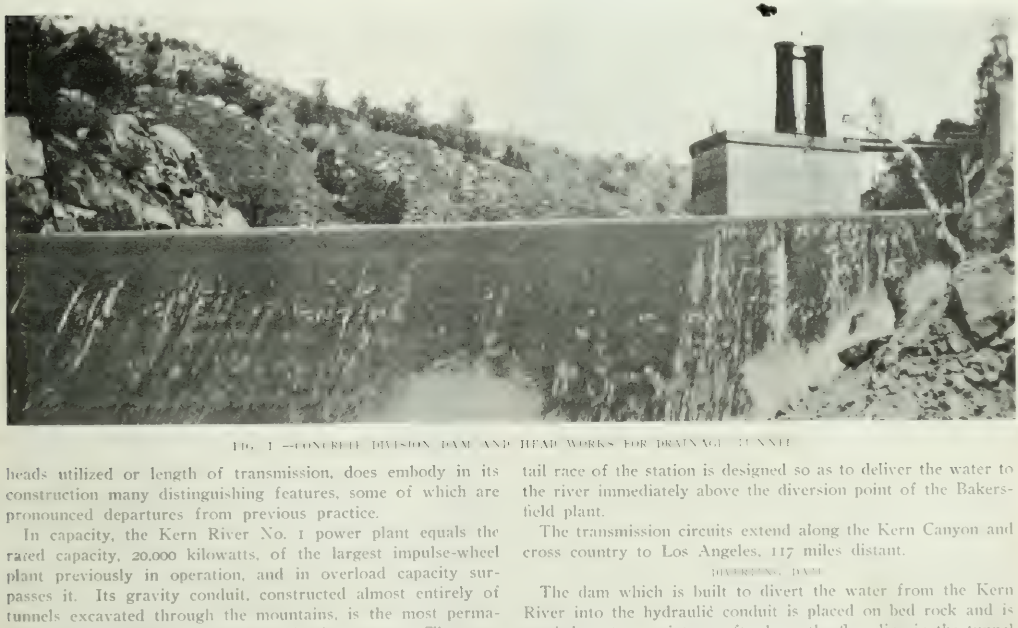


FIG. 1.—CONCRETE DIVERSION DAM AND HEAD WORKS FOR DRAINAGE TUNNEL.

The transmission circuits extend along the Kern Canyon and cross country to Los Angeles, 117 miles distant.

DIVERSION DAM.

The dam which is built to divert the water from the Kern River into the hydraulic conduit is placed on bed rock and is carried up to a point 1.25 ft. above the flow line in the tunnel conduit, thus insuring a constant supply as long as the reservoir created by the dam is kept filled. In excavating for the dam, bed rock was found to exist at varying depths, the deepest portion being at the south end at about 35 ft. below the stream bed. A coffer dam was built to divert the river during the construction and while the fill overlying the bed rock was being excavated. Trenches were then cut in the bed rock and holes bored in which steel bars were driven in two rows across the canyon. The first layers of concrete were placed on the bed rock and secured to it by means of the trenches and the steel bars. Cyclopean concrete was the material of construction, the rock used being the granite found in the canyon. Many of the blocks were of large size, some weighing several tons each. About 1500 cu. yards of material were placed in the foundation and 3500 cu. yards in the dam proper.

The dam is of the overflow type as shown in Figs. 1, 4 and 5. Its length on the crest is 203.50 ft. and its height above

ordinary water level in the river about 20 ft. At the base in the thickest part it is 52.81 ft. wide. The crest has a small angle with the horizontal, and is 7 ft. in width. The crest and lower face were designed so as to give a true hydraulic curve to the water overflowing, and to attain this end the upper 15 ft. of the face was built with a batter of 1 to 1 so as to allow an air space under the water. The theory of the design is that air will enter this space under the water from the ends of the dam and that enough will be carried down with the water to form an air cushion. With from 2 ft. to 3 ft. of water flowing over the dam a very smooth surface is presented. Below the 45 degree batter the down stream face has a radius of 100 ft. The up-stream face has a batter of three-quarter inch to the foot.

HEAD WORKS.

The head or diversion works of the gravity conduit con- [illegible] section of the main tunnel

FIG. 2.—HYDRAULIC CYLINDERS FOR OPERATING INTAKE GATES.

with controlling gates operated by means of hydraulic cylinders. In order to prevent contraction as the water enters and to afford sufficient screen area to admit the water, the tunnel is widened out at the entrance to 16 ft. 6 ins. The screens or grizzlies are made of slanting bars and extend both in front and on the side of the controlling gates. The bars are ½ in. x 3 in. and are spaced on edge 3 ins. between centers, by means of 2¼-in. thimbles, the thimble rods being 4 ft. apart. The screen is 20 ft. long on the slant and 8 ft. high and is supported on 4-in. cast-iron pillars.

Behind the screen and just above the gate is a 10-ft platform on to which can be raked any detritus caught by the screen. The grade at the entrance of the diverting tunnel is increased above the normal grade so as to accelerate the water from its state of rest above the intake to normal velocity in the tunnel below.

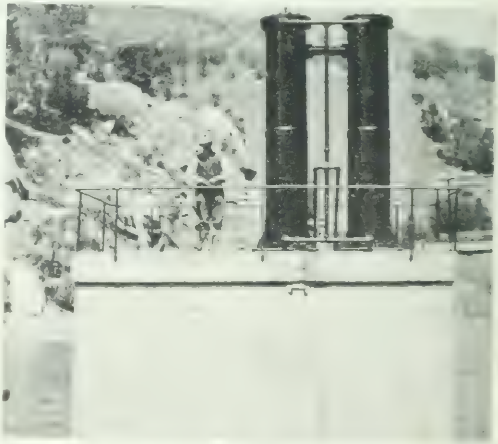
Another important feature of the head works is the drainage or sluicing tunnel, 365 ft. in length, that is driven through bed rock below the intake at the south end of the dam, penetrating to the bottom of the reservoir above the diverting dam. A heavy grizzly, built of 70-lb. T-rails, protects the entrance of this tunnel, and behind are two gates operated by hydraulic cylinders, by means of which the tunnel can be closed or opened as desired. The drainage tunnel was first used to divert the water from above the site of the dam during its construction to the river at a point some distance below the headworks. Its permanent purpose will be to sluice out, at such intervals as may be necessary, any silt accumulating in the reservoir above the dam. The gates of this drainage tunnel are constructed for operating under a pressure corresponding to from 35 ft. to 45 ft. [illegible] flowing over the dam, the hydraulic cylinders for the gates being designed to move them under a head of 20 ft. of water over the dam, should a flood of this magnitude ever occur.

Each of the gate openings is 8 ft. 10¼ in. high and 3 ft. 8 in. wide, the side frames being of cast iron, and the sill a 10 in. x 10¾ in. redwood timber. The gates are built up of 5/16-in. steel plate and 6-in. 15-lb. I-beams, the sides being formed of 12-in. I-beams. There are two cast-iron hydraulic cylinders installed in each gate. The set for the east gate is mounted on top of the concrete operating shaft, the west set being placed directly below as there was not sufficient lateral space to place them both on the same level. The lower cylinders are placed 38 ft. 8 in. above the sill of the gate and operate their gate by lifting rods 26 ft. long. The upper cylinders operate their gate by means of 40-ft. rods. These lifting rods are 4½ ins. in diameter, and are made of wrought iron incased in brass tubing to prevent rusting. The gates are guided at each side by four bronze rollers 3 ins. in diameter. In order to equalize the pull of the two cylinders on each gate there are installed two racks 10 ft. long and 6 ins. wide into which mesh two 12-in. pinions mounted on the top of the gate.

The gates for the intake tunnel are similarly constructed. The hydraulic cylinders, both for the intake gates and the sluice gates in the drainage tunnel, are operated by means of oil pressure supplied by gravity from a tank on the bank. The oil discharged from the cylinders is pumped up to this tank by a triplex pump, electrically driven, a sufficiently powerful hand pump being installed for emergency use.

TUNNELS.

The hydraulic conduit of the Kern River plant is noteworthy by reason of its being the most permanent construction of its character in the country. The Edison Electric Company after its 14 years' practical experience with the construction and operation of hydroelectric power plants has profited by the knowledge gained of the different forms of conduit used, such as timber flumes, earthen ditches, concrete-lined ditches, cement pipe and tunnels, and for its Kern River work determined that the most efficient, and, in the long run, economical construction would be a system of concrete-lined tunnels. The expense of driving the tunnels was a large item, but it was warranted in



[illegible] DRAINAGE TUNNEL.

this instance because of the large quantity of water handled and by reason of its permanency and the fact that it will be subject to practically no depreciation losses and but little expense for maintenance. Another important feature of the tunnel construction is that there will be practically no evaporation loss from the conduit. As the evaporation from the natural stream of the Kern River is estimated to be from 15 to 20

per cent, when the water is low during the summer months, this factor will be an important one during periods of minimum flow. Another advantage of the closed conduit is that no leaves, sticks or other débris can enter the water after it leaves the headworks.

Between the intake and the forebay there are 19 tunnels

FIG. 4.—PLAN OF DIVERTING DAM AND INTAKE.

forming approximately eight units of gravity conduit. The number and length of these tunnels are given in the following table:

TUNNELS, KERN RIVER, NO. 1 POWER PLANT

No. of Tunnel.	Length in Feet.
1	[illegible]
2	[illegible]
3	[illegible]
4	[illegible]
5	[illegible]
6	[illegible]
7	[illegible]
8	[illegible]
9	[illegible]
10	[illegible]
11	[illegible]
12	[illegible]
13	[illegible]
14	[illegible]
15	[illegible]
16	[illegible]
17	[illegible]
18	[illegible]
19	[illegible]
Total	42,910.5

The tunnels are numbered from the intake down, Tunnel No. 1 being the intake tunnel, the entrance to which has already been described.

The tunnels were excavated in the rough to be [illegible] ft. in width and 7½ ft. from the bottom to the spring line of the arch, and 9 ft. in height in the center. Afterwards they were lined with concrete 6 ins. to 10 ins. thick on each side and the floor paved with 3 ins. of concrete, the net section thus obtained being 8 ft. in width by 7 ft. in height. The entire surface of the side and floor was covered with a cement mortar-plaster ¼ in. thick, composed of one part of cement to two parts of sand. At the corners of the walls and floor a curve with a 3-in. radius was formed in order to prevent wear at that point and also to smooth up the flow of water.

The section of tunnel adopted is not the most favorable to give the highest velocity on a minimum slope, but is the most advantageous for the purpose, as by making a wider tunnel

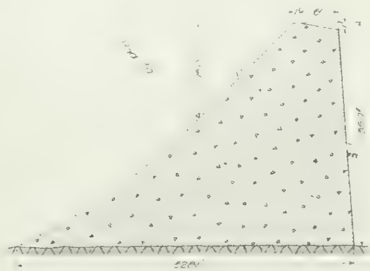


FIG. 5.—SECTION OF DAM.

greater difficulties would have been encountered with the roof of the tunnel where it passed through loose or shattered formation. The grade of the tunnels is 7.92 ft. per mile, it being intended that the water should be carried at a depth of 6½ ft. The cross-sectional area of the stream is, therefore, 52 sq. ft., the wetted perimeter is 21 ft. and the mean hydraulic radius 2.5. Assuming the cofficient of roughness to be 0.012 in Kutter's formula, the conduit has a discharge capacity of approximately 470 cu. ft. per second. Experiments made on other tunnels of the company indicated that the coefficient would be about the value stated for this particular conduit. Observations made during the first few days after the conduit was placed in service showed that the coefficient is even less than 0.012.

In places where the tunnels pass through seamy and shattered formation or "blocky" ground, they had to be arched overhead in order to support the roof, the concrete at the center of the arch being from 12 ins. to 18 ins. thick. Less than [illegible] per cent of the length of the tunnel required such overhead arching. Where this was necessary, it was placed by using a templet, with lagging overhead, the concrete being

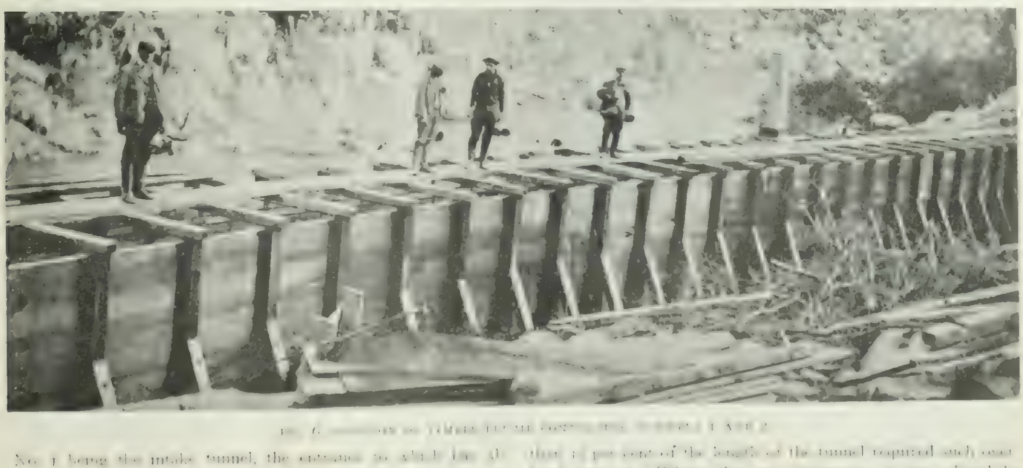


FIG. 6.—[illegible]

[illegible] ft. between centers and holding the rock back by 3-in. planks. In such sections the timbers were left in position and completely covered by concrete.

The concrete at the sides was tamped into place behind boards supported by vertical forms. Wherever large cavities had been blasted out in driving the tunnels, they were filled with backfill of riprap, the interstices of which were filled with sand and gravel. The same method was pursued above the concrete in the arches. Consequently there are no cavities existing between the bed rock and the concrete lining in the [illegible]

[illegible] places springs were encountered and as the pressure that would be created by stopping them up might be disastrous to the tunnel lining, vents were installed through which the water can flow into the tunnel. These vents consist of sections of pipe from ¾ in. to 3 ins. in diameter and 6 in. to 8 ins. long, set in the floor or wall and left open at both ends. The water being under higher pressure than that flowing in the tunnel, continues to flow into the tunnel and thus relieves it of any strain.

The excavation of each of the 19 tunnels was carried on from both ends, thus dividing the work up among 38 headings. The work was principally done by pneumatic drills with 3¼-in. cylinders. Some hand work was done in opening up approaches and adits and where loose formation was encountered. The ordinary progress in driving with pneumatic drills was 5 ft. for a ten-hour shift using two machines in the face. This

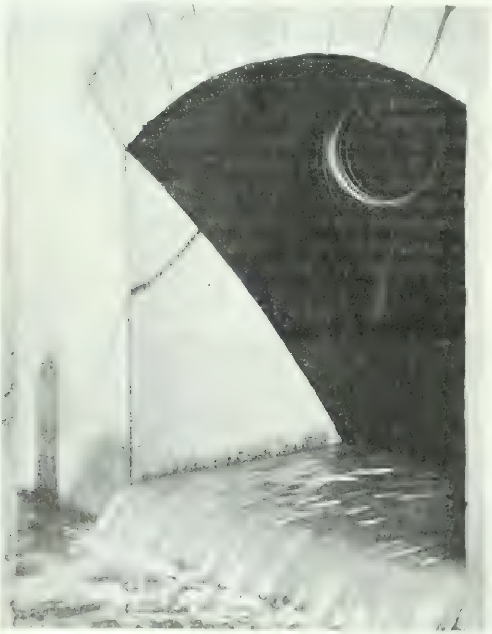


FIG. 7.—[illegible] TUNNEL NO. 10.

varied considerably, however, as the number of holes required for breaking the ground varied from 10 to 24. The depth of the holes usually employed was as follows:

[illegible]

The amount of [illegible] also varied according to the formation so [illegible] per round of holes can be relied upon. In [illegible] rock encountered it was sometimes found necessary to reload the holes the second time in order to break the ground, the first blast blowing out the rock at only the upper end of the holes.

The pneumatic drills were supplied with compressed air through 3-in. and 4-in. steel casing laid from the six construction camps located at suitable points along the canyon between the power house and the intake. Ventilation was pro-

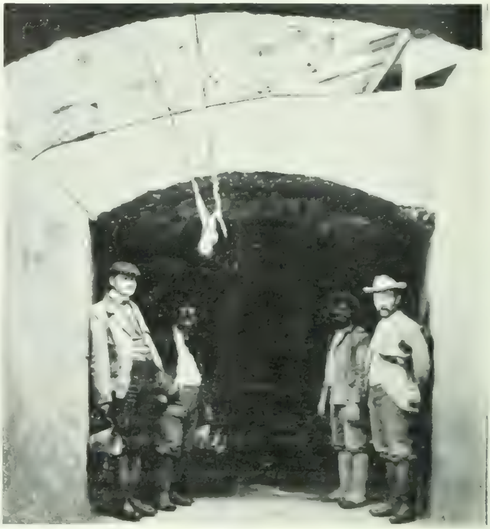


FIG. 8.—MANHOLE BETWEEN TUNNELS NOS. [illegible]

vided by means of motor-driven Root reversible blowers located at the tunnel or adit openings and connected with the working faces by means of galvanized iron stove pipe. Other details of the tunnel construction may be found in the ELECTRICAL WORLD of March 11, 1905.

The Edison Electric Company carried on all the tunnel excavation work itself, the only contract work being that of teaming, the supply of provisions and feeding the men. By this method the company has been able to secure construction data which will be invaluable to it in carrying on similar work in the future and in the consideration of contract work.

The only contract work done on the tunnels of the Kern River No. 1 plant was for the concrete lining. This was done by Glass & Fischer, of Los Angeles and Redlands, this firm also contracting for the boarding houses. Standard and Colton brands of Portland cement, supplied by the two California manufactories, were used throughout for the concrete, the mixture being in the proportion of 1, 3 and 5. For the sand and aggregate, the granite excavated from the tunnels was used. The rock was crushed to 1½-in. and 2-in. size and for the sand was crushed and rolled so as to pass through a 60 screen. Gates gyratory and Blake jaw crushers and Buchanan 10-in. rolls were employed. As no adequate water supplies were available along the route of the conduit, the water necessary for mixing the concrete had to be pumped up from the river, Rumsey triplex pumps being employed for that purpose. For mixing, one Smith and two Ransome mixers were used. The men worked on two nine-hour shifts, illumination being furnished by a construction power plant, to be mentioned later. A total of 110,000 ft. of lumber was used for forms on the concrete work.

After the tracks had been removed from the lower tunnels and when the roads to the upper camps were impassable because of heavy rains and snow, two automobile wagons proved indispensable in carrying cement and other supplies through the [illegible] tunnels from Camp [illegible] to the upper tunnels. [illegible]

average distance of 5½ miles. In all about a million pounds of freight was carried by the two machines. Even the steel rails of the construction track were carried out on the automobiles. With light loads a speed of about 18 miles an hour could be made, precautions being taken at curves, which were indicated by white signal flags.

After the tunnels were completed two two-wheeled hand carts with rubber-tired wheels were used for carrying cement and light tools for such finishing and repair work as was necessary. They were also brought into service in stringing the telephone line that is carried throughout the entire tunnel connecting the power house with the diversion works at the dam. The two galvanized-iron wires of this telephone line are carried on inverted T-shaped brackets about 10 ins. from the roof of the tunnel. The brackets are formed of ¾-in. pipe with porcelain insulators bolted on each end of the horizontal arm. The vertical pipe is secured in the holes of the rock or cement by wooden plugs.

TIMBER FLUMES.

The tunnel work was planned so as to avoid wherever possible flumes for spanning the side ravines encountered along the line. However, in order to maintain a good alignment and make the line as short as possible, a few exceptions had to be made to this rule. Some of these side ravines leading down to the main canyon and crossing the line of the conduit were

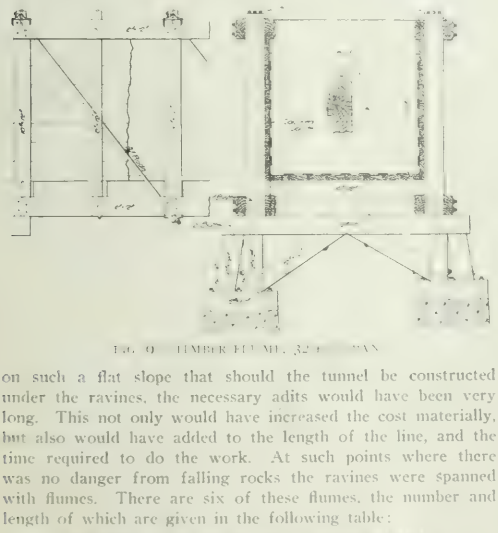


FIG. 9.—TIMBER FLUME, 32-FT. SPAN.

on such a flat slope that should the tunnel be constructed under the ravines, the necessary adits would have been very long. This not only would have increased the cost materially, but also would have added to the length of the line, and the time required to do the work. At such points where there was no danger from falling rocks the ravines were spanned with flumes. There are six of these flumes, the number and length of which are given in the following table:

FLUMES, KERN RIVER NO. [illegible] POWER PLANT.

No. of Flume.	Length in Feet.
[illegible]	[illegible]
[illegible]	[illegible]
3 Steel and Concrete Flume	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

All are constructed of timber except No. 3, which is built of reinforced concrete with a steel frame.

Fig. 6 shows the method of constructing the timber flumes. They are placed on concrete foundations and are designed with a factor of safety sufficient to make them last [illegible] 40 years. [illegible] Oregon pine, being so designed and distributed that no part of the timber comes in contact with the earth or is exposed to the drip should the flume at any time spring a leak. In this way the life of the Oregon pine will be great, as it is invariably kept dry and [illegible].

The flume box is built up of [illegible] redwood grown in swamp lands [illegible] California. The grade of this lumber is perfectly clear, and its quality is such that its life should not be less than 40 years. The edges of all planks were beveled so as to give a quarter inch opening on the inside of the joint, which is caulked with ship chandler's oakum. The bottom seams were covered with hot asphaltum and 1-in. x 6-in. redwood battens were nailed down over them.

On the sides of these flumes a specially designed batten is used. This batten is of 1-in. x 6-in. redwood, the upper half being cut away on a curve, permitting asphaltum to be poured between the batten and the side of the flume. At the corners of the flumes a quarter-round strip is nailed.

The design of the flume above described has been thoroughly tested and even if it should remain dry for months in the hottest weather, its designers state that it may again be filled with water without having any perceptible leakage

In some cases where crossing streams that are apt to carry considerable water in winter, span flumes are constructed. Fig. 9 shows a 32-ft. span built with a 10 in. x 12 in. timber frame and resting on 12 in. x 12 in. beams.

In connecting the wooden flume with the portal of a tunnel use was made of a construction of a special nature, which offers two points of contact between the wood and the concrete, and a well between the two, from which the water may be pumped out, and any leaks repaired should these ever occur between the wood and the concrete.

Synchronous Motor Compensation for Lagging Currents.

By Clarence P. Fowler.

The advantages in the use of synchronous apparatus for the improvement of power factor are becoming better recognized with the increased utilization of alternating currents for general power service. It may be of interest to note, therefore, some of the more important underlying principles which govern the operation of such apparatus when used for this purpose.

Of the different classes of load which may be imposed upon alternating-current apparatus and networks, one of the most prolific sources of relatively low power factor conditions, is found in the supply of power to induction motors.

The current which an induction motor draws from a circuit to which it may be connected may be considered as made up of two components, namely, first, a power component in time phase with the impressed e. m. f., which is just sufficient to overcome the motor losses plus that necessary to drive the extraneous load to which the motor may be mechanically connected and, secondly, a wattless magnetizing component of current, which latter element gives rise to power factors below unity. The wattless or lagging component of the current is somewhat greater when starting from rest than under normal running conditions, as well as being relatively great under running conditions and when the motors are lightly loaded.

From what has been said it is apparent that on a system in which induction motors form any considerable portion of the total load, low power factors are likely to be the rule, this condition becoming more aggravated on circuits where motors are frequently starting or operating at fractional loads.

Since the induction motor produces loads on the supply system having low power factors it becomes of importance to briefly discuss some of the more important effects of such conditions on the general electrical system and which may be summarized as follows:

[illegible] EQUIPMENT.

1. *Weakening of* [illegible] lagging wattless currents give rise not only to an increased generator armature current for a given amount of real power, but this increased current exists at a time when the armature coils have such a position with reference to the field that the magnetizing action set up by the armature ampere turns is directly opposed to those of the field turns and is therefore demagnetizing. To hold the generator e. m. f. constant under such conditions, it is, therefore, necessary to increase the field excitation by an amount

which, in some cases, may be so great that should the generating equipment become suddenly relieved of a heavy inductive load by the opening of a circuit breaker, the voltage may run up to the danger point before the attendant has time to reduce the field current to its proper value.

(*b*) *Heating of Generating Equipment.*—Due to the fact that low-power factors mean increased current and as a safe temperature rise and therefore the rating of the generating equipment is largely limited by the value of the armature current, irrespective of its phase relation, it is evident that the idle currents limit the possible amount of useful current which may be derived from an alternating-current generator. Further, as considered above under the head of regulation, the increased field current necessary with loads having low power factors gives rise to increased field copper losses and core losses, which in turn result in additional temperature elevation.

(*c*) *Wear and Tear on Circuit Interrupting Devices.*—The up-keep of circuit interrupting devices is much greater with low power factors, due not only to the greater volume of currents ruptured, but also largely to the vicious arcs which invariably result when opening circuits supplying inductive loads.

[illegible]

(*a*) *Line Regulation.*—Low power-factors result in increased line drop due to increased current necessary for a given amount of real power. Moreover, if a circuit possesses any considerable amount of inductance, which may be the case with a long-distance transmission line, then a condition exists with inductive loads which is favorable to increasing the total line drop, when there are lagging wattless currents. For example, if a circuit have a resistance drop of 5 per cent of the delivered e. m. f. and a reactance drop of 15 per cent of the delivered e. m. f., then the total line drop at 100 per cent power factor would be only 6 per cent of the delivered e. m. f., whereas at 60 per cent power factor the total drop would be increased to 15 per cent of the delivered e. m. f.

(*b*) *Line Loss.*—The increased current incident to low power factors causes increased line loss which is dependent upon the square of the total current flowing, so that a small decrease in power factor results in a much more rapidly increasing line loss.

The above review of some of the more important detrimental effects of lagging wattless currents suggests the desirability of neutralizing these in the generating and transforming equipment and supply networks by supplying them from another source, if possible. This may be accomplished, as will be seen in what follows, by the use of synchronous apparatus in connection with the electrical system.

The commercially obtainable synchronous machines capable of improving the power factor or of phase control, as it is sometimes called, are the rotary converter and the synchronous motor. In the first of these—the rotary converter—the action taking place in the armature is somewhat complex owing to the manifold functions of the current entering the alternating current side and will be excluded from consideration here. It may be noted in passing, however, that the effects are quite similar to the effects obtained with synchronous motors.

The two usual methods of using the synchronous motor for the phase control of the load on alternating-current circuits and which are considered below are:

(1) A synchronous motor may be used exclusively for compensating purposes, running perfectly free and not being required to perform any mechanical work.

(2) A synchronous motor may be used partly for compensation and partly for converting electrical into mechanical energy.

The use of the synchronous motor, for phase control, can perhaps be better understood by first outlining some of the inherent operating characteristics of this type of apparatus. The e. m. f. which is effective in determining the total amount of current which a synchronous motor will draw, is, in a degree, analogous to the e. m. f. which is directly responsible for current flow in the armature of an ordinary shunt-wound direct-current motor.

With the latter type of motor the factors which determine the armature current, for a given external load, are the impressed e. m. f., counter e. m. f. and the armature resistance. The counter e. m. f. is dependent on the field strength of the motor and its speed, and, as its name implies, is opposed to the impressed e. m. f., the difference between the latter and the former giving rise to a resultant e. m. f. which divided by the armature resistance in accordance with Ohm's law, fixes the value of the armature current and which may be expressed by two simple equations thus:

[illegible]

E_r [illegible] (2)

Where E = *e. m. f.* impressed on motor.
E_c = counter e. m. f. of motor
Er = resultant e. m. f.
I = armature current.
R = armature resistance.

Since the torque produced by a direct-current shunt-wound motor is dependent upon the armature current and the field strength, it is evident from the two above equations, that any change in current required to meet a change in load conditions, with constant impressed e. m. f., must be accomplished by a change in the magnitude of the counter e. m. f. The counter e. m. f. for a given motor being dependent upon the field strength and speed it follows that if the former also remains constant, the changed current conditions, to handle new load, are brought about by a change in speed.

In a synchronous motor, there are somewhat similar quantities to deal with, namely, the impressed e. m. f., the counter e. m. f., the resultant e. m. f., the armature impedance and current, all of which quantities may be expressed by two equations similar to those for the direct-current motor, thus:

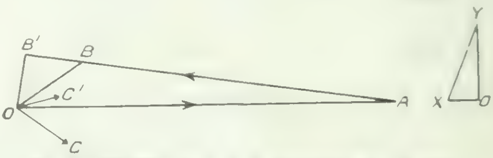
[illegible]

$$I = \frac{E_z}{Z} \quad [illegible]$$

Where E = e. m. f. impressed on motor
E_z = resultant e. m. f.
C = armature current
Z = impedance of armature.

Owing, however, to the alternating character of the e. m. f.'s acting on a synchronous motor, equation (3) cannot be interpreted in its true algebraic sense, as with the direct-current motor since the direction of these various magnitudes in the former have to be considered, and in general, the impressed e. m. f., the counter e. m. f. and resultant e. m. f. of the synchronous motor, are not directly in time-phase one with the other.

Since a synchronous motor must operate at synchronous speed or not at all, it follows that when the load changes on such a motor with constant impressed e. m. f. and field strength, the change in armature current demanded by the changed tor-



[illegible]

que conditions cannot be produced by a decrease in speed, as with the direct-current motor.

The counter e. m. f. of a synchronous motor is alternating and generally similar to that of the e. m. f. impressed upon its terminals and opposed to the latter, a change in current caused by a variation in load conditions, being brought about by a change in magnitude of that component of the counter e. m. f. which is opposed to the impressed e. m. f.

The above remarks can be illustrated by Fig. 1, which rep- [illegible]

and current in a lightly loaded synchronous motor. In Fig. 1 let OA represent the direction and magnitude of the e. m. f. impressed on a synchronous motor circuit. Let AB represent the magnitude and direction of the counter e. m. f. of the motor, which (since the motor is assumed to be lightly loaded) will have a large component directly opposed to the impressed e. m. f. OA and therefore the angle OAB will be small, as shown. The magnitude and direction of the resultant e. m. f. will then be given by the line OB which is directly active in forcing current through the armature impedance.

The armature impedance may be regarded as the total "virtual resistance" offered to the alternating current through the armature, at the normal frequency for which the motor is designed, and is composed of ohmic resistance and magnetic reactance.

With alternating current in the armature, each of these elements gives rise to a voltage drop which is called respectively the resistance and reactance drop. The virtual value of the resistance drop due to alternating current is the same as would be caused by a value of direct current which is equal to the virtual value of the alternating current. The reactance drop is dependent upon the rate of change of the magnetic lines surrounding the armature conductor locally, and may be considered as proportional to the rate of change of the current and will therefore have its maximum value when the current has its greatest rate of change or when the current is passing through zero, which is equivalent to saying that the reactance volts will be 90 time degrees (leading) from the resistance volts, with which the current is always in time-phase. So that the resistance and reactance volts may be represented as the two sides of a right-angle triangle, with the hypotenuse representing the e. m. f. consumed by the total armature impedance.

In Fig. 2 let OX represent the magnitude and direction of the armature resistance drop in the synchronous motor, and let OY represent to the same scale the magnitude and direction of the armature reactance and the resistance, which is not absolutely to the same scale, the magnitude and direction of the armature impedance drop. Now by equation (4) above, the resultant e. m. f. is equal to the impedance drop, hence XY of Fig. 2 and OB of Fig. 1 represent the same drop, and since the current is in time-phase with the resistance drop its direction will make the same angle with OB as OX does with XY. Therefore by laying off the angle COB (Fig. 1) equal to the angle OXY (Fig. 2) the direction of the vector representing the current will be given, and its magnitude will be dependent upon the ratio of OB (Fig. 1) to the armature impedance, the magnitude of this current may be represented by the length of the line OC (Fig. 1).

Considering an anti-clockwise rotation of the vectors it is seen from Fig. 1 that the current OC lags behind the impressed e. m. f. OA by the time angle COA.

Next let the excitation of the motor be increased thereby increasing the counter e. m. f. from AB to AB', the resultant e. m. f. then taking up the position OB' and since the current makes the same angle with this resultant e. m. f. as before the current will now swing around into the position OC'. The angle $C'OB'$ being equal to the angle COB (in assuming these two angles equal it implies a constant ratio between the armature reactance and the resistance, which is not absolutely true for all values of current, but is near enough for most practical purposes).

From the above it is seen (Fig. 1) that by increasing the field strength of the motor the current is caused to lead the impressed e. m. f. OA by the time angle $C'OA$. Hence it appears that the synchronous motor has the property of introducing lagging or leading currents into an electrical system of which it forms a part.

In Fig. 1 the conditions prevailing in a lightly loaded synchronous motor have been considered. Now suppose the motor to drive an external load, and as before explained, the increased current necessary will flow because of a decrease in [illegible]

the angle between these two e. m. f.s. This condition will be noted by reference to Fig. 3, in which the line OA represents the magnitude and direction of the e. m. f. impressed on the motor, AB representing the magnitude and direction of the counter e. m. f. of the motor running light, with OB and OC representing respectively the direction and magnitude of the light load resultant e. m. f. and armature current as in Fig. 1. Let the load now be increased, such that the counter e. m. f. takes the position of the dotted line AB', the impressed and the counter e. m. f. remaining constant. The resultant e. m. f. may now be represented by the dotted line OB', and as the direction of the current will as formerly make the same angle with the resultant e. m. f. as the armature resistance volts make with the armature impedance volts, by constructing the armature impedance volts, triangle, in a manner similar to that previously described, the direction of the armature current will be determined, with its magnitude depending as formerly, upon the ratio of the resultant e. m. f. to the armature impedance.

After going through this construction, the armature current will now have the magnitude and direction of the dotted line OC', from which it is seen that the increased load has caused the current to increase in value from OC to OC' and to change its phase relation with reference to the impressed e. m. f. Hence the phase relation of the armature current in a synchronous motor with a given impressed and counter e. m. f. is dependent upon the load and may even be made leading under certain conditions, such as those shown in Fig. 3.

The ability of a synchronous motor to introduce leading cur-

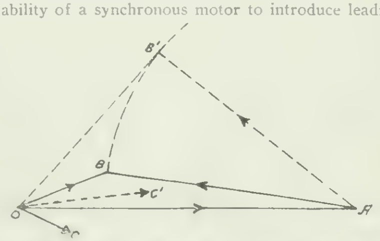


FIG. 3.—CURRENT AND E. M. F. RELATIONS UNDER LOAD.

rents into a system may be utilized to annul the effects of lagging currents and thereby raise the power factor as will be seen in what follows.

Suppose a 1000-volt, three-phase circuit to have a connected induction motor load of 200 kilovolt-amperes operating at an average power factor of 80 per cent. It is required to determine the kilovolt-ampere rating capacity, operating power factor and counter e. m. f. (from which latter quantity the field strength may be determined when the armature reaction characteristics of the motor are known) of the necessary synchronous motor to bring the power factor up to unity when such a motor is used exclusively for compensating purposes.

The total current per lead representing the above induction motor load is $\frac{200{,}000}{\sqrt{3}\ 1000} = 116$ amperes, approximately. This current, as pointed out above, may be resolved into a power component in phase with the impressed e. m. f. and a wattless component in time quadrature therewith. As the power factor is assumed to be 80 per cent, the power component of the above current would be $116 \times 0.8 = 93$ amperes approximately.

This latter current may, therefore, be represented as one of the sides of a right angle triangle with the hypothenuse representing 116 amperes. The wattless or magnetizing component [illegible] amperes approx.

These quantities are shown to scale in Fig. 4, in which OA is the impressed e. m. f., OC represents 116 amperes, the total current per phase required by the induction motor load, OD being 93 amperes, the power component of this load and DC [illegible] wattless component.

Now, since the synchronous motor current necessary to neu-

[illegible] will be leading the im[illegible] may be similarly resolved into two components (wattless and power), the former [illegible] and opposite to DC and the latter the power component (the motor is furnishing no mechanical torque) will be represented by a line in phase with OA the magnitude of which will represent a current just sufficient to handle the losses in the synchronous motor itself. The power component will vary with the design of the motor, but as a fair average may be taken at 5 per cent of the wattless component in this case, or 5 per cent of 70 amperes = 3.5 amperes. Therefore, by laying off from O the length OE = 3.5 amperes on the scale chosen and in phase with OA and $EF_1 = DC = 70$ amperes to the same scale at right angles to OA, which combined with OE gives OF, which represents the magnitude and phase relation of the total current per lead in the synchronous motor armature. This current as [illegible] from which the total kilovolt-ampere rating of the synchronous motor would be [illegible] kilovolt-amperes.

The angle [illegible] e. m. f. OA measures approximately 87 degs. and the cosine of this angle, or, in other words, the power factor, is approximately [illegible].

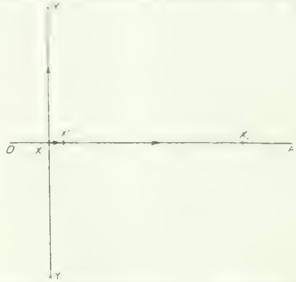
Now if the synchronous motor armature has a full load resistance drop of 2 per cent of the impressed volts or 40 volts, then this voltage may be represented to scale by the line OG, which will be in time phase with the armature current OF, as in Fig. 1, and if the full load reactance drop be 10 per cent of the impressed e. m. f. of 100 volts, then this quantity may be represented by the line GB to the proper scale and at right

[illegible]

angles to OG. The resultant of OG and GB will then be given in magnitude and direction by the line OB which represents the full load armature impedance drop. This drop has already been shown (Fig. 1) to be the resultant of the motor impressed and counter e. m. f. Hence by joining A and B the line AB is obtained, which represents, by its magnitude and phase relation, the counter e. m. f. of the motor and on the scale assumed measures [illegible]00 volts to which the ampere excitation of the motor will be proportional and which may be obtained by reference to the performance curves of the particular motor in question.

The magnitude and phase relation of the resultant line current will evidently be the vector sum of the wattless and power [illegible] required by the induction motor load. These are represented in Fig. 4, respectively, by EF and OE, and DC and OD. The vector sum of these quantities is given in Fig. 5 by drawing the various vectors to scale, radiating from a common center, X. In this diagram let OA represent the general direction of the impressed e. m. f. Draw XY at right angles to OA to represent the magnitude and phase relation of the wattless component of the synchronous motor current EF, and similarly from X draw XX' representing the power component of the synchronous motor current in phase with the impressed e. m. f. OA. From X draw XY' at right angles to OA representing the wattless component of the induction motor load DC and like[illegible] from X' draw XX'_1 in phase with [illegible] and representing the power component of the induction motor load OD. Then, since XY and XY' are equal and opposite, the former representing a leading wattless current and the latter a lagging wattless current, their resultant will be zero. The resultant of the total line current will, therefore, be represented by the vector sums of XX' and $X'X'_1$, which is given by the direction and magnitude of the line XX'_1, and this on the scale chosen represents a line current of 96.5 amperes per lead.

Hence it is seen that by the use of an over excited synchronous motor the line current has been reduced from 116 [illegible]



[illegible]

per lead at 100 per cent power factor and from the previous discussion of some of the more important detrimental effects of low power factors on line and station equipment, it is at once apparent that the general regulation and efficiency of the system as a whole has been much improved by the use of the synchronous motor as a compensating agent.

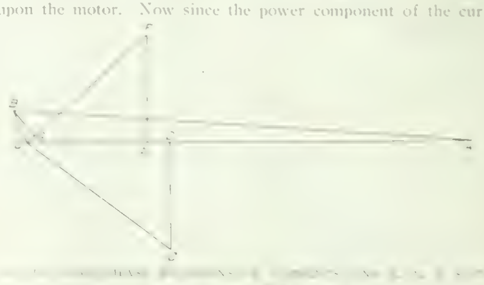
The synchronous motor as used partly to convert electrical into mechanical energy and partly for annulling the effects of lagging currents will now be considered.

Suppose a 500-kilovolt-ampere, 2000-volt, three-phase synchronous motor operating with a real horse-power input of 75 per cent of its normal capacity (including losses). It is required to find what induction motor load at 80 per cent power factor may be supplied so that the power factor of the total load on the system will be 100 per cent, and so that the synchronous motor will not be overloaded. Also determine at what counter e. m. f. (to which the field strength is proportional) and at what power factor the synchronous motor should be operated to attain this result.

Since the motor is three-phase and of 500 kilovolt-ampere capacity operating at 2000 volts, the full load current per phase including losses [illegible] 145 amperes [illegible].

As the motor is operating at 75 per cent of full load current, the total current per lead under this condition = 145 × 0.75 [illegible] amperes.

In Fig. 6 let OA represent an e. m. f. of 2000 volts impressed upon the motor. Now since the power component of the cur-



[illegible]

rent is in time phase with the impressed e. m. f. OA, this current may be represented [illegible] by the line [illegible] amperes. Since the total current rating of the synchronous motor has

been found to be 145 amperes, this current may be resolved into a power and a quadrature wattless lagging or leading component (depending upon the field excitation) and as the power component is 109 amperes represented by OE and OF representing the full load current of the motor per lead of 145 amperes, the remaining side of the right angle triangle EF represents the wattless component of 96 amperes.

The armature resistance volts will be in time phase with the total current OF and may be represented to scale by the line OG, which is assumed to be 1.5 per cent of 2000 volts or 30 volts and $GB = 7.5$ per cent of 2000 volts or 150 volts at right angles to OG and which represents the reactance volts—the resultant of these two elements, OB, will then represent the armature impedance drop. This drop has been shown to be equal to the vector difference between the counter e. m. f. and the e. m. f. impressed upon the motor. Hence by joining A and B there is obtained the line AB, which represents by its magnitude and direction the counter e. m. f. at which the motor should be operated, and which scales 2070 volts. The operating power factor for the synchronous motor is evidently given by the ratio

$$\frac{OE}{OF} = \frac{109}{145} = 0.75$$ or 75 per cent. Since EF represents the magnitude of the wattless leading component of OF available for compensating purposes, evidently this will also represent the magnitude of the wattless lagging component of the current which the induction motor load may have in order that the total line current may be in phase with the impressed e. m. f.

As the power factor of the induction motor load is assumed to be 80 per cent, and as the wattless lagging component is represented by EF reversed or 96 amperes lagging, the tangent of the lag angle would be three-fourths, from which the power component of the induction motor load $= \frac{4}{3} \times 96 =$ 128 amperes. Let this current be represented in Fig. 6 by OD in time phase with the impressed e. m. f. OA and let DC at right angles to OD represent the wattless component or 96 amperes, then OC represents the magnitude and phase relation of the total current per lead taken by the induction motor load, which on scale assumed measures 160 amperes. Then the total kilovolt-ampere induction motor load is

$$\frac{160 \times 1.73 \times 2000}{1000} = 550 \text{ apparent kilowatts.}$$

Summing up it appears from the above that a 500 kilovolt-ampere synchronous motor operating at 75 per cent power factor is capable of driving a mechanical load of $500 \times 0.75 = 375$ real kilowatts in addition to compensating for the lagging element in an induction motor load of $550 \times 0.80 = 440$ real kilowatts at 80 per cent power factor, when the field strength of the synchronous motor is increased to such a point that the counter e. m. f. of the latter is 2070 volts.

Illuminating Engineering Society Convention.

In our issue of last week we published a partial report of the convention of the Illuminating Engineering Society, held at Boston, July 30 and 31. As the convention was in progress at the time of going to press with that issue, the report of the last day of the convention is here given. As noted last week, the convention was well attended. The registration the last day reached 208, a considerable proportion of which was from outside of Boston.

[illegible]

Mr. C. Howard Walker gave a very interesting talk on this subject at the beginning of the Wednesday morning session. His address related particularly to the lighting of architectural features of a building, both inside and out, for the purpose of bringing out these features. [illegible] brought out and defined by lighted surfaces rather than by shadows. The light should therefore be placed on the projections rather than in the recesses. If buildings are to be outlined with lamps, the major factors of the buildings should be outlined rather than the insignificant features. Light thrown on surfaces gives the idea of space and emptiness, an example of which could be found in the meeting room, where the sides of certain beams were brightly illuminated from a cove. This gave the impression that there was an empty space between the bottoms of the beams and the ceiling, and that the ceiling had no support. Among other conclusions he drew, were the following: The best effects are obtained by light reflected from surfaces rather than by direct light. The skeleton of a building should be outlined with light to bring out this architectural proportions rather than features not corresponding to the skeleton framework. Masses of light should only be used for their own intrinsic beauty and not for the purpose of bringing out the architecture. In outlining buildings, the horizontal lines should be thus brought out rather than the vertical. Use the highest candle-power on the main factors of the building.

In the discussion of this paper, in answer to a question as to how Mr. Walker would modify the cove lighting in the convention hall to avoid the appearance of emptiness above the bottoms of the beams, Mr. Walker indicated on the blackboard a cove placed up near the top of the beam close to the ceiling. The cove in the room was placed at the bottom of the beam.

Mr. J. E. Woodwell asked as to the lighting of long corridors, whether its was better to have a large number of small units at regular intervals or to have a less number of larger chandeliers or fixtures. The latter plan would produce less uniform illumination, but would correspond more closely with the architecture. Mr. Walker's reply was that lighting features repeating themselves in the same way as the architectural features would give the best effect unless as an alternative indirect or cove lighting was used.

THE LIGHTING OF THE BOSTON EDISON BUILDING

Dr. Louis Bell read a paper on behalf of the committee which was appointed by the Boston Edison Company to design the illumination of its new building, in which building the convention was held. This committee consisted of Dr. Bell and Messrs. L. B. Marks and W. D'A. Ryan. The paper consisted mainly in a description of the lighting of the different floors of the building, but it was stated that subsequently definite values for the watts expended, the dimensions of different rooms and the illumination in foot-candles would be incorporated in the paper for publication in the *Transactions*. The meeting room was especially interesting as presenting an unusually efficient example of cove lighting. The efficiency was due to the proper curvature of the reflecting surface of the cove, so that the loss by multiple reflection in useless directions was less than with many other coves previously designed. With an expenditure of about six watts per square foot, an average illumination of about six foot-candles was obtained. The O'Brien tubular lamp was used in these coves. In the basement, which had a low ceiling, one-lamp pendants with large, deep Zalinski enameled reflectors covering Gem lamps were used. These reflectors were so large as to completely cover the lamp and keep direct rays from the eye. At the close of this paper, the committee was asked a great many questions in regard to various features of the building, which showed that the members had been carefully studying its features.

WHAT IS [illegible] LIGHTING

Mr. W. H. Blood, Jr., read a paper in which he endeavored to define what constitutes good lighting. He said that brilliant light, rather than good illumination is the thing now sought by the average city official. He favored the use of smaller units than are now common in street lighting for reasons well known to illuminating engineers. These small units produce the more uniform illumination along the street, and it is uniformity that is desired for street lighting. The small unit is less blinding in its effect, hence one can see the way along the street much better. He referred to the plans adopted in various cities for lighting of downtown streets by festoons, arches and posts. Festoons and arches give the street a festive appearance, but are somewhat [illegible]

He thought lighting of downtown streets by incandescent lamps placed on ornamental posts at frequent intervals was more dignified. He cited Los Angeles business streets lighted with incandescent post lamps as much more pleasing than the arc lamps used in New York and Denver or the arches used at Columbus. He thought that the present tendency was towards the use of high candle-power incandescent lamps for street lighting. The incandescent lighting situation had been recently changed by the introduction of higher efficiency street lamps and more satisfactory small constant-current regulators.

In discussion of this paper, Mr. J. R. Cravath said that one of the greatest obstacles to the introduction of incandescent street lighting (which all illuminating engineers knew, produced more satisfactory illumination on the majority of streets) was that of first cost. He did not consider this always a sound objection, considering the superior results obtained, but the objection was an obstacle nevertheless. It was more of an objection in underground districts where boulevard posts at $100 apiece must be used for each lamp than in overhead districts.

Mr. F. W. Willcox said that gas companies could afford to put in ornamental posts at frequent intervals and he thought electric companies should do the same thing. Mr. V. R. Lansing said that the central station company of Washington, D. C., was doing this and was putting in ornamental poles fully equal in appearance to those used by gas companies. It was further experimenting with reflectors which changed the horizontal distribution of light so as to take light from crosswise of the street where it was not needed and throw it lengthwise of the street. Mr. Litle said that reflectors were also being [illegible] redistribution.

Mr. George R. Stetson, of New Bedford, Mass., said that it was hard for electric companies to put in underground copper at a price which would compete with a 12-in. gas main. They had gas, electric and naphtha systems of lighting in Hartford. The naphtha system had been one of the cheapest until the rise in the price of naphtha.

Mr. Ryan put in a plea for the arc lamp in street lighting. He maintained that it gave streets an appearance of brilliancy which was desirable. It lighted high up on buildings, which could not be done with incandescents and gave the streets a well-lighted appearance. The Los Angeles post lighting he characterized as a piece of colossal extravagance.

[illegible]

Mr. J. S. Codman gave the results of some calculations which he had made and some new formulas which he had derived. He had taken the photometric curves of a number of individual reflectors and had plotted the combined resultant curve which would theoretically be obtained if these reflectors were used in a cluster. This was compared with the photometric curve obtained from such a cluster by actual test. The results corresponded fairly well. Besides the value of Mr. Codman's paper, as a check on these photometric curves, it presents, for the first time, a method of calculating illumination from lamps placed at an angle, a feat not heretofore attempted to any extent by illuminating engineers. The formulas which he derived should, therefore, be of value in instances where it is desirable to make such calculations.

[illegible]

Dr. Louis Bell presented the society with a table giving the values of diffuse reflection from a large number of wall papers. These were tested both by electric incandescent lamps and by daylight. The highest factor of reflection obtained was from a very light greenish tint of wall paper, which by incandescent lamp gives 64 per cent and by daylight, 53 per cent. The lowest reflection obtained was from dark greens and reds, where it fell as low as 5 per cent. The creams and yellows ranged from 40 per cent to 60 per cent, while the deep yellows, light reds and pinks were from 20 per cent to 40 per cent. Some of the dark fashionable papers were from 15 per cent down. In most cases less reflection was obtained from incandescent light than from daylight, but the light creams and yellows were better by incandescent light.

[illegible]

Mr. C. E. Stephens presented a paper descriptive of the new Westinghouse luminous flame arc lamp. As this was described before the National Electric Light Convention last June, report of which has appeared in our columns, pages 1144 and 1162, June 8 issue, an abstract of this paper will be unnecessary here.

ILLUMINATION PHOTOMETERS.

Mr. Preston S. Millar presented a paper dealing with illumination photometers, in which it was stated that an instrument designed specifically for the measurement of illumination differs from the laboratory instrument used to measure candle-power merely in that it is equipped with an illumination test plate and is generally rendered portable and is so enclosed that it may be used in a brightly lighted room. Many of the published results appear to be utterly unreliable, on account of the methods employed and by reason of the fact that the observers have failed to recognize the limitations of the instruments used. The paper contained a brief outline of 11 different types of illumination photometers which are in common use. These photometers are subject to the following errors: Photometric device of low sensibility, from 6 to 10 per cent; flame source as comparison lamp, from 3 to 5 per cent; direct comparison method, neglecting personal equation, from 13 to 34 per cent; improper design and location of test plate when measuring diffuse illumination, from 20 to 29 per cent. It is needless to state that not all of these errors are found in any one instrument, yet each of the photometers listed fails to meet theoretical requirements in one or more particulars. The paper closes by offering the following maxims, which the illuminating engineer would do well to bring to bear upon photometric problems:

An instrument must be a good photometer before it can be a good illumination photometer. Measurement of illumination is more difficult than the measurement of candle-power. In obtaining a photometric setting one does not necessarily determine the value of the light studied. Every photometer is to be regarded with suspicion until its accuracy is demonstrated. It is then to be regarded with suspicion until it is shown that no change has occurred since verification.

INEFFICIENCY IN [illegible]

A paper by Mr. Preston S. Millar reported the results of a series of tests made with the object of determining the relative inefficiency which characterizes diffused lighting systems. A study was made of the efficacy of the illuminants, expressed in lumens per watt; the efficiency of light utilization expressed as the ratio of the lumens applied to the lumens generated; and the efficacy of the lighting installation as a whole expressed as the total lumens applied per watt. It was found that in one installation tested 68 per cent had been sacrificed to secure diffusion and in another 72 per cent had been lost. The author expressed the opinion that it is doubtful if the loss from this cause is ever below 50 per cent. In certain classes of lighting, the best results will be obtained by reducing the intensity of illumination on unimportant objects which are unnecessarily well lighted. By taking advantage of this method efficiency is gained and the lighting is improved.

[illegible]

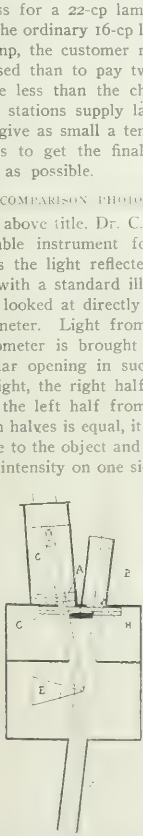
Mr. R. S. Hale in this paper gives some essential factors that cannot be ignored by central-station managers in dealing with the question of free lamp renewals. He believes that while too great an improvement in illuminants may cut down the sales of electricity, there is an intermediate point where the improvements may actually increase sales and the improvements that are now apparently coming on in the opinion of the author are about this point. In any event the final result will be the same whatever the central station does and the central station should not attempt to interfere with the final result any more than the hackmen of the city should be allowed to force the railroads to have several stations instead of a union station.

The immediate result, however, to a central station that sup-

plies free lamp renewals is a very important one. With the new illuminants, the effect will be to give the customer more light in proportion to the money paid; which may result in a decrease in income followed possibly by an increase. The author shows that the falling off in income due to a sudden introduction of the tungsten lamp might be very much greater than the falling off in expense, since the latter is not affected by the immediate use of energy. The cost of renewals is also important, since if this is large in proportion to the cost of electricity, it is difficult to handle the question of free renewals. Therefore from a central station viewpoint, the new illuminants should be developed along the line of lamps whose renewal cost will be small in proportion to the cost of electricity, or otherwise the central stations will be forced to give up the policy of free lamp renewals. This situation has actually arisen to-day in the case of very large wholesale customers using electricity for very long hours. On the other hand small consumers object to paying for tantalum lamps even though the combined cost of the lamp and the energy used is less for a 22-cp lamp than for the cost of energy alone used by the ordinary 16-cp lamp. The same is true of the flaming arc lamp, the customer rather paying a greater amount for energy used than to pay two charges even if the total of the two were less than the charge for ordinary arc lamps. When central stations supply lamps they must handle the question so as to give as small a temporary loss of income as possible and so as to get the final result from the new illuminant as quickly as possible.

NEW COMPARISON PHOTOMETER

In a paper with the above title, Dr. C. H. Williams described a compact and portable instrument for measuring in foot-candles or other units the light reflected from an illuminated surface as compared with a standard illumination. The object to be photometered is looked at directly through a semicircular opening in the photometer. Light from a small electric lamp attached to the photometer is brought by means of a prism through another similar opening in such a direction that the eye sees the disc of light, the right half of which comes from the object tested and the left half from the photometer lamp. If the intensity of both halves is equal, it shows that the intensity of the illumination due to the object and the standard are equal. If they are unlike the intensity on one side is reduced by means



[illegible]

of a movable photographic film of gradually increasing intensity, until both are equal. The scale on the film gives the illumination due to the object as compared with the standard.

The photometer shown herewith is a thin metal box three inches square by one inch deep. At A and at B are the semicircular openings. Over the opening A is a closed tube containing at one end a small tipless five-volt incandescent lamp, and at the other end near the opening a piece of fine, ground glass. E is a prism and F is the tube through which the light and object are seen. G and H are strips of glass about six inches long by one inch wide carrying the photographic films, which can be moved vertically before each opening so that the light at each opening can be made more or less intense at will.

In use, the instrument is first compared with some standard lamp placed at such a distance from a piece of rough white Bristol board that the surface of the board receives an illumination of one foot-candle. The photographic film before the opening H is placed at zero, so that no light is absorbed by this film, the film before the opening G is moved up and down before the opening until both halves of the field, as seen in the tube F are equal. The lamp of the photometer is then giving on the ground glass an illumination equal to one foot-candle of illumination as viewed by the photometer.

In order to measure the illumination of objects in the room, the film at G is left unchanged in position, and while looking at the object through the film H, this film is moved until the two halves of the field are again equal. The position may be read from the scale attached to the film, and from a calibrated chart one can then get the intensity of the illumination of the object looked at in foot-candles.

If the object to be tested has an illumination of less than one foot-candle, the film H is placed at zero and the film G is moved to a position of less density until the field is equalized. The scale shows the position of the film to get the fractions of one foot-candle of illumination.

After all the measurements are finished, the photometer is tested by comparing it with the original source of standard light, the film H being at zero. If the same position of the film G that was found in the first setting before the measurements were begun equalizes the two halves of the field, it proves that the comparison lamp of the photometer has not varied in its intensity, and this checks up the photometer both at the beginning and at the end of the measurements in a way that is not easily done with other instruments.

A small tipless lamp fed from a 5-volt storage battery gives a light which is sufficiently steady for an ordinary test.

In all comparisons of daylight and artificial light, and with light reflected from different sources, a troublesome difference in color in the two halves of the field is often obtained: this can, to some extent, be remedied by placing a light blue glass in addition to the ground glass in the tube C before the comparison lamp, but it is surprising to see how quickly and with what small errors the setting of the films can be made to give an equalization of the two halves of the field even with differences in color, and this is due somewhat to the fact that the photographic films are neutral and non-selective in their effect on colors. They are the same films which have been for some time used at the Harvard Observatory in some of the astronomical work.

Where measurements are made of surfaces illuminated by artificial light, the color difference between such light and the photometer lamp is less marked than it is between daylight and the lamp. Street lighting can be measured by holding a piece of white Bristol board normal to the direction of the light at a uniform distance from the street lamps to be tested, and measuring, with the photometer, the amount of light reflected from the board.

A GRAPHIC ILLUMINATION CHART

A chart was presented by Mr. Albert F. Parks by which horizontal illumination from a lamp with a known photometric curve can be obtained very quickly in foot-candles. The chart is one which is very easy to use and no doubt will find extensive use for the purpose for which it is intended when published in the society *Transactions*.

ENTERTAINMENT FEATURES

Besides the luncheon at Cook's restaurant tendered to the convention on Tuesday, the entire party was taken by boat Wednesday afternoon to Nantasket Beach, where a shore dinner was given, which was a novelty to not a few of the members. Following this, tickets were given to all the attractions in Paragon Park. All the local arrangements were beautifully carried out by Mr. John Campbell, chairman of the convention committee.

LETTERS TO THE EDITORS.

Transmission Cable Spans.

[illegible]

[illegible] relating to papers presented by Messrs. Hewlett and Buck at the recent A. I. E. E. [illegible] the permissible length of span [illegible] determined by . . . the proper securing of lines against damage by swaying . . ." In another of your recent issues a similar statement was also made.

[illegible] in designing and construct[illegible] transmission line [illegible] right of way when installing poles was a difficult problem, made some tests on the liability of aerial cables swinging together. Two cables of 4-0 aluminum were erected, spaced 24 inches apart in a span of 500 feet and having a sag of 25 feet. With wind up to sixty miles per hour the cables showed no tendency to swing together, the original spacing being preserved throughout practically the entire swing of the cables.

This experiment led to the installation of a transmission line with wooden poles and spans up to 325 feet, having a sag of approximately 9 feet. This line was recently rebuilt by substituting heavier cable, and the cable was given a sag up to [illegible] feet.

There is installed over the Calumet River at South Chicago, a six cable span of 400 feet with 18 ft. sag, the cables being supported at their ends in the same horizontal plane and spaced approximately 30 inches apart. This span has been subjected to the severest winds of Lake Michigan and there has been absolutely no tendency of the cables to swing together.

South Chicago, Ill. R. [illegible]

Simplified Spelling.

[illegible] Editors of Electrical World:

Sir:—Permit me to say a few words suggested by Prof. William Kent's interesting letter which appeared in the ELECTRICAL WORLD of July [illegible]

Prof. Kent proposes, as the standard of good usage in spelling, the agreement of two modern dictionaries.

As a basis for argument, such a tentative definition should prove eminently satisfactory, and opens the way for the broad discussion as to what modern dictionaries would best be selected to establish a consensus of opinion as to usage.

To this open question, Prof. Kent's answer would appear to be that the present editions of Webster's and the Century dictionaries would be satisfactory.

I should like to suggest, however, that fundamentally the question how we should spell lies deeper than in deciding what are the best artificial standards or authorities. Would we not find a more fundamental and reasonable basis for approaching the subject by defining what our spelling is, in terms of the function which it is used to perform?

Would it not be rational to say:—A written language is a system of symbols, mutually agreed upon by those who use it, for the purpose of representing the spoken language, or for recording the thoughts which may be exprest in spoken words? Of such a system, our spelling is an example.

This definition postulated, would it not be rational to define good usage in the written language as:—The selection of the most suitable system of symbols, *that can be mutually agreed upon*, for adequately fulfilling the functions which the symbols are intended to serve?

From this it follows that further argument turns upon the questions, what system is most suitable and what symbols, or combination of symbols, can be mutually agreed upon.

The answer to these questions (which for brevity I give without argument) are:

First, a phonetic system of writing is the best that has yet been invented. It is the ideal guiding principle compared with which all other considerations are secondary; it is almost the only element of value in our present system.

Second, as to mutual agreement for the spelling of our language, we must accept, as a practical basis, our present alpha[illegible] mutually intelligible to the users of English.

With these rational principles of orthography thus briefly outlined, we are prepared to answer Prof. Kent's specific inquiry, when he asks, why should we spell "practise" with s instead of c. The reason is, that when spelled with s, the word "practise" approaches more nearly to the ideal phonetic system, and at the same time, that form is not so radical a change from the form which, for a while, has been the more common one, as to render it, in any essential sense, mutually unintelligible.

Some day we shall drop the final e from "practise," which in the old form "practice," served the purpose of giving to c the soft sound like s. We shall then write "practis" which is the pure phonetic form of the word, and is the amended form approved by the Philological Societies of both England and America, being so listed along with some 3500 amended spellings in the Century Dictionary.

Is it rational, that we should use the two letters ce when our alphabet (deficient tho it is) has a single symbol s, which answers best the purpose for which spelling was invented? In the Scientific Alphabet promulgated by the American Philological Association and adopted by other eminent and expert authorities, the letter s always has its own proper hissing sound and none other, while c always has its hard sound of which k is a redundant equivalent. [Except in the diagraphs sh and ch.] That is the reason "practise should be spelled with s instead of with c."

Such considerations as these, show that there are fundamental principles involved, in this question of phonetics and spelling, to which the discussion of the best artificial standards and the recommendations of any particular board or association are only important incidentals, leaving the way open for differences of opinion as to expediency and method, without in any way compromising the fundamental principle of *developing in our system of spelling, that which is good, and eliminating that which is bad, because wasteful.*

Thus Prof. Kent points out, what he holds to be, objectionable ambiguities in two of the words given in the 300 word list of the Simplified Spelling Board, namely, "past" and "passed;" "mist" and "missed," and indeed there are so many other words that could well be amended, against which this criticism could not be raised, that it would seem expedient to leave the spelling of homonymous words untouched and to follow the rule, that, where a *valid* distinction would be lost, at least for the present, no change should be made. Personally, I believe the scarecrow of ambiguity raised in the field of a pure phonetic system has been very much overworked and it is instructive to note that those who raise this bogy-man do not show their sincerity by suggesting, that where ambiguity now exists, in words spelled alike, but pronounced differently, any change should be made. If they did, their arguments would indicate more of reason and less of prejudice. Why, for instance, spell *close*, meaning near, in the same way as *close*, meaning to shut, when by writing them more nearly phonetic, we have *close* and *cloze*? Why spell *bow*, a salute, the same as *bow*, an arrow-shooting weapon, when one could be written *bau*, the other *bo*, leaving the form *bow* for the prow of a boat?

Thus it is that many arguments against the betterment of our spelling are only pretexts (unwittingly so, it may be,) advanced in the desire to appear rational while governed by prejudice.

Prof. Kent's explanation of his personal antipathy to the form *thru* is interesting. The reason assigned being that *thru* is likely to be confounded with *then*, when carelessly written. I do not believe he wishes this to be taken as a serious argument, for, *so far as the argument from ambiguity is concerned*, there is no more reason to use the [illegible] to distinguish *thru* from *then*, than there would be to introduce the same combination for distinguishing *truth* from *tenth*, spelling it *troughth*. I might suggest, however, that *if* a distinguishing

sign *were* required for *thru*, a rational one would be a short horizontal line or dash over the *u*, which then makes the spelling absolutely phonetic in accordance with the Scientific Alphabet.

The real explanation of the rather prevalent aversion to the form *thru* is to be found, not in any fault in the form of the word itself, but in the constitution of man's mind. It is the distress of readjustment, experienced by some, to any radical innovation however wise. When compared with the Anglo-Saxon forms *thurh*, later at times *thruh*, from which it is derived, the form *thru* does not appear unusual, but by comparison with the more recent form, *through*, it is seen to be a rather violent break with the *immediate* past, a circumstance which to some people seems peculiarly irritating, and to seek any, more reasonable, objection than that of unfamiliarity is simply man's desire to believe himself rational where his proclivities are unfortunately asinine. (See Prof. Lounsbury's "Confessions of a Spelling Reformer" in *Atlantic Monthly* for May, 1907.)

In a fair and open mind, the appreciation of the consistent and true will generally prove a far stronger mind-motive than the indifferent apathetic tendency to drift along the channel of least resistance, thus the predominating motive of our temperament will, to a large degree, determine our attitude toward the movement for spelling reform.

Let us not lose ourselves in incidentals and trivialities, but remember that our written language, or spelling, is simply a convention to be mutually agreed upon, and just as in mathematical and physical symbolism it is our endeavor to mutually agree upon the most suitable system of conventions and symbols, so with our spelling, having the phonetic principle as its basis, it should be our endeavor to mutually agree upon such symbols and their combinations as are best suited to the purpose intended.

Perth Amboy, N. J. [illegible]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Compound Alternators.—A. Heyland.—An article giving several illustrations of compound alternating-current commutator machines which have been used for several years, with an account of observations which have been made during the use of the same. Operation in parallel of a number of such machines is quite satisfactory. It is recommended to design such machines with a comparatively "stiff" field and not to use too low a saturation of the magnetic circuit. A special point which is discussed in the article refers to the peculiar behavior of simply compounded machines when loaded with leading currents.—*Elek. Zeit.*, July 14.

Single-phase Motor.—M. Osnos.—An illustrated translation in abstract of his recent German article on the series-shunt, single-phase motor of the Felten & Guilleaume-Lahmeyer Works.—Lond. [illegible], July 12.

Alternating-Current Commutator Machines.—R. R[illegible]berg.—A mathematical article on eddy-current losses in alternating-current machines with an elliptic rotating field.—*Elek. und Masch.*, July 7.

Lamps and Lighting.

Flame Arcs.—A. Blondel.—An article giving general considerations on flame arcs. They are divided into two classes distinguished by the nature of the substances which are used and by the phenomena which predominate in the production of the light. The first class is that of flame arcs in which compounds of alkaline or alkaline earth metals are employed, giving rise to white incandescent fumes. The second class relates to the arcs formed by metals or compounds of the iron or titanium group, which give rise to luminescence effects. With respect to the use of alkaline-earth compounds, Rasch and others have proposed the use of pure oxides, but this has not found industrial application on account of distinct disadvantages. Others use electrodes of carbon with additions of mineral substances. Among the latter the calcium fluoride introduced by Bremer is the most [illegible] eliminated by Blondel in his "carbo-mineral" arc. Instead of using a homogeneous pencil like Brener, Blondel constructs his pencil with two zones, the central one being strongly impregnated while the [illegible] the inner core. Blondel also adds certain highly refractory [illegible] of zinc, etc. He then briefly discusses "effect" flame arcs of German manufacturers. The article is to be continued.—[illegible]

Mercury Arc.—[illegible] article on the mercury arc and its technical applications. The author [illegible] are available for starting the lamp and gives briefly the fundamental principles of its operation, discussing how it behaves with variations of voltage. He finally discusses the attempts which have been made to improve the spectrum of the mercury arc. Concerning the specific power consumption it is stated that a consumption of from 0.45 to 0.5 watt per hepner candle (including the series resistance) can be obtained in practice. Kuch and Retschinsky have obtained even a consumption of 0.185 watt per hefner candle with a column of light 27 centimeters in length using very high vapor pressure. The mercury vapor lamp is the more economical the greater the distance between the electrodes.—*Elek. Zeit.*, June 27.

New Incandescent Lamps.—An article giving a brief summary of recent advances in incandescent lamps, dealing with the graphitized filament lamp, the tungsten filament lamp, the tantalum filament lamp, the helion lamp, the osmium filament lamp, and the Nernst lamp and giving also some notes on recent developments in incandescent gas lighting. The same issue contains an illustrated article on the fundamental principle of artificial illumination.—*Eng'ing News*, July 25.

Power.

Italian Water Power Plant.—G. Anfossi.—An article on the change which the water power plant of Acquedotto de Ferrari Gallieri near Genoa is undergoing. This was the first large Italian transmission plant, built in 1889, and in it the direct-current series system of Thury was used. The plant was enlarged in 1901 and three different water falls were developed in three power stations containing series dynamos for 1000 volts and 50 amperes, constant direct current. The transmission e. m. f. with 16 machines in series is 16,000 volts. Since at low load one of the plants was unloaded and further developments were not possible, it was decided to unite the three power stations in a single one and employ three-phase transmission at 25,000 volts. The new power plant will contain 10 turbines of from 300 to 500 hp running at 500 r. p. m. Three Pelton turbines will drive each two Thury machines for 1000 volts and 50 amperes, while the other turbines will drive three-phase generators of 500 kilovolt-amperes at 5000 volts, the frequency being 50. The voltage is raised from 5000 to 25,000 for transmission. The direct-current transmission circuit has a length [illegible] wires of 65 square mm cross-section, while the three-phase transmission has a length of 14 km and consists of three wires [illegible] March and April; abstracted in *Elek. und Masch.*, July 7.

[illegible] article on the value of refuse destruction for electrical engineering. The author discusses the different methods for re[illegible]

[illegible] themselves in the refuse-destructor problem, it has been found that the refuse may be easily used, without any addition of coal, in specially constructed furnaces for steam raising. However, the quantity and the composition of the refuse varies and especially the calorific value is higher in summer than in winter. The author then describes several refuse-destructor plants erected by English and by German firms.—*Elek. Zeit.*, June 27, [illegible]

Steam Turbines.—An article by F. Langen gives results of some recent tests of steam turbines in commercial practice. In another article W. A. Mueller discusses the question whether a 200 hp steam turbine installation is economical, and shows that to compare it with a reciprocating engine plant it is not sufficient to compare the steam consumption in the two cases, but the yearly cost of operation with both machine types must be considered also. He shows that in a certain case a 200 hp steam-turbine installation may be more economical than a 200 hp reciprocating-engine plant, although the steam consumption of the former is higher.—*Zeit f. d. ges. Turbinenw.*, May 20; abstracted in *Elek. und Masch.*, July 7.

Water Power Plant.—An illustrated description of the hydro-electric station utilizing the Traun Falls. It contains three three-phase generators each of 1100 kw at 10,000 volts. There are four transmission lines one of which acts as a reserve to the power plant of St. Wolfgang, which is also described. It really consists of three plants, a small steam plant of 30 kw and two water power plants of 100 kw and 50 kw respectively.—*Elek. und Masch.*, June 30.

Traction.

Single-Phase Railroad.—E. Kerkaber.—A description of the new Val Brembano single-phase railroad which has a length of 30 km and runs from Bergamo to San Giovanni Bianco. Power is supplied from a hydro-electric station near one end of the line. The electric locomotives were built by the Westinghouse Company. Each is equipped with four 75-hp, single-phase commutator motors designed for 250 volts, geared to the four axles.—*L'Elettricista*, June 1; abstracted in *Elek. und Masch.*, July 7.

Petersburg.—Orgabrau.—An illustrated description of the new electric street railway system of Petersburg, which is in course of construction. The power station contains three turbo-alternators, each of 2200 kw generating three-phase currents at 6600 volts. The substations are equipped with rotary converters of 750 and 500 kw. The three-phase cable net-work is designed for 6600 volts and the direct-current net-work for 600 volts.—*Elek. Zeit.*, July 11.

Installations, Systems and Appliances.

[illegible] article on the policy of central-station management under such conditions as exist in the Austrian Alps. The following data refer especially to the City of Klagenfurt. The author first discusses the right of an electric station to connect to its net work only such plants as have been erected by the station itself. The prices for electrical energy in Klagenfurt are, if metered, 9 cents per kw-hour for lamps with discounts up to 40 per cent. For motors the charge is 4 cents with discounts up to 70 per cent. The average price paid for lighting on a flat rate is 4.2 cents and if metered 7.2 cents, for motive purposes 1.6 cent and for public lighting 1.6 cent. Gas costs 7.2 cents per cubic meter for lighting and 3.6 for power purposes. The electric station has, therefore, no difficulty in getting new customers, especially after the new metallic filament lamps have been introduced. No special canvassing is being done. By a systematic introduction of meters, the consumption curve has become far more favorable since the connections and the number of kw-hours sold have increased while the maximum load during the day has somewhat decreased. On account of the danger from ice in winter the 2400-hp hydro-electric station is now to be supplemented by a 1200-hp steam station which acts as reserve.—*Elek. und Masch.*, July 7.

Wires, Wiring and Conduits.

[illegible] The conclusion of his long article. His results are summed up as follows. In all the dielectrics tested (various kinds of glass ebonite, dielectric of the Grisson condenser plates, impregnated jute) the square law (according to which the loss is proportional to the square of the voltage) is obeyed with perfect accuracy when the voltage alone is varied. Apparent digressions from the square-law result whenever another quantity by which the loss is influenced (for instance, the temperature) is varied; in glass and ebonite, tested in this respect, the loss increases appreciably even with a small rise of temperature. In the cables tested, however, the departure from the square law caused by rise of temperature occasioned by the loss itself does not take place except above the working voltage: the loss thus increases strictly in proportion to the square of the voltage in these cables also. A further apparent digression from the square-law is exhibited by the loss in a condenser at high voltages if point discharges are allowed to take place. In this case the loss caused by the point discharges, increasing much more quickly than the square of the voltage, soon becomes so large at high voltages that in comparison with it the amount of energy wasted in the dielectric itself is almost inappreciable. The energy loss in the dielectric is proportional to the capacity, and may be considered as proportional to the frequency through the range of frequencies used for technical purposes. Although only dielectrics with comparatively small loss were selected, the amount of the loss exhibits rather considerable differences in the different materials tested. Great variety in the loss was found with different kinds of glass. The smallest loss in all the solid dielectrics tested, except paraffin, was observed in flint-glass, while the loss in the cable insulated with rubber and impregnated jute was only slightly greater. Owing to strict compliance with the square-law the quantity by which the loss is measured remains the same at all voltages, and there is, therefore, no reason for undertaking the measurements at high voltages. Since exact measurements of loss can be made at comparatively low voltages for capacities of 0.001 mfd. and upwards, the method presents a suitable means for determining the energy loss in dielectrics. As to cables, especially, far more accurate measurements can be made on pieces a few meters in length at from 1100 to 1500 volts than by the method used hitherto on lengths of several hundred meters and at much higher voltages. The method, therefore, appears to be very well suited for technical measurements of loss in cables, and moreover, it might replace advantageously the insulation test on alternating-current cables, as it provides all the effects required by an insulation test on such cables and is much more to the point than the methods used hitherto for this purpose. In extensive high-tension cable networks the amount of energy wasted in the dielectric is by no means negligible. In the case of short or medium lengths it affords by far the greater part of the no-load loss, and only in very long uninterrupted cable lines can it be neglected in comparison with the copper loss.—[illegible]

Fuses.—A. Schwartz and W. H. N. James.—A communication in which the writers object to a recent statement by Meyer concerning the suitability of aluminum for fuse wires. They cannot see any advantage in the use of small aluminum wires as compared with copper.—Lond. *Elec.*, July 12.

Electrophysics and Magnetism.

[illegible] paper on "some newly observed manifestations of forces in the interior of an electric conductor." The author refers to the so-called "pinch phenomenon" of C. Hering, which has already been discussed in Electrical World, and describes a simple lecture-room experiment which shows this phenomenon very clearly. He then gives a brief theory of the forces around and in an electric conductor. In addition to the field of force exterior to an electric conductor, there is a field of force in the substance of the conductor itself. While in the interior of a solid cylindrical conductor the field intensity increases from zero at the axis to a maximum at the circumference, the conditions are reversed on the outside of the conductor, the intensity of

the field decreasing with the distance from the axis. The following experiment illustrates the variation of the field within the conductor: The glass tube shown in Fig. 1 is closed at the top and the bottom with copper disks, and a silk thread is stretched along the axis of the cylinder. At the center of the cylinder two small magnets are placed with their south poles pointing to the axles and their north poles to the circumference. The magnets begin to rotate as soon as current is sent through the liquid. When the current passes from the

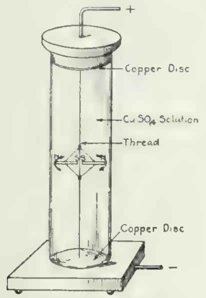


FIG. 1.—PINCH PHENOMENON.

top to the bottom the rotation is clockwise. Reversing the current reverses the rotation. This result depends upon the distribution of the field intensity in the interior of a conductor. There exists a static pressure in the interior of a conductor. This pressure may be shown in the above apparatus by suspending a fine manganin wire of high resistance within the liquid column, one end of the wire being fastened to the upper copper disk near its circumference and the other end to the corresponding point of the lower copper disk. The wire is slightly longer than the distance between the disks and hence hangs loose between them, and it may be arranged to hang near the circumference of the liquid column. When current passes through the liquid column a current in the same direction and of greater current density also passes through the wire. On completing the circuit the loose wire is instantly urged from the circumference and forms a bow, which bends toward the axis of the liquid column. In place, now, of an actual wire in the inside of the liquid column, this liquid column may be considered as being made up of a great many filaments parallel to the column. All these filaments will be attracted toward the axle of the cylinder, so that if the conducting liquid column have elastic walls it will contract so as to diminish in cross-section, and in consequence increase in length. If the column cannot increase in length, it will tend to contract. In other words, there will be a static pressure at the center greater than the pressure near the surface. This pressure is hydrostatic. The author describes an experiment which shows the existence and magnitude of this hydrostatic pressure. He then compares the forces produced by an electric current in a conductor of circular cross-section with the forces produced by gravity in the interior of an infinitely long cylinder of the same radius and section as the electric conductor. He finds the attraction due to the electric current, which would act on a unit length of a unit current, to be of the same nature and in the same direction as the gravitational attraction which would act on a gram of matter, but 3928 times as great, the number of units of current per unit of cross-section of the conductor being equal to the number of grams of matter per unit of cross-section in a unit of length of the cylinder. It is then shown that if the pinch phenomenon causes a conductor to contract, whatever may be the change in the diameter of the conductor, the total number of lines of force in its interior remains the same, provided the current is always the same. The total number of lines exterior to the conductor is increased when the conductor diminishes in diameter, and as the number inside the conductor remains the same, the coefficient of self-induction of a small wire is greater than that of a large wire. If the current be maintained constant when the conductor diminishes in diameter, electromagnetic energy is stored up in the medium around the conductor. The author finally describes an arrangement by which it is possible to obtain forces of sufficient magnitude to be useful in practical applications, for instance, for making a direct or alternating-current ammeter of large capacity. The internal pressure at one point in a conductor is here added to that of another point, and so on. In his final remarks the author says that it is quite certain that this force, which depends only on the square of the current and linear dimensions, may be used as an accurate measure of the current, either direct or alternating. As the forces can be enhanced by a proper disposition of iron in the heterogeneous circuit, motors without brushes or slip rings may be made operative. And remembering that power is the product of current and electromotive force, it is not impossible, even if large operative currents are required, that fair efficiencies may be obtained.—*Physical Review*, June.

Magnetic Alloys of Non-Magnetic Elements.—J. C. McLENNAN.—An account of a series of experiments made concerning the magnetic properties of Heusler's alloys, and relating mainly to magnetostriction and permeability. One of the results is that the permeability of these alloys can be considerably increased by continued heating at moderate temperatures. In general it seems that the magnetic properties of the different alloys are intimately associated with their molecular structure, and since the structure of an alloy at any temperature can be ascertained by rapid cooling from that temperature, it is possible that the magnetic properties of the alloy may also be investigated by the same procedure.—*Phys. Review,* June.

Arc Spectra.—W. J. HUMPHREYS.—Two Physical Society papers, in the first of which some effects of heavy pressures (42, 69 and 102 atmospheres) on the arc spectra of a number of metals are described. In the production of arc spectra under heavy pressure it is necessary for one of the poles to rotate, since it is not possible at pressures of 50 or more atmospheres, at least with ordinary voltages of 250 or less, to maintain a steady arc between fixed poles. The apparatus for the production of a rotating electric arc under heavy pressures is described in a second paper.—*Physical Review,* June.

Determining the Potential of Hot Gases.—C. D. CHILD.—An article in which the author points out that the determination of the potential of hot gases by carbon pencils is liable to introduce errors, since between the hot carbon and the surrounding bodies there is an e. m. f. which depends in amount and sign on the temperature of the carbon.—*Physical Review,* June.

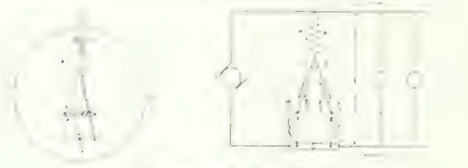
Electrochemistry and Batteries.

Determining the Size of a Storage Battery for a Given Load Curve.—W. PEUKERT.—The author has formerly given a formula on the relation between the ampere-hour capacity of an accumulator and the discharge current. This formula is $i^n t = K$, in which the exponent n depends only on the construction of this battery and is a constant for the same type of plates and the same system of storage batteries. K changes with the size of the battery of a given system. The constant K may be easily calculated for all different sizes of a system if it is known for the smallest size only. If the problem is to find the proper size of a storage battery to satisfy a given load curve, the constant K corresponding to this load curve is to be found. For this purpose the author plots the current curve i over a given period of time and then plots as a second curve the curve i^n. The surface included between this latter curve and the axes of the ordinates gives the constant K. The author finally shows that the above formula is also valid for the Edison alkaline battery.—*Elek. Zeit.*, July 18.

Units, Measurements and Instruments.

Hot-Wire Instrument.—An illustrated description of the hot-wire instrument of Chauvin and Arnaux, which may be used as ammeter, voltmeter, wattmeter and phase meter. As shown in Fig. 2, it consists essentially of the hot-wire $A\ C\ D\ B$, which is fixed in the two metallic blocks A and B and passes around the cylinder D. Connection is made at C between the wire and

[illegible] transmits to the needle on the dial the displacement of the cylinder due to the unequal elongation of the two halves of the hot wire. Temperature increases in the testing room are with- [illegible]

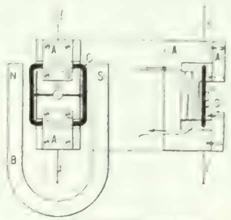


[illegible]

elongation of both halves of the hot wire. The right-hand diagram shows the connections of the instrument when used as a wattmeter. The terminals A and B are connected to a resistance S in one main conductor, while the terminal C is connected through a non-inductive resistance R to the second main conductor. A current proportional to the main current flows through the whole hot wire in the direction of the drawn-out arrows, while a current proportional to the tension flows through the hot wire in the direction of the dotted arrows. The second current, therefore, increases the first current in one half and diminishes it in the other half of the hot wire. If the connection at B is broken, the apparatus measures the voltage. If A and C are connected to S and the connection B is broken the instrument measures the current, while with the connections, as shown in the right-hand diagram, the watts are measured. If the three measurements are made quickly in succession, the power factor may also be found.—*L'Elec.*, April 27; abstracted in *Elek. und Masch.*, June 30.

[illegible]—R. H. [illegible] and [illegible]—A Physical Society paper on an investigation in which the requirement was to have a very constant frequency even when the power was changed considerably. The paper refers to the operation of a direct-current shunt-wound motor in synchronism with a tuning fork. In the arrangement described the dynamo voltage is so regulated as to keep the motor at a constant speed. On the shaft of the motor is a half-ring commutator. Two brushes bearing on this commutator are connected to the terminals of an auxiliary resistance in the field circuit of the dynamo. The arrangement shunts the auxiliary resistance of the dynamo during one-half of each revolution of the motor armature. This action increases the field current of the dynamo and, therefore, the voltage generated. In parallel with these brushes is a contact operated by a tuning fork and closed during one-half of each of its vibrations. When the phase of the commutator is 90° behind the phase of the tuning fork, the auxiliary resistance during three-fourths of each revolution of the motor armature and the dynamo generates a definite voltage corresponding to this phase difference. Now if, due to any cause whatever, the speed of the motor is decreased slightly, the phase difference continually increases (and therefore the field current of the dynamo and consequently the voltage generated also increase) until the power supplied to the motor is sufficient to keep it from falling below synchronism. Or, if due to any cause whatever, the speed of the motor increases slightly, the phase difference continually decreases, and consequently the power supplied to it decreases. This action prevents it from going above synchronism.—*Physical Review*, June.

[illegible]—A [illegible] constructed by Carpentier, for throwing alternating-current curves on a screen in a lecture room. It consists essentially, [illegible] of [illegible] iron sheets and provided with a primary winding through which passes the current the curve of which is to be tested. The secondary coil, which consists of a single winding C, is suspended on thin cocoon threads ff so as to be parallel to the primary winding. [illegible] manent horseshoe magnet B. When alternating current is sent through the primary coil, currents are produced in the secondary winding, which then oscillates in a horizontal plane so that a light ray which falls on the mirror m is reflected and



[illegible]

throws an image on the screen. By means of rotating mirrors and a rotating prism the image is elongated into a continuous curve.—*L'Elec.*, May 4; abstracted in *Elek. und Masch.*, June 30.

[illegible]—P. Humann.—If in a well-balanced three-phase system the energy is measured by means of two watt-hour meters or meters connected according to the system of Aron, the power factor may be found from the ratio of the two readings. For this purpose a curve is plotted which gives the relation between that ratio and the power factor.—*Elek. Zeit.*, July 18.

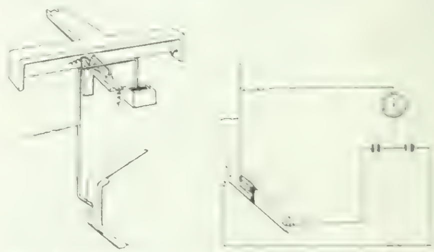
Hysteresis Tests.—G. Kapp.—A paper illustrated by diagrams on a method of plotting the hysteresis loop for iron The method depends on noting the form of the time-current curve after a sudden reversal of the e. m. f. applied to a coil surrounding the iron to be tested. The method is applicable to transformers.—Lond. *Elec. Eng'ing*, July 11.—Lond. *Elec.*, July 12.

Switchboards for [illegible]—[illegible]—An illustrated article in which the author deals with the design of switchboards used for testing purposes, and describes a switchboard employed at present at the Central Technical College in London.—Lond. *Elec.*, July 12.

Resistance Thermometers.—H. C. Dickinson and E. F. Mueller.—An abstract of an (American) Physical Society paper on the calibration of calorimetric platinum resistance thermometers.—[illegible], June.

Telegraphy, Telephony and Signals.

Electrocapillary Receiver and Relay.—A description of some recent improvements made by A. Orling in his electrocapillary receiver for delicate telegraphic signals. Fig. 4 represents a siphon recorder, the siphon of which is actuated by a light bridge-piece with its ends resting on the surface of mercury



[illegible]

in a capillary tube. The mercury column is interrupted by a drop of acidulated water, and in accordance with the well-known properties of this arrangement, the slightest difference of potential between the two bodies of mercury causes a displacement of the latter, which movement is communicated to the siphon and recorded in the usual way. Fig. 5 relates to the use of the apparatus as a relay: the moving arm which replaces the siphon tube is kept in vibration, and it plays over the [illegible]

movement of the arm to one side or the other closes local circuits which produce corresponding signals, either for direct retransmission or for reading.—Lond. *Elec. Review,* July 5.

Relay.—An illustrated description of the Steljes relay which consists of an arrangement which has for its object the provision of independently pivoted polarized tongues in combination with a single core, whereby three or more circuits can be opened and closed under the control of a main controlling circuit or three or more other devices or sets of mechanism can be operated under the control of a main or controlling circuit. The relay has recently been tested by the British Post Office for high-speed telegraphy with good results. A modification of the arrangement may also be used in connection with speed recorders, etc.—Lond. *Elec. Review,* July 5.

Telephony and High-Tension Transmission.—F. Schrottke.—The first part of a mathematical article on the influence of high-tension transmission lines on the operation of telephone lines in the neighborhood.—*Elek. Zeit.,* July 11.

Detector for Electric Waves.—L. W. Austin.—An illustrated note on the high-resistance contact thermo-electric detector for electric waves. The principle is as follows: If two metals standing far apart in the thermo-electric series be so brought in contact that their contact resistance is sufficiently high and if the surfaces of the metals are of such a nature that heat is not conducted away too rapidly from the point of contact, then the passage of electrical oscillations through the junction will produce direct electromotive forces which may be detected in a galvanometer or a telephone in series with the thermo-element. As a pair of metals suitable for the purpose, tellurium and aluminum are mentioned. Silicon may be substituted for aluminum. This type of detector compares favorably with the electrolytic type.—*Phys. Rev.,* June.

Miscellaneous.

Factories.—An illustrated description of the switch and switchboard factory of Dorman & Smith in Salford, and a description of the works of J. H. Holmes & Co., in Newcastle-on-Tyne who in addition to making direct-current machines have now taken up the manufacture of three-phase equipments. —Lond. *Elec. Review,* July 5.

BOOK REVIEWS.

Traite de Physique. Par O. D. Chowlson. Translated from the Russian into French by E. Davaux. Paris: A. Hermann. 312 pages, 136 illustrations. Price, 12 francs.

This is the third part of the first volume of a complete treatise of physics written by O. D. Chowlson, who holds the chair of physics in the University of St. Petersburg, and translated from the Russian and German editions by M. E. Davaux. The present volume treats of phenomena connected with the liquid and solid states of matter. By its thoroughness of treatment and the excellence of the diagrams, it reminds one of the classical "Cours de Physique de l'Ecole Polytechnique," published by Prof. Jamin between 1858 and 1861.

A valuable feature of the work is the lengthy bibliography appended to some of the chapters. An English translation is much to be desired.

Zur Theorie der Abschmelzsicherungen. By Georg J. Meyer. Munchen: R. Oldenbourg. 101 pages, 26 illustrations. Price, 3 marks.

The writer has undertaken to present in this little book the mathematical theory of the melting of fuses with electric currents. The treatment is from the engineering standpoint and from experimental data. The work is divided into two sections. The first considers the simple fuse formed of a straight wire or strip of fusible metal situated in air. The second section treats of the parallel connection and successive operation of graded fuses. The modern enclosed fuse is also considered to a certain extent, although the treatment is not very full. A number of useful tables of experimentally derived data complete the book. The work will be useful to mathematically trained engineers, who make a special study of fuses and their behavior.

Les Lampes a Incandescence Electriques. Par J. Rodet. Paris: Gauthier-Villars. 200 pages, 92 illustrations. Price, 6 francs.

The first chapter of this volume is in itself a valuable treatise on the scientific principles involved in electric illumination generally as well as on the theory and practice of photometric measurement. The second chapter is interesting mainly from the historical point of view, as it contains a notice of the progress achieved from the early experiments of Justice Grove (Sir William) in 1840, down to the novel and highly interesting results obtained by Mr. Cooper Hewitt between 1900 and 1906. Subsequent chapters are devoted to a study of the best-known forms of electric incandescent lamps, involving their construction, physics, illuminating power and economy. Among them are the carbon-filament lamp, the osmium lamp, the tantalum lamp, the Nernst lamp and the mercury-vapor lamp. The writer is well acquainted with the work done in this country in connection with the progress in the science and art of electric illumination as evidenced by his frequent reference not only to Mr. Peter Cooper Hewitt, but also to such men as Edison, Kennelly, Whiting, Clifford, as well as to our leading electrical periodicals.

Reporting Yacht Races by Wireless Telephony.

The first actual application of radio-telephony to practical work anywhere in the world was made at Put-in-Bay, in Lake Erie, during the week of July 15 to 20, in reporting the regatta of the Interlake Association. The Radio Telephone Company installed the De Forest wireless telephone on board of the cruiser yacht "Thelma," and also equipped a shore station at the Fox Dock at Put-in-Bay.

FIG. 1.—YACHT "THELMA."

The "Thelma" followed the competing yachts around the course through most of the races and full and graphic accounts were telephoned into the shore station.

The greatest distance at which the reports from the yachts were heard and recorded was four miles, considered remarkable in view of the height of "Thelma's" spars and the power of the transmitter on board. Her equipment comprised a 220-volt generator of 1 kilowatt capacity, the DeForest oscillator and transmitter, and for the receiving apparatus an audion detector and "pan cake" form of syntonizer or tuner. Her aerial wires led through the roof of the wheelhouse to a small cross-arm on top of the foremast and thenc to a similar arm on the mainmast. Ground connection was at first made to the pro-

peller shafts of her twin screws, but as this was found insufficient, more area was added by fastening two sheets of zinc to the yacht's hull at the bow.

The telephone dynamo was belted direct to the flywheel of her starboard engines, aft, and the rest of the radio apparatus [illegible] to all.

On shore 110-volt direct-current was available and this was transformed to 220 volts by a motor generator. The current was led through a rheostat and choke coils to the oscillator. Connected to this oscillator is a shunt circuit consisting of a condenser of peculiar construction and a primary coil, the exact number of turns of which could be varied at will to alter the tune or wave length of the electrical waves which were generated. A second coil within this primary had its upper end connected direct with the antennae or aerial wire, while its lower end led first through the microphone transmitter and thence to the earth plate. In this way the changes in resistance in the microphone produced by the modulations of the human voice directly affect the intensity of the high-frequency currents which are continually passing from the air wire to the ground plate. Inasmuch as the receiver instrument is affected exactly in proportion with the strength of the received electric waves, it is evident that every variation in the microphone resistance by the voice will be reproduced to the listening ear at the distant station by the vibration of the telephone diaphragm there. The microphone transmitter and the telephone receiver are exactly the same as used in the wire telephone, with which all are familiar. The "oscillator" and the "responder" are the only new and additional features, and the ether takes the place of the connecting wire.

Upon the finish of the regatta the telephone apparatus from the "Thelma" and the Put-in-Bay shore station was shipped to Toledo, where it is the intention of the Radio Telephone Company to install it permanently, where it can be in communication with other wireless telephone sets to be installed on vessels sailing Lake Erie. The Great Lakes offer, perhaps, the most promising field anywhere in the world for the first general application of this new invention to the needs of a merchant marine, and it is the intention of the company to at once enter this promising field.

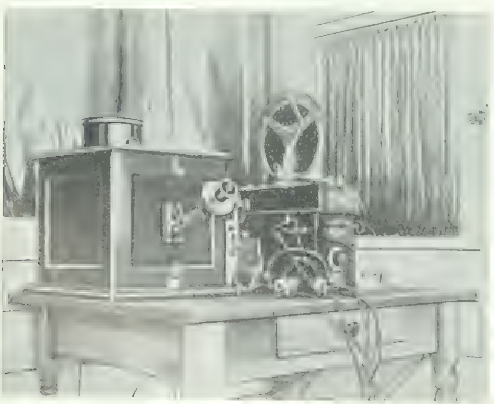


FIG. 4.—WIRELESS [illegible] YACHT "THELMA."

Panel Circuit and Switch Parts.

The Trumbull Electric Manufacturing Company, of Plainville, Conn., has brought out a new line of panel circuit and switch parts some of which are illustrated herewith. The line is designed to meet the demand of those wishing to procure their own slate and marble and who wish to arrange the circuits as they desire, rather than accept a stock pattern which in many cases would not be applicable. Moreover the freight rates on plain marble or slate are so much lower than on completed panels that a material saving may be made in transportation charges alone. The switches, etc., are built to Code standards and the fuse receptacles are intended for standard fuses. Bus-bars as well as the necessary lugs are also procurable so that complete unmounted panel parts can be obtained. The panel circuits are arranged for 125 volt, two to two or three to two wire circuits and for 250 volt, two to two wire circuits. Open link, plug and standard enclosed fuse panel circuit parts are made. Lugs are carried for No. 5 and for larger wire and bus-bar copper having various cross sections.

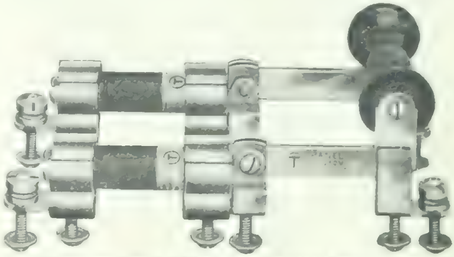


FIG. 1.—[illegible] PANEL CIRCUIT WITH [illegible] FUSES.

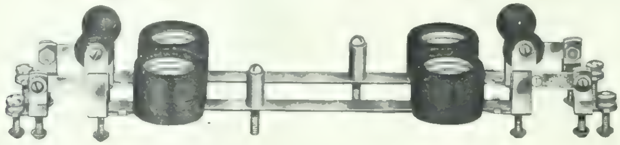


FIG. 2.—DOUBLE PANEL CIRCUIT PARTS WITH PLUG FUSES.

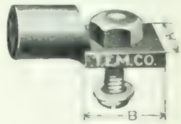


FIG. 3.—[illegible]

A Miniature Telephone.

Telephone operators, as is well known, use to a large extent what are called main telephones, carried in front of the ear by means of a spring surrounding the head. By the use of these telephones, both hands being disengaged, the speed of operation of telephone exchanges is greatly increased, as much time would be lost in approaching a telephone receiver to the ear. However, these telephones show some disadvantages, making their use rather inconvenient. On one hand the apparatus is fairly heavy, so as to become troublesome after some time's wearing, while on the other the pressure of the spring is bound to produce considerable uneasiness.

In order to eliminate these drawbacks experiments have been recently commenced at the Stockholm Royal Telephone Exchange with a miniature telephone, which is calculated for being inserted into the outer duct of the ear, being kept there permanently without any inconvenience after once being fitted. The conductor is preferably arranged behind the ear in the shape of an ordinary eyeglass string.

The miniature telephone comprises a hard steel cylinder, which is so magnetized as to place one of its poles in the annular rim to which the membrane is applied. The other magnet pole is located in front of the middle of the membrane, viz., at the end of the iron core of an electromagnet situated in the interior of the cylinder. By the magnetic circuit thus constituted extremely satisfactory effects are ensured with the use of a single

electromagnet. On the other side of the membrane is attached a lid bearing an ebonite extension, the shape of which is adapted to the shape of the ear.

The miniature telephone is constructed on plans by K. Ericsson in the Swedish telegraph workshops. This apparatus is also adapted for the use of partly deaf people. The telephone is carried without any inconvenience and is practically invisible in the ear, the microphone being worn in a fitting on the breast. A dry cell and an induction coil are carried in the pocket.

Tregoning Electric Light Specialties.

The accompanying illustrations show three specialties of the Tregoning Electric Manufacturing Company of Cleveland, Ohio. Fig. 1 shows a separable attachment plug whose object is to provide a means whereby a ready connection may be had for heating devices, dental appliances, motors, etc. To protect the device and also the fixture to which it may be attached, a separable cap is provided so that if the cord is subjected to strain the cap severs connection from the plug proper. Such a con-

FIG. 1.—SEPARABLE ATTACHMENT PLUG.

FIG. 2.—CLEAT FUSIBLE ROSETTE.

dition occurs quite frequently in practice, as for instance, where desk lamps are connected to a circuit by means of a plug. The separable cap also eliminates the frequently occurring annoyance of cord twisting. The cap terminals permit of circuit polarity being changed without disconnecting the cord in the cap. A fusible rosette is shown in Fig. 2. In this device, ample space is provided for cord knot and fuse links. There is also a long break space which precludes the possibility of arcing at the points of contact when the cap is being removed. A very

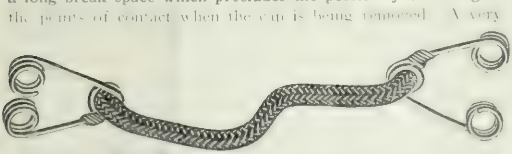


FIG. 3.—BATTERY CONNECTOR.

useful device known as the "lobster claw" battery connector is shown in Fig. 3. This simple device is provided with phosphor bronze springs and is designed to effectually prevent loose battery connections, so common on automobiles, naphtha launches, etc. No thumb nuts are necessary on the binding posts, the connector being attached to the battery terminal by simply compressing the springs.

Small Types of Storage Battery.

The problem of furnishing storage batteries for work in which small amounts of energy are required, as in operating police, fire alarm, railway signals, telegraph and private telephone exchanges and the like has been solved in the novel design introduced recently by the Gould Storage Battery Company, New York City, and termed the Gould tandem couple type cell.

The essential characteristic of this cell is that the plates are set end to end in each cell, one positive plate and one negative plate only in each glass jar. This differs from the old method of placing plates side by side in the jar or tank where the charging and discharging took place from one side of each plate only; which produced a tendency toward buckling and caused the wear and tear to take place on one side only.

With the plates placed end to end, the discharge takes place from both sides of the plate and from practically all parts of the plates at once, as the current rate is very low for this class of work. This construction eliminates the chance of grounding or short circuit between plates for which there is more or less chance when plates are placed side by side.

A striking advantage of this new design is that the removal of any couple for inspection, cleaning or renewal is not attended by the unbolting of connections, sawing of lead, the lead burning outfit, etc. The positive plate of one cell is lead-burned to the negative of the next cell, no bolted connections being used whatever except at the end of the rows. This insures perfect contact between all the cells and eliminates all chance of the circuits being interrupted on account of poor connections—a point of considerable importance, especially in fire alarm work.

This method of grouping at the same time greatly facilitates the replacing of any couple with the minimum possible interruption to the circuit, the changing of all groups in the set being a matter of only a few minutes as there are practically no connections to unbolt and positively no separators to remove and replace. This method has done away with the use of separators for this class of work, cheapens and simplifies the construction of and use of the small type of storage battery.

Data on the Westinghouse Organization.

Mr. George Westinghouse, president of the Westinghouse Electric & Manufacturing Company, has addressed a letter to stockholders, in which he comments upon the efficiency of the managers and officers of the corporation. He refers to the work of Vice-President Herr; Second Vice-President Osborne; Vice-President McFarland; Engineers Scott, Lamme, Davis, Storer and others; Treasurer T. W. Siemon; General Auditor J. C. Bennett and Purchasing Agent W. J. Longmore and their assistants. He says: "In the annual report the affairs of your company are dealt with at length. From the favorable comments already made by the press throughout the country and by many stockholders, your managers trust they have met the expectations of all of those who are interested in any manner in the continued prosperity of the company. In its infancy your business occupied a space having less than 100 square feet of surface. To-day it is carried on in the most complete workshops ever constructed, having a floor area of over seventy-five acres and employing 23,000 operatives.

"Twenty years ago, when your business started, there were no managers, officers, or engineers familiar with the class of business which was then wholly unknown, and these had to be developed. The managers, officers, and engineers now in your employ would make a full regiment of active, earnest skillful soldiers, possessed of technical and business knowledge of the highest order, fully competent to carry forward a business which has really only begun.

"The Westinghouse Electric & Manufacturing Company, relief department has a present membership of about 3,400. Medical attention is given each day to from 75 to 100 covering sickness, accident cases and redressings of prior injuries. About 30 per cent of those reporting as sick are found to be entitled to benefits. Present sick and accident benefits aggregate $1,000 per month, while the income from premiums is about $2,500 per month.

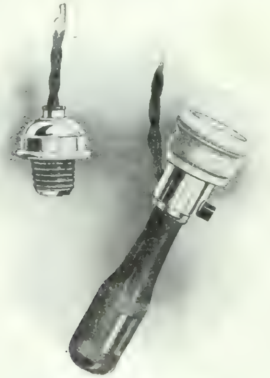
"During the past ten years your company has had, besides customers, thousands of visitors from all parts of the world, many of whom have been sent by foreign governments to study with care the extensive developments which have resulted in the manufacture of electrical and mechanical apparatus on so

[illegible] commendations of these visitors have been most gratifying, especially because of the very frequent references to the superior character of your employees and the facilities provided for them, with the consequent result that your product has always been spoken of in the very highest terms.

"It has been frequently said by those who have studied the business of the various Westinghouse companies that their general co-operation for a common benefit could be made a power of the very highest importance. During the past few years there has been developed a spirit of co-operation which has resulted in greatly spreading the influence of these organizations. This can be made still more effective by each shareholder in the several companies also taking an active interest in this important work."

Electric Cigar Lighters.

The Besseltric electric cigar lighter illustrated herewith is one of those handy little contrivances which central stations can push to good advantage among their customers.. It is a consumer of electrical energy and at the same time affords an opportunity of lighting cigars much cheaper than the use of matches. The user simply removes a lamp from the socket, inserts the plug and it is ready for service. The manufacturers claim that they provide 1500 "lights" for one cent, and from our own experience, having had one in use for some



ELECTRIC CIGAR LIGHTER.

months past, the manufacturer's claim seems to be thoroughly within the bounds of truth. It has a lighting disk which the user can readily insert. The cap is made of colored porcelain, the body of oxidized brass and the handle of hard composition rubber, the whole appliance having a suggestive outward resemblance to a telephone receiver. It works on either alternating or direct current and is made for any voltage from 10 to 135 volts. It is furnished in a variety of artistic styles to match any decorative scheme and it is made by the Besseltric Lighter Company, Scranton, Pa.

Belted and Geared Motors in Paint Factory.

The paint grinding machinery of a large Western manufacturer of pigments, the Wadsworth-Howland Company, of Chicago, has for some months past been operated by means of forty-odd Allis-Chalmers, 3-phase, 60-cycle, 220-volt, belted-induction motors, ranging from 1 horse-power to 30 horse-power, all of which are suspended from the ceiling. The motors are at present operated by electrical energy purchased from the local lighting company, although a 100-kw engine driven alternator is available for use if necessary. In order to ascertain the exact difference in power consumption between belted and geared motors, and the relative efficiencies of the two methods, a test was made on one of the paint grinders and the power actually consumed was accurately measured, using first a belted Allis-Chalmers motor, and second a geared motor of another design.

The mill on which the tests were made is used for grinding yellow ochre, after it has passed through a mixer. The machine consists of two pairs of mill stones about 30 in. diameter, each mounted with axis vertical. The lower stones of each pair revolve while the upper stones are fixed. One pair of stones is located in front of, and below the other, so that the paint discharged from the upper pair will drop into the hopper of the lower. The fixed stones are fastened to the frame of the mill while the lower revolving stones are carried on the ends of vertical shafts connected together by spur gearing and driven from the main shaft by a bevel gear and pinion. The main shaft runs at a speed of approximately 132-136 r. p. m., and with the present belted outfit is provided with tight and loose belt pulleys. The mill is driven from a small countershaft located directly above the main shaft, the motor being suspended from the ceiling and located about 10 feet from the countershaft.

Paint mixed with linseed oil is fed, from a mixer, into the upper pair of stones, and after passing through them is discharged into the lower pair. The process is continuous, and when the mill is first started, it requires considerably more power than after an hour or so, when the stones have become heated and the paint more easy flowing. The power required also depends on the rate of feed, and the setting of the stones.

Each of these grinders is provided with an individual 10 hp belted motor running at approximately 1130 r. p. m. at full load, and equipped with a type "A" potential starter. The following tests were made: first, motor running idle with belt off. Second, motor running belting and countershaft, mill belt on loose pulley. Third, motor running mill and grinding paint.

In tests one and two, readings of volts, amperes and watts were taken, Weston instruments being used for measuring volts and watts. Current was measured by a Thompson ammeter, which had a range of only 15 amperes, and hence was not available for load readings. In test three, indicating wattmeter readings were taken at the beginning, and end of the test, and in addition thereto a Fort Wayne polyphase watt-hour meter, installed by the lighting company, was placed in circuit to record the total watt-hours during the run. A four-hour run was made, the mill being cold when started.

DATA OF TESTS.

	Belted.	Geared.
Watts, motor running idle	[illegible]	[illegible]
Watts, motor running [illegible]	[illegible]	[illegible]
Watts, motor running [illegible]	[illegible]	[illegible]
Watts, motor running [illegible]	[illegible]	[illegible]
Kilowatt-hours for 4 hours' run [illegible]	[illegible]	[illegible]
Total weight of paint ground [illegible]	[illegible]	[illegible]
Average power factor	[illegible]	[illegible]

It would appear that the geared slow-speed motor, instead of saving energy, actually requires about 10 per cent more energy than the belt drive. On a longer run, the showing of the geared motor might be improved somewhat because the over load period, during which this motor has a low efficiency, would then be a smaller part of the total. It will be noted that the amount of paint ground with the geared motor was less than with the belted showing that the greater energy consumption was not due to any increase in the amount of paint fed into the mill.

The geared motor must necessarily be run at slower speed than the belted, and a slow-speed, 60-cycle motor of small output is inferior in electrical performance to a higher-speed belted machine. Its no-load losses may be less than for the belted motor as in the present test, but its efficiency at or near full load will be lower.

The lower-power factor of the slow-speed motor is not a great objection where energy is supplied from a large system, since energy is measured by watt-hour meters. If, however, the motors were at any time operated from the customer's isolated plant, the lower-power factor would be a decided disadvantage, as the current output of the generator is limited.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade reports from all leading centers were uniformly good. Crops, particularly corn and cotton, showed further improvement and there was freer buying for fall at leading southwestern markets. In some lines of wholesale trade, such as cotton dry goods, the activity manifested is still notable, considering the long spell of preceding buoyant buying, but other lines display more quiet; and in iron and steel, while production is of record proportions and orders ahead are heavy, new buying of both crude and finished products is less active than a year ago at this time, with price concessions more readily obtainable. In some lines of trade, while buying is free and active, there is in evidence some conservatism as regards the future. In the case of cotton goods, the mill men themselves are advising against overbuying. In the East business in foundry pig iron improved a little, but on the whole the markets are listless, and prices are lower both for spot and future deliveries. Structural material is in fair demand, but a number of contracts are being held up on the theory that price concessions will be made by the sellers. New business in steel rails is fairly good, though activity is confined to Chicago. Demand for plates for shipbuilding is quite good. Steel bars, wire and merchant pipe are active. An order for several thousand tons of structural steel for the uptown power house at 201st Street of the New York Edison Company was given out last week. An order for 1000 steel cars has been placed with a Western concern and it is estimated that about 20,000 tons of structural shapes will be required. Copper is weaker, the closing quotations being 20 @ 21c. for lake; 19.50 @ 20c. for electrolytic, and 20 @ 20½c. for casting stock. Copper exports in July were 14,646 tons, 1547 tons less than in June, and 3663 less than in July last year. In the seven months from January 1, copper exports have been 96,229 tons, comparing with 120,074 tons in the corresponding period last year. Railway earnings in July were 9 per cent larger than in July of last year, and the net earnings of 30 roads for June show an increase of 11.97 per cent. *Bradstreet's* reports 731 business failures during July with liabilities of $12,499,491, being increases of 3.8 and 73 per cent respectively over July, 1906. The number of failures during the week ended Aug. 1 was 142, against 155 in the preceding week and 170 in the corresponding week last year.

STONE & WEBSTER OFFICE BUILDING.—The expanding business of the Stone & Webster organization in Boston has led to the purchase of a modern eight-story, fire-proof building at 147 Milk Street in the name of the Stone & Webster Engineering Corporation, which will be occupied exclusively by the purchasers. The building is located centrally in the business district of the city, diagonally opposite the Exchange Club and close to the offices of the American Telephone & Telegraph Company and the Boston Elevated Railway Company. The firm of Stone & Webster will occupy the first four floors while the engineering corporation will occupy the four upper stories, aggregating 13,000 square feet. On the fifth floor will be the executive offices, construction and accounting department, with the engineering department on the sixth, purchasing and mailing on the seventh and drafting on the eighth. The corporation now occupies a floor of 8000 square feet at 84 State Street. During the year ending May 1, the corporation expended on construction work over $4,800,000, and has now on its books agreements calling for the expenditure of $4,000,000 additional. The main reason for the existence of the engineering organization of the firm is to keep together for the benefit of the Stone & Webster companies a force of men specially trained in all the branches of engineering and construction so that the work can be done for the companies and other clients more rapidly and at less expense than by local managements.

BRILLIANT ELECTRIC COMPANY.—The annual meeting and conference of the sales force of The Brilliant Electric Company was held in the offices in Cleveland during the week commencing July 29 under the presidency of Mr. E. J. Kulas, general manager of the company. In addition to the regular members of Mr. Kulas' staff a number of salesmen of jobbing houses which handle Brilliant lamps were present. The banquet on Monday evening at the Colonial Hotel which was attended by 26 men was greatly enjoyed as was the outing trip to Put-in-Bay the following day. In addition to Mr. Kulas the following men took this trip: C. F. Koepge, E. O. Hennecke, F. Harshaw,Jr., H. B. Parke, M. G. Campbell, G. O. Durfee, W. E. Groves, D. W. Hopper, M. C. Jones, C. H. Cudmore, C. R. Foster, M. H. Nason. At the conclusion of the conference on Thursday, Mr. Kulas was presented with a beautiful walrus-covered suit case, decorated with his initials in sterling silver. This speaks volumes for Mr. Kulas' popularity with his salesmen.

BATTLE CREEK POWER.—An erroneous report has been circulated that the Battle Creek Power Company has stopped work on its 130-ft. dam on Battle Creek, east of Cottonwood. The Battle Creek Power Company is a corporation subsidiary to the Northern California Power Company, of Redding. The report probably originated in the fact that the company did lay off fifty Greeks three weeks ago. They were working on a ditch and the company suspended that part of the work until rights of way lawsuits are settled. In the meantime, the Northern California Power Company has installed electrical machinery for continuing the work on the dam itself. The rock quarries have been opened, railroad laid, transformers set up, power line connection made and 200-hp motors installed. The Northern California Power Company will have great need of the new Battle Creek plant when the Heroult electrical iron smelter runs steadily. That plant alone will use 2000 horse-power.

GROWTH AT FARIBAULT, MINN.—The Faribault Gas & Electric Company has recently placed an order with the General Electric Company for latest type three-phase generators, transformers, switchboards, etc., making the plant thoroughly modern and up-to-date. A local correspondent says: "The city is now paying $415 a month for lighting the streets. The stock of the Polar Star Company is now owned by the receiver of the First National Bank of Faribault, who has been unable to dispose of the plant for more than the bonded indebtedness. The machinery is of an obsolete type and pretty well worn out." An aldermanic committee was appointed not long ago to consider taking over the system for a municipal plant.

WESTINGHOUSE ORDERS.—It is stated from Pittsburgh that during the past twenty days there has been an increase in the orders received by the Westinghouse Electric & Manufacturing Company for large apparatus, with an increasing number of inquiries from all parts of the country which indicates a cessation of the halting period which has been somewhat in evidence for the past three months. The orders which have been received have been of an exceptionally good character, taken at advanced prices, and will probably exceed the July shipments.

PLANT EXTENSION.—Mr. Robert Ferris, manager of the Yankton Light, Heat & Power Company, South Dakota, writes us that they are proposing to change from 125 to 60 cycles, and to establish a day service for the purpose of developing a power load. They expect to push small motors, as well as heating and cooking devices, and expect a good sale of fans next year. They also think favorably of installing gas producers and engines or crude oil engines. They will be glad to hear from manufacturers in all these lines.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, has received through G. & O. Braniff & Company, agents for the former company in Mexico, an order for one of the electrical equipments of the tramways built by the Vera Cruz Light, Power & Tramway Company. Vera Cruz is the second city in Mexico to be electrified.

SOUTH AFRICAN MARKET.—It is stated from South Africa that the Rand gold mining requirements for electrical machinery and equipment are very heavy at the present time.

NATURE OF EXPORTS.—More than three-quarters of a billion dollars' worth of manufactures passed out of the ports of the United States in the fiscal year just ended. To foreign countries alone the total was $740,000,000, while to the non-contiguous territories of the United States the value of manufactures sent was $40,000,000, thus bringing the grand total to considerably more than $750,000,000, against less than $250,000,000 a dozen years ago. Of this $750,000,000 worth, practically two-thirds went in finished form ready for consumption and practically one-third in partially manufactured form for further use in manufacturing. The figures of the bureau of statistics, Department of Commerce and Labor, just completed for the fiscal year 1907, shows that of the $740,000,000 worth of manufactures exported to foreign countries, $480,000,000 were manufactures ready for consumption and $260,000,000 manufactures for further use in manufacturing, while of the $40,000,000 worth of manufactures sent to the non-contiguous territories, practically all went in the finished form. Finished manufactures exported show an increase of about $20,000,000 over last year and $267,000,000 over 1897, a decade earlier, while manufactures for further use in manufacturing show an increase of $34,000,000 over last year and of $162,000,000 over 1897. Of this $740,000,000 worth of manufactures sent to foreign countries in 1907, $181,000,000 was iron and steel manufactures; $89,000,000, manufactures of copper; $80,000,000, manufactures of wood; $78,000,000 mineral oil; $45,000,000, leather and manufactures of; $32,000,000, cotton manufactures; $27,000,000, agricultural implements; $22,000,000, naval stores; $21,000,000, cars and carriages; $18,000,000, chemicals, drugs and medicines; $15,000,000, scientific instruments; $10,000,000, paper and manufactures of; $9,000,000, paraffin and paraffin wax; $7,000,000, India rubber and manufactures of; $7,000,000, furs and fur skins; while the remaining $100,000,000 worth is made up of miscellaneous manufactures, chiefly in the finished form. Iron and steel manufactures form by far the largest single item in the year's exportations of manufactures, the total value of this single group being, as above indicated, $181,000,000 against $161,000,000 last year, and of this total, practically 85 per cent went in finished form ready for consumption. Copper forms the next largest item, amounting to 89 million dollars, of which a large proportion went in the partially manufactured form of pigs, bars and ingots, and of this 89 million dollars' worth of copper exported, probably 85 millions went to Europe.

ORDERS FOR CABLE.—A quotation in this department last week from the bulletin of the National Conduit & Cable Company, has excited some comment as not being quite in accord with the facts. The bulletin said: "The kernel of the situation, as we understand it, lies in the present unsatisfactory condition of the money and bond markets. No permanent improvement can be looked for until it becomes possible to finance new enterprises with greater facility than can be done at present. The trouble is not with the price of copper per se, but the root of the difficulty is traceable to the inability of various utility corporations to secure the necessary funds against bonds whereby the money can be raised for executing contemplated improvements. A curtailment of business would send money into other channels, and investment funds would gradually become available for purchase of bonds, and with a ready market for the latter work already mapped out could be taken up and carried through successfully." This is quite emphatically denied by certain well informed critics, who say that heavy orders for cable have been held back by some of the largest traction and lighting interests during the past year because the cable manufacturers have put prices up to an inordinate height, by means of their pool, and have not been satisfied with a fair advance. It is claimed that the increase in price is three or four times what is necessary and justifiable. In fact, if the assertions that reach us are warranted, the price has swung from a very moderate profit to an extravagant one, and the large consumers simply will not stand for it. A rather tense situation seems to be developing, and some of the more strenuous traction and lighting men talk, somewhat vaguely, of a cable plant of their own. Meantime, we are satisfied from the data and information in our possession that orders of considerable magnitude are being held off the market, and will be held indefinitely, not because of any money stringency, but because the seller and purchaser are far from finding a point of accord, where they can do business.

RAILWAY EQUIPMENT.—The July business of the Westinghouse [illegible] average. The last information from East Pittsburg stated that the railway department alone showed a record for orders booked approximating about $2,500,000. Among these were two of more than ordinary importance. The Brooklyn Rapid Transit Company contracted for 400 electric railway motors, 200 of which, of 200-hp each, are for the elevated railway cars, while the others, of 60-hp each, will be surface car equipment. In connection with the elevated car equipment, the company will also furnish the Westinghouse multiple unit control. The other large order comes from the Schoepf interests of Cincinnati, which control one of the largest urban and interurban electric railway systems in this country, operating cars in eastern and central Ohio and southern Indiana. This order includes a complete equipment of electrical apparatus for 24 sub-stations, consisting of rotary transformers and switchboard appliances, as well as four Westinghouse turbo-generators aggregating 26,000 horse-power.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was less activity in stock speculation, opinion being adversely influenced by firm money here and abroad, attacks on corporations, and the failure of dividend increases and phenomenal earnings like those of the United States Steel Corporation to stimulate interest in stocks. The quarterly report of the United States Corporation showing record-breaking earnings practically fell flat, the effect on the steel stocks being of the slightest kind. What seemed to influence the market chiefly in connection with the steel statement was the additional announcement that since July 1 there has been a marked falling off in the volume of new orders received. A circumstance which contributed more or less to weaken the market was a further lowering of speculative copper prices, which was held to indicate that considerable concessions must yet be made in the price of the metal by the large producers before they can count upon receiving an increased volume of orders. Discussion was heard throughout the street in regard to the complications growing out of the North Carolina passenger rate law and the surrender by the Southern Railway and others to the state authorities, this being reflected by the very heavy tone of Southery Railway stocks. Electric stocks are all lower and little business was done. The curb market was very dull, prices dropped, but rallied slightly at the close. Following are the closing quotations of Aug. 6:

NEW YORK.

	July 30	Aug. 6		July 30	Aug. 6
Allis-Calmers Co.	10½	19.	General Electric	138½	132
[illegible]	[illegible]	[illegible]	[illegible]	—	—
[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Mackay Cos.	68½	68
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
American Tel. & Tel.	105	—	Marconi Tel.	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	N. Y. & N. J. Tel.	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

BOSTON.

	July 30	Aug. 6		July 30	Aug. 6
[illegible]	[illegible]	107¼	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	—	Mexican Telephone	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	West. Tel. & Tel. pfd.	[illegible]	[illegible]

PHILADELPHIA.

	July 30	Aug. 6		July 30	Aug. 6
[illegible] Railways	48	48	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			

[illegible]

	July 30	Aug. 6		July 30	Aug 6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Metropolitan Elec. com.	22	22			

DIVIDENDS.—Directors of the Electric Properties Company have declared a dividend of 1½ per cent on the preferred stock, payable August 10, to stock of record August 1. They also declared a dividend at the rate of 6 per cent per annum from April 30, 1907, or the respective dates subsequent thereto, upon which payments were received by the company on account of subscriptions for preferred stock to July 31, 1907, payable August 10 to holders of preferred stock subscription receipts of record August 1 on the basis of the amount actually paid on account of such subscriptions respectively.

MACKAY TELEPHONE INTERESTS.—Advices from well-informed quarters in Boston send the following to New York: It is understood that the Mackay companies availed itself of the decline in American Telephone shares which followed the announcement of the recent issue of stock in the early part of June, to average up its American Telephone holdings by acquiring several substantial new blocks of stock, until at the present time the Mackay companies is the owner of nearly 90,000 shares of American Telephone Company stock, of which between 11,000 and 12,000 shares were acquired by right of subscription to the June issue of $22,000,000 stock. It will be remembered that during 1906 the Mackay companies purchased in the open market between 25,000 and 30,000 shares of American Telephone Company stock. This stock was picked up in accordance with a certain fixed ratio, i. e., whenever by selling a certain number of Mackay companies' preferred shares a certain fixed number of Telephone shares could be secured a transaction was completed. The object was to make the incoming dividend return on the Telephone shares exactly balance the outgoing dividend on the Mackay preferred. The cost of the American Telephone stock secured by the 1906 purchases averaged close to $130 per share. At that time Telephone stock was paying 7½ per cent dividends and the increase to 8 per cent last October has had the practical effect of making the cost price of the Telephone stock secured by the Mackay companies in 1906 about $123 per share. With the block of 11,000 or 12,000 shares which was acquired by subscription at par and through such purchases as have since been made the average price of Mackay companies' Telephone holdings must have been reduced several points further.

AUTOMATIC TELEPHONY.—The fight appears to be on still between the Automatic Electric Company and the Strowger Automatic Telephone Company, and attempts to secure Strowger stock have advanced the price from $5 up to $15 per share. The Automatic Electric Company some 18 months ago made an effort to break the contract, which provides for the payment of a $2 royalty on each telephone and switchboard. The Strowger company brought suit and the courts upheld its contention. The Automatic's defense was that the contract called for royalties of $1 for each telephone and the same amount for each switch. The defendant corporation appealed from the decision, and, according to the Strowger management, the Automatic interests have prolonged the litigation with a view to tiring out the plaintiff concern. The technicality of the proceedings is evident, as on the $2 royalty basis for telephones and switchboards, which the lower court has held to be a valid agreement, the Strowger revenue would be nearly double that which would be derived from the manufacturing concern if the amount was made to cover both telephones and switchboards. Since the litigation was started the Automatic Electric Company has not paid any part of the royalties to the Strowger company. The latter discontinued dividends and used its treasury funds to fight the case. This money was exhausted some time since, and the case is therefore being allowed to take its course on the appeal. The Strowger company now has more than $100,000 in royalties due from the Automatic for telephones manufactured in this country, and in excess of $20,000 from a German contract, which is also being held up by the litigation.

MEXICAN TELEPHONE.—The Mexican Telephone & Telegraph Company, an American concern which operates telephone exchanges in a number of cities of Mexico, in its annual report for the year ended Feb. 28, 1907, gives a review of its business up to that date, as follows: "The total increase in subscribers for the entire territory was 550, a gain of 106 subscribers over the increase of last year. The total increase in rentals for exchange service in all exchanges was $49,177, or an average monthly increase of $4,098. Exchange service has continued to increase throughout the territory covered by the company. The larger increases have been made, as in the year previous, in Mexico City and Monterey. During the past fiscal year our new installation in the City of Mexico has been completed, and we are now connecting our subscribers to our underground cable system, preparatory to cutting over from our old equipment to a new switchboard. The underground conduit system was completed this year. It consists of 256,423 duct-feet of conduit, 110 man-holes and 74 lateral connections to terminal poles. Our conduit system covers the entire business portion of the city and extends into the more thickly settled residence portions." It is stated by T. G. Nee, assistant general manager of the Mexican Telephone & Telegraph Company that it is planned to construct an extensive system of long-distance lines in the states of Nuevo Leon, Coahuila and Zacatecas. It is also planned to install new exchanges in a number of towns in the northern part of the republic. Several local exchanges will be improved.

NEW YORK TELEPHONY.—The *Wall Street Journal* has the following: "The State Line Telephone Company now has seven construction gangs at work building lines south of Peekskill and Brewsters to connect up Westchester County with the present system. The company's lines now extend from Columbia County as far south as Peekskill. The proceeds of the bonds issued under the collateral trust mortgage for $5,000,000 made to the Commercial Trust Company of New Jersey in June are now coming in in sufficient amounts to provide for the construction needs at the present time. The money thus raised is costing the company about 6⅛ per cent. It is the ultimate intention of this company to confine its operations to Westchester County, a portion of western Connecticut and those counties on the west bank of the Hudson. This will make the company's territory a compact one contiguous to the metropolitan district. The long distance lines which are now being built to connect the various independent telephone systems in the state will be a big aid to this company as it will permit of long distance business being done without relaying through so many switchboards as is at present the case. These links are being rapidly completed and by this means the independent telephone systems are being solidified into a compact working organization."

KANSAS CITY NOTES.—The stockholders of the Kansas City Railway & Light Company have been offered subscription rights to the $4,125,000 6-per cent convertible 5-year notes which have been underwritten by Blair & Company and Kuhn, Loeb & Company. The notes are offered to stockholders at 95, with the privilege of subscribing to 22 per cent of their holding of stock. In addition to these notes, $1,375,000 6-per cent notes have been authorized but not sold. The two classes are divided into series A and B, the former, which is the convertible issue, being the one underwritten. Both series are redeemable at the option of the company at par and interest upon eight weeks' notice after Sept. 1, 1908. They mature Sept. 1, 1912. Each of the series A $1,000 notes is convertible at the option of the holder after Sept. 1, 1908, into six and one-half shares of common stock and seven shares of preferred stock of the company.

ST. LOUIS CAR COMPANY.—The St. Louis Car Company has closed negotiations for the sale of $3,000,000 7-per cent, non-voting preferred stock in France. President Kobusch of the company has been informed by cablegram from the French bankers that $1,000,000 will be deposited in the Bank of France to the credit of the car company upon notification that an equal par value of stock has been deposited at the National Bank of Commerce in St. Louis. The balance of $2,000,000 will be deposited to the credit of the St. Louis company in the same manner in exchange for the remaining $2,000,000 of new stock in October and November. The company, which manufactures electric and steam railroad passenger cars, has recently added automobiles to its output, and has been pressed for working capital.

SALE OF TROLLEY BONDS.—The Boston & Worcester Street Railway Company has sold to E. H. Gay & Company an issue of $475,000 20-year 4½-per cent bonds, which are being offered to investors at 98½ and interest. The bonds are issued to pay for the double tracking of the last section of the road, between Boston and Worcester.

PACIFIC GAS & ELECTRIC.—The board of directors of the Pacific Gas & Electric Company, of San Francisco, controlling the systems in California, has voted to levy an assessment of $3,000,000, or $10 a share, on the stock of its shareholders for rehabilitation and improvement purposes.

SALE OF BONDS.—The city of Murray, Calloway County, Kentucky, is to receive sealed bids for the sale of $19,500 bonds 4 per cent, for electric light and water works plant, on August 23. The interest is payable semi-annually, due in 20 years, with the option to pay same in 5 years.

CHICAGO TELEPHONE.—The Chicago Telephone Company gained 2,111 telephones during July. The total stations now in use is 192,264. Stockholders are subscribing readily to the $4,000,000 of new stock.

GENERAL NEWS

Construction News.

[illegible] Tahoe Railway Company have filed several notices of location with the county recorder which include water rights, dam and reservoir sites on the middle fork of the American River for storage of water for generating electricity. The company has secured all of its rights of way in Placer and El Dorado counties.

BERKELEY, CAL.—The San Francisco, Oakland & San Jose Railway Company is planning several important extensions to its system in Oakland and Berkeley. It is said that the improvements under way and contemplated will involve an expenditure of at least $3,500,000.

COLUSA, CAL.—An ordinance granting the right and privilege of erecting and maintaining poles and wires and other appliances for the purpose of conducting and transmitting electricity upon certain streets in this town has been passed by the Board of Supervisors. Charles H. Glenn and others own the franchise.

LODI, CAL.—The Mokelumne River Mining Company is making arrangements to install electricity for operating its mines. Electric energy will be furnished by the American River Electric Company.

LOS ANGELES, CAL.—Preliminary surveys have been made by the Pacific Light & Power Company for a power plant in San Gabriel Valley. E. A. Beck is superintendent.

LOS ANGELES, CAL.—The Home Telephone & Telegraph Company, of Pasadena, has certified to an increase of capital stock from $500,000 to $1,000,000. The directors are W. M. Easton, J. H. Holmes, W. H. Vedder, McD. Snowball and J. C. Brainerd.

REDDING, CAL.—F. L. Evans has applied to the City Trustees for a franchise to operate a double-track electric railway through several streets of the city, the same to become a part of the system of the Eureka & Redding Railway.

REDDING, CAL.—The Northern California Power Company is making arrangements to increase the voltage of its lines from 20,000 to 35,000 volts. As soon as the company is able to supply the power the electrical smelter at Heroult-on-Pit will be put in operation. The smelter will require 2,000 horse-power.

SAN BERNARDINO, CAL.—The San Bernardino Gas & Electric Company, controlled by the Pacific Light & Power Company, of Los Angeles, is to spend $17,000 at once in enlarging its street plant.

SAN BERNARDINO, CAL.—The Redlands Central Railway Company has given a trust deed to the Los Angeles Trust Company covering all its railway property to secure a bond issue of $500,000, the proceeds to be used for paying outstanding indebtedness for rights of way, to purchase rolling stock and to build and equip the road. The first $100,000 will be issued immediately.

SAN DIEGO, CAL.—At a recent meeting of the City Council the San Diego Electric Railroad Company was granted three railroad franchises in the city, for which it paid $1,250, $1,000 and $2,500 respectively.

SAN FRANCISCO, CAL.—The stockholders of the United Railroads have voted to increase the capital stock of the company by $5,000,000.

SAN JOSE, CAL.—The San Jose, Los Gatos Interurban Railway Company has applied to the Board of Supervisors for a franchise to operate an electric railway over certain streets in the city.

STOCKTON, CAL.—The Ceneral California Traction Company has been granted a franchise in this city.

WILLOWS, CAL.—The first issue of stock of the Snow Mountain Electric Company has all been sold and active construction work will commence soon. The erection of a long flume, which will require 1,000,000 feet of lumber, will be started as soon as the mill begins to saw the lumber. Work will be pushed to completion, and inside of a year the company will be furnishing electricity in Glenn and Colusa counties.

YREKA, CAL.—John Macauley has appropriated 500 miner's inches of water from Dutch Creek for mining, milling and electric power purposes.

JEWETT CITY, CONN.—At a special meeting held recently the citizens voted to appropriate $2,500 for making repairs and putting a new generator in the municipal electric light plant.

NEW BRITAIN, CONN.—The State Legislature has passed the resolution granting an amendment to the charter of the Stanley Works, by which the company is empowered to increase its capital stock from $1,500,000 to $3,000,000, to build a dam in the Housatonic River in Kent, and construct a power plant there, and erect a transmission line from Kent to New Britain to furnish electricity to operate its plant in this city.

WALLINGFORD, CONN.—At a special meeting of the Court of Burgesses held July 30 it was voted to issue bonds to the amount of $5,000 for enlarging and extending the municipal electric light plant.

WASHINGTON, D. C.—The Potomac Electric Company will erect a sub-station at Sherman and Harvard Streets Northwest, in order to furnish better service to that rapidly growing section.

ATLANTA, GA.—Surveys have been made for the proposed electric railway between Atlanta and Augusta, which is to be built by the Atlanta & Carolina Construction Company. The company is capitalized at $5,000,000, and the officers are: James W. English, president; Matthew Mason, vice-president and general manager; M. T. Edgerton, secretary.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company, the North Augusta Land Company, North Augusta Hotel Company and North Augusta Electric & Improvement Company have been consolidated under the name of the Augusta & Columbia Railway Company. The company now operates about 28 miles of track, and is contemplating an extension from Aiken to Columbia, S. C. W. T. Van Brunt, of New York, N. Y., has been elected president, and James U. Jackson, of Augusta, vice-president.

CORNELIA, GA.—L. F. Maxwell, city clerk, writes that an election will be held Aug. 12 to vote on the proposition of establishing a municipal electric lighting plant in the city.

MAROA, ILL.—D. S. Anderson has applied to the Town Board for a franchise for a telephone line connecting Maroa and Argenta.

PEKIN, ILL.—Plans have been prepared by the Pekin Electric Light Company for improvements to its plant and system, which will cost about $50,000.

PEORIA, ILL.—The Peoria Gas & Electric Company has awarded the contract for installing the new underground system to G. M. Gest, of New York, N. Y. The work will involve an expenditure of [illegible]

BROOKVILLE, IND.—The Board of Trustees has passed an ordinance granting a 20-year franchise to the Electric Light & Ice Manufacturing Company to operate an electric light and power plant. The directors of the company are: J. G. Hall, Charles Andrews and Parker S. Johnson, of Cincinnati, Ohio; John H. Brockman and Robert H. Cook, of Brookville. The company has purchased the local electric light plant, which has been in operation for 15 years.

GOSHEN, IND.—The Indiana & Michigan Electric Company, recently organized by the merging of several power companies, has filed with County Recorder O. C. Vernon a mortgage to the New York Trust Company for $7,000,000. The syndicate was recently formed to control the power dams of the St. Joseph River, between Elkhart, Ind., and Berrien Springs, Mich.

HAGERSTOWN, IND.—A special election has been ordered to vote on a proposition for the purchase of the electric lighting and power system of this place, now owned by Pittsburg, Pa., and local citizens, who offer to sell the plant. If the proposition carries the plant will be enlarged and equipped with new machinery.

LAPORTE, IND.—The South Bend Telephone Company has filed amendments to its charter increasing its capital stock by $200,000 for the purpose of extending its system into southern Michigan. The Berrien County Home Telephone Company is also being organized by the company to operate exchanges in all towns of southern Michigan.

LOWELL, IND.—Clifford Wiley has purchased the local electric light plant. The new company will install a new plant, and will be known as the Lowell Light & Power Company.

MOUNT VERNON, IND.—The City Council has ordered the Cumberland Telephone Company to remove its poles and wires from the streets of Mount Vernon within thirty days, or apply for a franchise to do business in the city. There is a misunderstanding between the city and the company, in which the city claims that the company is operating without a franchise, while the company claims that it is operating under a franchise purchased from the American Telephone & Telegraph Company some years ago.

NAPOLEON, IND.—The Napoleon Telephone Company, recently incorporated, will receive bids for material and equipment; also for the construction of an exchange and telephone system. Frank Henir, J. H. Newman and J. A. Meyer are the directors.

PLYMOUTH, IND.—C. D. Snoeberger, proprietor of the Plymouth electric light plant, contemplates making some improvements to the plant, at a cost of about $10,000. He will establish a day service if the city will extend his franchise and contract.

PLYMOUTH, IND.—C. D. Snoeberger, proprietor of the Plymouth electric light plant, writes us to the effect that the item in our issue of June 22, announcing the incorporation of the Plymouth Electric Lighting Company, was rather misleading. The gentlemen named as directors installed a gas plant, under the name of the Plymouth Lighting Company, and have nothing to do with the Plymouth electric light plant.

SCOTTSBURG, IND.—The question of lighting the city by electricity and building water works is being agitated here. A franchise may be granted.

WORTHINGTON, IND.—The Home Telephone Company (independent) has purchased the Bell interests and investments at this place, thereby doing away with the dual system in Greene County.

CLAREMORE, I. T.—Application will be made at the next meeting of the City Council for a franchise for an electric street railway in Claremore.

RED FORK, I. T.—The Red Fork Power & Development Company is contemplating the construction of a power plant which will cost when completed about $100,000. F. L. Smart is president, and Graham Burnham, vice-president and manager.

DAVENPORT, IA.—A permit has been granted to the Independent Light & Power Company for the erection of a two-story brick power house in the west end of the city.

HUMBOLDT, IA.—The capital stock of the Rural Union Telephone Company has been increased to $100,000.

CHAPMAN, KAN.—C. A. Scherer has been appointed receiver for the Dickinson County Power & Light Company, which was promoted by Arthur Williamson and put in an electric lighting system here about a year ago. The company issued $24,000 in bonds on which no interest has been paid. The bondholders through C. C. Wyandt as trustee, are seeking to foreclose the bonds.

COVINGTON, KY.—The Union Light, Heat & Power Company has submitted a proposition for lighting the city for a term of five years. The company offers to furnish 450 or more arc lamps at $55 per lamp per year, and as many 32-cp lamps as are needed at $27 per lamp per year. The offer also includes a reduction on the commercial lighting as follows: To consumers whose bills amount to from $1 to $10, 10 per cent; to $15, 15 per cent; to $30, 20 per cent; $30 to $50, 25 per cent; $50 to $75, 30 per cent; $75 to $100, 35 per cent; $100 or over, 40 per cent.

LOUISVILLE, KY.—It is announced that the Louisville Railway Company will receive sealed bids for $150,000 short-term notes, the proceeds of which will be used for new cars, extensions and improvements.

NEWPORT, KY.—The City Council is reported to be in favor of establishing a municipal electric light plant.

NEWPORT, KY.—The Board of Aldermen has passed the ordinance granting the South Covington & Cincinnati Railway Company permission to construct an electric railway on Twelfth Street.

DEERING, ME.—The Portland Light & Power Company, which recently purchased the Deering Electric Light Company, has notified its Deering district consumers of an increase in rates for electricity for lighting purposes. The new rate is 10 cents per kw-hour, with a discount of 10 per cent if paid within 10 days. The old rate was 10 cents per kw-hour, with a discount of 20 per cent if paid within 30 days. Under the new rate the company will renew burned-out lamps.

LEWISTON, ME.—Owing to the increase in the demand for electricity for lighting purposes the committee on lighting is considering the question of increasing the capacity of the municipal electric lighting plant by the installation of a new water wheel and generator.

CAMBRIDGE, MD.—The Board of Commissioners of Cambridge has granted John H. Burgess, Jr., and W. H. Medford, representing Baltimore capitalists, an electric franchise for a term of 30 years, renewable for the same length of time, with an option of purchase by the town in [illegible] years.

POCOMOKE, MD.—R. P. Stevenson, owner and manager of the [illegible] boiler and a 25-kw direct connected unit in the plant this fall.

ATHOL, MASS.—The L. S. Starrett Company will commence at once the construction of a new power house at Main and Crescent Streets.

ATTLEBORO, MASS.—The Attleboro Steam & Electric Company is installing a new steam turbine in its plant.

CHESTER, MASS.—The Chester Electric Light Company has announced an increase in the rates for electricity, which went into effect July 1. The minimum service charge is $1.50 per month. The primary rate is 18 cents per kw-hour and will be applied to the first 18 kw-hours [illegible] Ten per cent discount will be allowed on all monthly bills paid on or [illegible]

DALTON, MASS.—Dwyer Brothers have secured the contract for the construction of the addition to the power house of the Dalton Power Company [illegible] The company furnishes electricity for operating the machinery of the Crane paper mills.

FRAMINGHAM, MASS.—The Railroad Commissioners have approved [illegible]

[illegible] to the plant and the floating indebtedness of the company.

[illegible] Electric Light & Power Company permission to erect poles and wires [illegible] line to connect with the Franklin Electric Light Company [illegible] Falls.

HOLYOKE, MASS.—The Railroad Commissioners have authorized the consolidation of the Amherst & Sunderland Street Railway Company with the Holyoke Street Railway Company, and have given the latter company permission to issue additional capital stock to the par value of $120,000 for the purpose of exchange on a share-for-share basis.

MILLERS FALLS, MASS.—An agreement has been reached between Millers Falls fire district and the Franklin Electric Light Company, of Turner's Falls by which electricity is to be furnished by the company for lighting the village. The plant is now operated by gasoline power and costs seven cents per kw-hour. Under the new contract the cost will be reduced by half, the highest rate in the scale being three and one-half cents per kw-hour. The district agrees to use an amount equal to $1,200 a year. The Franklin Electric Light Company will expend about $4,000 in extending its lines and making connections.

NORTH ABINGTON, MASS.—The Electric Light & Power Company, of Abington and Rockland, has been granted permission by the Board of Gas and Electric Light Commissioners to issue 600 shares of capital stock at $100 per share, the proceeds to be used in the payment of additions to the plant made prior to Jan. 1, 1906.

NORTH ADAMS, MASS.—The North Adams Manufacturing Company is installing an electric motor in its mill to supplement the water wheel when the water is low.

NORTHBORO, MASS.—The contracts and agreements for lighting the streets by electricity for ten years have been signed by the lighting committee and the Marlboro Electric Lighting Company. The service is to be ready by the last of October.

ADRIAN, MICH.—An electric railway to run from Adrian to Detroit is being promoted by M. Antoine Robert, of Montreal. It will be known as the Detroit & Adrian Traction Company and will be capitalized at $2,000,000. It is said that the company has received liberal franchises from Adrian, Tecumseh and Milan. Outside of the cities the road will be built on private right of way.

BAY CITY, MICH.—The Common Council has decided to remove the east side electric lighting plant from its present location at Eleventh and Jefferson streets to the old water works building on the west side of the river.

HOUGHTON, MICH.—The Copper Range Consolidated Company is making arrangements to build an electric power plant.

L'ANSE, MICH.—Bids will be received by C. D. Shea, city recorder, until Aug. 14, for constructing a water power plant. E. P. Burch, Minneapolis, Minn., is engineer.

WYANDOTTE, MICH.—An election will soon be held here to vote on the proposition to issue $20,000 in bonds for extensions to the municipal electric plant.

ST. PAUL, MINN.—The State Fair Board has decided not to install an electric light plant for the fair grounds, and has entered into a contract with the General Electric Company for service for five years.

COLUMBUS, MISS.—[illegible] remodel the electric light and gas plants.

POPLARVILLE, MISS.—The municipal electric lighting plant was put into operation July 23 for the first time and is giving satisfaction.

BROWNING, MO.—J. L. Kille, city clerk, writes that the citizens on July 22 voted to issue $6,000 in bonds for an electric light plant. As yet, no engineer has been engaged.

ST. JOSEPH, MO.—Plans have been made for a large telephone exchange building to be erected on Tenth Street for the Citizens' Telephone Company, at a cost of about $62,000. The company is also making arrangements to place its wires underground in this city. The plans call for the installation of approximately 1,000,000 feet of duct.

BILLINGS, MONT.—Yegen Brothers will begin at once the construction [illegible] Billings. The City Council has granted a franchise to erect poles and wires for the transmission of electricity through the principal thoroughfares. The city reserves the right to have all wires placed underground after giving reasonable notice.

BOZEMAN, MONT.—President Casey, of the Gallatin Valley Club, [illegible] veys are being made to connect Bozeman with all the principal towns of Montana within a radius of 100 miles, and the Yellowstone National Park. [illegible]

FREMONT, NEB.—The City Council has decided to construct an [illegible] of about $65,000. The plant is to be ready for operation by Nov. 15. [illegible]

TECUMSEH, NEB.—Frank Dinsmore, city clerk, writes that bids are [illegible]

[illegible]

[illegible] Philadelphia [illegible]

[illegible] cost of $200,000. The power plant will have a capacity of 4000 horse-power.

NEWARK, N. J.—Bids will be received until Aug. 23 by the special committee of the Common Council for furnishing and installing an electric light plant in the city hall. The equipment will consist of three engines and three generators, switchboard, instruments, wiring, steam piping, etc. The work will include foundations and masonry work. James M. Seymour is consulting engineer.

ALBANY, N. Y.—The United Traction Company has purchased from the city of Troy a franchise for the construction of an electric railway on several streets in the city.

BATH, N. Y.—The contract drawn up by the Village Trustees and submitted to the Bath Electric Light Company for street lighting for a period of five years, has been returned by the company unsigned. The company objected to the clause asking it to try a day service for a period of one month each year during the life of the contract, to ascertain if it is feasible to maintain a permanent day service.

BATH, N. Y.—The Village Trustees on July 25, signed a contract with J. G. Tower and Clinton K. Degroat, of Buffalo, for lighting the streets of the village for five years, beginning Oct. 5, when the contract with the Bath Electric & Gas Light Company expires. Messrs. Tower and Degroat have given a bond guaranteeing to have their plant in readiness to furnish electricity for street lamps on Oct. 6, and to install a plant within four months to furnish incandescent and commercial lighting. The street lighting service consists of 75 arc lamps at $62.50 per lamp per year for all night and every night service, making a total of $4,687 per year. The company agrees to light the rooms of the fire companies and the engine house free, and also to maintain ten 32-cp incandescent lamps in the parks and alleys as the trustees may direct. There is to be an all-day service with a sliding scale of rates for commercial lighting, the highest price being 12 cents per kw-hour, and the rate for motors above one horse-power is to be three cents.

BLACKWELL'S ISLAND, N. Y.—Bids will be received by Robert W. Hebberd, commissioner, Department of Public Charities, New York City, until Aug. 22, for all materials and labor required for the complete conduiting, electric wiring, and all other work in connection with the installation of a complete electric lighting and power system for all the buildings and grounds under the jurisdiction of the Department of Public Charities, and comprising the New York City Home for the Aged and Infirm, Blackwell's Island, borough of Manhattan. Raymond F. Almirall, 51 Chambers Street, New York City, is the architect.

BROOKLYN, N. Y.—Bids will be received by John H. O'Brien, commissioner water supply, gas and electricity, New York City, until Aug. 15 (read advertisement), for furnishing, installing, maintaining and reserving for the use of the high-pressure fire service, all apparatus and equipment necessary for generating and transmitting 1830 kw, three-phase, 6600-volt, 25-cycle electric power, and furnishing and delivering this power under terms of this contract to Aug. 15, 1908, at each of the high-pressure fire service pumping stations, located in the borough of Brooklyn, at Furman and Joralemon Streets, and at Willoughby and St. Edwards Streets, respectively.

CANANDAIGUA, N. Y.—Franchises have been secured from the villages of Cohocton, Atlanta and Naples by the Canandaigua-Southern Railway for its electric line to be built from Atlanta to Canandaigua. It is said that the line between Atlanta and Naples, a distance of six miles, will be built this fall.

FLUSHING, N. Y.—The New York & Queens County Railway Company is contemplating extending its lines to Whitestone and Bayside in the near future. The company has purchased a tract of land on the Flushing meadows, to be used for laying out storage yards and an auxiliary power plant, barns and repair shops.

LYONS, N. Y.—The stockholders of the Wayne County Electric Company are contemplating increasing the capacity of its plant to meet the present and future demands. The company now takes 250 horse-power from the power house of the Rochester, Syracuse & Eastern Railroad Company. The company furnishes electricity for lighting and power purposes in Lyons and Clyde.

NEWBURGH, N. Y.—The Newburgh Electric Light, Heat & Power Company has petitioned the Public Service Commission at Albany for permission to issue $250,000 additional stock, to be used to improve its electric light plant and perfect the line to Poughkeepsie.

NEW YORK, N. Y.—The New York & Queens Electric Light & Power Company has applied to the Public Service Commission for permission to issue bonds for $2,000,000, the proceeds to be used for buying realty, equipping and extending its plant and development of its system.

NEW YORK, N. Y.—Bids will be received by John H. O'Brien, commissioner of water supply, gas and electricity, until Aug. 15, for furnishing electricity for lighting and power purposes, to the equipment owned by the city now installed or to be installed on the Williamsburg Bridge, for the term of this contract from Aug. 15, 1907, to Dec. 31, 1907, both inclusive, in the borough of Manhattan.

NEW YORK, N. Y.—Bids will be received until Aug. 12 by C. B. J. Snyder, superintendent school buildings, New York City, for installing electric equipment in the additional story of Public School 80, borough of Brooklyn, in addition to and alterations in Public School 13, and in [illegible]

[illegible] a[illegible]

NEW YORK, N. Y.—Bids will be received by John H. O'Brien, commissioner water supply, gas and electricity, until Aug. 15 (read advertisement), for furnishing, installing, maintaining and reserving for use of the high-pressure fire service, all apparatus and equipment necessary for generating and transmitting 3250 kw, three-phase, 6600-volt, 25-cycle electric power, and furnishing and delivering this power, under the terms of this contract to Aug. 1, 1908, at each of the high-pressure fire service pumping stations, located in the borough of Manhattan, at Oliver and South Streets, and at Gansevoort and West Streets, respectively.

NIAGARA FALLS, N. Y.—The local authorities are experiencing some trouble in securing electricity for the illumination of the Falls. The Ontario Power Company and the Canadian Niagara Power Company have announced their willingness to donate all the electricity required, but direct current, not alternating current, is needed. The plant of the Ontario company is in close proximity to the place where the battery of search lamps will be located on the Canadian side, but they can furnish the city only 100 horse-power of direct current, while 300 horse-power is necessary. The Canadian Niagara Power Company can furnish the power needed, but its plant is located so far away that the cost of erecting a transmission line is too much to consider. A plan is now being considered whereby a motor-generator will be installed on the river bank to provide the necessary power.

NYACK, N. Y.—The New York State Board of Railroad Commissioners has granted the West Shore Traction Company permission to build a high-speed electric railway from Tomkins Cove along the Hudson River to the State line at Carteret; to increase its capital stock from $250,000 to $500,000, and to issue a first mortgage of $900,000.

SODUS, N. Y.—The Sodus Gas & Electric Company has made arrangements with the Rochester Railway & Light Company to furnish electricity for this section. The purpose of the arrangement is to supply electricity for a 24-hour service and for manufacturing plants from Webster to Sodus Point, and also to furnish electricity to farmers to run their apple machinery. Additional machinery will be installed before fall to take care of the day business.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Railway Company has been granted a franchise by the Board of Trustees of East Syracuse, to double track its line on several streets of the village.

TONAWANDA, N. Y.—The Tonawanda Power Company, of North Tonawanda, on July 30 entered into a new contract with the city for street lighting, under the terms of which the company agrees to furnish arc lamps for $57.50 per lamp per year. Under the old contract, which had three years to run, the city paid $70 per lamp per year. The officials of the power company voluntarily released the city from the old contract, giving Tonawanda the same price for which it furnishes street lighting in North Tonawanda.

UTICA, N. Y.—The Utica Southern Railroad Company is making arrangements to extend its line from Hamilton to Norwich, N. Y., a distance of about 22 miles. The total length of the line will be 43 miles, and the Waterville branch will be five miles.

WEST POINT, N. Y.—Bids will be received by the Quartermaster, United States Military Academy, until Aug. 26, for furnishing and installing an electrical distributing and street lighting system. Proposals from manufacturers of electric cables only will be considered.

MOORESVILLE, N. C.—James Donald, superintendent of the municipal electric light plant, writes that the city has contracted with the Southern Power Company, of Charlotte, to furnish electricity to operate the municipal plant, and arrangements are now being made to connect with the lines of the power company.

MURFREESBORO, N. C.—The North State Telephone Company has increased its capital stock to $25,000.

NEWTON, N. C.—Bids will be received until Aug. 15 by W. B. Gaither, mayor, for $75,000 improvement bonds to be issued for lighting, water and sewer improvements.

ASHLAND, OHIO.—Bids will be received until Aug. 26 by the Board of Trustees of Public Affairs, for furnishing and installing a water pumping plant at the pumping station, to consist of a high-duty horizontal cross-compound condensing crank and flywheel steam pumping engine, with a capacity of 1,500,000 U. S. gallons per day of 24 hours, and two 125-hp each, internal furnace boilers, together with boilers, engines, feed pumps and all apparatus necessary to operate the pumps and boilers. Plans are on file at the office of A. P. Black, village clerk.

CLEVELAND, OHIO.—The Cuyahoga Light Company has filed a mortgage of $150,000 in favor of the Guardian Savings & Trust Company. The company will furnish light, heat and power for the Britton Block and perhaps some other buildings in this city. R. A. Wilbur is secretary.

COLUMBUS, OHIO.—The trustees of the Columbus State Hospital on July 30 awarded a contract to the Electric Supply & Construction Company for a dynamo, switchboard and additional wiring, for $7,200, and a contract for a cement floor and conduits in the main building, to the Blakeslee Concrete Block & Machine Company, for $5,759.

DAYTON, OHIO.—The Dayton Lighting Company is reported to have closed a contract with the Dayton Motor Car Company to supply the latter company with electricity for lighting and power purposes.

ELYRIA, OHIO.—The Elyria Milling Company is making arrangements and has completed specifications for the installation of an electric

lighting and power plant. The equipment will consist of a 250-hp water turbine, and a direct-connected unit consisting of a 175-hp gas engine and a generator of 175-kw capacity.

MILFORD CENTER, OHIO.—The municipal electric light and water plants were sold recently to Dr. John L. Boylan for $7,335. Under municipal ownership the plants have been a failure, the revenues not being sufficient to meet expenses.

MILTON, OHIO.—Bids will be received by John Coate, village clerk (P. O. address, West Milton), until Sept. 16, for lighting the village with 30 enclosed arc lamps and a few incandescent lamps in clusters. The successful bidder will be given a franchise and commercial lighting privilege.

SPRINGFIELD, OHIO.—The power house of the Indiana, Columbus & Eastern Traction Company, on the Urbana line, was destroyed by lightning July 20.

OKLAHOMA CITY, OKLA.—A. B. Hulit, of Chicago, Ill., has made application for an electric light and power franchise.

COTTAGE GROVE, ORE.—The electric light plant of the Willamette Valley Company at Cottage Grove was recently destroyed by fire, entailing a loss of about $20,000. It is said that the plant will be rebuilt at once. Russell Welch, of Eugene, Ore., is manager.

CHAMBERSBURG, PA.—It is reported that the State is making preliminary arrangements for the erection of an electric lighting plant at Mount Alto, for furnishing electricity for lighting the Forest Academy and the White Pine Sanitarium buildings.

INDIANA, PA.—It is reported that the Indiana County Railways Company has placed contracts with the Westinghouse Electric & Manufacturing Company for the machinery for its power plant to be built near Twolick, and also for the sub-stations; one to be located at Chestnut Grove and the other near Chambersville. The equipment will consist of boilers of 500 horse capacity; one 1000-kw turbine and engines; a direct-current generator; condensers, pumps, etc., and rotary converters for the sub-stations.

LANCASTER, PA.—Papers have been filed at the court house in this place for the extension of the Lancaster & York Furnace Street Railway lines, from Pequea to York Furnace, and thence across the Susquehanna River, making a connection between the Lancaster and York County systems.

MAHONOY CITY, PA.—The Mahonoy City Light, Heat & Power Company is making extensive improvements and additions to its plant. The company is at present installing an 800-hp Westinghouse turbine and a 500-kw generator. Two new generators will be installed shortly. It has also been decided to build an extension to the power house.

MARTINSBURG, PA.—The Morrison's Cove Electric Light & Power Company has filed articles of incorporation with a capital stock of $50,000 for the purpose of generating electricity for lighting, heating and power purposes. The incorporators are J. W. Wagner, of Barbara, J. W. Suther, of Indiana, and others.

OHIOPYLE, PA.—It is said that the Ohio Company is preparing to straighten out the Youghiogheny River at this place and to erect a large electric plant to supply electricity for manufacturing plants at Connellsville, Uniontown and other places.

PITTSBURG, PA.—The Dauphin Street Railway Company will apply to the state for a charter August 14. The company proposes to construct an electric railway from Pittsburg to Dauphin. The road will be affiliated with the Central Pennsylvania Traction Company. The applicants are Frank B. Musser, W. [illegible], A. G. [illegible], [illegible] J. Wolfe and C. L. Bailey, Jr.

PITTSTON, PA.—The stockholders of the Citizens' Electric Illuminating Company have voted to increase the capital stock of the company from $40,000 to $200,000.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Electric Railway Company is contemplating building an extension from Greencastle to Chambersburg, and a short line from Shady Grove, where its system connects with the Hagerstown Electric Railway, to the proposed Chambersburg-Greencastle line.

WESTERLY, R. I.—It has been announced that Ahern Brothers, builders of the Norwich & Westerly Electric road, have secured the contract to build the six-mile extension of the electric road from Westerly to Pleasant View, and also the contract for a branch line to Ashaway, a distance of about five miles.

KENNEBEC, S. D.—Byron Reid and others will install a local telephone exchange.

LAWRENCEBURG, TENN.—Bids will be received until Aug. 20 by James T. Dunn, city secretary, for $25,000 water and light bonds.

SAN ANTONIO, TEX.—The San Antonio Gas & Electric Company is contemplating the purchase [illegible]

WHARTON, TEX.—[illegible] by A. P. Borden & Company [illegible] tions for a power plant for the [illegible] land.

SALT LAKE CITY, UTAH.—The Utah Sugar Company, which owns the hydro-electric power plant [illegible] has been consolidated with the [illegible] Sugar Company. The new [illegible] Sugar Company. The power from [illegible] by the Utah Light & Railway Company [illegible] sugar company's transmission line to Ogden. The officers of the new company are: Joseph F. Smith, president; Thomas R. Cutler, vice-president and general manager; H. G. Whitney, secretary and treasurer.

BARRE, VT.—Barclay Brothers, granite manufacturers, have recently installed an electric plant in their works to take the place of steam power. Motors aggregating 175 horse-power have been installed. Electricity for operating the plant is supplied by the Consolidated Lighting Company.

WHITE RIVER JUNCTION, VT.—The Mascoma Electric Light & Gas Company has under way improvements which include the establishment of a day power circuit in the towns where it is now doing business. A water power about one mile below the site of the present electric station, between Lebanon and West Lebanon, is being developed. It is expected that the new plant will be completed by next spring.

CENTRALIA, WASH.—The Centralia-Chehalis Electric Railway & Power Company has been granted a franchise by the City Council to build an electric railway between Chehalis and Centralia.

PUYALLUP, WASH.—It is reported that improvements are to be made by the Government at the Indian School at Puyallup, at a cost of $127,000, which include an electric light plant and new buildings.

TACOMA, WASH.—The Westinghouse Electric Company was awarded the contract for 75 arc air-cooled transformers for the light department for $1,001. Kilbourne & Soloman secured the contract for 375 Nernst lamps at $5,946 and the National Carbon Company will supply 56,000 carbons for $1,410.

PRENTISS, WIS.—Charles Ferguson, of Antigo, is reported interested in the construction of a dam on Jump River for the development of water power for electrical purposes.

MENOMONIE, WIS.—The Chippewa Valley Electric Light & Power Company submitted the only bid for lighting the city of Menomonie for a term of seven years beginning January 1, 1908. The company offers to furnish arc lamps of 2000 candle-power, all-night service, for $75 per year. If more than 50 lamps are used, $70 per year.

DAWSON, YUKON DISTRICT, CAN.—Plans are being prepared for the construction of a smelter at Whitehouse having a capacity of 250 tons per day. Plans are also being made to install an electric plant to furnish electricity for operating the mines. A. B. Palmer is manager.

WINNIPEG, MAN.—The City Council has notified the Winnipeg Electric Railway Company to proceed with the ten proposed extensions. It is announced that the company will issue $1,500,000 in capital stock for improvements.

YARMOUTH, N. S.—The Hood-Godfrey Electric Railway Company has been granted a franchise by the City Council to construct an electric railway from Cumberland to Cliff Streets. The officers of the company are T. W. Carten, president; Jesse C. Robbins, secretary, and S. C. Hood, Jr., treasurer.

CAMPBELLFORD, ONT.—Bids will be received until Aug. 15 by Mayor W. J. Doxsee for concrete work, turbine wheels, generators and about 2¼ miles of transmission line for power development at Middle Falls on the Trent River. The plant will have a capacity of 4000 horsepower. The date for receiving the above bid has been extended to Sept. 15. John S. Fielding, Toronto, Ont., is consulting engineer.

THREE RIVERS, QUE.—The Shawinigan Water & Power Company has acquired the controlling interest in the North Shore Electric Company of this place. The Shawinigan company, it is understood, takes over all the outstanding common stock and bonds of the North Shore company, which amount to $100,000 in stock and $150,000 in bonds. The new company contemplates increasing the capacity of the plant and the installation of modern electrical apparatus.

Company Elections.

PETALUMA, CAL.—At the annual meeting of the [illegible] Telephone Company the following officers were elected: [illegible], president; E. P. Nisson, vice-president; George Gaston, secretary, and Bank of Sonoma County, treasurer.

GREENFIELD, ILL.—The Greenfield Light & Power Company, which was recently incorporated, has elected [illegible], president, and C. R. Shepard, [illegible]

FITCHBURG, MASS.—At the annual meeting of the Fitchburg Gas & Electric Light Company held July 31 the following officers were elected for the ensuing year: Herbert I. Wallace, president; Henry F. Coggshall, treasurer and [illegible] manager.

New Industrial Companies.

THE DYNAMO ELECTRIC MACHINE COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $25,000 by W. W. Piddington, C. E. Johns and Emma Piddington.

THE GOUCHER ELECTRIC PURIFYING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing electrical apparatus. The directors are F. Goucher, J. L. Goucher and C. H. Coolidge, of New York, N. Y.

THE ELECTRIC [illegible] COMPANY, of [illegible], has been chartered with a capital stock of $50,000 for the purpose of manufacturing

[illegible]

[illegible] has been incorporated with a capital stock of $100,000. The incorporators are: [illegible]

[illegible] COMPANY [illegible]

New Incorporations.

[illegible] CAL.—[illegible] Electric [illegible] Company [illegible] by H. H. [illegible] E. Morgan, E. V. D. Johnson, E. E. Mead and E. Whaley.

DOVER, DEL.—The Juneau Water, Light & Power Company has been granted a charter by the State Department at Dover. The company is capitalized at $4,000,000 and the incorporators are J. Herbert Miller, [illegible] W. [illegible], of New York, and [illegible] M. Harvey, of Brooklyn.

AUGUSTA, ME.—The United States Light & Power Company has been incorporated with a capital stock of $500,000 by J. Berry, I. E. Chadbourn, Anson M. Perley, Joseph Williamson, of Augusta; E. M. Leavitt, W. M. Bearce, of Winthrop; H. A. Watkins, Newport, N. Y., and [illegible] C. Whiton, New York, N. Y.

Legal.

MEMPHIS THREE-CENT FARE.—At Memphis, Tenn., on August [illegible] Federal Judge McCall denied a petition of the Central Trust Company of New York City, holder of the Memphis Street Railway bonds, asking an injunction to restrain the City of Memphis from inaugurating three-cent street-car fares. The case had been appealed to the State Supreme Court from the State Circuit Court, the issue being the constitutionality of the city ordinances. The suit for a Federal injunction was entered pending a decision from the State Supreme Court.

MILWAUKEE TURBINES.—By a decision last week in Milwaukee, Judge Charles M. Rogers held that the board of public service had a right to award its contract for turbines for the electric light plant to the Allis-Chalmers Company of Milwaukee. The Westinghouse Machine Company, of Pittsburg, which submitted a bid $2,000 higher, asked City Solicitor George S. Marshall to bring a test suit, which he did. On the points in controversy, Judge Rogers held that the turbines of both companies were essentially of the Parsons type, which had been in successful operation for more than two years and that for all practical purposes the Allis-Chalmers turbines complied with the specifications. Bond for appeal was fixed at $300.

AN ASTOUNDING FINE.—In the United States Court at Chicago, Judge Landis has imposed upon the Indiana branch organization of the Standard Oil Company a fine of $29,240,000, under the Elkins Act, for accepting rebates from the Chicago & Alton Railroad that were secret, other shippers not receiving the same rate. Judge Landis used strong language as to the dishonesty of the transactions involved. There were 1470 counts on which the Standard Oil was found guilty, the fine for each illegal shipment being $20,000. It is understood that legal machinery will be set in motion at once by the Government against the railway.

WAGNER INFRINGEMENT DAMAGES.—One of the largest damage claims ever assessed for the infringement of a patent was returned in the United States Circuit Court in St. Louis last week against the Wagner Electric Manufacturing Company, of St. Louis, by Master Henry H. Dennison, in the case of the Westinghouse Electric Manufacturing Company against the St. Louis company. Master Dennison has recommended that the latter company be ordered to pay to the Westinghouse company the sum of $132,433.35. He has had the case under advisement for three and one-half years. Accompanying his recommendation are four bulky volumes of testimony. Dennison was appointed master three and one-half years ago by the United States Circuit bench in St. Louis. The suit was on oil cooled transformers patented by Mr. George Westinghouse, the patent being No. 366,362. The testimony taken before the United States Circuit Court showed that the patent had been infringed, and the case was put into the hands of Dennison as master to determine the amount of damages. The damages are the estimated profits of the Wagner company from the sale of the transformers manufactured. The report enters into elaborate calculations in order to arrive at the [illegible]

RIGHT TO TELEPHONE SERVICE.—Another decision has been given recently as to conditions under which telephone service must be given, by Justice Andrews in the Supreme Court, Syracuse, N. Y., some days ago. The decision affects the form of contract which has been entered into by the Bell local companies with large users of the service and holds that a clause giving the exclusive right of service to the Bell companies is void because it is against public policy. The case arose from the attempt of the proprietors of the Yates Hotel in Syracuse to violate one of these contracts with the Central New York Telephone and Telegraph Company. The contract was made in 1902, and in consideration of the installation of booths and a branch exchange in the hotel the owners were to furnish space for the booths and wires, were to pay for service and were to undertake to allow no other telephone to [illegible] company to remove its wires and booths and arranged to install another [illegible] it was decided that the right to terminate the contract on ninety days' notice did not exist. The court then took up the consideration of the question as to whether the exclusive feature of the contract was against the public interest and in restraint of trade, and on these points a temporary injunction was granted in July, 1906. Later a motion for reargument of the questions involved was granted, and upon this reargument a motion to vacate the temporary injunction forbidding the installation of the independent telephone system has been granted. The case will be carried to the Court of Appeals. The original decision to issue the injunction was made by Justice Andrews, and in reversing himself, he says: "Each case that arises must be decided on its own merits and on the particular circumstances developed. This being so, Lough agt. Outerbridge cannot be deemed a controlling authority where the question arises with regard to corporations engaged in a different kind of business under different circumstances." The decision in Lough agt. Outerbridge was one by the Court of Appeals, and Justice Andrews had granted the injunction with the explanation that he was bound by it, although the circumstances were widely different from those in the Syracuse case.

Personal.

MR. M. L. SPERRY has been appointed manager of the Savannah Electric Company, Savannah, Ga., to succeed Mr. L. R. Nash.

MR. HERBERT THOMAS has accepted the position as manager of the Apalachicola Electric Light & Telephone Company.

MR. GEORGE G. WARD, vice-president of the Commercial Cable Company, has been in Europe for some little time, but is now expected home shortly.

MR. J. F. COLLINS, formerly superintendent of the Toledo Railways & Light Company's lines, has been promoted to be manager of railways with entire charge of the transportation end of the business.

MR. JOSIAH C. NORCROSS, manager of the municipal electric light plant in Hudson, Mass., has tendered his resignation to take effect Aug. 20. Mr. Norcross will go to Reading and take full charge of the municipal electric plant in that place.

MR. C. R. McKAY, superintendent of light and power of the Toledo Railways & Light Company, has been promoted to be manager of light and power, and in addition to the gas and electric departments, he will have charge of the power and heating plants.

MR. BERNARD W. TRAFFORD, recently general manager of the Chesapeake & Potomac Telephone Company, has been appointed general manager of the Michigan State Telephone Company. Mr. Trafford succeeds Mr. James F. Land, who has resigned to assume the management of the Michigan Tellevent Company.

MR. S. B. STORER, consulting electrical engineer, announces that he has opened an office for his practice at 732 University Block, Syracuse, N. Y., where he will give special attention to power transmission problems and enterprises, and the execution of investigations and reports of electrical and industrial undertakings.

MR. J. R. STRONG, the effective and energetic president of the National Electrical Contractor's Association, has been presented by the members with a very handsome silver service, in connection with the recent seventh annual meeting, and his services in promoting the best interests of that now large and influential organization.

PROF. CHARLES H. BENJAMIN has been appointed dean of the School of Engineering at Purdue University to succeed Prof. William F. M. Goss, who resigned to accept a similar appointment at the University of Illinois. Prof. Benjamin comes to Purdue from the chair of Mechanical Engineering at the Case School of Applied Science, at Cleveland.

MR. ALFRED B. NELSON, of Trenton, N. J., has accepted the position of chief engineer of the Columbus Railway, Light & Power Company, of Columbus, Miss. For the past two years Mr. Nelson has been engineer of construction for the Conestoga Traction Company, of Lancaster, Pa. It is the intention of the Columbus Railway, Light & Power Company to build several extensions to the railway systems and enlarge and remodel the electric light and gas plants.

MR. F. B. DUNCAN, formerly general superintendent of the Northern Electrical Company, and since then manager of the Akron Electrical Manufacturing Company, resigned from that company to organize with Mr. H. C. Hale the firm of Hale & Duncan, contracting and designing engineers. Mr. Hale, who resigned as manager of the Mineral Ridge Manufacturing Company, to enter the new firm, was for many years mechanical engineer and designer of mining machinery for the Webster, Camp & Lane Company, and the Wellman, Seaver & Morgan Company. In their new firm with headquarters in Cleveland, Ohio, these gentlemen will give their principal attention to the electrical equipment of mines, especially in regard to electrical operation of hoisting apparatus. Mr. Duncan will also continue to devote considerable of his attention to the field of motor driven machine tools.

Business Notes.

THE CHASE-SHAWMUT COMPANY, of [illegible] has recently placed upon the market a new [illegible]

constructed to comply with new rules by the Board of Fire Underwriters, which require pockets to be fused on the switchboard. In placing this article upon the market the Chase-Shawmut Company has taken into careful consideration the rough usage received by articles of this nature in street railway park theatres, etc., and sincerely believe that this simple, safe and durable pocket will fulfill all requirements.

THE LUNKENHEIMER COMPANY, of Cincinnati, Ohio, largest manufacturers of high-grade engineering specialties in the world, gave its 45th annual picnic at Whitewater Park on July 27. The park is about 25 miles from Cincinnati on the C., C., C. & St. L. R. R. and three special trains of 15 coaches each were necessary to carry the employees and their families to the park. About 5000 people attended the picnic. A concert band of 20 pieces furnished the music for those who did not care to dance, while an orchestra played for the dancers. The firm furnished all refreshments, cigars, transportation, etc., free of charge. A troupe of actors was hired for the afternoon and a vaudeville was given. Prizes were awarded to the winners of various athletic and other contests.

FUEL-TESTING DRAFT.—The valuable work done by the United States Geological Survey at the St. Louis Exposition in determining the actual steam-making values of American fuels is to be continued with a similar plant at the Jamestown Exposition. The report on the St. Louis tests, which fills three large volumes, is devoted largely to fuels from the Middle West and Western coal fields. The plant now being erected at Jamestown will give an opportunity for analyzing, testing and placing on record in a similarly thorough and comprehensive manner the coals from the eastern fields. The Jamestown plant will contain three 300-hp boilers, each equipped with an engine-driven 100-in. mechanical draft fan and a 35-ft. stack, both supplied by the Green Fuel Economizer Company, of Matteawan, N. Y. The fans will be so controlled that the draft can be regulated as desired by hand or automatically. The wheels of the fans measure 5 ft. in diameter by 2 2-3 ft. width at the tips of the blades and are driven by 6 x 7-in. Green vertical center-crank engines. The laying out of the mechanical draft plant was entrusted by the Survey to the Green Fuel Economizer Company.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 30, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

861,249. ELECTRICALLY HEATED SAD IRON; William J. Barr, Cleveland, O. App. filed Dec. 17, 1906. A bracket is secured to the base of the flatiron so as to yieldingly project upward and support the flexible electric cable which leads to the electric heater within the iron.

861,275. INSULATOR FOR ELECTRIC WIRES; Constantine Gallagher, Richmond, Va. App. filed June 14, 1904. A rectangular box of insulating material has a curved slot extending inward from its end face in which the conductor is received. The slot is transversely deflected at its inner end so as to lock the conductor therein.

861,280. ELECTRIC SMELTING; P. L. T. Heroult, La Praz, France. App. filed April 25, 1906. In the smelting of ore in an electric furnace, the process which consists in introducing with the charge a sufficient quantity of the most refractory material thereof to form a scale of desired thickness thus restricting the cross-section of the zone of fusion and thereby concentrating the energy of the current through such cross-section.

861,281. ELECTROLYTIC ALTERNATING-CURRENT RECTIFIER; A. S. Hickley, Manasquan, N. J. App. filed Feb. 7, 1907. In an electrolytic cell, the combination with a receptacle for containing an electrolyte, of an electrode, and solid heat conducting members extending above and beyond the wall of the receptacle and of sufficient area to prevent undue heating of the electrolyte and the electrode.

861,282. ELECTROLYTIC ALTERNATING-CURRENT RECTIFIER; A. S. Hickley, Manasquan, N. J. App. filed April 16, 1907. In an electrolytic cell, the combination with a receptacle for containing an electrolyte and forming a hollow electrode, a supplemental electrode within and in electrical contact with said hollow electrode, and a hollow member connected to the hollow electrode.

861,310. ELECTROTHERMAL SWITCH; James G. Nolen, Chicago, Ill. App. filed July 6, 1903. A thermal cut-out having blade springs normally pressed against a capsule filled with an expansible fluid so that the spring is displaced and a circuit closed in case the fluid is unduly heated.

861,315. FUSE; Ralph S. Peirce, Hinsdale, Ill. App. filed June 12, 1905. Details of construction of a fuse having an insulating tube with metallic caps fastened to the body of the tube and soldered to the adjacent leading-in wire.

861,316. APPARATUS FOR ELECTROLYTIC REDUCTION OF METALS FROM ORES OR SALTS; C. E. Robertson, St. Louis, Mo. App. filed July 30, 1906. Construction of electrolytic furnace having a plurality of hollow electrodes.

861,325. DEVICE FOR CLEANING OVERHEAD TROLLEY WIRES; John L. Sniker and Wilmer S. Carl, Cincinnati, Ohio. App. filed Aug. 29, 1906. The trolley pole has an elastic hook extending upward therefrom and extending adjacent to the trolley conductor so as to clean the same in advance of the wheel.

861,340. TELEPHONE APPARATUS; Charles S. Winston, Chicago, Ill. App. filed Jan. 3, 1905. The combination, with an electromagnet in a circuit subjected to varying currents, of other apparatus in the circuit of said electromagnet, a non-inductive resistance permanently connected in parallel with said magnet to prevent the kick or extra current from the magnet coil from affecting said other apparatus, substantially as described.

861,343. INCANDESCENT LAMP SOCKET; James J. Wood, Fort Wayne, Ind., App. filed Aug. 22, 1906. Construction of lamp socket having a permanently connected rotative screw socket combined with a yielding central contact.

861,349. APPARATUS FOR TREATING THE SCALP; Robert E. [illegible], Chicago, Ill. App. filed April [illegible] helmet having a rubber edge and an electrode vertically depressible to contact with the patientt's head.

861,357. DEVICE FOR LOCATING DEFECTS IN TELEPHONE AND TELEGRAPH LINES; G. G. Buttler, Oklahoma, Okla. App. filed Sept. 11, 1906. Details of construction.

861,365. RHEOSTAT [illegible], New York, N. Y. App. filed Dec. 8, [illegible] an insulating bushing, and a spring for frictionally holding the arm, the bushing and the support together.

861,394. ELECTRIC CHAIN WELDING MACHINE; [illegible] son, [illegible] machine having various detail features.

861,458. CONNECTOR; Edwin T. Greenfield, Kiamesha, N. Y. App. filed Oct. 24, 1906. Form of connector for electric conductors adapted for the connection of [illegible] box through an opening in which the conductor extends to the interior of the box. [illegible] conductor may be subjected.

861,459. TELEPHONE ATTACHMENT; Henry Gross, New York, N. Y. App. filed May 9, 1906. The herein described attachment for telephone mouthpieces comprising a frame attached to the transmitter by a threaded connection with the edge of the central opening of the said transmitter and provided with guide lips and an intermediate groove, a mouthpiece connected to a slide mounted to move in said groove, said slide having an opening in line with the mouthpiece, and an imperforate portion adapted to cover the central opening in the transmitter, substantially as described.

861,468. CONTACT DEVICE WITH A SWINGING PLUG FOR ELECTRICAL CIRCUITS; Wilhelm Kreinsen, Burbach-on-the-Saar, Germany. App. filed June 11, 1906. Provides means for preventing the wiring or plug or box from being torn away from its wall or support by any tension to which the cable therefrom is subjected.

861,488. MOTOR COMPRESSOR; William L. Waters, Milwaukee, Wis. App. filed Oct. 15, 1906. Covers features of a motor compressor provided with oil wells into which the various moving parts dip to throw the oil over the bearing surfaces.

861,510. CIGAR LIGHTER; Charles E. Gervais, New York, N. Y. App. filed May 31, 1904. Cigar lighter having a vertical standard from which depends an electric contact device in the path of a tilting lamp, the wick of which is exposed in close proximity to the contact devices.

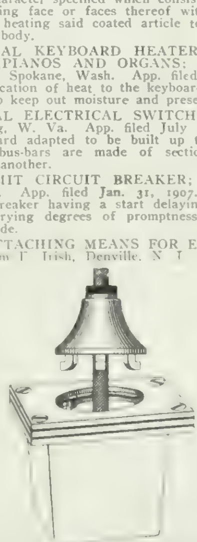
861,558. PROCESS OF FINISHING THE SURFACES OF ROLLS, DIES, ETC.; R. C. Totten, Pittsburg, Pa. App. filed May 5, 1906. The process of forming hard, smooth wearing surfaces on cast iron articles of the character specified which consists in electroplating the working or wearing face or faces thereof with metal of the nickel group, and then heating said coated article to cause the coating to weld to the iron body.

861,560. ELECTRICAL KEYBOARD HEATER AND TONE PRESERVER FOR PIANOS AND ORGANS; Rose R. Turner and John C. Bernitt, Spokane, Wash. App. filed March 7, 1906. Relates to the application of heat to the keyboard and mechanism of a piano or organ to keep out moisture and preserve the instrument.

861,587. SECTIONAL ELECTRICAL SWITCHBOARD; William D. Graves, Wheeling, W. Va. App. filed July 11, 1906. A sectional electric switchboard adapted to be built up to any desired size or capacity. The bus-bars are made of sections shingled or overlapped upon one another.

861,611. TIME LIMIT CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed Jan. 31, 1907. Construction of an electric circuit breaker having a start delaying device adjustable to respond with varying degrees of promptness to applied forces of different magnitude.

861,654. COVER-ATTACHING MEANS FOR ELECTRICAL FLOOR-BOXES; William F. Irish, Denville, N. J. App. filed March 15,



861,654. Cover-Attaching Means for Electrical Floor-Boxes.

1906. [illegible] whereby the cover may be quickly attached and removed and whereby greater durability is attained.

861,677. MAGNETIC SWITCH; Jacob I. Schureman, Chicago, Ill. App. filed May 22, 1905. Mechanical features of a circuit controller or contactor operable from a distant controlling switch through a pilot circuit.

861,692. SWITCH SOCKET FOR ELECTRIC LAMPS; Ernst Anderson, Chicago, Ill. App. filed Nov. 15, 1906. A keyless socket in [illegible] switched on and off by a [illegible] movement applied to the lamp.

[illegible] trolleys or conductors are laid alongside the usual track rails and are adapted to establish various alarm and signaling circuits within the locomotive cab.

[illegible] upon the conductor by a threaded bushing.

[illegible] PHONE OFFICES; W. H. Gabel, Hazel, S. D. App. filed Oct. 26, 1903. Covers features of construction.

861,744. ELECTRIC MUFFLE-FURNCE; A. L. Marsh, Lake Bluff, Ill. App. filed Feb. 18, 1907. In an electric muffle furnace, the combination of a housing having a head at one end provided with an aperture, a muffle removably insertible into said housing and composed of a refractory material with an electrical resistance element contained therein having terminals on an end of the muffle, and an electric coupling-head adapted to engage with said terminals and housings and forming a removable fastener operating to clamp the [illegible]

861,759. RAILROAD SIGNALING DEVICE; Elmer G. McGath, Lancaster, Ohio. App. filed April 11, 1907. A form of train-stop having an arm positioned in the path of the train by an electric circuit connection from the semaphore signal and which is adapted to close a local alarm circuit within the engine cab.

861,761. FIRE ALARM SYSTEM; Newman M. Ogle, Walbrook, London, England. App. filed Feb. 23, 1907. Features of improvement in fire alarm systems by which the heat of the fire itself generates an electric current which is registered or indicated at a suitable station.

861,772. SIGNAL CONTROLLING MECHANISM; Valentine I. Smart, Chicago, Ill. App. filed July 13, 1906. Provides means by which signals at different stations are controlled by two or more operators located at different points so that an operator at one station cannot give a safety signal except with the co-operation of the operator at the succeeding station.

861,782. PROCESS OF SEPARTING ORE; Henry H. Wait, Chicago, Ill. App. filed March 20, 1905. The herein described process of separating mica from molybdenite which consists in impregnating the mixture of such ores with a solution of an iron salt, exposing the impregnated ore to the air and finally subjecting the mixture to the action of an intense magnetic field whereby the mica is attracted and removed.

861,783. INTERRUPTER FOR ELECTRIC CIRCUITS; R. H. Wap [illegible] N. Y. App. filed Jan. [illegible] A [illegible] cal interrupter for electric circuits, comprising a base, an armature, means for causing the armature to be self-starting, an electromagnet for actuating the armature after the same has been started, a movable contact, means for imparting a reciprocating movement to the movable contact, a stationary contact, means for adjusting the position of the same and electrical connections to and from the parts aforesaid.

861,790. CONTROLLER; Thorsten Von Zweigbergk, Preston, Eng. App. filed Nov. 28, 1906. Form of controller having a hoisting motor with means for reversing the motor and automatically establishing an electric brake for such reverse motor whereby the load may be lowered under control.

861,800. SWITCH FOR ELECTRIC CIRCUITS; Herbert S. Brown, New York, N. Y. App. filed May 12, 1906. Relates to switches such as are used for connecting an incandescent lamp with the circuit from which it is supplied or for connecting sections of lighting or power circuits. Has two movable spring retracted interlocking circuit terminals and means whereby an actuating finger is caused to engage first one terminal and then the other to make and break conducting contact.

861,806. ELECTRODE FOR SECONDARY BATTERIES; L. Chronik, New York, N. Y. App. filed Jan. 2, 1907. An electrode for secondary batteries, comprising pairs of plate sections, each section comprising a bar having secured thereto spaced strips elliptical in cross-section and provided on each side with integral oblique ridges, the ridges on one side [illegible] in the opposite direction to the ridges on the other side, said strips being arranged with their [illegible] the strips of one section being arranged between the strips of the other section, substantially as described.

861,808. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed Nov. 20, 1901. In a telephone system, the combination of subscriber's lines, an operator's cord circuit for connecting any two of said lines, a repeating coil associated with said cord circuit, and a switch for severing the cord circuit and introducing the said repeating coil, so as to provide an inductive connection between the two parts of the cord circuit, the arrangement as a whole including means whereby the repeating coil, when not in use, is totally disconnected from the talking circuit.

861,809. TELEPHONE SWITCHBOARD APPARATUS; H. P. Clausen, Chicago, Ill. App. filed Nov. 21, 1903. A central-energy multiple switchboard telephone system, provided with operators' cord-circuits having normally short-circuited impedance-coils, together with spring jacks adapted to be connected with the cord-circuits in the establishment of connection between different subscribers, each spring jack having an outer contact constituting a part of both the talking and busy test circuits.

[illegible] said means including a by-pass to permit the flow of [illegible] a valve.

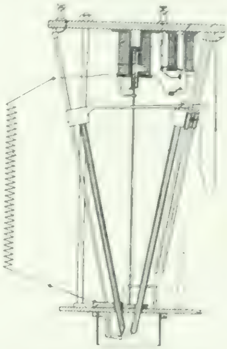
861,851.—Electrical Heater for Hot-Water Pipe.

[illegible] Ill. App. filed Feb. 23, 1907. Relates to cable terminals employed in connections with cables of various kinds for distributing the cable conductors and connecting them with the line conductors.

861,813. [illegible] March 2, 1907. Relates to modifications of the above.

861,851. ELECTRIC [illegible] HOT-WATER PIPES; [illegible] V. D. Hill, St. Louis, Mo. App. filed Sept. 15, 1906. Has a special- [illegible] and containing a resistance wire or element.

[illegible] struction of a flaming arc mechanism in which the feed of the down-



861,856.—Electric-Arc Lamp.

wardly converging electrodes is determined by a stop or ledge for one of the [illegible] other.

861,862. FIRE TRUCK SIGNAL; John Kenlon, New York, N. Y. App. filed May 22, 1906. Has means for preventing a fire truck leaving the station before the steersman has taken his place at the rear wheel.

861,887. HANGER FOR ELECTRICAL CABLES; Ralph S. Peirce, Chicago, Ill. App. filed Feb. 27, 1905. A flexible cord or wire is wrapped around the cable and the ends thereof are sealed into a sheet metal band which passes over the suspension wire.

861,931. DYNAMO ELECTRIC VARIABLE-SPEED AND REVERSING GEARING; Martin Albrecht, Friedberg, Germany. App. filed Feb. 13, 1907. An electric transmission for automobiles having a dynamo and a motor within a single frame or casing and an electric controller by which they may be connected to operate in different speed relations.

861,940. ELECTRIC LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed July 14, 1904. A multiple lamp socket of large capacity having a sheet metal frame perforated to receive various insulating bushings each of which constitutes a complete lamp socket.

861,941. ELECTRIC LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed July 14, 1904. Relates to modifications of the above.

861,942. ELECTRIC LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed Oct. 17, 1904. Additional modifications.

861,950. PROCESS FOR THE INSULATION OF ELECTRIC WIRES AND CABLES; Frederic M. Chaplet, Laval, France. App. filed May 4, 1905. Method of insulating electrical conductors which consists in applying layers of fibrous material longitudinally of the conductor and separately smoothing and compacting each of said layers as it is applied.

861,956. TROLLEY POLE ATTACHMENT; Partick F. Duross, New York, N. Y. App. filed Dec. 22, 1905. Among other features the patentee has a specially constructed cup or funnel with a laterally extending spout which is attached to the trolley cord so as to keep rainwater from running down the cord and inconveniencing the operator.

861,958. ELECTRIC SIGNAL; Martin A. and Joseph H. Ewing, Gallatin, Tenn. App. filed Jan. 12, 1906. Has a mechanical lever or tappet on the locomotive which is engaged by magnetically positioned train stop arm to blow the whistle in the locomotive in case a signal [illegible]

861,965. SAFETY FUSE; Carl Gehrke, St. Louis, Mo. App. filed Jan. 16, 1907. Means for firmly locking a fuse wire within its tubular casing. The metallic caps of the fuse are internally threaded and engaged by bushings which bind upon the ends of the fuse wire.

862,026. AUTOMATIC ALARM; Charles W. Smith, Fredericksburg, Ohio. App. filed Dec. 14, 1906. An automatic alarm designed for bakers' use intending to show when the bread has risen to a predetermined extent. Has a sort of float which moves a lever to close an alarm circuit after a predetermined elevation thereof.

862,072. SWITCHBOARD CONSTRUCTION; T. A. Hammond et al., Passaic, N. J. App. filed Nov. 18, 1903. A single-wire circuit switchboard apparatus comprising a plurality of jacks, and means for making either a patching or a looping connection at any individual jack.

862,082. WIRE-CLAMP; O. E. Lewis, Ulysses, Neb. App. filed June 19, 1906. A clamp comprising a plate provided with terminal and intermediate lugs disposed in staggered relation and defining wire-receiving seats, and projections extending laterally from the plate at the terminal lugs to assist in guiding the wire to its seat.

862,084. RELAY AND SOUNDER; G. W. Lorimer, Piqua, Ohio. App. filed July 22, 1902. The combination of an electromagnet, an armature lever, a short-metal frame having a base, and uprights or standards, means for securing the magnet to the base, ears, bent over from the material of the uprights and cross-bars, between which the armature lever plays.

862,092. MANUFACTURE OF PHOSPHORUS AND CALCIUM CARBIDE; J. T. Morehead, Leaksville, N. C. App. filed Oct. 14, 1895. The process of producing phosphorus and a metallic carbide, [illegible] metallic base with a reducing agent for the phosphoric acid and an abundant excess of carbon to combine with the metallic base, whereby [illegible]

862,093. CALCIUM CARBIDE PRODUCT; [illegible] New York, N. Y. App. filed June 19, 1906. The new product herein described, the same being a metallic carbon containing a metallic phosphide.

Electrical World

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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During 1906 ELECTRICAL WORLD *printed and circulated* 970,000 *copies, an average of* 18,827 *copies per week. Of this issue* 16,000 *cobies are printed.*

NEW YORK, SATURDAY, AUGUST 17, 1907.

CONTENTS.

ELECTRICAL HAND LABOR.

Aptly compared by Manager Bruch, of the Postal, to a bad storm in its effects, the telegraph strike is now on. In some way the operators had the strike fever in their veins, and would not be happy until their vague discontent had thus found violent expression. Only a few months ago, they were given a 10 per cent increase in pay, but now appear to be asking for more in the shape of another 15 per cent and an 8-hour day; although the real grievance would also seem to be the alleged ill treatment of nine Western Union men discharged "for cause," including drunkenness and insubordination. As a matter of fact, the Postal men had no personal grievances, but went out sympathetically and without any warning. The union leaders were unwilling to order a strike, but the younger hotheads who do not remember the disastrous days of the early eighties forced the situation on them.

The strike will soon be over, for even if it had better warrant, men who serve the public so intimately have no right to make their attempted redress of injustice with utter disregard of business and social necessities and of the public convenience. As a matter of fact, it is a pity the strike is not more thoroughgoing, as then the telegraphic managements would be more forcibly compelled to abandon hand labor and take up the various automatic systems that are so eminently worthy of adoption to-day. We should be heartily glad to see every operator improve his condition, but he can best do that by abandoning the key utterly. There is little expansion and less profit in the telegraph industry of to-day, and on a basis of manual toil, the companies cannot afford to raise wages very much if at all beyond the present point. It is a great pity, we repeat, the operators cannot see the economic conditions that beset their drudgery.

FREQUENCY SINGLE-PHASE RAILWAYS.

At the present time, we have in America two standard alternating-current frequencies, namely, 60 and 25 cycles-per-second. There are, however, a number of other frequencies in commercial use in America, such as 30, 40, 50, 125 and 140 cycles-per-second, which, at the time they were installed, were perhaps considered as likely to remain standard as any others. As regards the existing standards, it would have been better if they had been 25 and 50, instead of 25 and 60; but it now appears hopeless to make a change in this direction, notwithstanding the handicap in foreign trade that the latter frequency imposes. The amount of capital invested in machinery and systems of 60-cycle frequency in this country is comparable with the amount of capital invested in the rolling stock and roadbed of railroads with 4 ft. 8½ in. gauge, which is so large that there is not the least hope of changing this gauge, say, to 5 ft. 6 in., although it is said that the existing gauge was adopted by a mistake. It is possible that a single frequency

such as 30 cycles per second, might have been adopted as a universal standard for all classes of electric light or power transmission and distribution, if it had not been for the sensitiveness of the eye to flicker of light at luminous frequencies lower than 60 cycles-per-second. It has recently been demonstrated that flickering illumination of stationary objects must be very powerful if the flicker is detectable by the eye at rest when the frequency of flicker reaches 50 cycles-per-second or more. This frequency is reached by incandescent lamps at an alternating-current frequency of 25 cycles per second, because there are two flicker cycles to each alternating-current cycle; but it is not reached by arc lamps until the alternating-current frequency attains 50 cycles per second, because the brightnesses of the anode and cathode are not alike, and this difference in brightness produces a flicker frequency equal to that of the alternating current. Consequently, it has been necessary to use a frequency of 60 cycles per second for the successful operation of arc lamps whose carbons added largely to the light of the arc itself. If arc lamps had confined all their light to the arc flame, with its two cycles of flicker to each alternating-current cycle, it might have been possible to operate them satisfactory at 30 cycles per second.

It is now seriously proposed to add another frequency to the list, say, at 15 cycles per second, so as to make the list 60, 25 and 15. This is for the sake of the recently developed single-phase series-motor, for interurban and electrified steam railroads. Two papers on this subject were presented at the Niagara Falls convention of the American Institute of Electrical Engineers. One of these papers was in favor of adopting the proposed new frequency, while the other was opposed to the addition. It is admitted on both sides that the output of an alternating-current series motor is increased by lowering the frequency from 25 to 15 cycles per second, although the amount of increase is a matter of difference of opinion, those in favor of the change claiming 30 per cent to 35 per cent, and those opposed claiming only about 15 per cent. It is also agreed on all sides that the reduction in frequency would involve an increase in the size and weight of the generators at the power houses and of the transformers, both step-up and step-down.

The question at hand is whether a certain percentage more motor power can be placed on a single-phase locomotive sufficient to pay for the inconvenience and expense of a change in frequency. The question is a serious one from the standpoint of the future, although not a serious one from the standpoint of the present. Railroads, more than any other engineering structures, must correspond, and be built to standards. If one large railroad should become electrified at a frequency of 15 cycles per second, it would probably necessitate the sequence of future roads on the same frequency. It would then probably be too late to retrace steps, or change the frequency. Just as the 4 ft. 8½ in. gauge is practically universal in America, so the frequency for alternating-current railway traction would probably have to be. It is, therefore, necessary to proceed with great care when passing judgment on new standard frequency. If the frequency of 25 cycles per second did not exist, the frequency of 15 would still be too low for good incandescent lighting with high-efficiency lamps, owing to the flicker, and it would *a fortiori* be too low for arc lamps. Only dire commercial necessity, or Hobson's choice, should bring the frequency of 15 cycles [illegible]

The Electron Rampant.

The recent British Association meeting seems to have been a mild understudy for Donnybrook Fair in the sections where physicist and chemist waged the battle of the electrons. Sir Oliver Lodge proclaimed the atom squirming with electrons, a simile that quite irresistibly suggests a bit of ancient cheese; while Lord Kelvin threw the weight of his authority upon the other and more conservative side of the question. We have from time to time presented something of the evidence both for plaintiff and for defendant and can even now only reiterate our advice to go slowly and to sift the facts without bias. Hypotheses on the nature of matter run back clear to the Greek philosophers, but so far they have remained only hypotheses, often stimulating and helpful, but never rising even to the rank of probable fact. It is not in the least necessary for a hypothesis to be literally true in order that it may be useful in directing research toward valuable discoveries. It would be difficult to mention any proximate doctrine that has been more important to theory and practice than the splendid and fruitful speculation of Kekulé, and yet in view of the work of Van t'Hoff and his successors no chemist would seriously defend the thesis that the carbon atoms in a molecule of benzol are literally arranged in the conventional hexagon. It is quite sufficient that they behave in many respects as if they were actually hooked together with valences.

As with the molecule so with the atom. For more than a quarter-century past it has been perfectly well understood that the atom must be dynamically complex and the epoch-making work of the lamented Mendeleéf left little doubt in the mind of any serious thinker that the so-called elements are in some way structurally related. No definite light on the nature of that relation has yet appeared, in spite even of the admirable discoveries of Sir William Ramsay regarding helium. When it becomes possible to deal with the element radium, pure in the ordinary chemical sense, and to derive helium from it, a vast step in advance will have been taken, but just that step is as yet lacking. It is well to remember that no man has yet seen radium, and that all the properties attached to the name belong really to haloid salts of radium, contaminated with unknown impurities. The relation of this mixture to the so-called "radium emanation" remains as yet undiscovered, and while the appearance of helium in the emanation is definitely proved, its relation thereto is a matter of speculation rather than of certainty. If helium really is a true decomposition product of radium or of any other quasi element no one will be greatly surprised, and the only regret will be that the result was not obtained by a process of more general applicability. Certainly the matter is in the hands of an investigator who is both capable and cautious, which is more than can be said of some of the hustling experimenters who have butted into the field of radioactivity. This phase of the question, depending as it does upon exact investigation, can be safely left to take care of itself in due season.

As to the electronic theory of matter, it works out very prettily up to a certain point, like other theories of matter, and then gets into trouble. If one postulates subatomic particles endowed with any plausible set of properties, their interactions can be made to fit a large number of the more general properties of ponderable matter, as witness various speculations from the [illegible] Epinus up to date. We have had Maxwell's idle

wheels and the vortex atom and a few others within recent years, and it does not help the matter much to call the fundamental unit chosen "electricity." Truth to tell, there is very little known experimentally about the electron and until more is found out about its dimensions and relations, its derived properties are of secondary interest. Those whose experimental knowledge is the most direct and precise are the least disposed to slop over into hasty generalizations. This much is clear, that a sufficient breach has been made in subatomic dynamics to justify an assault in force, which, whether it succeeds now or a century hence, can never wholly be driven back. But it needs determined leadership and all the resources at the command of science. Great experimenters are particularly needed just now and they are painfully scarce. There is a tendency toward rushing into print with work half completed and ill done that is perhaps in keeping with the spirit of the times, but which accords ill with scientific conscientiousness. The mystery of the structure of matter is, save the mystery of life, the greatest which science has to face, and any light that can be thrown upon it is clear gain. But it is altogether premature to suppose that either can be penetrated by changing the terminology of the philosophic conceptions, and that is about all that speculations past or present have been able to accomplish. In the existing premises, science does not need Lucretius or Kant, but the inspired aid of Newton and Faraday and Helmholtz; and upon whom has their mantle yet fallen?

Characteristics of Synchronous Alternators.

One of the papers presented at the recent Niagara Falls convention of the American Institute of Electrical Engineers was on the "Interaction of Synchronous Machines," by Prof. Morgan Brooks, and considers the relations of current, voltage, power and phases, of two single-phase machines running together in synchronism. The treatment is essentially graphical, and lends itself excellently to the case of a constant-potential alternator, driving a motor on which the load varies, or of which the excitation may vary. The diagram is made by drawing a base line of length representing the generator voltage, and a direction line at each end, making an angle therewith equal to the antitangent of the reactance-factor of the circuit. These two lines will intersect at a point which is called the center of the diagram. Any concentric circle about this center is the locus of the vector motor c. e. m. f. for a corresponding constant power imparted to the motor. So much at least of the diagram has been already worked out by Blondel. The new graphical contributions of the paper are certain additional loci to the Blondel diagram, such as a system of internal osculating circles for constant motor efficiency or constant heat loss. There can be no doubt that the circle alternator diagram is the simplest key to the operation of a variable motor working on constant-potential mains, just as the rectilinear alternator diagram, also first given by Blondel, is the simplest key to the operation of a synchronous motor on a circuit of variable potential. Without these diagrams, there is nothing to guide the mind's eye but a mass of algebraic formulas. With the diagrams, each and every varying factor can have its individual influence noted and taken into account

The paper calls attention to an interesting fact not generally known, namely, that the initial impedance of a synchronous machine when its main switches are first closed may be much less than its synchronous impedance. That is, the current which may flow through an alternator armature when first switched on to the bus-bars near synchronism may be much greater than the current which will flow through the system, for the same phase difference, after the machine has been running in parallel. This is probably due to the fact that the synchronous impedance of a machine is much greater than its simple impedance, owing to the influence of armature reaction in modifying the generated e. m. f. When the armature of the incoming machine is first switched in, the simple impedance only is effective, and the effect of armature reaction is delayed by the hysteresis of the magnetic circuit for perhaps a second, or many cycles, during which a dangerously powerful current may flow. It is very important that series of measurements should be made with synchronous alternators, under practical conditions, to ascertain how closely their synchronous impedance is maintained uniform throughout the range of their synchronous operation. All of these useful graphical methods depend on this constancy of synchronous impedance for their precise application. It is generally hoped and believed that the constancy substantially exists, but the experimental support for the belief seems incomplete and this objection was pointed out in the discussion of the paper.

One of the most interesting and valuable properties of a synchronous motor is its ability to draw from the supply system a wattless component of current of either a positive or a negative value, according to whether its field excitation is above or below a certain degree. Thus the current taken by the synchronous motor is not dependent solely upon the load as is the case with the induction motor, but it varies largely with the field current. These facts are clearly shown in the diagrams given in the paper noted above. Some little use has already been made of the synchronous motor for absorbing leading wattless current and thus for compensating for the lagging wattless current demanded by induction apparatus, and it is probable that the future will witness an increasing application of the "synchronous condenser." Our last issue contained an article by Mr. Clarence P. Fowler discussing in detail the conditions which render desirable the compensation for wattless lagging currents, and explaining the operation of a synchronous machine exclusively as a "rotary condenser" and also as a combined motor and condenser. The article shows that the latter operation is of greater practical value than the former. Neglecting certain minor modifying influences, the facts may be outlined as follows: If instead of buying a 1000-k. v. a. "rotary condenser" the purchaser selects a 1414-k. v. a. synchronous machine, he obtains simultaneously the desired rating in a synchronous condenser and an additional rating of 1000 kilowatts in a synchronous motor. Moreover, the 414 k. v. a. increase in the rating of the synchronous machine should cost somewhat less per k. v. a. than the 1000 kilowatt rating in a synchronous motor. It would seem that an increase of 40 per cent in the investment for the combined motor and condenser apparatus might be equivalent to 100 per cent increase in the investment for separate motor and condenser equipments. The actual saving obtained depends largely upon the relative values of the motor and condenser loads and upon the power factors, a particular example being worked out in detail in the article in our last issue.

Electrification of the New York, New Haven & Hartford Railroad.

[illegible] cerning the adoption by the New York, New Haven & Hartford Railroad of single-phase locomotives for hauling its trains throughout the "electric zone," we are pleased to be able to give below the reasons assigned by Mr. E. H. McHenry, vice-president of the N. Y., N. H. & H. R. R. for the selection made by the company. The electric equipment which was placed in successful operation during the present month, has been described by us from time to time as the work of installation progressed. The locomotives were treated quite fully in our issue for April 14, 1906, while our issue for March 30, 1907 contained a brief description of the catenary line work. Additional information concerning the overhead system is given elsewhere in this issue.

The act of Legislature of May 7, 1903, of the State of New York, providing for the future regulation of the terminals and approaches thereto of the New York & Harlem Railroad in the City of New York, authorizes the New York Central & Hudson River Railroad Company and the New York, New Haven & Hartford Railroad Company, lessees of the New York & Harlem Railroad Company, "to run their trains by electricity, or by compressed air, or by any motive power other than steam which does not involve combustion in the motors themselves" through the tunnel and over the tracks more specifically described. The act requires that the change of motive power be made on or before July 1, 1908, and provides a penalty of $500 per day on and after that date for failure to comply with its terms.

As there was no available form of motive power other than electricity which met the conditions of the act, it accordingly became necessary for the N. Y. C. & H. R. R. R., and the N. Y., N. H. & H. R. R. to provide suitable locomotives, power houses and track equipment for electrically operating all trains between the Grand Central Station at Forty-Second Street and the prescribed sub-limits within the limits of the City of New York.

The terminal tracks of the New York & Harlem Railroad, between the Grand Central Station and the junction point at Woodlawn, a distance of 12 miles, are jointly leased and operated by both the Central and New Haven companies. The zone of electric operation on the lines of the latter was further extended 21 miles, to Stamford, to include the greater number of its suburban trains.

This feature of joint operation more than all others restricted and narrowed the latitude of choice in the selection of a system of electric traction by the New Haven company. The Central company was first in the field, and having previously adopted a system based on the use of continuous-current motors taking current from a third rail, it was obvious that no method inconsistent with such conditions was open to the New Haven company, and it was thus practically confined to a choice between continuous-current low-voltage system as adopted by the Central company and a more recently perfected high-tension single-phase system. The first has been in general use for a number of years and, as installed by the Central company, includes the generation of alternating currents at 11,000 volts and 25 cycles, high-tension transmission to sub-stations located approximately five miles apart, at which points it is transformed by transformers and rotary converters to continuous current at 666 volts. The current is supplied to the engine contact shoes through a secondary system of distributing feeders and an inverted third rail of improved type. Continuity and regularity of operation are further insured by a large and most noteworthy installation of storage batteries in each sub-station.

The single-phase system is the latest and most advanced step in the evolution of electric traction, and it was not until 1904 that the first commercial installation, on the Cincinnati & Indianapolis Traction Company, was operated. With this system, electric power may be generated, transmitted and supplied directly to the electric locomotive, substantially at the initial frequency and voltage, without intermediate reductions or transformations of any kind. In effect it duplicates the simplicity of the local street railway operating with continuous currents supplied directly to the motors from the trolley line. It avoids all necessity for the ordinary equipment of transformers and rotary converters, storage batteries, low-tension switchboards, and low-tension distributing and contact conductors, while affording the flexibility and economy of high-tension alternating-current transmission over long distances.

The characteristics of the single-phase motor are essentially identical with those of the more familiar continuous-current series motors. Single-phase series motors are adapted for operating with either alternating or continuous currents, and this valuable feature makes it possible to design locomotives which may be operated at will by high-tension alternating currents from an overhead conductor, or low-tension continuous currents from a third rail.

The New Haven railroad company was one of the pioneers in the field of heavy electric traction, and has operated six of its shorter branch lines by electricity in commercial service for a number of years past, beginning as early as 1895. Three of these lines, aggregating 33 miles in length, were equipped for overhead contact, and the remaining lines, aggregating 39½ miles in length, for a third rail contact. All lines were operated with 500-volt continuous-current motors, supplied from main stations and sub-stations of the familiar type. The third rail was rather primitive in form and without protective devices of any sort. So many fatalities and injuries followed the use of this method of supplying current to the motors that the railroad company was compelled by a decree of the Superior Court dated June 13, 1906, to abandon all third-rail operation in Connecticut and revert to steam service, and it now has no third rail in service excepting a junction overlap with the New York Central road at Woodlawn. Improved methods of protecting the third rail are available which considerably mitigate the more dangerous features of the earlier installations, but the unfortunate and unsatisfactory experience of the railroad company with this type of construction influenced its decision in favor of the single-phase system, which was finally adopted after a careful and complete investigation of the relative merits and disadvantages of the two methods of construction.

Had the study of the problem been limited to the equipment of the terminal section in New York City, considerations of uniformity and expediency would doubtless have influenced the decision in favor of continuous-current motors, taking current from a third rail. The New Haven company, however, recognized the great importance of its decision in its far-reaching effect upon future extensions of electric service to other parts of its system, and the final decision was based upon a study of the subject as a whole rather than upon the solution of the terminal problem only.

While both of the methods under consideration included high-tension transmission by alternating current, it was believed that the combination method requiring transforming devices and continuous-current motors was less well adapted to the conditions than its simpler single-phase competitor, for many reasons. The electric efficiency of the combination system between power house bus-bars and engine shoes is only 75 per cent, as compared with 95 per cent for the single-phase system. The flexibility of the former is impaired by the limited radius of the secondary low-tension distribution, thus requiring substations at frequent intervals, and still further by the limitations imposed by the use of a third or conductor rail. The position and height of this rail in its proper relation to the track rail must be rigidly maintained, and the practical margin of permissible variation is measured in fractions of an inch. Also, its continuity is broken at switches and crossings by frequent transference of the conductor rail to the opposite side of the track or to an overhead position. In contrast, the single-phase system requires no sub-stations or secondary circuits; the continuity of the overhead conductor is complete, and its position and height may vary within vertical and horizontal limits of eight feet and four feet, respectively, without

losing contact with the collecting shoes on the pantagraph frames.

It is yet too early to furnish definite and positive comparisons of cost of the two methods under consideration, but the calculations and experience of the railroad company's engineers indicate that the total cost of a single-phase installation will be much less than that of the continuous-current system, and that the higher electrical efficiency, lower fixed charges, maintenance, and operating expenses of the single-phase system all tend to reduce the relative cost of energy delivered to the engine shoes in about the same proportion.

The determination of the most economical and desirable frequency and voltage of the transmission system involved the consideration of many factors entering into the problem. The choice of frequency was practically fixed by the manufacturing companies within limits of 15 and 25 cycles, and the comparative merits of only these two frequencies were considered.

The lower frequency afforded a material reduction in weight, size and cost of motors, a reduction in conductor losses and induction disturbances, together with an increase in the power factor of the motors. On the other hand, its adoption would have materially impaired the commercial value of the system as a whole, in restricting or preventing its extension for many other uses incidental to railway operation. The standard power and railway frequency in general use is 25 cycles, and as the New Haven company already owned a number of power houses generating at this frequency for standard trolley operation, and, in addition, had equipped many of its shops with 25-cycle motors, the adoption of 15 cycles would have required the abandonment of a large amount of standard apparatus, or the interposition of costly and inefficient means of translation. The lighting of stations and other buildings was quite an important factor, as 25 cycles is the lowest frequency at which the carbon-filament lamps in general use can be satisfactorily operated. It was also considered desirable to provide for operation in parallel with the 25-cycle generators already adopted by the New York Central company. The practical effect of a change from 25-cycle to 15-cycle apparatus was thus substantially equivalent to a "break of gauge," and under existing conditions it was decided that the practical commercial value of the higher frequency outweighed the more theoretical merits of the lower one.

Various alternatives were considered before fixing the generating and transmission e. m. f. of the system. It was at first proposed to increase the economical radius of transmission to the utmost by generating at the highest initial voltage for which alternators could be safely designed (about 22,000 volts) and to provide sub-stations at suitable intervals, equipped with stationary transformers, for supplying current at 3000 or 6000 volts to secondary contact circuits. As the two motors in each electric locomotive truck are permanently connected in series, current must be supplied at 560 volts through the transformer forming a part of the locomotive's equipment.

It became evident, however, that a great gain in simplicity would result if the intermediate sub-stations and line transformers could be omitted altogether, and further study demonstrated the possibility of effecting this by reducing the initial e. m. f. to 11,000 volts and raising the ratio of the locomotive transformer to correspond. This plan was carried into effect with a resulting reduction in the capital and operating cost, coupled with an increase of electrical efficiency, which proved most gratifying. Incidentally, the difficulties in designing satisfactory collecting devices were greatly diminished.

The difficult and responsible task of determining and analyzing the operating conditions and the requirements was assigned to Mr. Calvert Townley, consulting engineer, and Mr. William S. Murray, electrical engineer, of the New Haven company, to whom, together with their able assistants, credit is due for the design, supervision and successful execution of the many and difficult details of this novel installation.

The following comments by Mr. McHenry upon the commercial aspects of electric traction are interesting in view of the natural prejudice of the stockholder in favor of the continued maintenance of dividends which must be respected, and because the technical expert too frequently neglects this aspect in his scientific ardor for the building of monuments of engineering skill and achievement:

Numerous analyses and comparisons of the comparative costs of electric and steam operation have been published from time to time, which tend to prove that a considerable saving of fuel, engine repairs and other operating expenses may be expected. Under favorable conditions this saving may be large enough to pay interest and other fixed charges upon the additional construction investment and still have a satisfactory margin to apply on dividends. Under general conditions, however, it is altogether improbable that the direct saving resulting from the simple substitution of electric for steam power will be sufficient to justify the additional investment and financial risk.

In changing the method of motive power on existing railways, the conditions are by no means so simple as in the construction of new lines, as in the former case a great amount of capital already invested must be sacrificed, and the problems of adaptation to existing conditions are peculiarly severe. In particular, the transition stage in bridging over the gap between steam and electric operation is both expensive and difficult, as the change affects train lighting and heating, telegraph and telephone service, signaling, and track maintenance, for which both temporary and permanent provision must be made. The simultaneous maintenance of facilities and working forces for both steam and electric service within the same limits will be rarely profitable, for the reason that a large proportion of expenses incident to both kinds of service is retained, without realizing the full economy of either.

To secure the fullest economy it is necessary to extend the new service over at least the whole length of the existing engine stage or district, and to include both passenger and freight trains, and in this connection it is interesting to note that in the case of the New Haven company the passenger train mileage forms so large a proportion of the whole that no additional generating and transmission capacity will be needed when electric traction is extended to freight service.

The application of electric traction to heavy railway service will probably be governed by other and more important considerations than its mere relative cost as a motive power under similar conditions, as illustrated in the development of the ordinary trolley service. In this development the commercial value of higher speeds and of increased car capacity is so large that the relative cost of electric versus animal tractive power becomes almost negligible by comparison. Analogous results may be hoped for in the corresponding development of electric traction in heavy railway service, as the new conditions will afford opportunities for at least two radical modifications of existing conditions, quite apart from minor economies.

In steam service the weight and speed of trains are limited by the horse-power of the locomotive, which generates its own power, and there are only a few locomotives which can generate sufficient steam to utilize their full cylinder tractive force at speeds in excess of 12 miles an hour. Consequently, any increase of speed beyond certain limits can be attained only by sacrificing train tonnage in a corresponding degree. The division of the train-mile cost by the lesser number of tons increases the ton-mile proportionately. The high cost of fast freight service is principally due to the effect of this diminishing divisor, while it would seem that electric traction should permit high speeds without sacrificing commercial tonnage, because, with a relatively unlimited source of power at command, the maximum drawbar pull permitted by the motor design, may be maintained at all speeds. The commercial value of high speed in freight and passenger service is so great that the prospect of escaping the present penalties accompanying reduced train capacity becomes doubly interesting.

Hardly less important is the opportunity afforded at the opposite end of the scale, for the economical operation of trains of minimum load. The train load cannot be reduced without loss, below the point where the earnings equal the train-mile cost, and if this cost cannot be reduced proportionately with

reduced load, the inferior limit of load may be uneconomically large. In steam service the irreducible elements entering into the train-mile cost are so large that it is rarely profitable to operate trains earning less than 40 to 50 cents per mile. In contrast, electric service permits an extreme reduction of the train length to single car units, costing to operate from 10 to 15 cents per car-mile. Hence, the frequency of service may be increased and the rates reduced, which in turn will react upon the volume of traffic, with the final result of increasing both the gross and the net earnings. It may, therefore, be claimed for electric traction that it will extend the limits of profitable operation of high-speed heavy trains, and also of light trains.

Other, but relatively minor advantages are possible in the effect upon earnings, due to the elimination of smoke, gases, dust, cinders and heat, the better ventilation of cars, the extension of electric train lighting and heating; and of the effect upon expenses due to the concentration of power production in large and economical power houses, a reduction of engine repairs, an increase of effective engine and train mileage, a more or less complete elimination of engine houses, turntables, fuel stations, water tanks, cinder pits and other operating facilities, the consolidation of power requirements for traction, pumping, operating shops, elevators and general uses, and the use of electricity for lighting switch lamps, stations and other buildings.

Finally, the availability and value of real estate and structures at large terminals will be greatly augmented by the possibilities of using two or more superimposed track levels, as strikingly exemplified in the plans for new terminals in New York City for the New York Central and the Pennsylvania companies.

A general change from steam to electricity will render unproductive a very large amount of invested capital, and create the necessity for the expenditure of additional amounts still greater, but there is no reason to doubt that the transition already in progress will be rapidly extended and applied at all points where congested terminals, high frequency of train service and low cost of energy create favorable conditions.

Ohio Telephone Independents.

The Ohio Independent Telephone Association met at Columbus on Aug. 6, when some 350 persons were in attendance, at the Southern Hotel. The presiding officer was Frank L. Beam, of Mt. Vernon, formerly general manager of the Columbus Citizens' Telephone Company.

There were several addresses on the programme preceding the report of the resolutions committee. Harry M. Daugherty, general counsel for the Columbus Citizens' Company, spoke on "Why Is Independent Telephony so Successful?" W. G. Thompson, of Hamilton; James B. Hoge, of Cleveland, and H. B. Folsom, of Circleville, discussed "Why Is Competition Desirable in the Telephone Business?" and A. Hess, of Sidney, told of the enforcement of the general laws of Ohio in reference to the telephone business.

After the addresses this resolution was adopted unanimously: "Whereas, It is the sense of the independent telephone companies of Ohio, composing this association, that its members refuse to enter into any contracts or arrangements whereby competition is eliminated and that all violation of law arising from such arrangements or contracts will be prosecuted by this association.

"Resolved, That the executive committee is hereby authorized to take such steps as are necessary to carry this resolution into full effect."

This resolution is understood to mean that the association will invoke the Valentine anti-trust law against any company which enters into a contract with the Bell company for the retirement of the latter from the local field in exchange for the long distance business of the independent company.

After luncheon the subject of the advances being made by the Bell companies to the independents was again taken up and, after a long discussion, the following resolution was unanimously adopted:

"Whereas, Certain independent telephone companies have violated their contracts with the United States Telephone Company by permitting unauthorized connections and interchange of business prohibited thereby, to the serious injury of every independent telephone company in Ohio, or interchanging business business therewith,

"And, Whereas, The maintenance of competition in long distance telephone business is deemed necessary for the best interests of the companies as well as the public,

"Therefore, Be it resolved by the Ohio Independent Telephone Association in convention assembled that we deem it the duty of the United States Telephone Company to enforce its contracts wherever violated, and, be it further resolved, that we demand that the United States Telephone Company bring suits, if necessary, against all companies violating their contracts with it and this association pledge its unqualified support to said company in the prosecution of such actions."

It is said the independent long distance company will bring suits for violation of contracts against several independent companies.

New York Destructor Plant for Lighting a Failure.

New York's refuse-burning plant as a means of lighting the Williamsburg Bridge across the East River has been abandoned and the Department of Water Supply, Gas and Electricity has called upon the New York Edison Company to illuminate the structure and to supply whatever additional electricity may be required. It will be remembered that this plant was described in the ELECTRICAL WORLD of Nov. 18, 1905. The destructor station is at Tompkins and Delancey Streets, just beside the bridge, and was used by the Street Cleaning Department for destroying a portion of the city's rubbish, which heretofore was taken out to sea and dumped. The fuel was supplemented with coal at times for feeding boilers supplying steam to two 100-kw and one 50-kw electric generating units, the energy from which was used to supply the Williamsburg Bridge. It was estimated at the time that the plant would save the city about $10,000 yearly.

The generators supplied 180 arc lamps, 767 incandescent lamps, three electric motors and 20 electric heaters. The following data on the plant for the year 1906 during which time it may be said to have been operating under its best conditions, having passed the experimental stage, will doubtless be of interest:

[illegible]	[illegible]
[illegible]	[illegible]
Cost of operating incinerator, including repairs, supplies, coal [illegible]	[illegible]
Cost of operating electric plant, including depreciation at 5 per cent and interest at 4 per cent..........................	31,418.28
Actual saving to the Street Cleaning Department as compared to the cost of final disposition..........................	8,052.67
[illegible]	[illegible]
Estimated cost of running the lighting plant with coal as fuel..	[illegible]7,232.00

It will be noted from the above figures that no charge is made for depreciation on the incineration plant, nor are any charges made for administration, taxes, etc. We regret that we are unable to obtain the total kilowatt-hours of energy generated so as to give the cost of energy per kw-hour, as compared with the cost if supplied by a central station. The city's engineers, however, have been frank enough to admit that the plant was being operated at a loss and was unsatisfactory at all times as a lighting plant for reasons given below.

The incinerator has disposed of 39,647 loads of rubbish a year. Each load consisted of approximately 7½ yards of material; but this was reduced by picking and compressing to about 2½ yards at the furnace. A large part of the difficulty encountered in the work of keeping up steam in the boilers was the accumulation of slag, which choked the flues and ran back on the grates. This slag was caused by glass, sand, etc., in the rub-

bish which escaped the pickers. Besides this, the quality of the fuel caused great variations in the heat obtainable, and the necessity of opening the large feed holes for putting large articles, such as sofas, barrels, boxes, etc., into the fire, caused contractions which ruined the incinerators. These are now practically fit for junk; but the electrical equipment is in first-class condition and does not represent a total loss. The building also may be utilized for some other purpose or may be still retained by the Street Cleaning Department.

Another condition which was inimical to economical operation was the necessary rehandling of the rubbish. This came in during the day, and the lighting plant was run at night, so that in the meantime the rubbish had to be stored. In addition, the heavy lighting load came during the winter months and the quantity of rubbish gathered in winter is not near so much as is gathered in summer. The plant, moreover, was being operated by the Street Cleaning Department, while the benefits were derived by the Bridge Department. When the Street Cleaning Commissioner, in an endeavor to cut down expenses, abandoned the plant, matters were brought to a head, and inasmuch as the bridge had to be lighted and the Bridge Department had no appropriation for that purpose, it fell to the lot of the Department of Water Supply, Gas and Electricity to supply the electricity with the result that a contract was made with the New York Edison Company at the company's regular rates.

The Department of Street Cleaning claims that the plant was built by a former commissioner as an experiment and was never expected to furnish enough steam to run the generating equipment to light the bridge. If it had been successful, however, and there had been no change of commissioners, a larger furnace installation would have been made so as to furnish sufficient steam to run the generating equipment. The Street Cleaning Department could supply more rubbish than necessary, the plant only using about one-eighth of the rubbish gathered, and it would be folly to burn this unless some use were made of the heat. The experiment of lighting the bridge was the only means of utilizing this heat, and after a two-year trial the experiment was found to be a failure.

Central Station Improvements at Houghton, Mich.

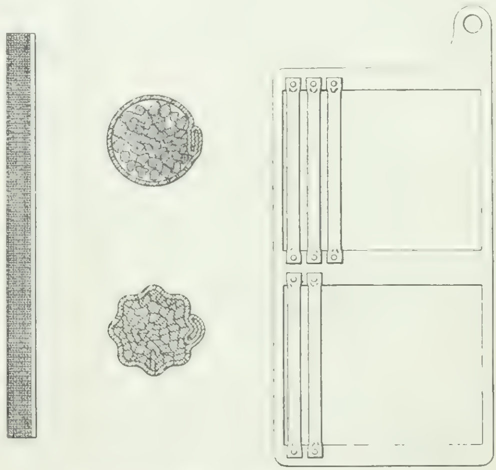
A number of important improvements have recently been made in the central station system of the Houghton County Electric Light Company, under the direction of the Stone and Webster Engineering Corporation. At the switchboard in the Houghton station the lighting circuits were formerly connected directly to one set of the main bus-bars through air-brake switches, and were protected by fuses and circuit breakers. As the loads on the circuits became too heavy for this method of control of a 2300-volt system the old switches were replaced by General Electric hand operated oil switches. In the new arrangement the lighting lines are fed from an auxiliary set of two-phase busses which may be thrown upon either set of main bus-bars through a four-pole double-throw oil switch, with automatic overload release.

Provisions have been made for running additional circuits by building a wire rack into the wall at the west end of the switchboard gallery, allowing for two new high-tension lines and seven 2300-volt, single-phase circuits. This outlet is primarily intended for the Atlantic mine. General Electric type V line drop compensators have been placed in some of the 2300-volt suburban lighting circuits. The company has always found it preferable to feed from alleys rather than streets. Outlying distribution circuits are also being extended in length and capacity.

Special power rates are now in force for day service. The minimum charge per month being 50 cents per hp of connected load. The rates depend on meter readings and vary from 7 cents to 1.85 cents, the latter rate being given on excess consumption of 100,000 kw-hours per month. Customers on these rates are allowed to use power at any time during the day except between 5 and 11 p. m. during November, December, January and February and except from 7 p. m. to 11 p. m. the remainder of the year. Customers who wish to use power 24 hours per day are charged $1.50 per hp per month in addition to the meter charge.

Edison Storage Battery Patent.

A patent issued July 6 to Thomas A. Edison relates to improvements in his form of cobalt-nickel alkaline storage battery, designed to reduce to a minimum the amount of active material in the form of flakes or films on cobalt or a cobalt-nickel alloy, and to secure a maximum degree of conducting capacity. A unit tube (Fig. 1) is formed from a thin perforated



FIGS. 1, 2, 3 AND 4.—EDISON STORAGE BATTERY.

sheet of sheet-iron or nickel, thinly coated on each side with cobalt-nickel alloy. After the seam is formed the tube is subjected to a high temperature in hydrogen to weld the seam, after which the tube is filled with active material and then corrugated longitudinally, as shown. The tubular units are then secured by rivets to grids, as shown in the illustration.

CURRENT NEWS AND NOTES.

MUNICIPAL ELECTRICIANS.—The twelfth annual convention of the International Association of Municipal Electricians was held at Norfolk, Va., last week, with a good attendance, and several papers were read. Seventy-five cities were represented. The Jamestown Exposition was one of the special attractions and entertainments.

IRON OXIDE RESISTOR ROD FOR LIGHTNING ARRESTER.—In order to limit the amount of current which can follow a lightning discharge across the air-gap of an arrester use is generally made of a series resistor in the form of a rod containing a mixture of graphite and clay. It has been found that the conductivity of such a composition is not constant, but varies with each discharge of current. The graphite burns out, especially at the terminals of the rod, thereby increasing the resistance of the rod and finally open-circuiting the device. A patent issued to Dr. C. P. Steinmetz, on July 23, discloses a method of overcoming the difficulty by substituting oxide of iron or of chromium for the graphite. These oxides are to a certain extent conductive, yet their resistance is high. The resistor rod is made fairly homogeneous by the use of a binder of potassium silicate or sodium silicate.

O. E. L. A.—The Ohio Electric Light Association will hold its thirteenth annual convention at Toledo, Ohio, on Aug. 20, 21 and 22 at the Boody House, when, as noted, a very interesting set of papers will be discussed. An unusually large attendance is expected, and a sumptuous special souvenir programme, large oblong quarto, bound in soft green leather and silk, has been issued to signalize the occasion. In addition to the regular business sessions, there will be a number of entertainment features.

TECHNICAL TRADE LITERATURE.—The Technology Department of the Carnegie Library of Pittsburg is making an extensive collection of trade catalogues, and will be glad to receive catalogues of any of the advertisers in THE ELECTRICAL WORLD. These catalogues will be given a prominent place on the shelves, carefully catalogued under both firm name and subject, and made accessible to the public. Catalogues should be addressed care of H. W. Craver, Technology Department. Carnegie Library, Pittsburg.

TELEPHONY IN ATLANTA.—Now that telephone franchises are falling in or being renewed, considerable interest attaches to the new terms made. The Southern Bell Telephone Company has made the announcement that it will waive all claim to a perpetual franchise in the city of Atlanta. The statement is made by Mr. W. D. Gentry, local manager, who offers in behalf of the company to pay ½ per cent of the gross receipts for 10 years and 1 per cent for 23 years, in addition to the regular ad valorem taxes, if the city will grant the company a 33-year franchise. The ad valorem taxes for 1908 will amount to about $9,000. The proposition is being considered by a special committee of the City Council.

HANDLING GLASS MAGNETICALLY.—An interesting variation in "lifting magnet" practice is shown in a patent recently issued to Mr. Ethan I. Dodds, of Pullman, Ill., for handling glass in sheet or crates, etc. Beneath the glass or other material, he places a sheet or pieces of magnetic material, and above the glass he operates electromagnets, manipulated and controlled by a crane, derrick, hoist or the like. The pull on the metal beneath the glass constituting the armature or armatures by the magnets causes the armature to support the glass, thereby permitting it to be transported by the crane. Mr. Dodds naturally uses a plurality of adjustable magnets for this purpose and, by rendering the magnetism sufficiently strong boxes or crates of glass or similar non-magnetic material can be conveyed safely and expeditiously from one place to another so long as the magnets are energized.

TELEGRAPH STRIKE.—The smoldering fire of discontent among the telegraph operators broke out in full blaze again this week, and several thousand operators went on strike all over the country, from both the Western Union and the Postal systems. This was apparently quite unexpected when the move was made last Sunday and Monday, and was contrary to the wishes of the union officials and to an agreement to wait until Friday, by which time it was hoped peace might be secured by intervention. Some of the Associated Press operators also went ont in sympathy. Both the great companies deny that they are crippled, although their forces are seriously lessened, and business is being carried on at all the large centers. One effect has been to increase telephone patronage, particularly the long-distance service. So far the striking telegraphers have been well behaved, but the offices are guarded by police.

WIRELESS DETECTORS.—A recent patent issued to Mr. H. H. C. Dunwoody, of Washington, D. C., deals with wireless telegraphy wave responsive to detecting devices. He claims to have found that what is ordinarily known as the "loadstone" is well adapted to the purpose, as well as the artificially produced material of crystalline form, whether the triferro tetra oxide commonly called the magnetic oxide Fe_3O_4, or the sesqui oxide, having the general formula Fe_2O_3, preferably the former, his tests showing it to be the more sensitive. This material may be of any desired shape or size, and is generally used in the form of a concrete mass or body of crystals which may vary in size and character. This wave responsive material can be connected in the circuit of a single receiving apparatus in many and various ways. One drawing shows a vessel with some such electrolyte as mercury, or an acid, or an alkali, and with the detector devices in the shape of a conical or pointed mass dipping its tip into the surface.

ELECTROLYTIC CONDENSER.—A form of electrolytic condenser has been patented in this country by Mr. Ignacy Moscicki, of Fribourg, Switzerland, the novelty of which is that one of its electrolytic coatings is contained in the interior of a tubular dielectric, which is itself sunk in the other coating. In one form which is illustrated, a vessel made of insulating material contains a fluid electrolytic conductor such as sulphuric acid, potash lye, soda lye, etc. Into this the electrolytic conductor which forms one coating of the condenser, a narrow tube, closed at one end and made, for example, of glass, is dipped, the top of the tube passing through a junction of the vessel and the interior, containing a fluid electrolytic conductor as an inner coating. This tube which acts as a dielectric is wound in spiral form so that while of considerable length it occupies exceedingly little space. A conducting wire made of lead runs through the whole interior length of the tube and projects from the top. On the bottom of the vessel is an electrode plate made of lead and connected with a conducting wire that runs through a junction of the vessel. The two conducting wires serve for connecting the two coatings with an external circuit. Owing to the conducting wire running through the whole length of the tube the resistance in this tube is greatly diminished. Another form is so modified as to give two such condensers arranged in series in the one vessel.

INTERRUPTER AND RECTIFIER.—Mr. Harold A. Yarnell, of Los Angeles, Cal., has assigned to the Pacific Wireless Telegraph Company of that city an interrupter and rectifier, capable also of serving to interrupt the circuit through the induction coil of the transmitter in wireless telegraph systems, or of use in X-ray work. A general idea may be formed from the first claim: "An electrical interrupter and rectifier comprising a liquid, a shell with a perforated end immersed in the liquid, an electrode in the shell with its end projecting through the perforation in the shell, a tube outside of the shell, the lower end of the tube having arms which support a cone upon which cone the lower end of the electrode rests, and means for securing vertical relative adjustment between the tube and shell whereby the effective contact area of the lower end of the electrode may be regulated." In using this form of apparatus in the transmitting station of wireless telegraph systems, Mr. Yarnell has connected with one terminal of a circuit using alternating current and with one pole of the primary of the induction coil; the other pole of the primary was connected to the other terminal of the supply circuit. Upon closing the circuit through the apparatus, the current passes through the terminal and through the electrolyte and through the electrode and primary of the induction coil. The effective contact of the electrolyte with the electrode is limited by the orifice, and upon the passage of the current, the liquid is forced away from the lower end of the electrode forming a bubble so to speak, which automatically breaks the circuit, which, however, is immediately closed by reason of the destruction of the bubble, the liquid renewing itself in contact with the electrode. This action takes place in quick succession whenever the circuit through the device is closed, even if closed only for an instant. This automatic interruption occurs also when a direct current is used. In addition to this automatic interruption of the current. the device, when used with an alternating current acts also as a rectifier, thus making it possible to employ the device for converting an alternating current into a direct current.

BUENOS AIRES TRACTION.—The city authorities of Buenos Aires, Argentine Republic, are advertising for short term tenders for the construction of underground contact street railway lines.

ELECTRICITY IN MANILA.—The Jesuit Fathers, it is stated in a recent Government bulletin, have just established an electrical laboratory at Manila, P. I., and will teach electrical science and engineering. The course is said to be laid out for five years.

OLD TIME TELEGRAPHERS.—The twenty-seventh annual reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps will be held at Niagara Falls, N. Y., Sept. 16, 17 and 18. Headquarters will be at the Cataract and International Hotel. Mr. John Brant, 195 Broadway, New York, is secretary of the Old Timers' Association.

LIGHTNING FATALITIES.—An average of 800 people are killed in the United States each year by lightning, according to data collected by the U. S. Weather Bureau. This means that about 1 in each 100,000 of population is killed in that manner. The region of greatest danger extends from southern Vermont to Kentucky. Four times more persons of outdoor occupations are struck than those indoors. One out of every three struck survives.

RECESSION AT NIAGARA.—At the recent Leicester meeting of the British Association for the Advancement of Science, an interesting paper was read by Prof. Spencer, of the United States. Three-quarters of a century ago the English geologist Lyell computed that Niagara had taken over 30,000 years to cut its rocky precipice to its present position. Prof. Spencer many years ago came to the conclusion independently that Niagara had taken at least 32,000 years to produce this result, and now, with still more minute investigation and measurements, he calculates the period at 39,000 years.

NEWS WHILE YACHTING.—During the recent cruise of the New York Yacht Club, the *New York Herald* did a clever piece of work in supplying the fleet with news of the stock market, etc., by means of the wireless telegraph. The success of the attempt was so great that Mr. E. C. Benedict, owner of the yacht "Oneida," with large financial interests, expressed his belief that the Club would never again take its annual cruise without this service. The messages were received by wireless on the newspaper boat and then communicated to the fleet by regular flag signals. In our issue last week, the converse of this idea was given in the article on reporting yacht races by wireless telephony at Put-in-Bay, Lake Erie.

GEORGIA WATER POWERS.—It is stated from Atlanta, that strong opposition to the so-called water power bill has developed in the Georgia legislature. This bill proposes to confer upon water power companies, the right of condemnation of property needed in power developments, similar to the privilege enjoyed by railway corporations. The advocates of the bill, on the other hand, claim that it will result in vast development of the water powers in Georgia, hitherto retarded by obstinate land owners. Millions of dollars, it is predicted, will pour into the state for this purpose as soon as the bill becomes a law. It is said the bill had its inception with capitalists interested in water power developments at Talullah Falls, representing East-[illegible]

SAN FRANCISCO [illegible].—[illegible] of Aug. 10 says: [illegible] has caused great inconvenience for three months, was called off this week. The girls gained little by their long idleness. Their chief demands were increased pay and recognition of the union, neither of which was granted. Some minor concessions were made in regard to hours, but the girls virtually lost the strike as well as three months' wages. The telephone operators were encouraged to continue the fight for weeks after it was plain they had lost by labor union leaders, who forced other unions to contribute to the support of the girls. These same labor leaders are responsible for the continuance of the street car strikes, which would collapse in a single day were it not for the support of the labor unions. President Calhoun, of the United Railways has demonstrated that he can run his cars with non-union men. He has almost completely restored service as it was before the strike on May 1. But the labor unions assess their members to support idle street-car men and the president of the carmen's union runs a line of omnibuses in which union men are forced to ride. Nearly all the unions have fixed heavy penalties for riding on the street cars, and the result is that workingmen must spend an hour or an hour and a half in going to and from work when they could reach their homes in half an hour by the cars. No attacks are made on cars in the city, but in the suburbs every Sunday or holiday witnesses assaults on motormen and conductors and damage to cars."

THE RHINE FALLS.—With regard to the protection of the Rhine Falls from power plants, a further dispatch from Schaffhausen says: "The romantic Rhine Falls near this city have been rescued by the local council from industrial exploiters, by whom they were threatened. The councilors have refused to permit the erection of new water power works for the supply of electricity to the surrounding district. The reply to the application of the exploitation company was decisive. 'The council is of opinion that not only should the falls not be further enchained, but an effort should be made to prevent an extension of the concession already granted at its expiration in 1928. The destruction of the present works,' continues the official documents, 'would restore the original imposing magnificence of the falls and the water power now obtained from them could easily be procured at some other point. The council, though aware that this is not immediately realizable, is resolved to do everything in its power to prevent any further damage to the beauty and romantic effect of the falls.'"

ELECTRIFICATION OF SPANISH TRUNK LINE.—Electricity is to be introduced as motive power on a first trial stretch of the main line from Linares to Almeria in Spain, about 145 miles in length. The line has a practically uniform grade of 2¾ per cent, which made it more and more difficult to handle the increase in traffic with steam locomotives. This is particularly true with reference to the comparatively heavy ore trains passing over the line. The electrification will be carried out with the use of the three-phase alternating-current system. A steam central station will be installed at Santa Fé and the electric energy will be transmitted from there at a pressure of 5500 volts direct through a double overhead contact line, thus entirely eliminating any separate transmission lines and sub-stations. The three-phase alternating-current locomotives will be designed with a normal capacity of 320 horse-power each and for the regular train service two of these units will generally be coupled together by multiple unit control, while the lighter trains may be hauled by one single unit. The schedule calls for trains weighing from 150 to 300 tons running at a schedule speed of 16 miles per hour both up and down grade. The normal time table is arranged so that one train will start from each terminal every hour. Full advantage is to be taken of the feature, unique with the three-phase, alternating-current system, whereby energy is returned to the line by the trains going down the grade. Operation on the trial stretch is to be begun early in 1908. If the trials turn out entirely satisfactory the complete line is to be electrified at once and water powers in the neighborhood have already been secured for that [illegible] & Company, [illegible] New York, for the above data on this interesting equipment

[illegible].—[illegible] St. Louis, Mo., Mr. T. B. Carter, proposes to bring electric meters within the present system of meter inspection which applies only to gas meters.

WIRELESS IN JAVA.—The Dutch Indian Government has granted to a syndicate a concession for establishing a wireless-telegraphy system between Java, Celebes, Borneo and the neighboring islands. The company, with a capital of 2,650,000 florins (florin = 40.2 cents American), is now in the course of organization, but there will be no public issue of stock.

GORKY ON CONEY.—Maxim Gorky in a recent description of Coney Island speaks of its electrical illumination as follows: "Thousands of ruddy sparks glimmer in the darkness, limning in fine, sensitive outline on the black background of the sky, shapely towers of miraculous castles, palaces and temples. Golden gossamer threads tremble in the air * * * Fabulous and beyond conceiving, ineffably beautiful, is this fiery scintillation."

THE TROLHATTAN FALLS.—That further utilization of the famous Trolhattan Falls is intended at an early date is shown by the fact that tenders are invited until Oct. 1, by the Swedish Government for three 350-kw direct-current generators; 1 accumulator battery of 4800 ampere-hours' capacity; 4 three-phase generators, each of a maximum of 11,000 kilovolt-amperes; 12 transformers, each of a maximum of 3670 kilovolt-amperes; cables, switchboard, etc. The execution of the work is in the hands of the Managing Director, Royal Trollhattan Canal and Waterworks, Trollhattan, Sweden.

USE OF LAMPS.—The August issue of the *Edison Light*, of Boston, says: "In a recent issue of a periodical issued by the Sterling Company, it was stated that Uncle Sam is the largest user of incandescent electric lamps in the country, requiring the enormous number of 850,000 a year. To supply its customers in Boston and the surrounding towns, the purchases of the Edison Company for this year will be between 1,200,000 and 1,300,000. The number used in such cities as New York and Chicago is probably larger. With these figures to serve as indications, some conception of the vast size of the electrical industry may be formed, and of the number of people it supplies with work directly or indirectly." The bulletin is publishing in color a series of front cover illustrations of electrical worthies at their work. The August issue shows Dr. Gilbert. That for July had Faraday. The original paintings are being done by the Hungarian artist, Havelka.

MILWAUKEE MUNICIPAL PLANT.—It is announced from Milwaukee that legal papers have been prepared in a suit to enjoin the city from erecting a proposed $1,000,000 electric light plant, to compete with the present private corporation, the Milwaukee Electric Railway & Light Company, the grounds for the injunction are that the city needs to invest $1,500,000 in bridges, viaducts, schools, and other necessary improvements. To erect the city light plant as proposed will mean an indefinite deferring of the other improvements, as the city is now too near its bond limit to build both the light plant and the improvements. The injunction is supported by all three of the city business men's associations. When the Socialists began their agitation for a municipal light plant there was considerable public sentiment in favor, but that has disappeared. The city controller has announced that owing to the city's financial condition he will not countersign contracts for the plant. The Socialist element, however, holds the balance of power in the city council, and the granting of the injunction will mean a bitter fight

TELEPHONY IN CONNECTICUT.—An illuminating comment on the telephone situation, and on public service corporations in Connecticut, is made by a special correspondent of the New York *Evening Post* as follows: "During most of the legislative session an acute conflict has been waged over the telephone question. For nearly a quarter of a century the Southern New England Telephone Company has had a monopoly of the state, except in the town of Greenwich, which belongs to the New York system. The corporation paid good dividends early; then was forced to suspend them for years during neglected renewals and improvements; and has since paid 6 per cent dividends, with occasional minor 'melons' in stock issued at par or slightly above. On the whole it has been a benign monopoly, with pretty good service, rapid extensions, reductions of rates, and stock, originally watered, solidified by betterment of plant and 'ploughing in' surplus earnings. It has been protected behind the so-called 'Parallel Telephone act' of the state, that requires new telephone enterprise to go to the courts on the question of public necessity and convenience, and also to obtain from the Legislature a special charter. Its contest with rivals, supported by the state granges, seeking to enter the Connecticut field, was sharp and continuous during most of the session. A good deal of money was spent by both sides in the lobby, and the judiciary committee, which had charge of the telephone bills, backed and filled many times. The outcome was an ostensible compromise that allows new telephone companies to organize under a general act, but compels them still to appeal to the courts on the point of local convenience and necessity. This presumptively leaves the existing company in possession of the field for another two years at least. The result must also be regarded as favorable to the company, and of general significance, as, by implication, the state recognizes the theory of 'national monopoly' in a public service corporation."

HYDRAULIC MINING.—There is an interesting discussion of hydraulic mining in *Mines and Minerals* for August, which mentions one electrical improvement. The power of the water issuing from a monitor is enormous and many men have been killed by monitors getting away from them. Improvements, however, have been made in handling them so as to render them comparatively safe. The effect of a monitor running away can be appreciated from the experience of firemen, where, with comparatively small hose and under small head, considerable damage may be done. If a 2-in. nozzle does this damage, the effect of an 8-in. or 10-in. nozzle and with water under a much higher head, can readily be appreciated. The method of control in turning the monitor easily in any desired direction, is said to have been discovered in a peculiar way. A man wanted to clean his shovel, so he placed it alongside the water column as it issued from the monitor and was surprised to see the monitor suddenly move. The foreman who had been watching the operation then rigged up a contrivance which has been subsequently called a deflector, which is a ring around the nozzle and which can be readily moved to allow the current of water to be projected against it. The pressure from the little finger on the deflector is sufficient to turn the monitor around as the latter works in a ball-and-socket joint. The introduction of the deflector has undoubtedly saved many lives and greatly facilitated operations. What promises to be one of the greatest improvements which has been made in hydraulic mining in the past few years is a device for operating and turning the monitor from a distance. The nearer the monitor can be placed to the bank the more effective will be the impact of the stream. The great danger of operation has been that where the bank is high, there is apt to be a fall of rock and dirt upon the men handling the monitor. "An attempt to solve this has been made by the manager of the LaGrange Mine, in California, by the use of magnets to move the deflector, controlled by means of electric wires leading to the magnets of the monitor, thus enabling the latter to be placed very close to the bank and operated from a distance, greatly increasing its efficiency without endangering the lives of the operators. This has been tried only on a small scale as yet but it is thought it can be made practical for large monitors."

Kern River No. 1 Power Plant of the Edison Electric Company, Los Angeles—II.

STEEL-CONCRETE FLUME.

THE flume between tunnels No. 6 and No. 7 across Laird Canyon is constructed of structural steel and concrete, as shown in Fig. 10. The whole structure is carried on 15-in. steel I-beams set 8 ft. 10 ins. apart and supported by concrete piers. These longitudinal girders carry 9-in. steel I-cross beams set 4 ft. from center to center, and on them is erected a framework of structural steel for the sides and bottom of the flume. The layers of expanded metal (1½ in. and 3 ins. mesh), are used in connection with this framework and, filled with concrete, form the plates enclosing the frame. This concrete construction is also reinforced on the floor by twisted ½-in. rods. The outside and inside of the flume were then plastered, making the thickness of the reinforced concrete sides and bottom 4 ins.

This type of flume or conduit had never been tried before, but in this case it has proved a decided success, and while it costs more than a wooden flume, it has the advantage of being as permanent as the tunnels themselves.

CONCRETE CONDUITS.

In the lengths of tunnels and flumes forming the gravity conduit enumerated for Kern River No. 1 power plant no account is taken of the concrete conduits which connect some of the tunnels and which also connect the tunnels with the flumes. There were places along the line where the tunnel emerged at the foot of a steep incline in such a manner that the flume if constructed on the grade would be threatened by landslides or boulders rolling down the side of the mountain. These places were spanned by means of concrete conduits, the interior of which has the same cross-section and slope as the tunnels themselves. The walls are made heavy and reinforced with steel and an arch overhead, the arch being covered with a cushion of earthen material to receive the impact of anything rolling or sliding down the hill, and passing over the conduit. There are eight of these conduits, the following table giving the length of each:

CONCRETE CONDUITS—KERN RIVER NO. 1.

No. of Conduit	Length in Feet
1	100.00
2	69.4
3	6.2
4	42.2
5	40.0
6	92.5
7	32.6
8	121.6

FOREBAY.

A terminal equalizing reservoir of some size at the end of the gravity conduit and feeding the pressure main would have been desirable in connection with the Kern River No. 1 project. However, the side of Mr. Breckenridge, where the lower end of Tunnel No. 19 emerges above the power house, is approximately on a 45 deg. slope, making it impossible to excavate any large area for a terminal reservoir or forebay. It was necessary, however, to have a small basin for regulating the flow into the force main, and for this purpose a chamber 30 ft. x 42 ft. was excavated to a depth of about 8 ft. below the grade of the supply tunnel. Inside of this and over the mouth of the force main were erected controlling gates and screens through which the water passes into the force main.

The walls of the forebay were made of concrete in the form of retaining walls, where they were enclosed in the excavation,

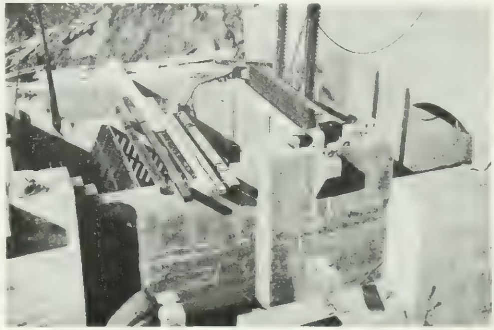


FIG. 11.—FOREBAY BEFORE COMPLETION, SHOWING PORTAL OF TUNNEL NO. 19.

and on the lower side where they were unsupported they were made sufficiently heavy to withstand the pressure of the water on the inside of the forebay. As the formation where the structure is located is somewhat shattered, the concrete work was heavily reinforced and the floor was paved with 3 ft. of concrete. In the rear these walls were extended up to a considerable height to prevent material caving from the mountain above from dropping into the forebay.

On one side is a spillway 9 ft. above the floor of the forebay, and consisting of five 82-in. openings over which the water flows into the waste flume when it is desired to divert part or all of the tunnel flow from the pressure main. The height of this spillway can be controlled by means of flash boards which may be inserted and removed as required, according to the quantity of water carried through the tunnels. The extreme height of the spillway is 3 ft. A 24-in. gate valve is set at each end of the spillway for sluicing into the waste flume.

The force main starts from the bottom of the forebay, thus making it possible to have the water enter it from opposite directions. This construction tends to prevent the formation of eddies or a whirlpool at the entrance

The controlling gates have an opening 6 ft. 2 in. high and 10 ft. wide, and are built up of 4 in. x 12 in. timbers on two vertical 6-in. steel I-beams. They are raised by means of hand-

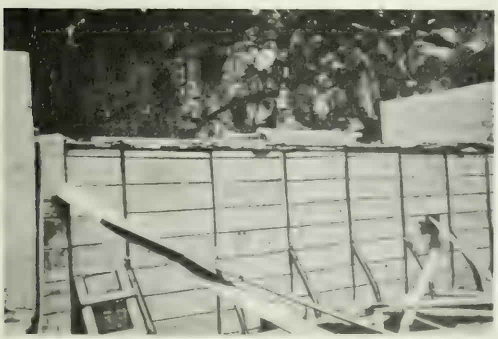


FIG. 10.—STEEL CONCRETE FLUME CONNECTING TWO TUNNELS.

FIG. 12.—FOREBAY AND UPPER END OF WOODEN WASTE FLUME.

[illegible] gears working into two racks (7 in. wide and 3 in. pitch) mounted on the front of each gate. Behind the gates and inclined upward toward each other are two heavy grizzlies. These are formed of 3½ in. x ½ in. iron straps, spaced 3 in. centers by thimbles of 2½-in. wrought-iron pipe, the rows of thimbles being set 1 ft. apart. Each screen is 11 ft. 6 in. long and is set on an angle with its top supported by a 4-in. steel I-beam. These two beams are set 3½ ft. apart, the space between forming a walk.

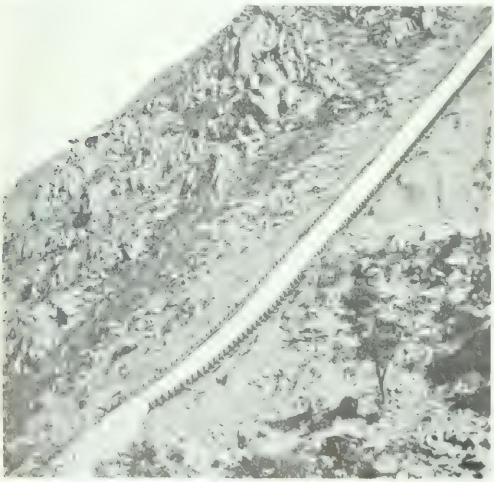
WASTE FLUME.

The forebay is constructed so that when the water is diverted from the force main, it passes over the spillway automatically into the waste conduit extending down the mountain side to the river. This conduit is of concrete at the upper end where it is on comparatively flat grade, the section being 8 ft. wide and 8 ft. 6 in. high. The water is discharged into a redwood flume 20 ft. wide, that carries it down the steep slope of the hill. As the slope is about 45 deg. no material except soft wood would stand the wear due to the high velocity. The spillway flume is 1200 ft. long and it discharges into the Kern River about 600 ft. above the power station.

The flume rests on 4 in. x 6 in. stringers bolted to 3 in. x 3 in. x ⅜ in. anchor plates imbedded in concrete footings. These footings are spaced 8 ft. apart and are securely set, although they are not carried down to bed rock in all cases. The cross beams of the flume are 4 in. x 6 in. timbers, 26 ft [illegible] up 3 ft. 3 ins., being secured at the bottom by angle plates [illegible] 4 in. x 4 in. pieces fastened at both ends by ½-in. bolts. For [illegible] joints in the floor being caulked and covered with 1 in. x 6 in battens. Quarter rounds were nailed in the corners as in the other flumes. The side lining, which is carried up 3 ft. high, is battened and caulked in the same manner as already described [illegible] flumes.

PRESSURE MAIN.

The greatest innovation in the entire Kern River No. 1 plant is the pressure main, the construction of which has been [illegible]



[illegible]

ary practice of laying a steel pipe on the surface of the mountain slope or merely burying it sufficiently to cover it for protection against freezing or expansion and contraction such as might be caused by a wide range of temperature changes. The pressure main constructed on Kern River consists of a tunnel approximately 1700 ft. long driven through the mountain on an incline, and lined with steel varying in thickness from 3/16 in. to 1½ in. This tunnel begins at the bottom of the forebay, passes down at an angle of approximately 45 deg., and, turning into a horizontal section, emerges at the lower end on a level with the floor of the power [illegible]

[illegible]

upper one forms an angle of 7 deg., 260 ft. from the forebay floor. The second curve, 32.5 ft. lower down, has an angle of 5 deg. and turns the pipe into a grade of 84.93 per cent on which it is carried 994.24 ft. to vertical curve No. 3. This latter curve has an angle of 40 deg., and from its lower end the pipe continues along on a horizontal grade to the power house, the total length of the main being 1697 ft.

The pressure main is finished to give it an inside diameter of 7 ft. 6 in. At the top a taper 20 ft. long and 10 ft. in diameter at the forebay entrance terminates in the regular 7½-ft. diameter of the completed tunnel tube. This diameter is maintained throughout the inclined tunnel, and on the horizontal beyond vertical curve No. 3 for a distance of 167.39 ft. At this point, 1454.44 ft. from the forebay, the force main emerges from the solid rock and is carried to the portal, a distance of 243 ft. through a detrital deposit lying between the mountain and the power-house site. Where the tunnel emerges from the solid rock a 20-ft. taper was installed, reducing the diameter of the main from 7½ ft. to 5¼ ft., at which diameter the pipe is carried to the branch piping at the power house.

The inclined part of the pressure main and the portion of the horizontal section that passes through solid rock were finished by installing a steel lining built up of plates 3/16 in. thick for the incline and ⅜ in. thick for the horizontal, riveted together to form a cylindrical pipe 7½ ft. internal diameter. The tunnel itself was driven in approximately circular form, and 9 ft. in diameter. The steel pipe was centered in the tunnel, being installed in 10-ft. sections, and the space between the outside of the steel lining and the bed rock was thoroughly filled with a mixture of concrete, consisting of three parts sand, three parts crushed rock and one part Portland Cement. The work of installing this lining was begun at the lower end in the horizontal section where the pipe is tapered down to the diameter of 5.25 ft. At this point the 20-ft. taper already mentioned was placed, it consisting of 1⅜-in. steel plate riveted together with butt straps. The

taper was placed back in the solid rock and around it was constructed a heavy bulkhead of concrete which was anchored into the bed rock by means of steel rods driven into the sides.

From this point the installation of the light steel lining with concrete back fill as already stated progressed from the bottom to the top of the tunnel, terminating at the reinforced concrete taper that connects with the floor and the forebay. The rock for-

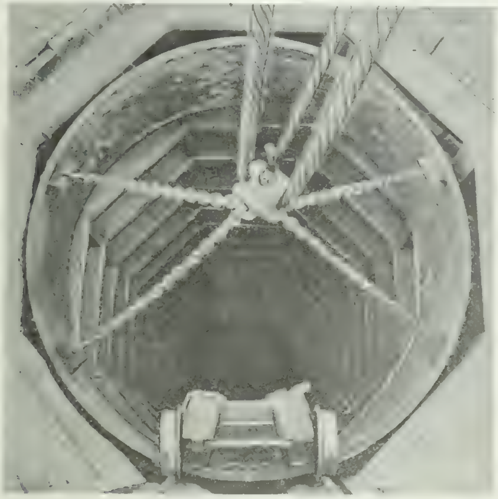


FIG. 15.—DOLLY CAR FOR LOWERING SECTION OF 90-IN. PIPE DOWN THE SHAFT.

mation through which the force main tunnel was driven is not of the best kind, being very much fractured and broken. It was necessary to timber the greater part of the shaft or incline when it was excavated, and these timbers had to be removed before the steel lining was installed. The timbers were removed ahead of the steel work, the bed rock cleaned off, and the concrete tamped into place without difficulty. At a point about 120 ft. below the top the men in charge removed some timbers without bracing the sets above. This precipitated a cave-in of the shaft ,and several men lost their lives, one man being imprisoned for two weeks, after which time he was rescued in good condition. In retimbering the caved portion, octagon steel sets of 7-in., 15-lb. I-beams were used. These sets were left in place when the concrete was put behind the steel lining. The lower end of the pressure main, from the taper reducing the diameter to 5¼ ft. in diameter, was made of 1⅜-in. steel plate, or sufficiently heavy to withstand the static pressure without any external support. No concrete was placed around this pipe, and the tunnel was merely left in its original condition with the timber sets to support the ground overhead.

At a point 215 ft. above the power house, a manhole was placed in the inclined tunnel for convenience in inspecting and for use in case any repair work is necessary. The regular 3/16-in. steel lining was replaced at this point by a section of 1½-in. pipe 30 ft. long.

The steel pipe was shipped to Camp No. 1 at the power house from San Francisco in 5-ft. lengths, five sections being nested together for shipment. The outside section was riveted complete on its two longitudinal seams, but the four inner sections were riveted on one seam only, so as to allow for the nesting. at the camp the pipe was riveted into 10-ft. lengths and hoisted by means of an aerial tram to the forebay site at the upper end of the pressure tunnel. There the sections were secured to a dolly car, and lowered by means of a hoist to the point where they were riveted together. The car consisted of a truck at each end of the pipe section, the latter being hung from two timbers that passed through the pipe and rested on the axles of the trucks, as shown in Fig. 15.

All the piping in the pressure tunnel, which is constructed of steel plates of ½-in. thickness and under, is made up with standard lap joints double-riveted on the longitudinal seams and single-riveted on round seams. All pipe on the work over ½ in. in thickness is made up of butt-strapped joints throughout, with triple riveting on each side of the longitudinal seams and double-riveting on each side of the round seams.

After the steel lining was completed, an inspection of it revealed the fact that there were several places along the bottom of the pipe where voids had been formed in the concrete backing. These voids, which were revealed by tapping, were caused mainly by the difficulty experienced in tamping the concrete thoroughly around the sections of steel lining. The steel sections were 10 ft. in length, and in a few places where large irregular rock excavation occurred at the bottom of a section with only a 9-in. space at the top for handling the tamping bars some voids were naturally formed because of the insufficient tamping.

Whenever a void occurred, a hole was drilled in the pipe and liquid cement was forced in until the hole was filled. The apparatus designed on the spot to accomplish this work was an ingenious one. A section of 3-in. steel tube 20 ins. long, was fitted at the bottom with a tap that would fit the hole drilled in the steel lining. Liquid cement was poured into the void by means of this pipe, which had a capacity of about an ordinary pail. When no more cement would run in, there was fitted in the pipe a screw with a plunger at the lower end and a crank on the outer end. By means of this device, the cement was forced into the void under pressure until it would hold no more. The pump was then removed and the hole in the lining stopped up by an ordinary flush pipe plug. There were 116 of these voids tapped and filled through the lining although only three of them were of large size. A number of the voids required only a pint of the liquid cement, the quantity used varying up to the largest, for which 10 buckets of the slush was necessary. The slush used was a liquid mixture of Portland cement and sand. The work was carried on from a dolly car fitted with beveled wheels and lowered down from the top by a steel cable. About 15 days were necessary to com-

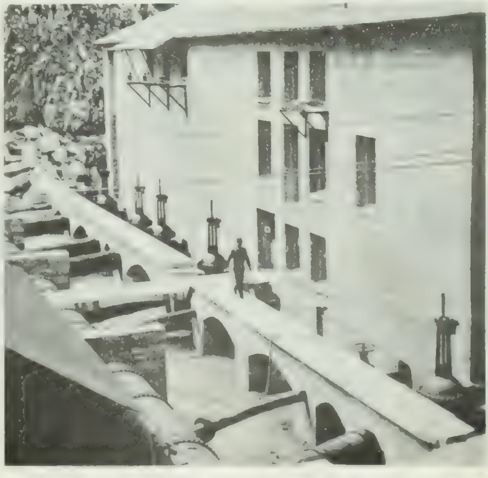


FIG. 16.—[illegible] BRANCH PIPING AND GATE VALVES AT POWER HOUSE.

plete this special work. After all the voids were filled the entire pipe was painted with asphaltum paint, the same dolly car being used for the purpose.

Although the design of the pressure main has been criticised by some, it is believed that the construction will stand criticism

and will prove to be permanent, and for that reason economical. The steel lining has a low factor of safety, being only heavy enough to keep its form and to resist the internal pressure, while all external pressure is taken up by the concrete back filling. which, backed up by the rock itself, also resists the internal

FIG. 17.—EXTERIOR OF POWER HOUSE.

pressures. Being entirely under ground and some distance from the surface no trouble will be experienced by reason of expansion and contraction due to temperature changes. The anchorage is the mountain itself so that no disastrous effects

consisting of the following specified lengths and diameters:

Length.	Diameter.
[illegible]	[illegible]
23.0 ft.	4¼ ft. pipe
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible] pipe at the end

These diameters were graduated to maintain as nearly uniform velocity as possible after withdrawing the water for the various branches to supply the water wheel units in the power house. In reducing the force main at the branch pipes to meet the diameters given, the following taper pipes were employed:

[illegible]	[illegible]	[illegible]
1 taper	5.25 ft. diameter to 4.75 ft. diameter,	10 ft. long
1 taper	4.75 ft. diameter to 4.25 ft. diameter,	10 ft. long
1 taper	4.25 ft. diameter to 3.75 ft. diameter,	10 ft. long
[illegible]	[illegible]	[illegible]
1 taper	3.00 ft. diameter to 2.33 ft. diameter,	10 ft. long

The branches from the force main were taken off by means of a Y on the header pipe and laid out in curved form entering the power house at right angles to the rear wall. There is one branch 28 in. inside diameter, 50 ft. long, made of ¾-in. plate, for each of the eight water wheels and a 10-in. inside diameter branch pipe for each of the two exciters.

At the end of the last section of the force main is a 28-in. gate valve which discharges into the river. It is proposed to attach to this pipe an experimental nozzle for the purpose of testing nozzle tips, needle valves, etc., and it is expected that from such tests, data will be obtained regarding the flow of water under varying conditions.

In each of the branch pipes leading from the force main to the water wheels are installed two 28-in. gate valves, one outside of the power house, and the other inside. The former is intended solely for the purpose of closing off the branch pipe in case of necessary repair to the gate or piping inside of the house. These outside gates are arranged only for hand drive, while those inside the power house are equipped for operation either by hand or by electric motor, as will be

FIG. 18.—INTERIOR OF THE POWER HOUSE, BEFORE COMPLETION, LOOKING WEST.

could result to the pressure main from any water ram that might be caused by improper handling of the water wheels or gate valves.

BRANCH [illegible].

At the lower end of the pressure main was constructed the header pipe, made of steel plates, varying in thickness from [illegible] ins. at the [illegible] in. at the outer end and

mentioned later. The Risdon Iron & Locomotive Works, of San Francisco, furnished the steel lining for the pressure main, the branch piping and header and the gate valves.

POWER HOUSE.

The pressure tunnel emerges from the side of Mt. Breckenridge at an elevation above the sea of 1061.95 ft. Directly in front of this point and slightly up stream there was a

boulder-covered wash protected by a bend of the river and bordered by a large mass of bed-rock standing at the edge of the main channel of the river. This space was chosen as the power house site. The intake of the Power, Transit & Light Company, of Bakersfield, is directly across the stream, and

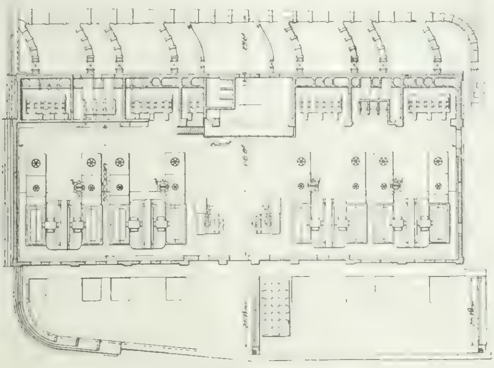


FIG. 19. PLAN OF POWER HOUSE.

it is necessary to discharge the water from the wheels in such a direction and at such an elevation that it will flow by gravity into their intake.

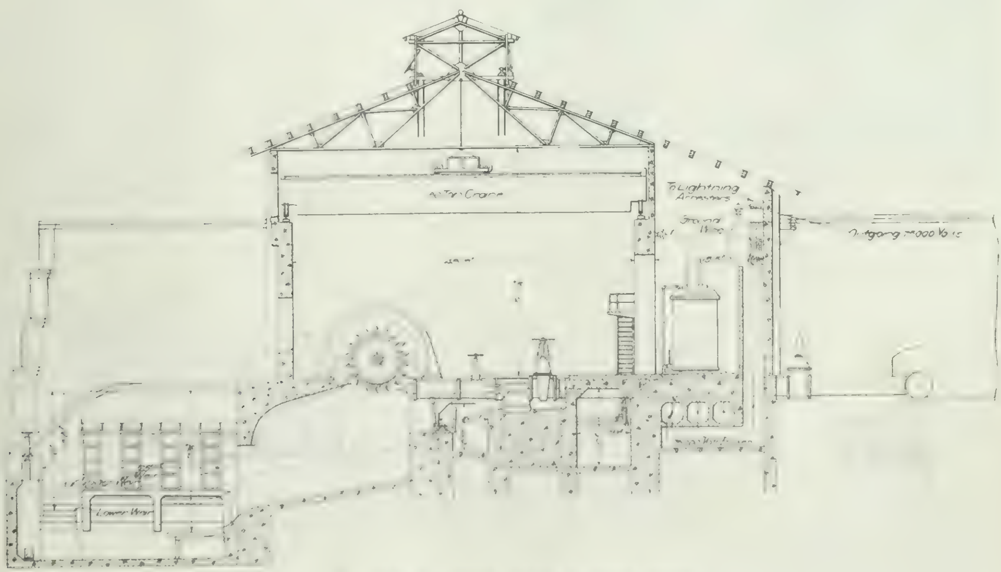
The Kern River is subject at times to very considerable floods, and the elevation of the header pipe and consequently of the water wheels was made sufficiently high to permit of running the units even when the stream is at its maximum flood.

The foundations were started on bed-rock and cemented, boulders low enough to avoid any possibility of the power house being undercut by floods, and the walls were constructed in such a manner that no important machinery rested on floors placed on backfill. All spaces between these walls, except those which could not be utilized on account of their falling so low as to be subject to flood, were filled in with compact backfill from other portions of the work

The available area was so crowded that it was necessary to make a deep excavation in the hillside to accommodate the inner or eastern end of the building. The debris from this cut and from the tailraces was wasted on the south side of the building as a dump upon which the header and branch piping from the pressure main were placed. On the north side of the station the spoil bank filled in a triangular area of the flat wash, raising its entire area above maximum high water and producing a bulkhead which will protect the power house against any possible flood.

The foundations proper are of monolithic concrete. The rock and part of the sand for the aggregate were secured by crushing granite boulders excavated from the site, as well as a large amount of rock which was lying on the pressure-tunnel dump. Additional sand was secured for a time from various small bars in the river adjacent to the power house. These were, however, covered by high water early in the year, and after that time all necessary make-up sand was hauled from the mouth of the cañon, about two and one-half miles distant.

The upper part of the machine foundations carries a small amount of reinforcement. The large block of masonry back of each water-wheel deflector is heavily reinforced and tied into the main foundation blocks. The crane-rail arches for the interior wall are reinforced concrete beams, with the exception of the long span above the switchboard, which contains an I-beam girder. By reason of the length of the building and the importance of the work, no account was taken in its construction of the additional strength resulting from the continuity of the beams, the bridging effect of the crane rail, nor its cushioning timbers, nor was any allowance made for the 12-in. curtain walls, which fill in below this beam in places. The north wall, however, is a 12-in. curtain wall reinforced with heavy pilasters, and contains only sufficient reinforcement to render it reasonably secure against shock and vibration. The south wall of the building is of a cellular construction for about two-thirds of its height, in order to provide wiring ducts for the 60,000-volt connections. This wall also contains only



nominal reinforcement. Between this wall and the interior crane wall, a space 15 ft. wide, a series of transverse partitions break up the area into transformer, switch and switchboard rooms. The transformer rooms are open up to the crane beam to permit of wheeling the transformers out under the main crane. The crane-rail columns are not highly stressed and have no bracing whatever. A 20-ton electric traveling

crane with a 30-ton [illegible] made by Maris Bros., serves the entire machine room.

The switchboard space contains a deck 8 ft. 6 ins. above the main floor level, upon which the control board is mounted.

The roof of the building is of galvanized iron laid on wooden purlins, which are placed on steel roof tresses of 52 ft. 1 in. clear span. The internal length of the machine room is 164 ft., and its clear width is 66 ft. 6 ins. The generating units are located along the north side of the station, 78 ft. from the center of the pressure header.

THE HYDRAULIC FEATURES.

Dead water leaving the water wheels flows down the floor of the wheel race into the main tail race. When the nozzles are deflected the water is diverted past the buckets onto a pair of heavy metal deflector plates.

Fig. 21 shows the water being discharged from the deflected nozzles of hydro-electric unit No. 1. These deflector plates are 7 ft. wide, and the lower one projects out into the tail race 8 feet.

The speed regulation of the water wheels is effected by a governor which deflects the jets of the two nozzles. The needles are adjusted by hand and are usually set to that maximum size of jet which will be sufficient to develop the maximum peak load expected for that period of setting on the needles. In other words, there is always a maximum amount of water leaving the nozzles. The governor adjusts the deflecting nozzles in such a way that only as much water is diverted upon the buckets as is needed for the load at the time

FIG. 21.—TAIL RACE, SHOWING WATER DISCHARGING OVER DEFLECTOR PLATES.

being; the balance discharges below the buckets into the tailrace. It is evident that at times when all load is thrown off the wheels, the governor will deflect the jets entirely. Each jet has a maximum diameter of 7⅜ ins. and leaves the nozzle tip at a velocity exceeding 225 ft. per second. It was, therefore, necessary to provide means for receiving the tremendous force and for deflecting the jet into the tailrace.

The arrangement designed consists of the pair of heavy deflector plates onto which the jet is diverted, as noted above. The upper of these plates consists of a channel heavily ribbed and bolted to the concrete foundation. The channel at its upper end is slightly more inclined than the deflected jet. Thus the jet strikes the bottom of the channel under a small angle and, therefore, tends to spread and fill the section of channel. The channel gradually widens and, consequently, the jet is offered a larger resistance area. The lower part of the channel is curved, and at its end the jet discharges almost perpendicularly downward. The bottom plate is S-shaped, its upper end being flush with the bottom of the wheel pit, the lower end practically level. The jet strikes the bottom plate almost in the turn of the "S" and under a small angle. Thus the jet is again forced to spread and follow the base of the bottom plate. In due consideration of the unavoidable wear and tear of these deflectors, they are lined with removable steel plates wherever the surfaces are exposed to the flow of the deflected jet, being held in position by lag screws.

The wheel races are lined with steel on both sides and fitted with steel plates just back of the nozzle tips to keep the splash water out of the shaft alley.

The tail race is 29 ft. wide, and extends the length of the power house. It is fitted with two 25-ft. steel-plate weirs, the lower weir at the end of the tail race being 4 ft. below the level of the upper weir which has its crest 13 ft. 6 ins. below the line of the nozzles.

The water-wheel branch pipes enter the power house at the south side and after passing across under the transformer room and before joining the nozzle bases, connect to 28-in. cast-steel gate valves. These valves are of a special design, and each is operated from the control switchboard by a 1.2-hp, 120-volt Allis-Chalmers motor. It requires 7½ minutes to open or close a valve by means of the motor. Each gate valve is equipped with a 4-in. by-pass.

In the machine room of the power house is installed a Dibble reservoir gauge equipped with an indicating dial and a registering chart for measurements of the water in the forebay.

CONCRETE USED FOR CONSTRUCTION WORK.

As will be noted from the description above, concrete entered largely into the construction of the Kern River No. 1 plant. This concrete was made from hydraulic Portland cement, all of which passed the specifications of the American Society of Civil Engineers. The mixture used, except for the pressure tunnel, consisted of one part of cement, mixed with broken stone five parts, and sand three parts, all by volume. All of the broken stone or crushed rock used was crushed to sizes which would pass through a 2-in. ring, the material being taken from tunnel waste deposited at the portals of the different tunnels during excavation. Very little sand could be obtained from the river, so that fully nine-tenths of all the sand used was also prepared from tunnel waste by passing the crushed rock through sand rolls.

CONSTRUCTION PLANT.

A construction plant generating 300 kw at normal rating was installed for furnishing the energy used in driving tunnels, mixing concrete, transporting materials, etc. This construction plant was located at Frenchtown, or Camp 5, power being developed by means of a flume about 800 ft. in length which supplies water under 40-ft. head to two McCormick reaction turbines each operating one 150-kw, 2300-volt generator. This plant furnished all the energy required while the work was in progress, being frequently and for long periods operated at 50 per cent overload, and was abandoned only after the completion of the main plant. From the construction plant, energy was transmitted at 10,000 volts to all parts of the work over a temporary transmission line.

METHODS OF CONSTRUCTION.

It can be said that the methods of construction employed were among the most modern known to engineering practice. For constructing the tunnels, air compressors were driven by motors using electric energy transmitted from the construction plant, as already stated, the air being piped into the various tunnels where it was used for operating pneumatic drills. Ventilating blowers for supplying fresh air at the face of the tunnels and for removing the fumes after a blast were operated by electric motors. In the construction of the diverting dam, a complete system of cableways designed by the company's engineers was installed, by means of which material was transported and placed in position in the dam. In the construction of the power house, the handling of materials as well as the crushing of rock and mixing of concrete was carried on by means of the most modern equipment operated by electric motors.

As has already been mentioned, the Edison Electric Company carried on all the tunnel excavations with its own men. The power house was also erected by the company. Glass & Fischer had the contract for all the concrete work on the job, except the power station; their work covering the construction of the dam, the lining of the tunnels and the backing of the steel lining in the pressure main.

Catenary Line Construction on the New York, New Haven & Hartford Railroad.

DURING the present month the steam locomotives used for handling the trains of the New York, New Haven & Hartford Railroad throughout New York City and its suburbs are being superseded by electric locomotives. On another page of the present issue is to be found a complete official discussion of the facts which caused the abandonment of steam in favor of electricity and which led to the adoption of high-voltage low-frequency alternating-current locomotives as the best available equipment for the propulsion of the trains. Below there is given a description of the catenary line work, which is one of the distinguishing features of the New Haven electrification. In subsequent issues descriptions will appear of the Cos Cob generating station, from which electrical energy is obtained for train propulsion, and additional accounts will be given of the single-phase locomotives, which were described at some length in our issue for April 14, 1906.

The electric trains of the New York, New Haven & Hartford Railroad leave the direct-current zone of the New York Central at Woodlawn, N. Y., and pass onto the alternating-current line of the New York, New Haven & Hartford Railroad, which at present extends as far as Stamford, Conn. Upon this section, as is well known, 11,000 volts are employed. The catenary construction, as well as the supporting bridges, were illustrated and briefly described in our issue for March 30, 1907, when an account was given of the method of erecting the bridges. It is the intention at this time to present an account of the details of the over-head work.

OUTLINE OF OVERHEAD SYSTEM.

The supporting bridges are of varying lengths, so as to accommodate four, five, six, or as many as twelve tracks, as the local conditions require, and are of two types, anchor bridges which are used only at intervals of about two miles, and intermediate bridges. The latter have side posts of square cross-section, and are of comparatively light construction. On the other hand, the anchor bridges have A-shaped posts and are made heavier to withstand the strain of the cables.

FIG. 1.—INTERMEDIATE BRIDGE EQUIPPED WITH SEMAPHORE SIGNALS.

The anchor bridges are provided with automatic circuit breakers, by means of which the different sections may be isolated, and also the several parallel tracks may be electrically separated from one another in case of accident to any one track. The anchor bridges also carry lightning arresters, shunt transformers for operating the circuit breakers, together with foot walks, hand railings, lamp circuits and the wires and conduit for the auxiliary control circuits.

The working conductors have sufficient area for the working current, but two auxiliary feeders extend along the entire length

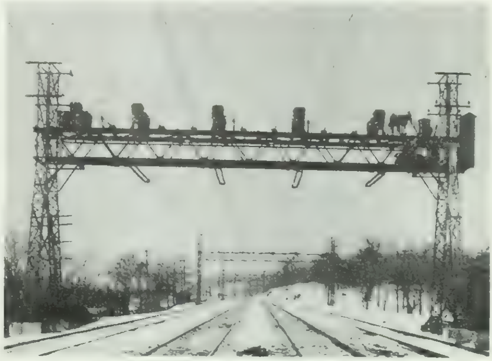


FIG. 2.—ANCHOR BRIDGE NEAR PELHAM STATION.

of the line from Stamford to Woodlawn. These feeders are connected with the main conductors at each anchor bridge through circuit breakers and provide means for feeding around any one section in case it is cut out of service on account of some accident in that particular section.

Provision is also made on all of the bridges for carrying two separate feeder wires called "power feeders," which are connected to the third phase of the generating system and are used for operating three-phase apparatus at certain intervals along the road. Provision is also made on the bridges for carrying two three-phase circuits, one circuit being supported on the top of each post at the ends of the bridges.

In laying out the bridges for the section from Woodlawn to Stamford, it was found that the sharpest curvature was 3 degs. As this curvature will permit of stringing the trolley wire in straight lines between points of support 150 feet apart without deviating from the center of the track more than $8\frac{1}{2}$ ins. on each side, it was decided to place all bridges a fixed distance of 300 feet apart, and on curves to provide guy poles to which pull-over wires are attached and secured to the catenary spans (see Fig. 1). By this means a minimum amount of [illegible] wiring was obtained, and the deviation from the center of the track was maintained within safe limits for use in connection with the sliding pantograph trolleys on the locomotives, the bow of which is 4 feet long.

INTERMEDIATE BRIDGES.

The general appearance of the standard four-track intermediate bridge is shown in Fig. 1. This illustration shows also signals mounted on the bridge, the semaphore blades being located below the truss so as to afford an unobstructed view. As will be noted, the bridge consists of two supporting side

posts and a horizontal truss. Each supporting post is approximately 38 ft. long by 1 ft. 10 ins. square. Each is composed of four 4 in. x 4 in. x 7/16 in. angles secured together by 2¼ in. x ⅜ in. lacing bars.

Each post rests upon a concrete foundation, containing about 9 cubic yards of concrete. Anchor bolts extend entirely through the concrete foundation and hold the base of the post to the foundation by means of heavy nuts. The cross-truss is attached by means of bolts to the vertical posts, allowing a distance of 23 ft. 4 ins. from the lower side of the truss to the top of the rails. The truss is 4 ft. 6 ins. deep from back to back of the upper and lower chord angles, which latter are placed 1 ft. 10 ins. from back to back. The lacing bars of the upper chord are depressed below the upper surface of the chord angles so that the latter are left free from rivets or other obstructions, thereby affording a ready means for attaching the insulators at any point. The lacing bars of the upper chord consists of flat strap, while the diagonals in the sides and bottom of the truss

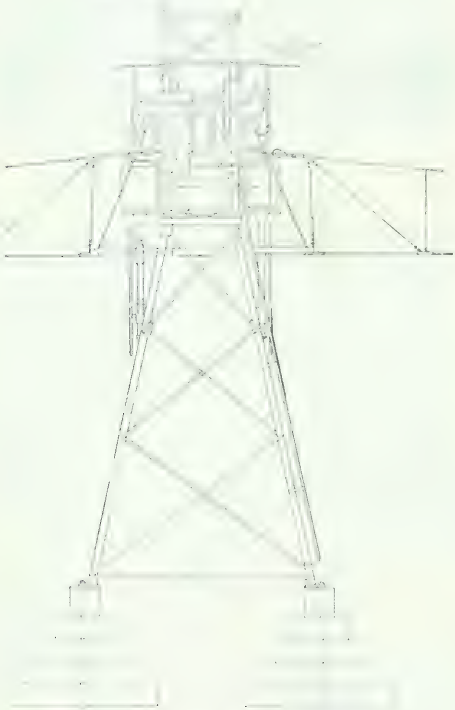


FIG. 2.—END VIEW OF ANCHOR BRIDGE.

consist of angles. The upper chord angles are 3½ ins. x 6 ins. x ⅜ in., and the lower are 4 ins. x 3½ ins. x 5/16 in.

The extensions of the side posts above the trusses are utilized for supporting the feeder wires which are carried upon angle-iron cross-arms bolted to the posts. The lower cross-arm carries two insulators, upon the inner one of which is carried the auxiliary feeder. The upper cross-arm is located 5 feet above the lower one and carries two wires of the three-phase circuit. The third wire of the three-phase circuit is carried upon a light vertical channel-iron support.

In the calculation of these bridges very heavy weather conditions were assumed, and provision was made for clamping the catenary cables on the intermediate bridges so that they are obliged to partially withstand the longitudinal pull of the latter. It was assumed that the entire system of the bridges and cables might become coated with sleet, and that this coating might be one-half inch in thickness around all surfaces. It was assumed also that the wind pressure on the bridges and the catenary spans might at the same time be as high as 25 lbs. per square foot. It was further assumed that the effective area of all round cables would be two-thirds of their projected areas.

Each catenary cable is clamped to its supporting insulator on every intermediate bridge, and it was assumed that if one pair of cables should be broken, the remaining cables would exert a balancing influence on the bridge. The truss, however, was made strong enough to prevent its buckling under the strain produced by the breakage of any pair of cables.

ANCHOR BRIDGES.

[illegible] every two miles, and against these bridges the catenary cables are anchored. Fig. 2 gives a view of a standard four-track anchor bridge with the auxiliary apparatus mounted upon it. The four-track anchor bridge consists of two A-shaped posts, each having a spread at the base of 15 ft., and a width at right angles to the track of about 2 ft. The main members of these posts consists of 6-in. x 4-in. x ⅝-in. angles. These posts are also extended above the truss in the manner shown in the illustration for the purpose of carrying the feeder wires. The truss is bolted to the side posts, allowing a clearance above the rails to the lower side of the truss of 24 ft. 3 ins. The truss is 4 ft. 6 ins. deep by 5 ft. wide between the backs of the chord angles. The upper chords consist of 8 in. x 8 in. x 9/16 in. angles, and the lower chords consist of 4 in. x 3½ in. x 9/16 in. angles.

Fig. 3 represents the side view of the anchor bridge, and Fig. 4 a plan view of the same bridge from which additional details of the construction may be noted. A ladder is provided on one of the posts leading to a small platform at the end of the truss. This platform is provided with a hand rail and carries upon it a box containing an 11,000-volt, low-equivalent lightning arrester. A portal is provided in the end of the truss, by means of which the attendant may step onto the platform supported upon the lower chord of the truss. From this platform access is provided to the short ladders leading to the signal lanterns, and a second short ladder extending up to another 2-A platform supported upon the upper chord of the truss. This platform, a view along which is given in Fig. 5, is surrounded by a hand rail, which is also attached to the iron supporting frames of the circuit breakers in such a manner that the attendant can in no way come in contact with live parts of the circuits. At each end of the truss a 5-kw, 11,000-volt shunt transformer is provided, one of them being connected directly into a bus-bar which runs around the outside of the circuit breakers and which is supported upon porcelain insulators and bus-bar brackets, secured to the upper chords of the truss. The other transformer is connected directly into one of the "power" feeders. As the "power" feeder is connected to the third phase of the generating system, means are available for operating the switches in case of accident to the trolley section. The four-track anchor bridge is secured to concrete foundation by means of long anchor bolts and nuts. Each post rests upon blocks of concrete, each block containing about 12 cubic yards of concrete.

CATENARY CABLES.

Each of the two catenary cables which support the copper trolley conductor consists of an extra high-strength steel cable, 9/16 in. in diameter, consisting of seven strands. This steel has an ultimate strength of about 200,000 lbs. per square inch, and each strand is heavily galvanized. The completed cable has a total strength of 33,800 lbs. These cables are strung between the bridges with a sag at mean temperature of 6 ft. in a standard span of 300 ft. Owing to obstructions at certain places along the right of way, the spacing of the bridges is occasionally varied from the standard distance of 300 ft. In order to allow for this the cable is run out in long lengths and is pulled up to a uniform tension until the sag in the span of 300 ft. is 6 ft. The sag in the other spans is allowed to adjust itself, since the tension is the same. After being pulled up to the proper tension the catenary cables are anchored to the

anchor bridges and are clamped to the insulators of the intermediate bridges.

MAIN LINE INSULATORS.

The insulators which support the catenary cables of the intermediate bridges consist of heavy porcelain insulators of the skirt type, which are 15 ins. in diameter and about 7 ins. high. These insulators are cemented upon short lengths of double, extra strong pipe, which in turn is held by means of U-bolts to a cast-iron yoke, bolted to the upper chords of the truss. The catenary cable rests in a groove in the top of the porcelain and is held by means of a malleable-iron clamp fitted with U-bolts and placed one on each side of the insulator. The head of the insulator is conical in shape and is surrounded by means of a split malleable-iron clamp and a lead packing. Fig. 6 represents the main line insulator complete with its supporting yoke.

One feature of the construction to be noted is the arrangement of the clamp and the collar, which is such that in case of the breakage of the messenger cable on one side of the insulator, the pull of the cable on the other side will cause the clamp to swing downwards, thereby lowering the point of application of the pull of the cable. Thus the porcelain is put in compression, and there is no tendency to shear off the top of the porcelain, as is usually the case with porcelain line insulators. Each porcelain is subjected in the shop to a test of 55,000 volts when assembled.

ANCHOR BRIDGE STRAIN INSULATORS

Fig. 7 represents the general appearance of the strain insulators which are used for dead-ending the catenary cables at the anchor bridges. These insulators, which are of special construction, are designed to withstand a shop test of 50,000 volts and a working load of 20,000 lbs. Each consists of a length of 2 in. extra heavy iron pipe, surrounded at its middle point by an iron collar. Outside of this collar a long insulating tube, composed of especially hard and reliable insulating material, is pressed. This tube is surrounded by a second collar into which a bolt is screwed and to which the turnbuckle of the catenary cable is attached. The entire surface of the insulating tube and the inner and outside collars are then effectively sealed against moisture by means of a high-grade insulating compound applied by means of hydraulic pressure. The insulator thus made up is supported by means of an iron yoke from cast-iron hooks bolted to the upper chords of the anchor-bridge truss.

FIG. 5.—VIEW ALONG PLATFORM ON ANCHOR BRIDGE

One of these insulators is provided in each catenary cable at each anchor bridge, thereby electrically dividing the road up into separate sections between the anchor bridges.

GUY POLES.

Midway between the supporting bridges and curves a guy pole is located on the outside of the curve. These guy poles are of two types, namely, rigid and anchored, the former being used wherever there is room on the right of way for the anchorage, while the latter is used in places where the width of the right of way is restricted. A pole of the latter type is seen in place in Fig. 1. Heavy strain insulators are attached to the guy poles at the proper height, and pull-over wires are attached to this strain insulator and to the catenary cable and trolley wires of the several tracks

The strain insulator is somewhat similar in appearance to the

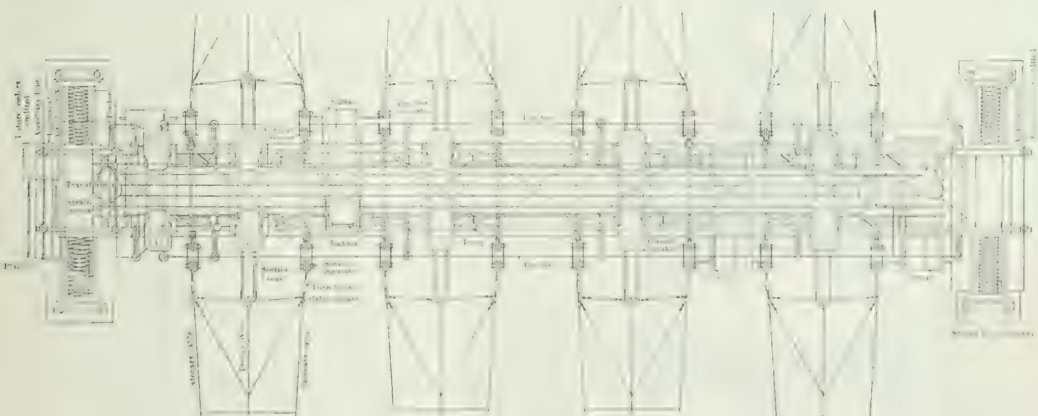


FIG. 4.—PLAN OF TOP OF ANCHOR BRIDGE

well known "giant strain," except that it is designed to withstand a test of 50,000 volts, and a mechanical pull of 15,000 lbs. It is made up of steel castings and solid mica insulating cones and is sealed with a high grade insulating compound. These strain insulators are attached by means of one loop in the guy poles, and the pull-over wires are attached to the other loop.

INSULATING SEPARATORS.

In order to enable any one track to be electrically disconnected from any other parallel track when the circuit breakers

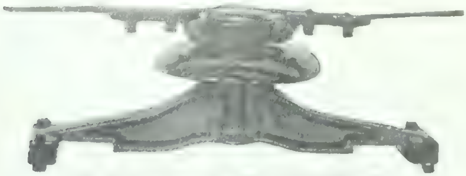
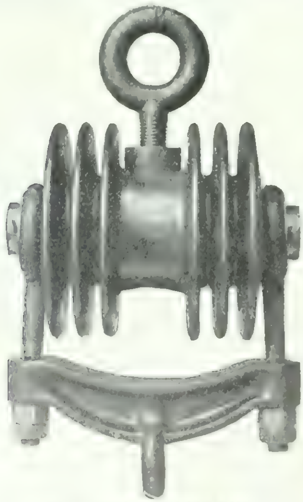


FIG. 6.—STANDARD MAIN LINE INSULATOR.

on the anchor bridges are open, insulating separators are provided in the pull-over wires between the tracks (see Fig. 1). Each separator consists of a 5-ft. rod of selected hickory, thoroughly impregnated and fitted at the ends with malleable-iron heads secured to the conical-shaped heads of the rods by means of bolts. Each insulator has an ultimate strength of about 16,000 lbs. At no point in the entire construction is wood relied upon for insulation to ground, and it will be noted that these wooden separators normally have no difference of potential upon them. They are merely provided in case of accident, when



[illegible]

it is necessary to isolate one section of track from another. They are, however, subjected to a test of 30,000 volts.

TROLLEY HANGERS.

The trolley wire is supported from the catenary cables at 10-ft. intervals by means of triangular trolley hangers of varying lengths. These hangers are so adjusted in length that the trolley wire is maintained in a horizontal position (Figs. 1 and 2), it being 6 ins. below the catenary cables at the middle point of the span. The hanger consists of a pair of small drop-forged steel jaws, which engage with the grooves of the trolley wire and are clamped by means of a malleable iron Y, which is screwed down upon the threaded portions of the jaws. The sides of the triangle are then screwed into the Y and are bolted to the messenger cable above. As all of the threads are right handed, it is impossible for the hanger to come loose.

[illegible]

At each anchor bridge it is necessary to provide an insulator in each trolley wire, and this is accomplished by means of the piece of apparatus shown in Fig. 8. Each consists of two bronze end castings, to which the ends of the trolley wire are bolted. Two parallel sections of impregnated hardwood are fastened to these castings, and to these wooden strips are fastened renewable pieces of trolley wire in such a manner that the ends of these renewable pieces overlap one another in distance along the track, although the two wires are electrically distinct. By this means it is possible for the sliding contact on the locomotive to pass from one section to the next without opening the circuit, thus avoiding all flashing. It will be noted, however, that an effective insulation is provided so that when the circuit breaker on the anchor bridge is open, the two sections will be disconnected. The manner in which this section insulator is installed is clearly shown in the end view of the anchor bridge, Fig. 3. Insulators in place under an anchor bridge are shown in Fig. 2.

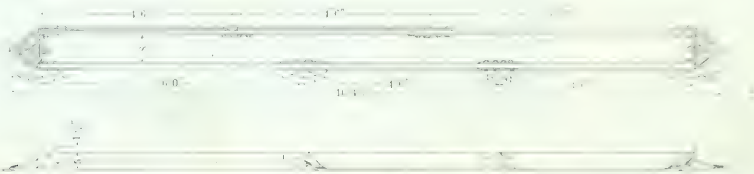


FIG. 8.—SECTION INSULATOR.

LOW BRIDGE CONSTRUCTION.

At a number of points along the road overhead bridges reduce the clearance above the tracks. The construction consists of a corrugated porcelain spool, mounted upon an iron pipe, which in turn is supported at each end from a skirt-type porcelain insulator, of the same design as that used on the intermediate bridges. The messenger cables where they pass under the bridge are heavily insulated, and the hangers which support the trolley wire from the messenger cable are placed midway between the porcelain insulators so that the maximum amount of flexibility is obtained. The trolley wire hangers are constructed of impregnated wood, so that the trolley wire is completely insulated from the catenary cables. A waterproof shield is attached to the bridge above the insulating structure so as to prevent accumulations of dirt and water on the insulators.

AUTOMATIC CIRCUIT BREAKERS.

The type of circuit breaker which has been developed for this installation is shown in Fig. 9, which gives the details of the device, while Figs. 2 and 5 show the breakers in place on the anchor bridges.

The breaker consists of a cast-iron framework adapted to be bolted to channel irons resting upon the upper chords of the anchor bridges. This framework carries an iron box provided with a hinged cover. This cover is arranged to fit tightly in place so as to exclude all rain and snow and be entirely weatherproof. The moving parts of the circuit breaker are contained within this box and are made especially rugged and reliable in their operation. The terminals of the switch are brought out through specially constructed insulators mounted in an overhung portion of the box at the rear (Fig. 9). Upon

the tops of insulators are carried knife switch jaws, and there are corresponding jaws mounted on the upper ends of the circuit breaker contacts. Two switch blades are carried on insulating pillars fastened to the hinged cover of the box in such a manner that when the cover of the box is closed one terminal of the switch is connected to the bus-bar on the anchor bridge and the other is connected to the trolley wire. Arrangements are provided so that if the cover is opened the circuit breaker will be automatically tripped so as to prevent any possibility of the attendant taking hold of live parts.

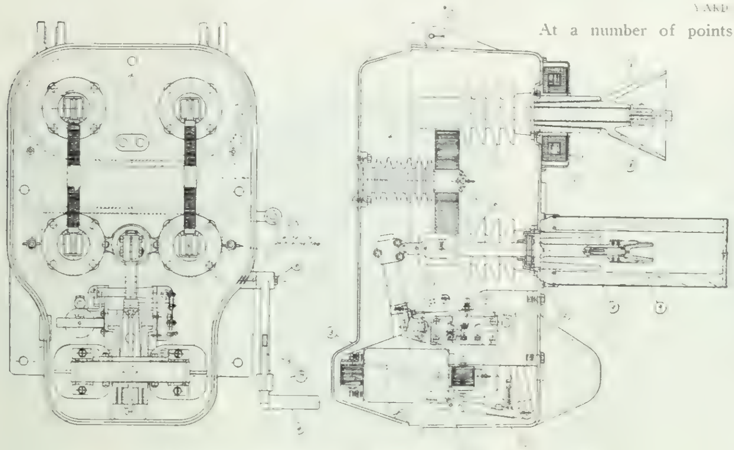


FIG. 9.—DETAILS OF AUTOMATIC LINE SECTION CIRCUIT BREAKER.

The circuit breaker is capable of handling 11,000 volts on heavy, short circuit. A tripping coil is provided, together with closing magnets, both of which are operated from a circuit supplied from the small shunt transformers on the anchor bridge. The switch is also arranged to open automatically on overload.

The control wires for the closing magnets and the tripping coils are carried in iron conduit and lead-covered cable to the adjoining signal tower, where a switchboard panel is provided. This panel is fitted with switches so that any circuit breaker may be tripped by hand, or closed by the attendant in the signal tower. There is also a switch by means of which the attendant may connect either of the shunt transformers on the anchor bridge to the control circuit.

The auxiliary feeders, which are supported on the inner insulators of the lower bracket arm on the bridges, are looped in to the bus-bars on each alternate anchor bridge. These connections are made through automatic circuit breakers, so that [illegible] bridge, one of the auxiliary feeders will pass around the grounded bridge to the next section beyond. On each anchor bridge one auxiliary feeder is broken by a strain insulator, and connections are made through circuit breakers to the bus-bar. The other auxiliary feeder is carried directly through, and a single tap connection is made from the feeder through the circuit breaker to the bus-bar. Upon the next bridge these conditions are reversed, so that each auxiliary feeder is divided into 4-mile sections. This arrangement provides a maximum flexibility of control.

YARD CONSTRUCTION.

At a number of points along the road, where there are numerous side-tracks, it is necessary to provide extra long bridge supports. Fig. 10 represents one of these long bridges, which is designed to cover 12 tracks. The catenary cable insulators are attached to the lower members of the truss.

TRACK BONDING.

Both rails of all tracks are bonded by means of No. 4-0 compressed terminal flexible bonds placed around the fishplates. It will be recalled that the trolley itself consists of standard No. 4-0 grooved copper.

TURN-OUTS AND CROSS-OVERS.

Whenever one track diverges from another a section insulator is inserted in the trolley wire. Insulators are also inserted in the catenary cables supporting the diverging wire between parallel tracks. The diverging trolley wire is connected to the main wire by means of a frog of standard design and in order to prevent the contact shoes on the locomotive from catching, deflector wires are placed in the angle between the trolley wires. These deflectors are carried by yokes secured to the trolley wire and are attached to yokes at the rods which are fastened to the catenary hangers. There being a certain amount of flexibility in the overhead trolley system, when the bow is pressed upward against the contact wire, this wire is raised above the level of the other contact wires in the immediate neighborhood. Thus, certain portions of the short length of trolley wire used to interconnect the two main trolley wires at cross-overs would tend to remain in a plane below that of the active trolley wire as the locomotive passes this point. The deflector wires are designed to tend to cause the cross-over trolleys and the main trolley to be raised partly in unison by decreasing the upward movement of the main trolley and increasing the upward movement of the cross-over trolley. The contact bow of the trolley mechanism on the locomotive is given a certain amount of upward curvature towards the center, so that the bow has no tendency to catch in either the cross-over trolley wires or the intermediate deflector wires.

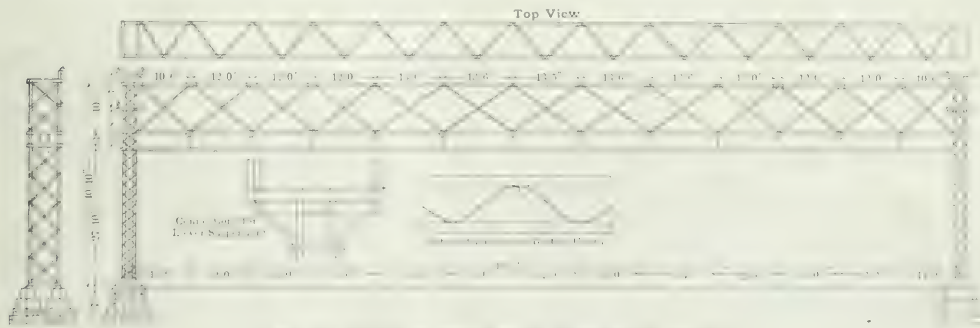


FIG. 10.—[illegible] OF TWELVE-TRACK INTERMEDIATE BRIDGE.

The Fuel-Testing Plant of the United States Geological Survey at the Jamestown Exposition.

The fuel testing work of the United States Geological Survey should be followed with close interest by all engineers, not only because it is important to all fuel consumers, but because this branch of the Government work is undertaken to point out new paths for the development of the natural resources of the country by locating, classifying and testing all kinds of available fuel.

Accurately compiled results of the more recent work of this branch will soon be published, and the following particulars of the plant at the Jamestown Exposition will doubtless be of interest.

Fig. 1 shows the plan of the Power and Alcohol Building in the grounds of the Jamestown Exposition, indicating the location of the boilers, gas producers and engines, nearly all of which apparatus was used at the St. Louis Exposition by the Geological Survey in conducting somewhat similar tests.

STEAM ENGINEERING DIVISION.

New apparatus has been added to this division as follows: A 250-hp Babcock & Wilcox boiler, with superheater, provided with a Roney stoker (Fig. 2); a Jones underfeed stoker with fan, added to one of the old Heine boilers; two direct-current De Laval turbine sets (Fig. 3) rated 300 horse-power at 9000 900 revolutions; also three Green Fuel Economizer Company's induced draft fans.

The method of work planned for this section is to be slightly changed, so that instead of testing a great number of coals, more tests will be made of the same coal, different sizes and different methods of stoking or feeding, etc., being employed with the object of determining the most economical performance under different rates of combustion and the best ratios of grate and heating surfaces.

The B. & W. boiler will be placed beside the two Heine boilers which have been brought from St. Louis, all three having been provided with induced draft apparatus in order to get a wide range of capacity. The Heine boiler provided with the Jones stoker has the usual arrangement for forced draft. The B. & W. boiler was inserted partly to enable tests to be made of the same fuel with different types of boilers. It serves to represent the types employing a perpendicular flow of the gases through the tubes, the parallel flow types being represented by the Heine boilers. The Heine boilers have been rebaffled or partitioned in such manner as to practically double their length by compelling all the heated gases to pass along the entire length of the tubes twice.

An additional alternating-current turbo-generator set may be installed as indicated to supply power for external and exhibition purposes.

The steam engineering division, which has now practically succeeded in isolating the performance of the boiler from that of the combined performance of the boiler and furnace, will carry on further tests with the object of still further determining the performance and efficiency of the furnace alone.

PRODUCER-GAS SECTION.

The apparatus in the producer-gas section is arranged as shown in Fig. [illegible] and Fig. 6, the producer gas immediately on

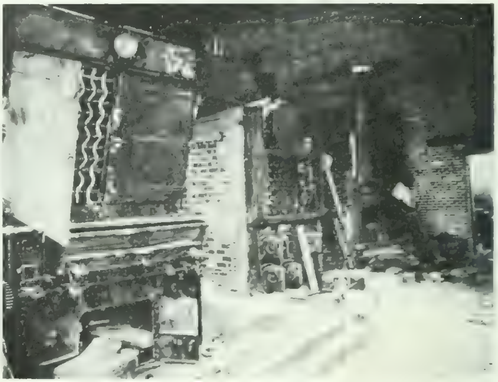


FIG. 2.—INTERIOR OF BOILER HOUSE.

entering the building, passing through the meter and thence to the Westinghouse gas engine, shown in Fig. 4, transferred from the St. Louis plant. Some slight changes have been made in this apparatus. For instance, producer No. 7 has been provided with a water seal at the base to permit the ashes to be removed without admitting air, and several holes have been bored at different heights to be used for extracting samples of the gas. The purifying apparatus used at St. Louis has been removed; (this, it will be remembered, consisted of the usual chamber containing iron filings and wood shavings) since experience indicates that the danger from impurities has been considerably exaggerated.

A special steam pipe has been provided to insure a steady water pressure, since the pressure of the supply mains fluctuates considerably.

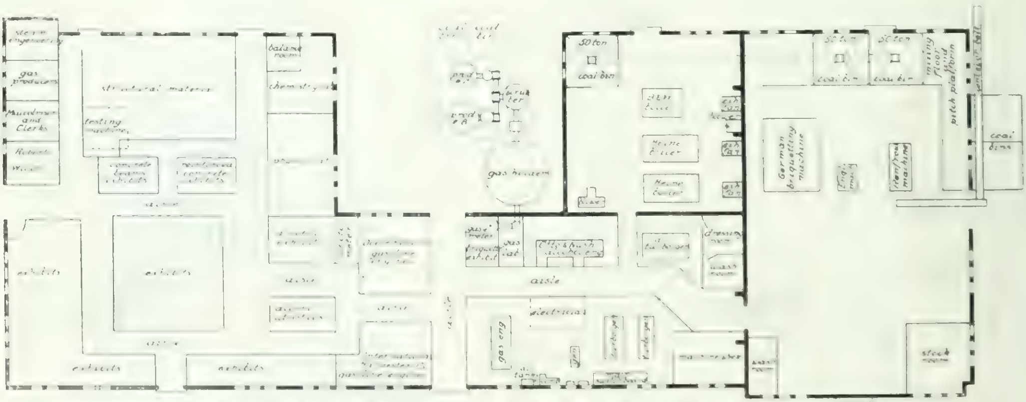


FIG. 1.—PLAN VIEW OF FUEL-TESTING PLANT AT THE JAMESTOWN EXPOSITION.

The gas engine is belted to a 200-kw Bullock generator, brought from St. Louis, which serves to drive the motors for the apparatus in the building, the machine shop, the briquette plant, the elevators and the conveyor. Any additional load required is obtained by means of a water rheostat, which can be regulated by the switchboard attendant so as to maintain a steady full-load value.

The plans of this section include the following determinations: The proper length for a test run, the effect of the size of the coal, the best depth of fuel bed, the effects of rapid load variations, the maximum returns from different fuels, and

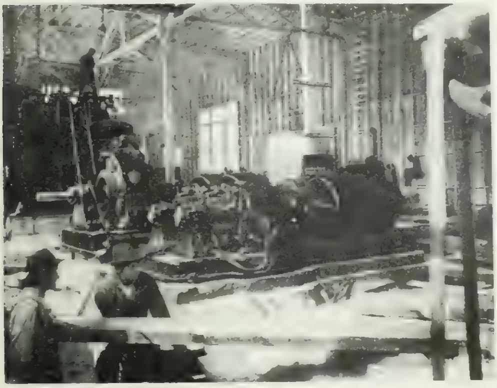


FIG. 3.—DE LAVAL TURBO-GENERATOR SETS.

the response of a producer plant to sudden demands for power.

ALCOHOL AND GASOLINE ENGINES.

A new work of great importance is being undertaken by this section. Its equipment includes two 15-hp, 250 r. p. m. Otto gas engines; two 15-hp Nash Company's engines; one 2-hp International Harvester Company's engine, and two John Deere engines rated at 14 and 18 horse-power, respectively.

Experiments will be made covering the whole range of this field, but for the present the work will be confined chiefly to

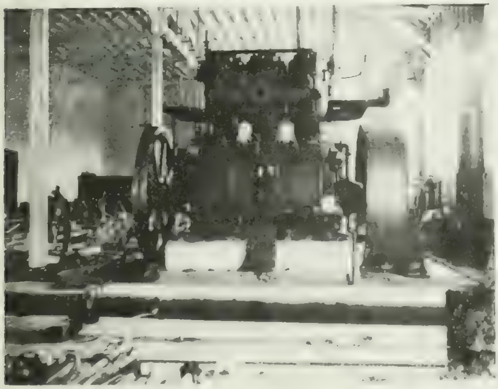


FIG. 4.—225-HP GAS ENGINE.

examinations of different carburetters with the object of showing the lines along which a more efficient method of vaporization may be obtained. The other more prominent work is the examination of the kinds of fuels available, with special reference to gasoline versus alcohol, and an investigation of the use of kerosene as fuel for this class of engine, an investigation necessitated by the increasing demand for gasoline and the limited supply available.

DISTILLATION OF COAL AND COMBUSTION.

The study of the destructive distillation of the coal and its combustion in gas producers, coke ovens and furnaces, especially from the standpoint of physical chemistry, will be undertaken by several divisions.

BRIQUETTING DIVISION.

The briquetting division, which occupies the large room at the

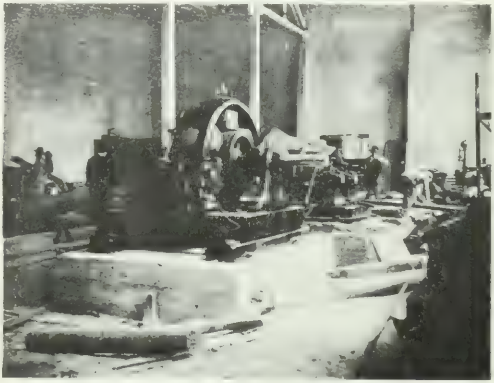


FIG. 5.—GENERATOR DRIVEN BY GAS ENGINE.

end of the building, is putting down one additional German briquetting machine, while the previous apparatus of English and American manufacture, that was used at St. Louis, is installed in the same room. The work of this division will be chiefly the manufacture of briquettes from various run-of-mine coals of the Eastern fields, which will be tested on war vessels under the direction of the steam engineering division.

OTHER PLANS.

The further fuel testing work of the Geological Survey includes tests dealing with the spontaneous combustion of the

FIG. 6.—GAS PRODUCER PLANT.

stored coals, in which an effort will be made to simplify the methods for its prevention; while a corps of specialists will be detailed to investigate closely the whole subject of explosions in coal mines with a view to eliminating danger from this source.

Electrically-Operated Water-Works of Tacoma, Wash.

[illegible]

[illegible] the many companies that have entered this field have found it profitable. But central-station managers do not seem to be so strongly attracted to large pumping contracts and one finds in most cities of moderate size, even where there is a lively, progressive central station company, that the city water pumps —the biggest pumping load in the town—are operated by an isolated and usually wasteful steam plant.

Sometimes this condition exists because the central station could not get the load without going into politics and dealing on other than a strictly business basis; more often the possibilities of the city pumping load are overlooked. Sometimes with small stations themselves operated by steam, electric drive could not be furnished any cheaper than the direct steam-driven pumps are costing, but usually the central station company is in a position to offer rates at once profitable to itself and considerably below the city's cost of pumping. Where the electric plant is driven by water power and the pumping station by steam, as is true in a great many towns in the west, the central station can usually cut the city's pumping bill from 30 to 40 per cent and still receive a fair profit for its services.

Under these conditions city water pumping furnishes a very desirable load and offers business well worth going after. Where there is a reservoir the pumping can usually be done in the early morning and forenoon, shutting down when the evening peak begins to appear. The load is uniform, dependable and comes on and off at fixed times. Whenever the load can be distributed throughout the non-peak period as suggested above, provided the pumping plant is of any size, a rather startling improvement in the load factor will result.

The electric driven plant at the wells of the city of Tacoma, Wash., furnishes a concrete example of what may be done with a city pumping contract. The energy is furnished by the Snoqualmie Falls Power Company. At South Tacoma, now a part of the incorporated city, are located eleven semi-artesian wells all about 150 feet deep. The total head pumped against is about [illegible] feet, corresponding to a pressure of [illegible] pounds per

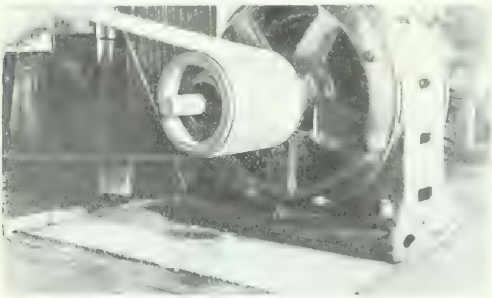


FIG. 1.—75-HP. MOTOR DRIVING AIR COMPRESSOR

square inch. On account of the topography of the city, the water is delivered into two distributing systems, the high level and the low level. The water for the low level system is delivered by the pumps into a flume situated at the station, through which it flows by gravity to the low-level reservoir. Two Gould pumps working against a head of 200 feet (90 pounds per square inch), pump the water directly into the mains of the high-level system.

The wells are from seven to twelve inches in diameter, and furnish from 90,000 to 600,000 gals. per 24 hours each, the whole set having a [illegible] gallons daily. The city council has recently appropriated $100,000 to sink a 1000-foot well and bring the capacity of the plant up to the demands made upon it.

The pumping is done by an air lift system, the motors operating the compressors. The air is led down through a pipe in the well casing, ending in a jet, the force of which pumps out the water. The total capacity of the station is 600 horse-power.

The machinery is owned and operated by the city; the power company merely furnishes the electricity. The present contract was made during a period of strenuous competition and the

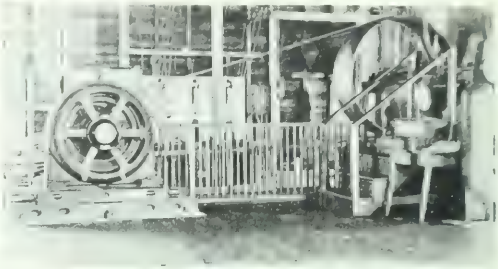


FIG. 2.—150-HP. MOTOR DRIVING PUMP

city gets its electricity at the absurdly low rate of three-tenths of a cent per kw-hour. The load was very desirable, however, and the company took it at the above figure with the understanding that at the expiration of the present contract, within a few months, the rate would be raised to the more reasonable figure of 1¼ cents per kw-hour.

Of course, the cost of maintenance and operation is considerably below that of an equivalent steam plant. One man on each shift operates the plant and has but little to do except to keep awake. A corresponding steam plant would require at least three men on each shift and a little over double the present wage expense. A steam plant would require three times as much oil and waste, to say nothing of repairs and miscellaneous expenses.

Another feature that makes the electric system attractive to the city is the ease with which the plant can be enlarged. Tacoma, like all Pacific Coast towns, is growing very rapidly, and the problem of increasing the capacity of the plant easily is an important matter. All that is necessary with the electric drive in use is to install a new transformer, motor and pump, bore a new well and connect the piping.

The present plant is housed in a frame building 100 by 40 feet in size. The air compressor equipment consists of one 150-hp, 2300-volt, 495 revolutions per minute two-phase Westinghouse induction motor belted to a horizontal two-cylinder Ingersoll-Rand compressor; and two 75-hp, 2300-volt, 600-revolutions per minute, two-phase Westinghouse induction motors, each belted to a 75-hp, horizontal, two-cylinder Ingersoll-Sargent compressor. The 150-hp compressor unit is now being installed and, as the occasion demands, others like it will be added. The air is compressed to 210 pounds per square inch For pumping into the high-level mains there are two 150-hp motors identical with the one belted to the large compressor, each belted to a vertical, triplex 12 by 14 inch, 42-r. p. m. Gould pump. Each of these pumps furnishes 2,000,000 gallons per 24 hours against [illegible] feet head.

The switchboard has three panels on which are mounted the station instruments and motor controllers. Back of the board are two manually operated 2300-volt oil-switches. The transmission line brings in the current at 23,750 volts and it is stepped down to 2300 volts by four 180-kw, two-phase, four-wire General Electric transformers. Adjacent to the transformers are the 23,750-volt, air-brake switches. In order to protect the plant from fire the transformers are placed in a concrete building forty feet from the main power house.

The city of Tacoma has in the above described installation a thoroughly efficient and satisfactory pumping station without which it could not furnish water at the prices it does. At the same time the power company has a highly desirable load paying, under the new rate, a reasonable profit and the arrangement is satisfactory to all concerned. Other central stations might investigate with profit the opportunity for making similar contracts, modified to meet local conditions, in their own cities.

The Synchroscope.

BY S. R. DODDS.

Almost every engineer or switchboard attendant who has used alternating-current apparatus is familiar with the use of the synchroscope, but probably the fundamental principles on which it operates are not so well known.

The construction of one of the instruments in common use, the invention of Mr. P. M. Lincoln, and the method of connecting it are shown diagrammatically in Fig. 1.

It is essentially a small bipolar motor having on its armature two coils whose planes are at right angles to each other. These coils A and B are connected to the bus-bars, or to the generator leads, through slip rings on the armature shaft. In series with one coil is an inductive resistance and in series with the other a non-inductive resistance. This arrangement is used for producing two-phase currents in the armature from one phase of the bus-bars or generator leads, the currents in the coils A and B being nearly 90 degrees apart. The currents being displaced 90 degrees both electrically and mechanically, a rotating field of flux is set up around the armature. The stationary field winding is connected to one phase of the generator leads, or it may be connected to the bus-bars and the armature connected to the generator leads.

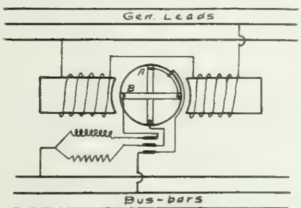


FIG. 1.—DIAGRAM OF CONSTRUCTION OF INSTRUMENT

From the figure it will be seen that the armature will have a rotating field which is acted upon by the pulsating field of the field coils. The action of the instrument depends on the relation between these two fields.

A conception of the physical relations between the fields may be had from a consideration of Fig. 2.

Suppose the machines are in synchronism and that at a given instant the north pole of the revolving field has the position N, shown by the full line, 90 degrees to the X axis, and revolving in a direction shown by the curved arrow. At the same instant let the pulsating field, the resultant of the sine wave of e. m. f., Fig. 3, be zero, and about to produce a north pole to the left. Since the pulsating field is zero no torque can be exerted on the armature at this instant. When N has turned through 90 degrees and is parallel to the X axis, the pulsating field will have reached its maximum value, point b on the sine wave, and since the fields are parallel and in the same direction, no torque will be produced in this position. When N has reached the position N^{11}, the pulsating field will again be zero, point c, and the torque will be zero. The same conditions will be repeated from N^{11} to N.

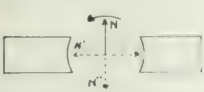
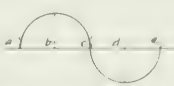


FIG. 2.—RELATION OF FIELDS



[illegible]

While N is passing to N^1 torque will be exerted in the direction of the curved arrow, tending to pull N into the position N^1. While passing from N^1 to N^{11} an equal pull in the opposite direction will be produced, the resultant torque for these two quadrants and for a complete period being zero.

If the machines are not in synchronism the torque will not be zero. Suppose that the rotating field is slow and that when the sine wave has reached the maximum point b, N has reached some point between N and N^1. The torque in this quadrant will now be greater than that between N^1 and N^{11} and the armature will rotate in the direction of the curved arrow. If the rotating field is fast the torque will be in the opposite direction and the armature will rotate clockwise.

The conclusion reached above may also be shown analytically.

Let F represent the maximum value of the pulsating field.

Let F^1 represent the resultant rotating field.

Let M represent the instantaneous torque between the two fields.

Let α represent the angle between the two fields.

Referring to Fig. 4, $F\ sin\ \alpha$ will be the vertical component of the rotating field and the instantaneous torque M between the two fields will be:

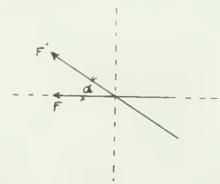


FIG. 4.—ANALYSIS OF ROTATING FIELD.

$$M = K\,F\,F^1 \sin \alpha \qquad (1)$$

Assume that the machines are in synchronism and that the pulsating field has a value of $F \sin \omega t$ then the frequency of F^1 will also be $F^1 \sin \omega t$.

If we assume F to be zero when $t = o$ then at a time t, when the pulsating field has the value F, the angle between the two fields will be $(\omega t + \alpha)$ and the expression for the instantaneous torque will be, substituting in (1)

$$M = K\,F \sin \omega t\,F^1 \sin(\omega t + \alpha) \qquad (2)$$

Because of its inertia the armature cannot follow the rapid alternating impulses of the torque between the magnetic fields, but its rotation will be due to the average torque for a complete period. The average torque may be found by taking the sum of the instantaneous values of torque and dividing by the time of a complete period.

Let M_{ave} represent the average torque for a period.

Let T represent the time of a period.

then

$$M_{ave} = \frac{1}{T}\int_0^{2\pi} [illegible] \qquad (3)$$

Substituting in (3) the value of M given in (2) we have:

$$M_{ave} = \frac{1}{T}\int_0^{2\pi} [illegible] \qquad (4)$$

[illegible]

$$M_{ave} = \frac{1}{T} K\,F\,F^1 [illegible] \int_0^{2\pi} [illegible] \qquad (5)$$

Integrating this expression and substituting $\frac{2\pi}{T}$ [illegible] obtain the result:

$$M_{ave} = \frac{1}{2} K\,F\,F^1 \cos \alpha \qquad (6)$$

In other [illegible] may be [illegible] for a complete period, when the machines are in synchronism, *cos* α of equation (6) must be zero, therefore α must be 90 degrees.

This shows that when F, which is parallel to the X axis, is zero F^1 must be 90 degrees to X. Under these conditions the resultant torque is zero and the armature remains stationary.

If α is less than 90 degrees *cos* α is negative and the armature will rotate in the same direction as the field. If α is greater than 90 degrees *cos* α is positive and the rotation of the armature will be opposite to that of the field.

In explaining the action of the split phase arrangement of the synchroscope the statement was made that the currents in the coils are displaced nearly 90 degrees. While it would be possible to produce such a condition, the phase displacement in the instrument as actually constructed is much less than 90 degrees and the rotating field is not uniform. The field is also distorted by the iron in the field poles. This irregularity of the field does not affect the final result as given above.

Recent Electrochemical Patents.

ELECTRIC FURNACES.

The large number of patents which have recently been granted for electric furnace processes and details of construction, emphasizes the great activity which marks just at present the introduction of the electric furnace into various fields of metallurgy.

In the field of ferro-alloys the Electro Metallurgical Company a new company closely allied with the Union Carbide interests has entered the field and has absorbed the pioneer ferro-alloy plant of this country, the works of the Wilson Aluminum Company. The latter company made chiefly ferro-chrome, but the new company will make a great variety of different ferro-alloys, as is indicated by a long series of patents recently granted to Mr. E. F. Price and Mr. Fred. M. Becket. Two patents of Mr. Price relate to the construction of arc furnaces for making ferro-silicon and silicospiegel; by providing a high column of charge above the real hearth and surrounding the electrodes, the heat is retained in the furnace and the electrodes are protected from the oxidizing and cooling effects of the atmosphere. In another construction of Mr. Price, the hearth or crucible at the bottom of the furnace is made detachable so that when it is filled with the desired product it is withdrawn and an empty crucible is substituted.

In several patents of Mr. Becket, chiefly relating to vanadium and its alloys, silicon is used as the reducing agent. Since the oxidation heat of silicon is very high and comparable with that of aluminum, silicon is a very strong reducing agent and it will be used to advantage in cases where the object is to produce a metal or alloy low in carbon. Vanadium may be reduced from vanadium sulphide in a single reaction by means of silicon. For the reduction of vanadium from the oxide, silicon and carbon, preferably in the form of carbon silicide, is a useful reducing agent. If vanadium is to be reduced from a higher oxide it is advantageous to divide the process into two steps: in the first step the higher oxide is reduced to a lower oxide with carbon in a gas furnace, and the lower oxide is later reduced with carbon silicide in an electric furnace. In this way the amount of carbon silicide required and the amount of electrical energy are reduced.

Even, however, if silicon or aluminum is used as a reducing agent in an electric furnace, carbon is liable to enter into the composition of the metal or alloy, this carbon coming from the electrodes. Since naturally the contamination by carbon will be higher the greater the contact surface between the electrodes and the charge, Mr. Becket recommends the use of electrodes of very small sectional area. Since they have to carry a strong current he cools them artificially by water circulation. Messrs. F. von Kügelen and G. O. Seward go a step further by employing water-cooled metallic electrodes for the same purpose. An [illegible] of Mr. [illegible] which [illegible] particularly adapted for the treatment of iron and steel contains titanium, calcium, aluminum and silicon and is produced by the reduction from the oxides with carbon in the electric furnace.

With respect to the manufacture of steel in the electric induction furnace it is interesting to note that Mr. E. A. Colby, of this country, the original inventor of the induction furnace, and Mr. F. A. Kjellin, the Swedish engineer, who was the first to make a commercial success of the induction furnace, have combined forces in this country, the American Electric Furnace Company being the result. Mr. Colby's fundamental patents have run out or are about to run out, but there are still many details left for working out, as is evidenced by the recent patent of Mr. Colby with no less than 36 claims. The primary is in the form of a copper-tube coil through which water is passed for cooling. Great attention is paid to proper insulation, ease of assembling the different parts of the furnace, etc.

Mr. J. Härdan wants to feed a single induction furnace with three-phase currents. A patent recently issued to him shows various arrangements in which stationary transformers are inserted between the polyphase line and the single-phase induction furnace. In view of the well-known fact that it is impossible to convert balanced polyphase current into single-phase without the aid of rotary machinery, it is clear that in Mr. Härden's arrangements the polyphase system must become unbalanced.

A simple improvement patented by Dr. Paul Héroult is interesting from an electrical engineering point of view. It relates to furnaces with one electrode suspended from above, the carbon crucible forming the other electrode. The body of the furnace is made of carbon and is bound or surrounded by jackets of rings of iron, steel, etc. As is well known, this gives a strong mechanical structure, but if the iron jacket is continuous all around the periphery, it has the great disadvantage that a magnetic flux is set up in this ring with self-evident results. By substituting copper or other non-magnetic material for the iron at some point in the ring, it is possible to reduce very largely the impedance of the furnace when operated with alternating currents.

New Telephone Patents.

A few weeks since we noted an improved transmitter for telephone apparatus for the deaf, invented by W. H. Holland Further improvements have now been patented by this same inventor in conjunction with G. W. Kauser, of Chicago. This transmitter is of same general form, but a membraneous diaphragm is used. An auxiliary diaphragm having a ring secured to its edge is pressed against the main diaphragm. This covers the major portion of the main diaphragm and helps to stretch it. The auxiliary diaphragm acts upon the microphone button.

A combined telephone and telegraph set for field use has been invented and patented by F. W. Medhurst, of Hobart, Australia. The whole apparatus is mounted in a leather carrying case, holding transmitter, receiver, switch, battery, telegraph key and reed sounder.

C. A. Anderson, of Lindsboro, Kan., has patented a step-by-step party line lock out and calling apparatus. The call is originated by a signal to the exchange operator, who then connects up both calling and called parties by means of their respective mechanisms.

For use on shipboard, a water tight switchboard is advisable and F. W. Wood, of Newport News, Va., has designed one with this in view. The switching is done by keys arranged in a bank. All keys in any vertical row are connected to one line, while all keys in any horizontal row are connected together. Two keys of a horizontal row similarly thrown connect therefore the two lines together which correspond to the vertical rows which include them. The key springs are mounted in a metal box, while the cams are mounted in a hinged false bottom, so that the springs may be quickly brought into view. A watertight cover seals the box when not in use.

LETTER TO THE EDITORS.

Fatal Contact Through Tape Measure.

To the Editors of Electrical World:

SIRS:—In regard to the note on page 276 in your issue for Aug. 10, in connection with the death of George Wesener, telephone lineman, by current transmitted through a cotton or linen tape drawn across a high voltage circuit, I would state that I remember distinctly a similar case near Stillwater, Minn., in which both the lineman and his ground man were killed by the measuring tape, apparently all linen, making contact with high-tension wires. I had the opportunity to examine the tape personally, after the accident, and while an external examination revealed no metallic parts the fact did not satisfy me. Upon cutting into the tape, I found that it was strengthened by means of fine flexible wires running lengthwise through it. Since that time, I have examined a number of tapes, such as are used by linemen, etc., and found that practically all of them are similarly reinforced.

While your article says there was no metal on the tape, it is quite likely that the tape was of a make similar to the above. It would be a good plan for all companies that are liable to use tape lines in the vicinity of high-tension wires, to examine the tapes, and make sure that there are no reinforcing wires inside of them, thus avoiding the possibility of placing lives in jeopardy.

NEW YORK CITY. M. A. MYERS.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Star-Delta Combination.—L. LEGROS.—A mathematical article on the use of the star-delta combination shown in Fig. 1 for three-phase machines. This method is found useful, for instance, when a machine has been wound and it is desired to get a greater saturation of the magnetic circuit for the given voltage in order to reduce the voltage drop. Another case where the method may be applied is when it is intended to raise or lower the normal voltage after the machine has been in operation for a certain time. In the diagram it is assumed that the machine was originally connected in star OA, OB, OC representing the three phases. The length of the three vectors is proportional to the number P of the coils per phase, all the

FIG. 1.—VOLTAGES IN STAR-DELTA COMBINATION.

coils having the same number of turns. Each coil corresponds to one pair of poles. In order to change the machine to the combination system, the end O of the phase OB is connected with the point O' of the phase OA, and the end O of the phase OC with the point O'' of the phase OB so that in the vector diagram OB becomes $O'B'$ and OC becomes $O''C'$. The end O of the phase OA is connected to the point O of the phase $O''C'$. There are p coils in each phase in star connection and the $P—p$ coils form the triangle $O\,O'\,O''$. The system remains symmetrical. The author gives several simple formulas which are useful for this change.—*L'Eclairage Electrique,* July 13.

Compounded Alternators with Commutators.—A. HEYLAND.—A description of a number of practical experiences with some large compounded alternators with commutators which have been running for several years. The same article, printed in a German paper, has already been noticed in the Digest.—Lond. *Elec.*, July 19.

Compensated Single-Phase Shunt Motor.—J. BETHENOD.—A further article in his series of notes on this subject. In the present installment he gives an approximate graphical solution of the problem.—*L'Ecl. Elec.*, July 20.

Lamps and Lighting.

Illumination of Side Streets.—An editorial discussion. In side streets the subdivision of sources of illumination into smaller units is essential since the capital outlay and yearly cost must be low, and if the lamps are placed a considerable distance apart a very spotty effect is produced. For this reason incandescent gas has been frequently adopted for illumination of side streets. Carbon incandescent lamps are unsatisfactory on account of their low efficiency, while metallic filaments appear to offer the best solution of the problem. In addition to the efficiency being high, there is the further advantage over incandescent gas that the metallic filament lamp retains its candle-power much more constant than does an incandescent mantle. Some figures given by McCourt are mentioned. Considering an osram lamp which gave 54.5 candle-power and 54 candle-power, respectively in two consecutive months, and taking the osram lamp at 52 watts, with electrical energy supplied at 6 cents per kw-hour and gas supplied at 70 cents per 1000 cu. ft., as charged at Harrogate, he found that there was a saving in favor of electricity of 17.6 per cent. Considering that 6 cents per unit is a high price for street lighting, it will be seen that the advantage of the metallic-filament lamp over gas should be very considerable. The use of a number of low-voltage lamps in series is not disadvantageous in street lighting, but it is necessary that all lamps run in series be practically identical.—Lon. *Elec.*, July 26.

Street Illumination.—K. EDGCUMBE.—A letter in reply to criticisms of H. T. Harrison. The minimum illumination should be kept high, but this is not sufficient. The mean illumination is very important. He makes some correctons in his table of

Tantalum in Reason-Harrison fitting	1.0
Osram in Reason fitting	1.2
Bastian mercury vapor	1.5
Tantalum in Loftus lantern	1.8
Low-pressure gas burner	2.1
Nernst lamp in holophane globe	2.[illegible]
Keith high-pressure gas	2.5
Three-burner high pressure gas	2.9

the relative cost of electric lighting and gas lighting. His corrected table is given herewith.—Lond. *Elec. Eng'ing*, July 18.

Nernst Lamp.—A note on an improvement made by the maker of Nernst lamps for Great Britain, the Allgem. Elek. Ges., English Manufacturing Company. "The current taken by the heating coil of a Nernst lamp is approximately 60 per cent of the current taken by the burner itself. If the cut-out coil is defective in insulation, the heating coil will remain in parallel with the filament. Not only does this affect the efficiency of the lamp, but, as the resistance of the filament decreases with the increase of temperature which results when the heater and the filament are in circuit at the same time, the burner is over-run and burns out. The maker states that the life of a Nernst burner when the insulation of the cut-out is defective may be as low as 20 hours, and when the cut-out coil has entirely burnt out, a burner may last for only an hour or two. The average life of the heating coil when in circuit is only 20 hours, and the average time required to heat the filament is said to be one minute. Thus, the heater should allow the lamp to be switched on and off about 1200 times if there is no defect in the cut-out coil. The maker announces that all

lamps supplied hereafter will be fitted with a cut-out coil of new design and high insulation resistance and old bodies will be fitted with the improved coil, free of charge."—Lond. *Elec. Eng'ing*, July [illegible]

Metallic-Filament Lamps.—An article illustrating "adapters" for coupling metallic filament lamps in series using ordinary sockets. On alternating-current systems the voltage may be reduced in an inexpensive manner by the use of small transformers. An auto-transformer, similar to those employed for supplying alternating-current arc lamps, can be used, in which the internal losses are so low that a large net saving in consumption can be shown. For example, with the best grade of magnetic iron now obtainable three-wire auto-coils have been constructed capable of dealing with an out-of-balance current of three amperes, and in which the losses do not exceed 3.5 watts. Some figures are given showing that such a method would be quite economical.—Lon. *Elec. Rev.*, July 19.

Power.

Test of a 3000-kw Turbine.—An account of a test on a steam turbine which took place at the electricity works in Moabit, Berlin. At full load (3115 kilowatts), with steam at a pressure of 12.1 atmospheres, and at a temperature of 309 degs. C., and with the turbine running at 1500 r. p. m., the steam consumption was 12.95 lbs. per kw-hour, not including that used for the condenser, but including the excitation. The amount used for condensation purposes was 73 horse-power at full load.—From *Zeit. f. d. ges. Turbinenwesen;* abstracted in Lon. *Elec.*, July 26.

Refuse Destructors.—G. Dettmar.—The conclusion of his long article in which he endeavors to show that the problem of refuse destruction is a very important one in hygienic as well as commercial respects. The best solution, in the author's opinion, is to use the heat which is thereby rendered available for the generation of electrical energy in combination with electric supply stations. He also recommends the combining of a bath house or a laundry with the plant, in order to use the heat from the refuse destructor at times when the electric station is not fully loaded.—*Elek. Zeit.*, July 18.

High-Tension Direct-Current Power Transmission.—An abstract of an article in *Elek. und Masch.*, recently noticed in the Digest, in which Highfield's paper on the Thury high-tension direct-current system of electric power transmission was discussed and criticised.—Lond.*Elec.*, July 26.

Winding Plant in a Mine.—An illustrated description of the electric winding plant at Ligny-les-Aire. A Koepe pulley is used, mounted with its motors, on a steel tower immediately over the shaft. Continuous-current motors are used, supplied with a varying voltage, controlled by alterations of the excitation of a motor-generator. A flywheel is used to keep the input to the motor-generator set practically constant.—Lond. *Elec. Eng'ing*, July 18.

Mauritius.—G. McAlpine.—An illustrated article on electrical development in Mauritius, a little island in the Indian Ocean. The staple industry is cane sugar, and electric power is entering this field. It is also intended to electrify the steam railways, since the cost of steam power in Mauritius is very high. Most of the electrical energy used at present is derived from water power.—Lond. *Elec. Eng'ing*, July 18.

Traction.

Surface Contact System in London.—On a certain line in London the "G. B." surface contact system will be used to replace horse traction. The overhead trolley system is not permitted by the city authorities, while the conduit system is believed to be too expensive. The G. B. system has been in use in Lincoln for 18 months, "and this line has been remarkably free from the troubles that have been met with on many of the competing systems." It is stated that "the cost of the G. B. surface contact system, under normal conditions, per mile of single track (exclusive of cables and equipment common to both systems) is estimated at $52,500, as against $85,000 for the conduit system, and this saving justifies the committee in recommending [illegible] and Bow. It must not be forgotten, however, that the cost is still much higher than that of the overhead trolley system. Alhough the cost of the latter may only be $5,000 per mile less than the expenditure which would be incurred in laying down the surface contact system, it must be remembered that in comparing double-track lines the saving is more marked."—Lond. *Elec. Eng'ing*, July 18.

G. B. Surface Contact System.—There are two classes of surface-contact system. In the first class, of which the Schuckert system is an example, the switches through which the surface studs are made alive are assembled in groups, which are placed in pillars or street boxes and connected by cables to the separate studs. The method by which the feeding cable is connected successively to the studs in step with the movements of a car are quite different in the different systems, but in each the switch movement is brought about by a current from the car skate when it first touches a stud. The current energizes a magnet, which moves a switch connecting the stud to the main, and at the same time disconnects a stud in the rear of the skate. The second class of design includes a switch movement in the stud block, the switch being moved to the live position by the pull of a "pick-up" magnet carried on the car, or by an electromagnet in the stud energized by the first contact of the skate. The G. B. system, which is to be used in London as an experiment on a certain line, belongs to the second class, and has a very cheap and simple construction. "The main conductor is a galvanized-iron, stranded cable drawn into a stoneware pipe and carried on reel insulators, supported by iron spindles crossing the pipe. As there are no joints or attachments made to this conductor at the studs, it can be drawn out for renewal or examination from suitable access boxes. The insulator spindles project through the pipe, and are attached to an earth wire or strip, bonded to the rails. As any surface leakage from the conductor, whether at or between studs, must get to the insulator spindles, this simple device constitutes a continuous 'guard ring' which appears to make the charging of a stud by leakage impossible, except in the event of a switch chamber being filled with mud or water. The switch-movement mechanism is fitted into a vertical branch pipe, jointed into a socket in the conduit pipe. It consists of a rectangular stem of laminated iron, carrying at its end a small block suspended in a recess by a coiled spring. This suspended block is armed with a carbon contact piece, and hangs over the iron conductor. The laminated stem is bolted above to a T-shaped stud, of which the top surface is nearly flush with the paving, let into a block of granite, which forms part of the paving, and the stem is luted into the vertical branch pipe with pitch. When the magnetized skate rubs the stud, the magnetic flux, passing down the laminated stem into the iron cable, causes the suspended iron and its contact block to move downwards, until contact is established and the stud is alive.—Lond. *Elec. Eng'ing*, July 25.

Installations, Systems and Appliances.

Effect of Metallic Filament Lamps on Central Station Output.—The Brighton municipal station had a loss of $5,000 last year which has increased this year to over $50,000. This is to some extent due to the introduction of a flat rate, which can be selected, instead of the maximum-demand system and which is sufficiently low (8 cents per kw-hour) to tempt unremunerative consumers from the maximum-demand tariff. The number of kw-hours sold has somewhat decreased, and the number of kw-hours sold per 8-cp lamp connected has fallen considerably below the figure of the last two years. This is attributed to the use of high-efficiency metallic-filament lamps. At Dudley the increase in income from private consumers is also said to be smaller than would otherwise have been expected. While this is attributed to the metallic-filament lamp, the engineer in charge of the station thinks that the new lamps should be cultivated, and it is suggested that it may be necessary when laying mains in new streets to put in a five-wire system with local balancers in place of a three-wire system, so that houses may be supplied at half the present pressure. In an editorial note

it is doubted whether this system would be advantageous since the addition of such a network with balancers necessarily adds considerably to the cost, and defeats the entire object of the double pressure supply which is now almost universally adopted in England.—Lond. *Elec.*, July 19.

Time-Lag Relays.—An illustrated description of some recent forms of time-lag relays of Statter. The general principle of their action is seen from the left-hand diagram of Fig. 2, which

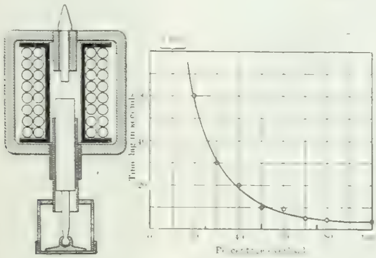


FIG. 2.—TIME-LAG RELAY.

gives a section of the apparatus. The disk is lubricated with glycerine, which adheres to the bottom of the case, and delays the action of the apparatus for a certain time, depending on the strength of the pull of the solenoid upon the core. The apparatus is set to come into action at any desired overload by raising or lowering the pot containing the sucker disk, which is attached to the tube surrounding the core. A screw adjustment is provided, and a scale is marked on the outside of the tube showing the current at which the appliance will ultimately break circuit if applied for a sufficiently long time. A typical example showing the variation of the time lag with different overloads is given in the right-hand diagram. The arrangement of connections for applying the device to an ordinary motor-starter, with "no-voltage" release, is shown in Fig. 3.

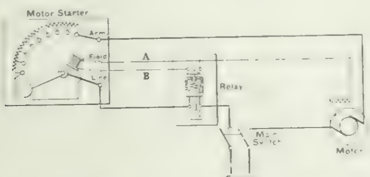


FIG. 3.—RELAY APPLIED TO ORDINARY STARTER.

The relay is arranged to act on the no-load magnet of a starter, and the connections are merely electrical ones which can be made quickly by any competent wireman. The action of this relay in short-circuiting the no-load coil is positive and definite and does away with the usual overload arrangement as applied to starters. Another form of relay is made for coupling to the trip-coils of circuit breakers or oil switches for alternating-current work in a way similar to the arrangement of induction relays.—Lond. *Elec. Eng'ing*, July 18.

Electrical Accidents.—G. S. RAM.—His report, as electrical inspector of factories [illegible] electrical causes. Many cases of burns have been reported due to flimsy main switches used in conjunction with starting switches of inferior construction. The starting switch fails to move back automatically when the main switch is turned off, and the resultant arc, when the main switch is put on again, flashes through the slot provided for the handle. Main switches in which the handle is attached to a bar of insulating material fixed between the two blades by metal studs, with projecting heads, are described as a "particularly dangerous type," although a "universal favorite," and the author expresses his [illegible] attached to an extension of the spindle and no slot is needed in [illegible] connection with portable appliances are reported, and also some due to the use of exposed fuse wires. Among the fatalities is one from a shock received by an arc-lamp trimmer through the imperfect action of a double-pole switch, in which one blade remained making contact when the handle had been turned off, one due to contact with a bare joint on temporary work at 200 volts, two from contact with unprotected live terminals, and one from a shock received from the pedestal of a defective desk fan. The author raises the questions whether all metal parts on portable appliances should not be definitely connected to earth, and whether it should be permissible for one man to work alone in large sub-stations, with moving machinery.—Lond. *Elec. Eng'ing*, July 18.

Electrophysics and Magnetism.

Tantalum.—M. VON PIRANI.—An account of measurements which show that the specific resistance of pure tantalum is 0.146 and the temperature coefficient between 0 deg. C. and 100 degs. is 0.33.—Lond. *Elec.*, July 26.

Vacuum Tubes.—A. A. C. SWINTON.—A Royal Society paper on the occlusion of the residual gas by the glass walls of vacuum tubes. The result is that the vacuum increases in the tube.—Lond. *Elec.*, July 26.

Electrochemistry and Batteries.

[illegible] Smelting of Iron Ore.—R. L. PHELPS.—An account of the latest developments at the electric iron smelting plant at Heroult-on-the-Pitt in California, where magnetite ore, available there in large quantities, is to be reduced in the electric furnace. The energy is obtained from a California transmission company using the three-phase system. By means of transformers the 22,000 volt, 60-cycle, three-phase currents of the transmission line are changed into 50 volts, 30,000 amperes, three-phase currents and are thus delivered to the electric furnace. The latter has three electrodes suspended from the top, while the neutral point is in the bottom of the furnace. The charge is made of charcoal, limestone and ore. The charcoal is made in kilns close to the plant, unlimited supply of timber being available.—*Mining and Scientific Press*, July 20; *Electrochem. and Met. Ind.*, August.

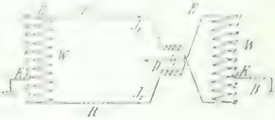
Electrolytic Refining of Tin.—O. STEINER.—An illustrated description of the Claus process of electrolytically refining tin which is in commercial use in a plant in England. The raw tin anodes are used in a 10 per cent sodium sulphide solution at a temperature of 90 degs. C., with a current density of one-half ampere per square decimeter electrode surface at a voltage between 0.1 and 0.18 volt. The tin is deposited on the cathode in pure solid condition, while the foreign metals are precipitated as sulphides and form the anode slimes mostly attached to the anode, but partly accumulating on the bottom of the tank. The precautions which must be taken in the use of the process are described in detail.—*Electrochem. and Met. Ind.*, August.

Chlorates.—G. ROSSET.—The first part of a serial on the electrolytic production of alkaline chlorates.—*L'Ecl. Electrique*, July 27.

Units, Measurements and Instruments.

Indicating the Level of Water at a Distance.—A description of an instrument devised by Rittmeyer for indicating the level of water in a reservoir, etc., at a distance. The arrangement is shown in Fig. 4. A float on the water actuates a sliding contact K (in the left-hand part of the diagram) so as to make connection with the rheostat W. The terminals of the latter are connected through two transmission lines R with the two coils of a differential galvanometer D connected to the receiving instrument, which contains a rheostat of the same resistance W' as at the other end. But at the receiving end the contact de- [illegible] through the battery B to earth. The galvanometer will show no deflection if the two currents J_1 and J_2 are equal, and this will be the case if the contact devices K make contact with the same notch at the receiving end and at the transmitting end. It is, [illegible]

[illegible] galvanometer shows no deflection. Then the height of the water at the other end is directly found. It is, of course, possible to let the needle of the galvanometer act on a relay which automatically moves the contact K at the receiving end until no current flows in the galvanometer. In this case the position of K at the receiving end shows directly the height of the water in the reservoir at the transmitting end.—*Schweiz. Elek. Zeit.*; Vol. 3, 1907, p. 635; *Elek. Zeit.*, July 18.



[illegible]

[illegible] Current.—G. ATHANASIADIS.—A description of a plan for applying the telephone method devised by Kohlrausch and Nernst to the measurement of resistances and capacities even without alternating currents. Direct, but undulatory currents from a central station will suffice. Sent through a telephone and suitable resistance, they give a pure note, whose frequency is equal to the number of commutator bars passing under the brushes per second. Such a note may also be produced by inserting a condenser of high capacity or a condenser and telephone. The substitution of direct for alternating currents is claimed to accelerate the measurements, simplify the apparatus and economize the consumption of electricity. The author describes in detail the measurement of a non-inductive resistance, of an electrolytic resistance, and of the capacity of a condenser. The condenser is used only for the last two measurements. The reading is taken with a Wheatstone bridge arrangement, the pointer being located either where the telephone becomes silent or midway between two positions where it is just audible. The [illegible] *Ann. der Phys.*, No. 7; abstrated in Lond. *Elec. Eng'ing*, July 18.

String Galvanometer for Alternating Currents.—G. ZEMPLEN.—Einthoven's string galvanometer has made its way as a useful instrument for studying direct currents, especially since Salomonson substituted field wires for field magnets and used this electrodynamic instrument as an electrometer and a wattmeter. The present author tried to apply it to alternating currents, but found that as soon as alternating current was used, the black string on the bright background disappeared from view. He states, however, that when the background is dark and the string is illuminated in a direction making a small angle with the optic axis of the micrometer microscope, the instrument becomes available for alternating current. Then, when alternating current is applied, the bright string broadens out into a bright band with sharply defined edges, whose position can be read on the scale to within a tenth of a division. The background must not be entirely black, as otherwise the micrometer scale would disappear. The author has obtained a width of two scale divisions from a current of a millionth of an ampere. For the same frequency, the width of the band is an accurate measure of the current strength, but the scale must be calibrated separately for each frequency. The instrument is specially adapted to the comparison of telephone currents.—From *Phys. Zeit.*, July 1; abstracted in Lond. *Elec. Eng'ing*, July 18.

Starting Current Ammeter.—The recent rules of the German Association of Electrical Engineers require that the starting current of a motor should not exceed a definite limit depending on the output. But owing to the fact that the initial value of the current is only momentary, the first swing of an ammeter will not measure it correctly, as the amplitude of the swing depends on the amount of damping. An instrument designed to overcome this difficulty has lately been put on the market. It is provided with [illegible] this the pointer may be carried round to any desired part of the scale. The pointer will then move only when the current exceeds the value corresponding to the position in which it has been placed. The position in which the pointer just moves when the circuit is closed is found by trial.—Lond. *Elec.*, July 26.

Three-Phase Meter.—An official communication by the German Reichsanstalt admitting a certain three-phase meter of the Siemens-Shuckert Company for calibration. It consists of two induction motors, the armatures of which are on the same axle, with a magnetic brake for each armature and with a common counting device.—*Elek. Zeit.*, July 18.

Telegraphy, Telephony and Signals.

Influence of High Tension Lines on Telephone Lines.—[illegible] SCHROTTKE.—The conclusion of his long paper in which the author attempts to calculate numerically the electrostatic induction of high-tension transmission lines on telephone lines in the neighborhood. His theoretical explanations are illustrated by numerous examples and some notes are also given on the problem of preventing electrostatic induction. In the appendix a collection of formulas is given for finding the "partial capacities" of conductors which are required for the calculation of the induction.—*Elek. Zeit.*, July 18.

Miscellaneous.

Electric Cooking.—An illustrated account of two heating and cooking installations in Switzerland of considerable size. At the Hotel Moserboden a load of 93.4 kilowatts results from the requirements of the kitchen, laundry and hot-water plant alone, irrespective of the power required for heating the hotel. At the Eismeer station on the Jungfrau the whole of the cooking is effected electrically by energy taken from the railway. Details are given of the apparatus in use and diagrams show the construction of water heaters, drawing-room stoves, baking ovens and ovens adapted for combining electric and coal heating.—Lond. *Elec.*, July 19.

Burner for Cutting Metals.—M. U. SCHOOP.—An illustrated description of a burner for cutting metal sheets, which consists of an ordinary oxygen-acetylene, oxygen-illuminating gas or oxygen-hydrogen burner, such as used for autogenous welding of metals, but provided with an additional small tube for separately supplying oxygen gas for cutting. First the oxygen supply is closed and by means of the simple heating burner the metal to be cut is heated to white heat along the line where it is to be cut afterwards. The oxygen supply is then turned on and the current directed against the metal along the cutting line. Under the action of the oxygen the autogenous burning of the iron starts immediately and the sheets are cut into pieces with sharp edges.—*Electrochem. and Met. Ind.*, August.

BOOK REVIEW.

LA TELEGRAPHIE SANS FILS. Par E. Monnier. Preface de E. Branly. Paris: H. Dunod et E. Pinat. 142 pages, illustrated. Price, 2 francs.

As the title implies, this little volume is written for the purpose of popularizing the subject of wireless telegraphy. Hence the simple elementary details which are given of a primary battery, a Ruhmkorff coil, a Hertzian oscillator and Branly coherer. These are followed by a brief description of the relay, antenna and other necessary parts of a wireless outfit.

Under the heading of telemechanics, reference is made to the control of various mechanisms and devices from a distance by means of electric waves. Such instances are given as the starting of ventilating machinery, the blowing up of submerged mines, and the direction of torpedoes. Details of how all this can be done are not given.

This little work can be read with interest and advantage by the non-technical reader.

Compact Resistance Unit.

The resistance unit illustrated herewith consists of a single layer of high-grade resistance wire embedded in Di-el-ite, a material having the same strength and mechanical qualities as good bluestone. When desired, the unit can be made ironclad,

COMPACT RESISTANCE UNIT.

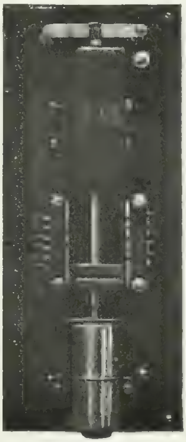


FIG. 1.—AUTOMATIC MOTOR STARTER.

in which form it will withstand a considerable amount of mechanical abuse. For intermittent work the large specific heat of Di-el-ite permits of a high rate of work, while for continuous service the resistance unit produces excellent results. Units of the above type are built for resistances varying from 1 to 10,000 ohms. They are manufactured by Charles Wirt & Company, Philadelphia, Pa.

Self-Starter for Motor Service.

Herewith is illustrated, Figs. 1, 2 and 3, a simple form of self-starter manufactured by the Ward Leonard Electric Company, of Bronxville, N. Y., together with wiring diagrams

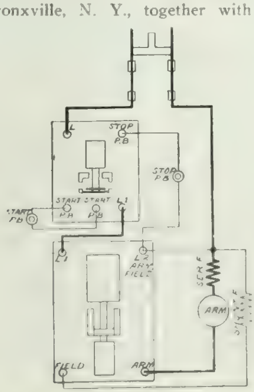


FIG. 2. MOTOR STARTER USED WITH A SELF-CLOSING SWITCH.

for same. The diagram, Fig. 2, shows the self-starter in use with a self-closing switch, and Fig. 3 shows it with a Ward Leonard float switch. The self-starter is equipped with a no-voltage release protective device. The resistance is in the form of enamelled resistance units of the enclosed ventilated type, readily removable. It is simply necessary to close a switch and the device will automatically start any kind of direct current motor of its rated horse-power and voltage with which it is used. This fact is an important one, for it makes the starter universal and assists the purchaser as it is only necessary to state the line voltage and the horse-power of the motor.

A self-starter of this character is an economical device in more ways than one, as it takes the starting operation out of the hands of unskilled men, leaving it merely necessary to push a button or close a switch.

Steel Reels and Spools for Wire and Cable.

For years it has been the practice to ship wire and cable on heavy wooden reels, while the smaller sizes of wire are wound on wooden spools. Not only is this still true of shipping, but

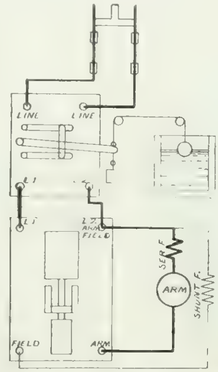
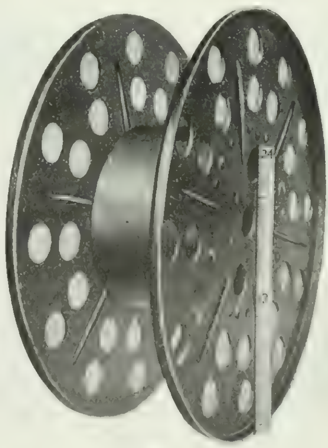


FIG. 3. MOTOR STARTER USED WITH A TANK SWITCH.

also in the handling and rehandling of wire for various purposes. The cumbersome wooden reel is an easy prey for rough usage and naturally necessitates much repair work in order to be kept fit for service. The Frank Mossberg Company, of Attleboro, Mass., has brought out a line of patented pressed steel reels and spools to take the place of the wooden devices now in use. The reels and spools are made with diameters of



PRESSED STEEL REEL.

flanges varying from 2⅛ ins. to 48 ins. and combine strength with moderate weight. Twenty-five different varieties of reels are made and special sizes are procurable to meet certain requirements. The steel reel is much more economical and serviceable than the old style wooden arrangement it is designed to supplant and may be used in connection with handling wire for braiding and twisting machines, vulcanizing wire, winding magnet and fuse wire, shipping wire and cable.

Flush Push Button Switch and Wall Cases.

The accompanying illustrations show respectively an iron conduit box, [illegible] a two-gang wall case, and a shallow push button switch in wall case, brought out by the Machen & Mayer Electrical Manufacturing Company, of Philadelphia, Pa. The wall cases are made of sheet steel and are two inches deep. They are provided with four knockout plugs, two in each end. The plugs are locked in position in such a manner that any one of them can be readily knocked out by a blow from a hammer without interfering with the others. The company also makes an extra unit by means of which gang boxes can be readily made by fastening the units together with one single box and steel strips furnished for the purpose. This enables the contractor to carry a stock of [illegible] which may be made into gang [illegible]

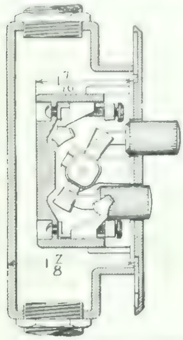


FIG. 1.—IRON CONDUIT SWITCH BOX.

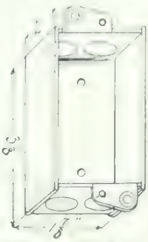


FIG. 2.—WALL CASE.

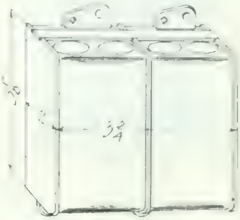


FIG. 3.—GANG WALL CASE.

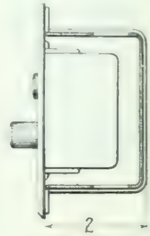


FIG. 4.—FLUSH PUSH BUTTON SWITCH.

as required. The wall cases while only two inches deep allow as much space for wiring with the company's shallowest flush push button switches or its receptacles as a box one inch deeper will allow with switches of other makes.

The conduit boxes are made for from one to ten gangs and are two inches deep. They are designed to allow ample room for wiring the company's switches and receptacles and are [illegible] plugs of the same character as the wall cases.

The company's shallowest flush push button switch will fit any standard box, giving an inch more space for wiring in the box than any other switch on the market. This is an advantage especially where there are splices in the wires or a cable running into a box when it has been found impossible to install the ordinary switch without the use of a wood mat in some cases.

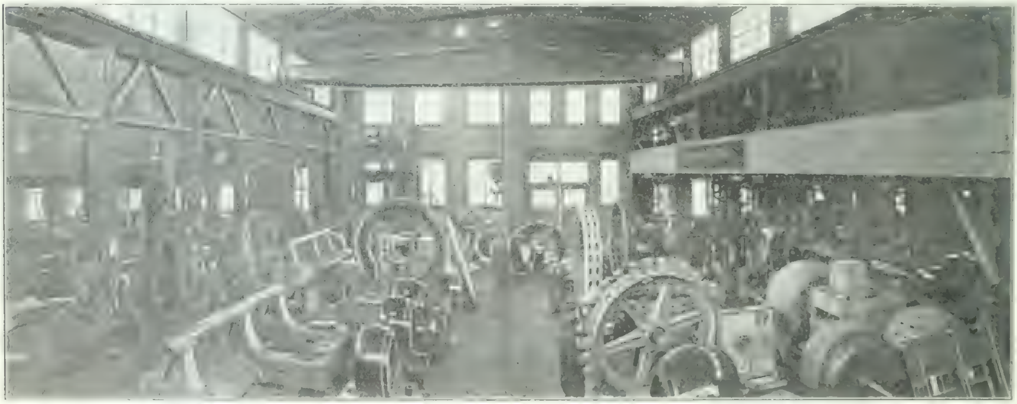
Manufacture of Dynamo-Electric Machinery at Sandusky, Ohio.

The Warren Electric Manufacturing Company, as a result of costly and unfortunate experiments with a new type of steam turbine, which it proposed to introduce, went into the hands of receivers in October, 1905, and in March, 1907, its business was sold out by order of the court, at public sale to the highest bidder. The purchaser was the Warren Electric Manufacturing Company, of Sandusky, Ohio, a new corporation formed with $175,000 capital, all paid in.

As a result of these events and changes, the new company not only has an excellent shop equipment, but plenty of working capital. Not satisfied, however, with its plant as acquired, it has already installed a number of modern machine tools, and is to add still further to its facilities in this respect. A view is shown herewith of the present interior of the shop, where several large alternators are under construction.

The old company made only alternators of the inductor type, and in comparatively small sizes, whereas the present company manufactures both inductor and revolving-field alternators up to 750 kw. Some such machines are now under construction. The company is also about to put on the market a full line of alternating and direct-current motors, which will embody some novel features and will be described later.

The president of the Warren Electric Manufacturing Company is Willard H. Nason, who is also the president of the Brilliant Electric Company, and is well known in the electrical field. Mr. Norman L. Hayden, the vice-president and general manager, was for ten years president of the Hayden & Derby Manufacturing Company, of New York, and founder also of the N. L. Hayden Manufacturing Company, of Columbus, Ohio, in which he is still a very large stockholder. Mr. Frank Warren, the secretary, was for years sales manager of the old company and is widely acquainted in this department of electrical industry.



SANDUSKY, OHIO, FACTORY OF THE WARREN ELECTRIC MANUFACTURING COMPANY.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Jobbing trade in fall and winter goods was active at the leading cities, country merchants being in large attendance and operating freely as a rule. Retail sales of seasonable merchandise were liberal, although at some points customary midsummer quiet is noted. While payments are somewhat irregular, mercantile collections show distinct improvement on the whole. A few labor disputes are pending, but there is little interruption in the leading industries, most manufacturing plants working full time and holding orders that promise continued activity. Commodity prices are lower, especially in cases where speculative inflation existed, favorable weather having greatly improved crop prospects. Railway earnings for July, complete for four weeks, show a gain of 9.3 per cent over the same month last year, and foreign commerce at the port of New York indicated an increase of $4,582,514 in value of imports as compared with a year ago. Ideal weather is reported for corn, except in parts of the Southwest; advices from the spring wheat section are better than for some time, and the hot weather benefits cotton. Winter wheat yields are also better than were earlier indicated, but oats are turning out short and light. In the Southwest, Northwest and at large Eastern centers, sentiment as to fall trade has been helped by these developments, and fall buying is becoming more noticeable, as country merchants are coming in in increasing numbers. In some of the large industries, however, quieter trade is reported in some branches, with prices easing. Pig iron and some finished lines are reported lower, and reports show less activity in current building. Steel rails were in relatively good demand, considering the volume of orders placed earlier in the year; new business amounts to about 40,000 tons. Demand for plates continued strong, car builders and shipyards being the principal factors. In the West specifications for structural material came in quite fully, but new business was quiet. Old material is in heavy supply and prices are lower. Although copper has finally worked below 20 cents, many in the metal trade look for still lower prices. *Bradstreet's* reports 157 business failures during the week ending Aug. 8, against 142 in the previous week and 137 in the corresponding week last year.

THE CHICAGO SUBWAY.—It is stated from Chicago that the chief concern of the Chicago Subway at the present time is not how much it can show in earnings, but how well it can handle freight. The volume of traffic offered is expanding daily. The Chicago & Western Telephone Company closed a contract early in the year for the lease of the tunnel company's telephone system. Plans are completed for rushing work on the installation of 100,000 automatic telephones. There are only 7000 or 8000 such instruments in use now, but according to the terms of the contract there must be 20,000 by the end of the first year, and not less than 10,000 additional each succeeding year until the total has reached 100,000. An order for all the equipment was placed some time ago with the Automatic Electric Company, involving about $4,000,000. The lessor company collects all revenue until 20,000 instruments are installed, but its compensation will be only $5 per year for each telephone if the agreement is carried out. Then the lease will be signed and the new company will pay $1,500,000 for the plant as it stood Jan. 1, 1907. The lease runs during the life of the franchise, 27 years. Subsidiary companies will take care of the long distance business.

UTILIZING TOLT RIVER.—The Tolt Power & Transportation Company has petitioned for the condemnation of certain lands in King County adjacent to the Tolt River, State of Washington. The company was organized to utilize the water power of the Tolt River and to convey water by ditches or flumes to points of use, and also to develop and furnish electric power to cities and towns in King County. The petition states that there is urgent demand for 50,000 electric horsepower in the cities and towns of King County, and in order to supply it the petitioners intend to secure franchises and rights-of way. It is stated in the petition that the company does not want the timber condemned now on the lands which are desired, and that it is willing the present owners should cut it off. The lands desired are owned by the Weyerhaeuser Timber Company and the Thomas Irvine Timber Company.

THE NEVADA-CALIFORNIA POWER COMPANY, after more than a year of quiet work, has announced its plans for the complete gridironing of the state of Nevada with high voltage power lines, which will call for the expenditure of more than $15,000,000 and will establish the longest power circuits in the world. This company now owns a third of the taxable land in Alpine County in California, where it has power generating facilities of the most extensive character. Thence it will run power lines that not only will supply Reno, Carson, Virginia City, Goldfield, Tonopah, Rhyolite and all of the southern Nevada mining camps, but will reach over into Greenwater and Death Valley copper districts and thence clear across the state of Nevada to Ely and the Cherry Creek mining district with a 100,000-volt line.

THE TELLURIDE POWER COMPANY, which owns extensive power-plant properties in Colorado, Utah and Idaho, and of which L. L. Nunn is manager, has secured the Bear Lake reservoir site and will impound the flood waters. These will be used for the irrigation of some 30,000 acres of land, but the principal feature of the enterprise is the generation of power which will be taken southward for use in Utah. The project is on a large scale. Four hundred cars of pipe are arriving. The pipe line is eight feet in diameter. Five miles of this pipe will be laid down the canyon, securing a head of some 500 feet for the feed pipe supplying the water wheels. This plant will cost about $2,000,000, and is the greatest undertaking of the kind in the state.

GENERAL ELECTRIC ORDERS.—A statement issued by the General Electric Company shows that the company in the first six months of the current fiscal year received orders aggregating a valuation of $35,096,117, as compared with $28,966,922 in the corresponding period of last year. Sales billed in the first half of the current fiscal year aggregated $35,406,878, as compared with $25,915,762 in the corresponding period of last year. The company is pursuing a conservative policy, however, as to the immediate future, believing that the anti-corporation agitation must necessarily tend to restrict new business, until there is a change for the better.

PALACE HOTEL, SAN FRANCISCO.—The Palace Hotel Company has accepted the bid of the Westinghouse Electric & Manufacturing Company for four 300-kw, three-wire, 250-volt, 150-r. p. m. engine-type generators, together with four generator panels and nine feeder panels. Each feeder will be protected by an automatic circuit-breaker, mounted on the feeder panel. The complete electrical equipments will be installed under the supervision of the Westinghouse engineers.

BIDS INVITED FOR PLANT.—Bids will be received until Aug. 27 at the City Hall of Trenton, Ill., for furnishing and erecting addition to building, engine, dynamo, switchboard, heater, boiler feed pump, piping and pole line material, for extending the present direct-current three-wire lighting system. Specifications are on file at the office of Newton Rule, city clerk, at Trenton, Ill., and at the office of the engineer, W. A. Fuller, 1122 Chemical Building, St. Louis, Mo.

WEST POINT, GA., DEVELOPMENT.—Among the recent developments in the South, there is little doubt that the undertaking of the West Point Manufacturing Company, of West Point, Ga., is one of the most extensive of the current year. This company through its engineers, Mr. Chas. T. Main, of Boston, Mass., and his hydraulic expert, Mr. John E. Porter, is making an installation at Langdale, Ala., a few miles below West Point, which will harness the waters of the Chattahoochee River. A reinforced concrete power house approximately 40 feet wide by 200 feet long will be built at one end of the dam, and in this plant will be installed the hydraulic and electrical machinery. The hydraulic equipment will consist of two 30-in. and eight 60-in. improved New American turbines which will be of the vertical shaft type and arranged for installation

in open concrete flumes. These turbines will operate under 13 ft. head and develop over 3000 horse-power. The vertical shafts will be extended sufficiently to place the gearing and harness work for the horizontal shafts on the power-house floor approximately 10 feet above head water level. Each of the 39 in. wheels will drive by means of bevel mortise gears a horizontal shaft at 168 r. p. m. from which a 100-kw exciter will be belted. Four of the 60 in. turbines will drive a 750-kw, 150-r. p. m., 3-phase, revolving-field, 60-cycle generator, there being two turbines on each side of the generator, connected by means of bevel mortise gears to horizontal shafts which will be directly coupled to both ends of the generator shaft. The other for 60 in. turbines will be divided into two parts, each consisting of two wheels geared to a common jack shaft and direct-connected to a 550-kw, 150-r. p. m., 3-phase, revolving-field, 60-cycle generator. There will be 19 sets of head gates for regulating the flow of the water into the wheel chambers, each of these gates being about 8 ft. 6 ins. wide and 10 ft. 6 ins. high, of the double-stem type and operated by special worm wheel and spur rack hoisting mechanisms. The water-wheel machinery complete with all gearing harness work, head gate hoists, trash racks, etc., is being built by the Dayton Globe Iron Works Company, of Dayton, Ohio, while the electrical apparatus will be furnished by the Westinghouse Electric & Manufacturing Company.

WESTINGHOUSE BUSINESS.—If the country is on the eve of a business recession, says the *Wall Street Journal*, the showing of the Westinghouse companies does not reflect it. It is significant that all of the Westinghouse companies are not only working to their full capacities, but that orders continue to be received in excess of the average shipments. The Westinghouse Air Brake Company closed, on July 31, its most prosperous fiscal year with the largest gross and net earnings in its history, and has now more men on its payroll than at any previous time. The Union Switch & Signal Company, which is adding to its plant to meet the increased demands for its apparatus, has in gross and net earnings for the first six months of the present year exceeded the figures of the corresponding period of last year, indicating, with orders and contracts in hand, that more men rather than less will be required in the near future. The Westinghouse Machine Company, makers of turbines, gas and steam engines, has also shown a large increase in gross and net earnings for the first four months of the present year, and has a large volume of orders in hand which is being constantly augmented by the receipt of important new ones. The Westinghouse Electric & Manufacturing Company continues to improve its showing in shipments and in receipt of new and profitable orders. It is now expected that the Electric Company's shipments for August will be greater than in any previous month of its history, and with the new orders already received orders for the month will be in excess of shipments.

A WONDERFUL BATTERY of the primary type is again heralded to a waiting world in the following special dispatch from Milwaukee, of Aug. 8: "A company has been formed in Milwaukee with $5,000,000 capital to put on the market a new battery which will provide electric light, heat and power at astonishing prices. A house can be fitted up for $200, it is declared, and the company will retain $175 of this as profit. Frank C. Curtis, a local chemist, has discovered a chemical compound which, used in a new style of battery, develops great power. The device has been in use on the Northwestern Railway for three months and in cars of the Pullman Company for the same time and will be installed on all cars of these companies. The new company has as its leading stockholders the Pullman Company, President Marvin Hughitt of the Northwestern Railway, President Underwood of the Erie Railway, E. H. Johnson, superintendent of the Western Union at New York; Frank Taber, of Denver, a mining engineer, and others. The company will not put its stock on the market, the entire amount having been subscribed for after the railroad test was completed." President Underwood doesn't seem to know much about this, and Superintendent Johnson is an unknown quantity.

TRUCKEE RIVER DEVELOPMENT.—The Nevada Consolidated Mining & Milling Company, Reno, Nev., has an extensive electrical equipment, comprising an 85-kw, three-phase, 1150-volt, 60-cycle generator belted to an Erie automatic engine, supplying the town of Olinghouse with light and power, and the mines of the Nevada Consolidated in the White Horse district. The 50-stamp mill belonging to the above company is situated six miles below on the Truckee River, and the arc and incandescent lighting and nine motors already installed are driven by a 75-kw, 250-volt, direct-current generator, belted to an Erie engine. The company is preparing to instal a 600-hp hydroelectric plant on the Truckee River, having contracted with the Government for the necessary power to be taken from the Truckee-Carson irrigation canal Fifty more stamps are to be added to the mill, and the entire 100 will be motor driven The Nevada Consolidated also controls the Wadsworth Light & Power Company supplying that town with electricity and water. Hence the Nevada Consolidated Company is in the market for quite a large amount of equipment. All the existing plant is Westinghouse. Mr. Frank Huff is the chief electrician.

POWER IN TEXAS.—According to advices from Rockdale, Tex., Messrs. Joseph J. Henry and T. B. Burbridge, of Denver, Colo., have been there in the interests of a proposed $3,500,000 electric power system in the lignite fields near the town of Rockdale. This concern will erect a large power plant in the coal fields and transmit to cities over the state. The plan is to offer each local company a fair price for their plant and franchise and if they refuse to sell, secure a franchise and freeze the little concerns out. But where little concerns will contract to use their power they offer the same to them at a lower rate than the present cost of production. Mr. Burbridge, in addition to a franchise in Waco, now has option on plants in Taylor, Temple, Rockdale, Waco, Cameron, Bryan, Hearne, Calvert, Belton and one representative is now working on Austin and Houston, while others close with Brenham, Marlin, Palestine, Georgetown and other towns in the circuit.

WHERE IT HURTS.—A special dispatch from Boston, of Aug. 13, says: "A Boston capitalist who has created many millions of wealth in the building of street railways, water powers, etc., says: 'The administration has started a wave of hysterical prejudice against corporate interests from the Atlantic to the Pacific over which the President no longer has control and which he could not stop if he desired to. It is a counterpart of the Granger agitation in the 70's, which, when started, had to run its course. I have plans in embryo for the organization of two immense water power propositions, but I have shelved them for 12 months, for I realize that it would be foolhardy to attempt to finance any new propositions now and I can see no promise of any change in conditions for a year. Business will naturally feel the effect of the general suspension of new construction and new enterprise.' "

CHICAGO DRAINAGE POWER.—It is stated that the Department of Electricity of the city of Chicago is making preparations to extend the underground conduit system for its various wires. Several extensions will be made at different points about the city, but the principal part of the present work will be the construction of a new conduit on Western Avenue to accommodate the cables which will carry the electrical energy contracted for from the Lockport plant on the Drainage Canal. Over 38,000 feet of six-duct and eight-duct conduit will be laid in concrete.

MECHANICAL DRAFT for boilers is being installed by the B. F. Sturtevant Company, of Boston, Mass., for the Kitson Machine Shops, Inc., Lowell, Mass.; R. B. Whitacre & Co., St. Paul, Minn.; State Hospital, Morganton, N. C.; Bemis & Call, Springfield, Mass.; General Chemical Company, Dundee, N. J.: General Chemical Company, Laurel Hill, L. I.; Lovegrove & Company, Inc., Philadelphia, Pa., and International Paper Company, Otis Mill, Chisholm, Me.

SOUTH CAROLINA POWER. — The Savannah River Power Company has begun development work at Cherokee Falls and Calhoun Falls, on the Savannah River, below Anderson, S. C. About 40,000 electrical horse-power will be developed. A large cotton mill has been built at Calhoun Falls, two and one-half miles from the power site. Other developments are contemplated in the vicinity.

ANTI-TRUST WAR.—The attorneys general of the Mississippi Valley states met at St. Louis on Aug. 12, to formulate plans for a National conference of attorneys general, at which concerted action to enforce various state anti-trust laws can be arranged. The meeting was at the invitation of Attorney General Herbert S. Hadley, of Missouri.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., have installed power station cranes, one of 20 tons capacity for the Toledo Gas & Electric Company, and two of 20 tons capacity in the Murphy Power Plant at Detroit, Mich.

Financial Intelligence.

THE WEEK IN WALL STREET.—Various influences were at work during last week to supplement the fervent heat of summer in taking the elasticity and spring out of the stock market. In England, consols went to their lowest point in 60 years, back to the levels of the days when Louis Napoleon was planning coups d'etat and new empires and alarming the good folk across the Channel. In the Mediterranean, France and Spain have been hammering at the seaward gates of Morocco, while Germany looked on in ill-concealed envy and disgust. In these United States, the height of the wave of hatred and revenge against trusts was seen in the infliction of a fine of nearly $30,000,000 on that sinner and scapegoat, the Standard Oil Company, for rebating, and for indulging in practices that are only too common, but which in the case of these big "combines" are subject to well-defined legal pains and penalties. On top of all this has come the threat of other fines on the railroads. A market that held its own under all these adverse conditions would be a marvel. People who are tired of prosperity never have to suffer long from the grievance, and last week saw losses inflicted on the nation that hardly a civil war could match. There must and will be a change, a swing of the pendulum toward the sane and normal, but in the meantime we must all take part of the loss forced upon the country as a whole by the exaggerated fear of capital in a day when labor earns more than it ever did and when capital never received so small a percentage of the wealth it helps to create. Fortunately there are signs of sober second thought, and even should prices go lower they will merely offer the greater inducement to investors and the growing number of those who save something every year. The course of prices during the week was downward and then to a lower scale, and the depression of last March has been more than equalled. The above table gives the quotations of Aug. 13.

NEW YORK.

	Aug 6	Aug. 13		Aug 6	Aug. 13
Allis-Chalmers Co	19	9¾	General Electric	[illegible]	[illegible]
Allis-Chalmers Co. pfd	26	25	Hudson River Tel	—	—
Am. Dist. Tel.	—	—	Interborough Met	[illegible]	[illegible]
American Locomotive	56	53	Interborough Met pfd	[illegible]	[illegible]
Amer. Locomotive pfd	105	[illegible]	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable	75	—	Mackay Cos. pfd.	[illegible]	[illegible]
American Tel. & Tel.	—	[illegible]	Marconi Tel	—	—
Brooklyn Rapid Transit	53[illegible]	46½	Metropolitan St. Ry	—	—
Electric Boat	33	—	N. Y. & N. J. Tel	—	—
Electric Boat pfd.	8[illegible]	—	Western Union Tel	[illegible]	[illegible]
Electric Vehicle	—	—	Westinghouse com	[illegible]	[illegible]
Electric Vehicle pfd	—	—	Westinghouse pfd		

BOSTON.

	Aug 6	Aug 13		Aug 6	Aug 13
American Tel. & Tel.	107¼	105	Mass. Elec. Ry. pfd.	55	54
Cumberland Telephone	—	102	Mexican Telephone	2	—
Edison Elec. Illum.	211	209	New England Telep.	109	—
General Electric	—	—	Western Tel. & Tel.	—	—
Mass. Elec. Ry.	—	12½	West Tel. & Tel. pfd		

PHILADELPHIA.

	Aug 6	Aug. 13		Aug 6	Aug. 13
American Railways	48	48	Phila. Electric	[illegible]	7⅞
Elec. Co. of America	9⅛	8⅞	Phila. Rapid Transit	19[illegible]	16⅞
Elec. Storage Battery	50	47	Phila. Traction	—	93
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Aug 6	Aug. 13		Aug 6	Aug. 13
Chicago City Ry.	155	[illegible]	National Carbon	[illegible]	—
Chicago Edison	—	—	National Carbon pfd	[illegible]	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.	—		Union Traction pfd.	—	—
Metropolitan Elec. com	[illegible]	[illegible]			

INDEPENDENT TELEPHONE BONDS.—Full details have been given out of the proposed reorganization plan devised by the committee of three for the United States Independent Telephone Company. The agreement which the bondholders are asked to sign binds them to take bonds of the new company that will be formed as the result of the reorganization to an amount equal to 20 per cent of their present holding of bonds. The consents are not to become binding unless signed by 90 per cent of the bondholders of the United States and Securities companies. The new company will issue $6,000,000 stock and $3,250,000 bonds. With each purchase of bonds the bondholders of the United States company will receive 40 per cent of stock, based on the present holdings; each bondholder of the Securities company will receive 45 per cent of his present holdings. The existing property, which includes the Stromberg-Carlson Company, is regarded as being worth twice the amount of the bonds. Persons who own a $1,000 bond of the United States company, upon paying $200 will receive $200 in bonds of the new company, and $400 in stock. Each person owning a $1,000 bond of the Securities company will receive, on paying $200, bonds of the new company for $450 and stock for $400. The bonds of the Securities company are regarded as much more valuable than those of the United States company; hence the larger percentage of bonds and stock of the new company given for the payment of the 20 per cent of the face value of the present bonds that will be foreclosed. The plan specifies the uses to which the $3,000,000 of bonds are to be put. The exact division will be: Rochester Telephone Company, $840,000; Syracuse Telephone Company, $840,000; Utica Telephone Company, $70,000; Stromberg-Carlson Company, $1,000,000. The $1,000,000 is furnished to the Stromberg-Carlson Company by purchasing and carrying the outstanding notes of the company, aggregating $775,000, and lending the company $225,000. The sums to be furnished the Rochester, Syracuse and Utica companies will enable such companies to pay off all floating indebtedness and make substantial provision for the extension and completion of these systems on a business basis. There is a margin of $250,000 left out of the $3,000,000 bond issue for emergencies. It is proposed to raise telephone rates all around.

BOSTON EDISON GROWTH.—Advices from Boston discuss the local situation as follows: "Since the Edison Company declared the extra dividend of 1 per cent on its stock last June, the question has naturally arisen as to its continuance. Speaking of the company's dividend policy, an official says: 'When the directors at their last meeting voted to declare an extra dividend of 1 per cent, their action was based on the results for the year ended June 30 last. The net earnings for that period were so satisfactory that the directors felt justified in making an extra disbursement, especially as a reduction in electricity prices had been made to consumers during the year. As to the continuance of the extra dividend the board took no position. The petition now before the gas commissioners for a further reduction in electricity prices is a factor the result of which will have a bearing on any further extra dividend declarations.' Prices of the Edison Company of Boston have averaged 8 per cent to 10 per cent lower this year than during the previous year, and the customers used electricity from 5 per cent to 6 per cent longer in time during the previous year. The gross earnings for the year were approximately $4,050,000, against $3,780,911 for the fiscal year ended June 30, 1906."

BELL TELEPHONE SITUATION.—Advices from Boston state that since Jan. 1 last, the subsidiary companies of the American Telephone & Telegraph Company have been making marked progress in the reduction of their floating debt. It has been one of the cardinal principles of the present administration that the associate companies should cut down the total of their obligations which they owe either to the outside public or to the Western Electric Company. On Dec. 31, 1906, 23 of the subsidiary companies had outstanding accounts payable of $75,518,451, against which were bills receivable of $16,941,282, leaving a net floating debt of $58,577,169. Since the first of the year 15 of the associate companies have issued new securities to the extent of $45,736,100 for the reduction of floating debt, etc., and it is figured that the floating debt has thus been reduced 70 per cent in the last seven months.

CUMBERLAND TELEPHONE.—The Cumberland Telephone stockholders have approved an increase in the authorized capital stock from $20,000,000 to $20,200,000. The increase of $200,000 was made to allow sufficient authorized stock to meet the October subscriptions on the $3,362,400 new stock offered to stockholders last January. The final payment of 25 per cent is to be made Oct. 1.

QUEENS ELECTRIC BONDS.—There was a hearing last week before Commissioner McCarroll, New York City, on the application of the New York & Queens Electric Light & Power Company for the approval of a bond issue. The company expects to issue bonds for about $1,000,000. The money is to be used for extensions and improvements.

WILLIAMS TELEPHONE & SUPPLY.—An involuntary petition in bankruptcy has been filed against the Williams Telephone & Supply Company, by the White Tool & Supply Company, the Cleveland Tool & Supply Company and Bates, Fouts & Hull, attorneys. It is alleged that the company owes debts of about $45,000, and that it has [illegible] its inability to pay them.

DIVIDENDS.—The North American Company, which controls various large lighting properties, has declared a quarterly dividend of 1¼ per cent on the capital stock, payable Sept. [illegible]

GENERAL NEWS

Construction News.

[illegible] constructing an electric light plant [illegible]

[illegible]

[illegible] municipal electric light plant, the installation of additional machinery [illegible]

DUNSMUIR, CAL.—The Southern Pacific Railroad Company has made application for permission to take 5000 miners' inches of water from the Sacramento River at Dunsmuir. The company proposes to erect an electric plant at this place to furnish electricity for the operation of its railway shops.

EXETER, CAL.—Glass & Fisher have secured the contract for the construction of the new power house of the Visalia Electric Railway [illegible] and will cost $20,000. The power station will furnish electricity for operating the electric railway between Exeter and Lemon Cove.

LOS ANGELES, CAL.—The West Ninth Street car line is to be extended from its present terminus at Tenth Street and Vermont Avenue to Grammercy Place.

[illegible] to complete its transmission line from the Rome power house to the Alaska mine at Pike City, a distance of about ten miles, during the fall when the machinery at the mines will be operated by electrical instead [illegible]

[illegible] Ockenden, which include the construction of an electric light plant and an artificial lake. The electric plant will have sufficient capacity to light the canyon adjacent to Ockenden.

REDDING, CAL.—At a recent special meeting of the stockholders of the Pacific Power Company, it was decided to place 150,000 shares on the market among the big stockholders and their friends on the installation plan, the installments aggregating sufficient each month to carry the proposition through to a successful issue, completing the auxiliary plant and placing poles and wires to Red Bluff.

SAN JOSE, CAL.—Charles J. Kuhn, general manager of the National Park Electric Power Company, writes that preliminary work is now being [illegible] the [illegible]

SONORA, CAL.—All the property and extensive holdings of the Big Creek Mining Company are to be taken over by a syndicate of Maine and Massachusetts men, of which Lester Wiley is managing director. All surveys for the installation of an electric plant have been completed. The plant will have a capacity of 22,000 horse-power. It is said that the pipe line alone will cost about $250,000.

STOCKTON, CAL.—The Stanislaus Electric Power Company, which is building a large power plant on the Stanislaus River in Toulumne County, is procuring rights of way for its transmission line through San Joaquin County. Rights through Calaveras County from the plant, 12 miles east of Vallecito, have been procured and the line will run from that point direct to San Francisco. The company expects to develop 30,000 horse-power. The transmission line is to be carried on steel towers 50 feet high, placed from 800 to 1000 feet apart.

STOCKTON, CAL.—The City Trustees of Stockton have been temporarily restrained by injunction proceedings brought by the Stockton Gas & Electric Company, from enforcing a recently adopted ordinance regulating the rates of gas and electricity charged to consumers by the corporation. The company has also asked for a permanent injunction and for a judgment, declaring the Council acted in excess of its authority in attempting to fix the rates. The hearing has been set for Sept. 3. The suit will determine the legality of the ordinance. The company alleges that the rates at which it has been supplying gas and electricity to its customers are reasonable and only sufficient to enable return on the investment. It alleges that the rates fixed by the Council are not sufficient to earn a just return. The rates fixed by the Council were [illegible] cents per kw-hour for electricity for lighting, and 4 cents per kw-hour [illegible]

ROCKY FORD, COL.—It is reported that the city authorities are con[illegible]

BRIDGEPORT, CONN.—[illegible] an addition to the boiler house and installing a new engine at the power plant of the Bryant Electric Company.

BRISTOL, CONN.—The town authorities have entered into a contract with the Bristol & Pl[illegible]

[illegible]

[illegible] work of surveying and laying out the site for the power plant to be erected in the town of Kent and for location of the dam to be built at that place.

[illegible] of Pittsburg, Pa.

WALLINGFORD, CONN.—Work is progressing rapidly on the municipal auxiliary electric lighting plant at "Quinnie," and it is expected to have the plant ready for operation about the first of October, when a day service will be established.

WATERBURY, CONN.—Owing to low water the power plant of the New Milford Power Company at Bulls Bridge, which furnishes electricity for operating the light and traction systems in the Waterbury, New Britain and Southington districts of the Connecticut Railway & Lighting Company, is unable to meet the demands made upon it. The two local steam plants have been put in operation, and the steam plant at Milldale is now furnishing power for the electric railway system at Southington.

WASHINGTON, D. C.—[illegible] plies and Accounts, Navy Department, Washington, D. C., until Sept. 3, to furnish at the navy yards, and naval stations the following supplies: Mare Island, Cal., schedule 192—incandescent lamps, electric fixtures, etc. Puget Sound, Wash., schedule 201—incandescent lamps, electrical fittings, etc. Also until Aug. 20 as follows: Newport, R. I., schedule 168—motors. Schedule 181—battery cells. New York, N. Y., schedule 143—wireless telegraph apparatus. Schedule 169—insulators, porcelain tubes, resistances, dry cells, etc. Schedule 170—hydrometers. Schedule 181—portable voltmeters and ammeters. Annapolis, Md., schedule 178—duplex and boiler feed pumps, tools, etc. Schedule 179—electrical instruments, etc. Schedule 181—copper conductor. League Island, Pa., schedule 168—electric panel boards. Washington, D. C., schedule 173—motor, starting panel, circuit breaker. Applications for proposals should designate the schedule desired by number. E. B. Rogers, paymaster general, U. S. A.

AMERICUS, GA.—Work has commenced on the large electric plant to be installed in Americus. Under its franchise the company will construct and operate a street railway system, and furnish the city with electricity and water for a term of 20 years.

COLUMBUS, GA.—Electricity is rapidly displacing steam for manufacturing purposes in this city. Practically all new manufacturing plants are operated by electricity, and it is said that several older industrial enterprises are considering electrical installations.

COLUMBUS, GA.—The Georgia Fertilizer Company has contracted with the Columbus Power Company to furnish electricity for operating its new plant, which is being built several miles east of Columbus. The Columbus Power Company will erect a new transmission line from its plant on the Chattahoochee River to the site of the new plant, a distance of between five and six miles.

COLUMBUS, GA.—The Central of Georgia Railway Company has decided to equip its shops in this city with electrical machinery, and has entered into a contract with the Columbus Power Company to furnish electricity for operating the plant. The company also awarded a contract for electrical equipment for its Savannah shops, and the company's new shops now being built at Macon will also be driven by electricity.

ALEDO, ILL.—The City Council has passed an ordinance granting a franchise to the People's Telephone Company, of Mercer County.

GREENFIELD, ILL.—The City Council has granted A. Y. Collins a franchise for an electric light plant.

NAUVOO, ILL.—The Mississippi Valley Electric Railway Company has awarded the contract for the construction of its road to Fort Madison, Ia., to the Federal Construction Company, of New York, N. Y.

OAKLAND, ILL.—The plant and system of the Embarrass Telegraph & Telephone Company has been purchased by Milton Collier, of Dana, Ind. The system includes the exchanges of Oakland, Borton, Redmon and Kansas.

CLAY CITY, IND.—The City Council is reported to be considering the question of constructing a municipal electric light plant.

EVANSVILLE, IND.—Preliminary steps are being taken by the Evansville Gas & Electric Company to place its wires underground in this city.

FT. WAYNE, IND.—[illegible] installation of the distributing system, has been in the city recently to [illegible] commence.

HAZLETON, IND.—C. L. Howard, city clerk, writes that a petition is being circulated for an election to vote on the proposition of construction of an electric light plant.

PETERSBURG, IND.—The Cumberland Telephone Company has refused to accept the franchise offered by the City Council, demanding two per cent on its annual gross earnings and a cash bonus for a 20-year franchise. The company has closed its exchange and is removing telephones from the residences of its subscribers. The Council in retaliation has declared the company interlopers and has given the company 50 days to remove its poles from the streets of the city.

TERRE HAUTE, IND.—E. E. Barclay, of Springfield, Ill., secretary of the St. Louis, Terre Haute & Quincy Traction Company, states that the company will let contracts for construction of its road soon. The road will extend from Terre Haute, Ind., to Quincy, Ill., a distance of about 250 miles. Surveys have been made for 140 miles, and the right of way obtained. Edward Yates, of Springfield, Ill., is president.

WASHINGTON, IND.—The stockholders of the local electric light company have directed the trustees of the plant to turn over to the city all of the books, machinery, etc., putting the plant in direct control of the City Council with power to enter into an agreement with a contractor to repair the plant, taking a mortgage on the property until final payment is made. The purpose is to install new machinery, including boilers and electric apparatus, a new system of arc lamps and extend the wiring system. The city is considering the proposition and may refer the matter to a vote of the citizens.

TULSA, I. T.—The Mid-Continent Traction Company, recently incorporated, will build an interurban electric railway connecting Tulsa, West Tulsa, Red Fork, the Glenn Pool oil fields and Sapulpa. The road will be 20 miles long. Most of the right of way has been secured and construction contracts will be let within 60 days. The officers of the company are: F. L. Smart, of Kansas City, Mo., president; P. J. Evans, of Kansas City, secretary, and Graham Burnham, of Tulsa, I. T., general manager.

WEBSTER CITY, IA.—The City Council is contemplating increasing the capacity of the municipal electric light plant by the installation of another engine and generator.

PITTSBURG, KAN.—F. C. Borden, of Wichita, has secured the contract for erecting the Century Building at Fourth Street and Broadway. The building will cost about $100,000 and will be equipped with an electric plant.

COVINGTON, KY.—The City Council has passed the ordinance authorizing the Mayor to enter into a contract with the Union Light, Heat & Power Company for the erection of 50 additional arc lamps to be placed in Central Covington. According to the terms of the contract the city will get arc lamps at $55 per lamp as soon as 450 lamps are used.

HOPKINSVILLE, KY.—The stockholders of the Cumberland Telephone & Telegraph Company have voted to increase the capital stock of the company from $20,000,000 to $20,200,000, and to move the legal offices of the company to Louisville.

MURRAY, KY.—W. O. Wear, city clerk, writes that bids will be received on Aug. 23, for the purchase of $20,000 in bonds, which were issued for electric light and water improvements.

CUMBERLAND, MD.—The Chesapeake & Potomac Telephone Company has petitioned the City Council for a permit to establish a conduit telephone system in Cumberland. It will cost the company about $100,000 to place its wires underground in this city.

ASHBURNHAM, MASS.—The citizens have decided to call a special town meeting at an early date to vote on the proposition of purchasing the poles and wires of the old electric light company and to take action on the best method of lighting the town.

ATTLEBORO, MASS.—The Attleboro Gas & Electric Company has been given permission by the State Board of Gas and Electric Light Commissioners to issue $75,000 additional capital stock, the proceeds to be used for enlarging the plant.

BROCKTON, MASS.—The Brockton & Plymouth Street Railway Company has petitioned the State Railroad Commissioners for authority to issue additional capital stock to the amount of $110,000, the proceeds to be used for payment of its floating indebtedness.

MARLBORO, MASS.—The Board of Gas and Electric Light Commissioners has given its approval to an issue of 1700 shares of additional capital stock of the Marlboro Electric Company, and has ordered that the new stock shall be offered to the present stockholders of the company at $100 per share. The proceeds of the stock issue are to be used as follows: $35,800 for the payment and cancellation of the entire bonded indebtedness of the company; $90,000 to the cancellation of an equal amount of floating indebtedness of the company, and the balance, $35,200, [illegible] July [illegible]

NEWTON, MASS.—The Newton Street Railway Company and the Waltham Street Railway Company have applied to the State Board of Railroad Commissioners for permission to consolidate under the name of [illegible] cancelled [illegible] retired.

NORTH ATTLEBORO, MASS.—G. K. Webster & Company are making arrangements to avail themselves of electrical power now being furnished by the municipal plant and have installed a 35-hp motor to operate their factory.

WORCESTER, MASS.—The Coughlin Electric Company, of this city, has secured the contract for wiring and installing electric fixtures in the new Slater Building, at Main, Pearl and Elm Streets.

WORCESTER, MASS.—The contract for equipping the fair grounds of the Worcester Agricultural Society for electric lighting has been awarded to W. L. Brown. The equipment will be permanent, so the fair grounds will be available for other purposes at night.

GRAND RAPIDS, MICH.—The City Council has granted a franchise to the Grand Rapids-Muskegon Power Company. W. A. Foote is manager.

IRON MOUNTAIN, MICH.—The [illegible] Company will rebuild its system at this place and install the central energy system at a cost of about $16,000.

LANSING, MICH.—W. E. Tench & Company have secured the contract for the construction work of 40 miles of electric railway for the Lansing-Jackson Interurban Railway. Work will commence at Holt, about five miles south of Lansing. T. W. Atwood is president of the railway company.

PAINESDALE, MICH.—The Champion Copper Company is designing a new plant, which will be located about five miles from its first mining location. The plant will be equipped with two 2000-kw, 13,200-volt, 60-cycle, three-phase generating units and 1500-hp water tube boilers. Three substations will be built, each to be equipped with three 400-kw oil insulated self-cooled transformers. It is expected to complete the building this summer and to install the machinery next winter. The plant will furnish electricity for Painesdale, Trimountain and Baltic. W. A. Rankin is electrical engineer.

TRAVERSE CITY, MICH.—The Carter Construction Company has petitioned for a franchise to construct and operate a street railway in this city.

UNION CITY, MICH.—The improvements to the municipal power plant, which operates the electric lighting and water works systems, has been completed and the service resumed after a cessation of five weeks. The improvements include a new engine and boilers and an addition to the power house.

DULUTH, MINN.—It is reported that the Duluth Boat Club has decided to install a lighting plant at Spirit Lake.

GRACEVILLE, MINN.—The citizens are contemplating improvements to the electric light plant and the water works system, which include the rebuilding of the lines of the lighting system and changing the pumping system. The village will be in the market for an air compressor. H. A. Raitze is superintendent.

ST. PAUL, MINN.—The Minneapolis General Electric Company has served notice upon Mayor J. C. Haynes that it could not comply with the portion of the ordinance, recently passed, requiring the company to reduce its rates for electricity for lighting and power. The Walker ordinance passed last month requires that the maximum price for electricity shall be eight cents for lighting and six cents for power purposes.

JOPLIN, MO.—The Joplin & Pittsburg Street Railroad Company has filed with the city clerk its acceptance of the amended franchise granted by the City Council. Work on the construction of the road will commence as soon as the right of way is obtained.

KANSAS CITY, MO.—The county court has granted W. E. Winner the right of way for an electric railway along the Blue Valley Boulevard. In return for the franchise Mr. Winner agrees to pay one-half of the cost of paving the boulevard and one-half of the cost of the bridge across the Blue River. The electric line is to connect with the Swope Park line of the Metropolitan Street Railway.

ROLLA, MO.—It is reported that an appropriation of $10,000 has been made for an electric plant at the Soldiers' Home.

OMAHA, NEB.—The Independent Telephone Company has been granted a permit to erect an additional story to its exchange building on North Twenty-fourth Street, to cost $5,000.

[illegible] the contract to install an electric light plant.

[illegible] Power Company, writes that the company will install at once a 2000-light alternating current electric plant. The equipment of the plant has not yet been decided upon.

[illegible] voltage power lines, which will call for an expenditure of more than $15,000,000. The company now owns a third of the taxable land in Alpine County, Cal. From there it will build transmission lines that not only will supply Reno, Carson, Virginia City, Goldfield, Tonopah, Rhyolite [illegible] Greenwater and Death Valley copper districts and thence across the state of Nevada to Ely and the Cherry Creek mining district with a [illegible]

BRIDGETON, N. J.—The Bridgeton Electric Company is rebuilding [illegible]

CAMDEN, N. J. [illegible]

[illegible] power house on Cooper's Creek, below Federal Street.

DEAL, N. J.—The New Jersey Consolidated Water & Light Company is contemplating extensive additions and improvements to its plant, which include the installation of a 1500-kw unit and two 200-hp boilers. The plant is to be made condensing, and lines are to be extended to outside territory. F. M. Inman is superintendent.

JERSEY CITY, N. J.—The Board of Freeholders on Aug. 1 awarded the contract for electric wiring the new almshouse to Reis & O'Donovan, 1123 Broadway, New York, N. Y., and the contract for electric light and gas fixtures to Ferdinand Fleshauer, of West Hoboken, for $2,400.

PARK RIDGE, N. J.—The municipal electric light plant has been seized by a United States marshal in execution of a judgment for $6,951, which was obtained in the United States Circuit Court by the engineering firm which installed the plant. The plant, which was to have been run by water power, has not been a success. The builders claim that this is due to inadequate power, not to improper installation, and the decision apparently supports their claim. The plant cannot be operated advantageously until a considerable amount of money has been expended upon it.

ROCKAWAY, N. J.—E. L. Thompson, of Dover, has purchased a controlling interest in the plant of the Rockaway Electric Light Company and will make improvements to the plant at once.

SILVER CITY, N. M.—A. D. Coleman, 1608 Amsterdam Avenue, New York, N. Y., writes that the Forest Power Company, of which D. E. Woods is president, will construct an electric plant, to cost about $250,000.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company, through its subsidiary, the Nassau Electric Railroad Company, has applied to the Public Service Commission for permission to construct tracks on Livingston Street, between Court and Flatbush Avenue, and on Lafayette Avenue, between Flatbush Avenue and Fulton Street, in accordance with the terms of the franchise granted by the Board of Estimate July 29, 1907.

COEYMANS, N. Y.—Zachary T. Vanderpool, of Ravena, has brought an action to restrain the town from carrying out its contract with the Atlantic Light & Power Company to pay $1,600 per year for lighting the village of Ravena with eighty 32-cp electric lamps for a term of five years. When the Town Board advertised for bids for lighting the streets of Ravena the Upper Hudson Electric Company offered to furnish eighty 32-cp electric lamps for $13 a year per lamp, or $1,040 for the year. The Town Board, it is alleged, without any legal reason, threw out the bid of the Upper Hudson Electric Company and accepted the higher bid of the Atlantic Light & Power Company.

FULTON, N. Y.—Work has commenced on the new power house for the Oswego Falls Pulp & Paper Company. The new plant will have a capacity of 2000 horse-power, and will cost between $60,000 and $70,000.

LITTLE FALLS, N. Y.—The citizens have voted in favor of issuing $10,000 in bonds to improve the electric lighting system.

NEW YORK, N. Y.—Owing to the fact that the waste material used as fuel to run the municipal plant for lighting the Williamsburg Bridge has proved unsuitable the plant will be abandoned and the bridge will be lighted by the New York Edison Company. It is said that it cost the city $60,000 each year to operate the plant. The Edison company has agreed to light the bridge for $25,000 per year. The plant will still be used as an incinerator, and may also be used for furnishing heat in the neighborhood.

NIAGARA FALLS, N. Y.—The F. P. Electrical Company, of Buffalo, has secured the contract to install the electric lighting plant on the Niagara State Reservation for $13,731. The plant is to be completed within 90 days.

ROCHESTER, N. Y.—The Board of Supervisors on Aug. 2 passed a resolution authorizing the purchasing agent to advertise for bids for the construction of a lighting plant for the court house, at a cost not to exceed $7,900. The county is now paying nearly $4,000 a year for lighting the building, and it is expected that with its own plant it can be lighted at a cost of about $1,000 per year.

SHERBURNE, N. Y.—The citizens of this village are considering the question of establishing a municipal electric lighting plant, to cost about $5,000.

SYRACUSE, N. Y.—The Village Trustees of Eastwood have granted the Syracuse Rapid Transit Railway Company a franchise to double track the car line through the village on Burnet Avenue. This is to form part of the new line to East Syracuse by way of Eastwood.

WAVERLY, N. Y.—The Waverly, Sayre & Athens Traction Company has been granted franchises in Sayre by which the railway will be able to connect South Waverly with Sayre. The company is planning to build new shops at Sayre.

CHARLOTTE, N. C.—It is reported that the water power at Linville Falls is to be developed. A dam 100 feet high will be built on Linville River near the falls, which will develop 22,000 horse-power. The plant will furnish electricity for lighting and power in the western part of North Carolina, east of the Blue Ridge.

CONCORD, N. C.—The Cannon, Carrabus, Young-Hartsell and Franklin cotton mills in this city are to be operated by electricity beginning about Sept. 1. Over 100 motors will be required in the operation of the four mills.

[illegible]—The [illegible] of the [illegible] Telephone Company has been approved by the town authorities. The company agrees to install a modern double-metallic circuit with long-distance connections. The improvements will cost about $30,000, and the company is given the privilege to increase its rates.

KINGS MOUNTAIN, N. C.—At an election held recently the citizens voted to issue $50,000 in bonds for an electric light plant and water works system.

NEW BERNE, N. C.—[illegible] enlarged and new machinery installed.

VALLEY CITY, N. D.—H. F. Halverson, city auditor, writes that the municipal electric lighting plant is inadequate to meet the city's needs, and is to be sold to the highest bidder, bids for which will be received some time this month.

ARLINGTON, OHIO.—O. T. Castor, village clerk, writes that bids for bonds and also for construction of an electric light plant will be opened on Aug. 27 by the Village Council.

ASHTABULA, OHIO.—The capital stock of the Ashtabula Rapid Transit Company has been increased from $150,000 to $500,000.

CINCINNATI, OHIO.—A mortgage has been given by the Cincinnati & Columbus Traction Company to the Union Savings Bank & Trust Company to secure a bond issue of $200,000. The proceeds will be used to pay the present indebtedness and to make certain improvements and extensions.

COLUMBUS, OHIO.—The Board of Public Service has approved the contract and bond of the Allis-Chalmers Company for the installation of new turbines in the municipal electric light plant.

DILLONVALE, OHIO.—The County Commissioners have granted a 25-year franchise to H. T. Roe, of Dillonvale, to erect poles and wires for the transmission of electricity along the Dillonvale and Mt. Pleasant Road.

LIMA, OHIO.—The City Council is considering the installation of an electric plant as an auxiliary to the present pumping plant at the waterworks.

PAINESVILLE, OHIO.—Plans are being made by the Commercial Electric Company to rebuild its plant in this city.

TOLEDO, OHIO.—J. W. Kerr, chairman County Commissioners, writes that all bids opened recently for building and equipping the new power house at the County Infirmary have been rejected.

COTTAGE GROVE, ORE.—Work has commenced on the reconstruction of the plant of the Willamette Valley Company, which was recently destroyed by fire. The new building will be 50 x 150 feet, with a wing 40 x 70 feet. The equipment will consist of a 180-kw Westinghouse generator and a 200-hp Russell engine. The old boilers will be used, if they can stand the test. It is expected that the new plant will be installed and in operation within 30 days.

EUGENE, ORE.—The $60,000 stock subscription required for the electric railway from Eugene to the mouth of the Siuslaw River, which is being promoted by Stephen Carver, has been secured among the people of Eugene and construction of the road is assured. It is proposed to organize a company with Mr. Carver as president, after which construction will begin. It is planned to build ten miles this summer and to complete the first 30 miles by next summer.

PANAMA.—Bids will be received by D. W. Ross, general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Aug. 22, for furnishing direct-current dynamo and engine, switchboard, shop machines, governors, electrical fixtures, magneto batteries, wires, etc., as per circular No. 382.

FREEDOM, PA.—The Federal Telephone Company, of Pittsburg, which was granted a franchise in Freedom in 1900, has asked that its franchise be repealed, declaring it did not obtain enough subscribers to make the business pay.

GETTYSBURG, PA.—It is reported that negotiations are under way for the connection of the lines of the Washington, Frederick & Gettysburg Railway Company and the Great Falls & Old Dominion Railway Company by the construction of an electric railway 29 miles long

HUNTINGDON, PA.—The Juniata Electric Street Railway Company is planning to build a railway from Huntingdon to Lewistown.

KITTANNING, PA.—Extensive improvements are contemplated by the new owners of the Kittanning Electric Light Company. Material has been ordered for a new transmission line from the power house at Garrett's Run to Market Street, where connection will be made with several of the company's circuits. It is not the intention of the company to abandon the Queen Street power house for the present at least.

LEMOYNE, PA.—The Valley Traction Company has entered into a contract with the York Haven Power Company to furnish electricity for operating its system after Aug. 1. Sub-stations will be built at Lemoyne and other places. When the sub-stations are completed the Lemoyne plant will not be operated, but will be held in reserve for emergencies. The transmission line has been erected from the York Haven plant to the Lemoyne station, but new machinery will have to be installed before power from the York Haven plant can be used.

PHILADELPHIA, PA.—Bids will be received by George R. Stearns, director of public works, until Aug. 29, for additional dynamos and pumps for the Torresdale filter plant. The bids call for three 150-kw generators to furnish electricity for lighting and driving the air blowers for the preliminary filters. Estimated cost is $25,000.

SCHUYLKILL HAVEN, PA.—The street lighting system of the municipal electric light plant is being changed to new enclosed arc lamps.

SLATINGTON, PA.—The right of way has been secured for the Franklin & Towamensing Street Railway Company from Slatington to Lehighton, a distance of nine miles, and work on the construction of the road will commence within two weeks.

RAPID CITY, S. D.—The Rapid City Electric & Gas Light Company is planning to change its system from single-phase to three-phase, 60-cycle, to establish a day service, and add another 120-kw direct-connected three-phase, 60-cycle alternating-current generator. The company has recently ordered a 200-hp Murray boiler, which when installed will give the plant 325-hp boiler capacity. A 100-kw, three-phase, 60-cycle alternator will be installed to take the place of the present 100-kw, single-phase, 133-cycle generator, and a direct-connected steam unit will also be installed.

HENDERSON, TENN.—At an election held recently the proposition to issue $10,000 in bonds for electric lights was defeated.

MEMPHIS, TENN.—The South Memphis Traction Company has applied for a charter to construct several new lines in South Memphis. K. D. McKellar and James F. Hunter are interested in the company.

NASHVILLE, TENN.—R. E. Chamber, of Cincinnati, Ohio, is interested in a proposition to build an electric railway to connect Louisville, Ky., with Nashville.

DENISON, TEX.—The Denison Light & Power Company has commenced work on improvements and additions to its plant, the cost of which is estimated at $40,000.

HANDLEY, TEX.—To meet the requirements of its increasing business the Northern Texas Traction Company has found it necessary to make another addition to the equipment of its power house at this place, machinery for which has been ordered.

HUNTINGTON, UTAH.—The Electric Light & Milling Company is preparing for the construction of an electric plant, and is now asking for bids for machinery. The plant, when completed, will furnish electricity for lighting Cleveland and Lawrence, as well as Huntington. William Howard is manager.

LURAY, VA.—The Page Valley Telephone Company has purchased a telephone franchise in this town for $25, with $25 annual franchise tax.

RICHMOND, VA.—Superintendent Bolling, of the Water Department, is reported to be in favor of installing an electric power and pumping station at the old pump house, to furnish electricity for lighting and pumping.

DAVENPORT, WASH.—The Washington Power Company is making arrangements to furnish electricity for lighting and power purposes in different cities and towns in Big Bend County. The company will operate under the name of the Big Bend Light & Power Company. The capital stock of the company is $300,000. Surveys are now being made for the pole line.

NEWPORT, WASH.—It is reported that work will soon commence on the water power development at Albeni Falls, two miles from Newport, and that the electric railroad between Newport and Spokane will be in operation within a year. The company, it is said, expects to develop about 30,000 horse-power.

PORT ANGELES, WASH.—Plans are being made to enlarge the electric light plant and to have it operated by water instead of steam power. Bonds have been issued to the amount of $80,000 for the work. The new plant is to have a capacity of 350 horse-power, but no specifications have been made as yet. John F. Hallahan is manager.

SEATTLE, WASH.—For the addition to the municipal water-power plant on Cedar River, R. H. Thompson, city engineer, has given a contract to the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., for two 4000-kw alternators, and to the Fort Wayne Electric Works, Fort Wayne, Ind., for 17 1500-kw transformers to be used in connection with the 60,000-volt transmission line to Seattle.

ELKINS, W. VA.—Bids will be received by the County Commissioners until Aug. 26 for electric and gas fixtures for the court house now under construction. Lee Crouch is clerk.

CEDARBURG, WIS.—The Freistadt & Cedarburg Telephone Company has filed amendments to its charter increasing the capital stock of the company from $3,000 to $[illegible],000. Joseph H. King is president.

GREEN BAY, WIS.—E. H. Joslyn, of Oshkosh, has petitioned for a franchise for an electric light plant.

MILWAUKEE, WIS.—It is announced from Spokane, Wash., that the Chicago, Milwaukee & St. Paul Railway Company is planning to install a series of hydro-electric plants on the St. Joe River, between North Fork and St. Joe, in Northern Idaho, east of Spokane, and utilize the electrical power developed for operating the railway across the Bitter Root Divide, and also for operating several sawmills and mining plants. The work will cover 35 miles of the St. Joe River, and it is said that 180,000 horse-power can be developed. The work will cost $9,000,000 and will take three years to complete. It is stated that three dams are to be constructed at once, and others will be built later. The work is in charge of C. B. Price, a hydraulic engineer.

LANDER, WYO.—O. C. Lander, president of the Lander Irrigation & Improvement Company, writes that the company is erecting a hydro-electric power plant at this place and is in the market for [illegible] feet of riveted pipe, turbines, generators, centrifugal pumps direct connected to motors having a capacity of 10,000 gallons per minute, with 60 feet head of elevation. The power plant has a 300-ft. head, with a supply of 9000 cubic feet of water per minute. J. C. Edsall is engineer.

GLACE BAY, N. S.—The Sydney & Glace Bay Railway Company has decided to locate its central power station and car house in this place.

GRAVENHURST, ONT.—The corporation is installing a 750-hp hydro-electric plant at South Falls to furnish electricity for light and power in Gravenhurst. W. W. Beall & Company are building a transmission line, including a telephone line, from the Falls to Gravenhurst.

ST. THOMAS, ONT.—The Ontario Railway and Municipal Board has approved the by-law providing for the issuance of $7,000 in bonds for the extension of gas and electric light systems.

New Industrial Companies.

THE ELECTRICAL CONSTRUCTION COMPANY, of Little Rock, Ark., has been incorporated with a capital stock of $25,000 by Richard Bragg, F. A. Bragg, A. D. McConnell and others. The company will sell electrical supplies and apparatus.

THE LEA EQUIPMENT COMPANY, of Camden, N. J., has been incorporated with a capital stock of $50,000. The incorporators are Edgar T. Earle, H. N. Earle and Albert G. Lea. The company will engage in electrical engineering.

Company Elections.

ATLANTA, GA.—The directors of the Georgia Railway & Electric Company have elected George Brine and T. K. Glenn directors to succeed Albert E. Thornton, deceased, and W. L. Cosgrove, resigned. Mr. Brine recently succeeded Mr. Cosgrove as president of the Atlanta Gas Light Company, and is vice-president of the Georgia Railway & Electric Company.

PITTSFIELD, MASS.—At the annual meeting of the Pittsfield Electric Company, held July 24, the following named officers were elected for the ensuing year: Alexander Kennedy, president and treasurer; William L. Adam, clerk, and W. A. Whittlesey, superintendent.

New Incorporations.

LOS ANGELES, CAL.—The Western Gas & Electric Company has been incorporated with a capital stock of $25,000 by F. O. Collins, J. N. Black, E. V. Reeves, S. S. Lawson and R. G. Roberts.

SAN FRANCISCO, CAL.—The Nevada Miners' Power Company has been incorporated with a capital stock of $1,000,000 by M. F. Remington, T. G. Roberts, J. Rutishauser, W. H. Davis and B. R. Reynolds.

SAN FRANCISCO, CAL.—The Stockton Gas & Electric Corporation has been incorporated with a capital stock of $1,500,000 by Paul McDonald, A. H. Winn, R. T. Hooper, H. F. Allen and J. T. Handy.

DENVER, COL.—The Summit County Power Company has been incorporated with a capital stock of $500,000 by John McConnelly and others.

WILMINGTON, DEL.—The Nicholas Power Company has been incorporated with a capital stock of $250,000 by R. C. Lupton and others.

PADUCAH, KY.—The Southern Construction Company has been formed for the purpose of building the interurban line from Mayfield to Paducah. The company is capitalized at $10,000 and the incorporators are B. H. Scott, H. H. Loving, John F. Harth, George Rush and others.

WILLIAMSBURG, KY.—The Williamsburg Electric Light Company has been incorporated with a capital stock of $5,000 by E. E., L. A. and L. Nelson, of Williamsburg.

BOSTON, MASS.—The E. Ericson Electric Company has been incorporated with a capital stock of $40,000 by Leonard Erickson, Frank M. Edmonds and B. F. Borhek.

DULUTH, MINN.—The Interurban Power Company has filed articles of incorporation with a capital stock of $100,000. The company proposes to generate electricity for all purposes and to furnish water to municipalities, and to construct and operate canals. The incorporators are: Charles C. Cokefair, Francis A. Cokefair and William Harrison.

ALLIANCE, OHIO.—The Youngstown, Alliance & Akron Railway Company has been incorporated with a capital stock of $10,000 by T. H. Given, of Pittsburg, Pa.; M. K. McMillin, of Pittsburg, Pa.; E. H. Brosius, Hugh Blakeley and R. S. Kayler, of Alliance.

CLEVELAND, OHIO.—Articles of incorporation have been filed for the Toledo & Fort Wayne Electric Railway Company with a capital stock of $10,000. The incorporators are E. J. Pinney, H. J. Nord, Lewis A. Goldstein, Thomas C. Willard and others.

HARRISON, OHIO.—The Harrison Electric & Water Company has been incorporated with a capital stock of $30,000 by William F. Boyd, Edward Avesmer, Samuel L. Farland and others, to acquire and operate the electric and water plant in Harrison and West Harrison.

CHEROKEE, OKLA.—The Cherokee Light, Ice & Power Company has been incorporated with a capital stock of $50,000. The incorporators are: E. T. Carpenter, J. W. Howard, A. H. Stout, A. J. Titus and Luther Martin.

Obituary.

[illegible] gether with three brothers and two sisters.

Personal.

[illegible]

[illegible] Company, of New York City. In [illegible] of the sales end of the United Com- [illegible] tracts for electric light, power, heat and sign work, together with the company's advertising. Mr. Jones is an electrical engineer, graduating from the Massachusetts Institute of [illegible] Immediately after graduating he took a position with the American Telephone and Telegraph Company in its New York office. In this position he identified himself with the work of the inspection and traffic de- [illegible] Superintendent Brooks, of that company, the first school of instruction for employees engaged in telephone traffic, which has since become an important adjunct of all telephone companies' work. After four years' experience with the American Company, Mr. Jones took up similar duties with the New York & New Jersey Telephone Company in its New Jersey division, where he had charge of the traffic department. While engaged in this work, Mr. Jones prepared and delivered a course of lectures on telephone and electric light topics for the evening branch of the New [illegible] present time; last year giving two courses, one on telephone engineering and one on illuminating engineering. The early part of the present year, Mr. Jones accepted a position as illuminating engineer with the Nernst [illegible] offered the managership of the sales department of the United Company. [illegible] author of a number of articles on electrical topics, among them being: "A Study of the Efficiency of the Electric Light Plant of the Boston Public Library," "Notes and Suggestions for the Instruction of Employees Engaged in Telephone Traffic," "The Progress of the Telephone," "Five Papers on Illumination Engineering." The new sales manager will make his headquarters at the general offices of the United [illegible]

[illegible] field has just resigned from the [illegible] Insulated Wire & Cable Company, to become general sales manager for the Duplex Metals Company, of Chester, Pa., with office headquarters in the Lincoln Trust Building, 208 Fifth Avenue, New York City. Mr. Eckert, who is one of the younger members of the famous electrical family bearing the name, began his career with the old Metropolitan Telephone Company—now the New York Telephone Company —with which he spent six years, gaining technical experience in practically every department. He then spent three years with the Kerite Company, and for the past fourteen years has been very actively identified with the Safety interests. For several years he served also as the efficient secretary of the Electrical Trades Society of New York. He is therefore in many ways a man with ideal qualifications for introducing the remarkable specialty known as the Monnot wire, which with other forms and shapes of combined steel core [illegible] the Monnot process, now a well tried and proven advance. Wire of this [illegible] have been made to determine its feasibility for telephone lines. The breaking strength of No. 17 copper clad wire, as this new wire is called, and No. [illegible] Metals Company, which shows that with the net cost of a mile of No. [illegible] mile for wire having a conductivity sufficient for the requirements. This process of welding metals is not only applicable to iron and steel, but to [illegible] the material exclusively for steam turbine blades, for which it has extraordinary recommendations. In short, there is work enough ahead to keep Mr. Eckert extremely and indefinitely busy, and a host of friends all over the country will watch with great pleasure his effort and success.

[illegible] Telegraph Company, organized last November, with the idea of consolidating the Marconi and De Forest wireless systems.

MR. H. R. HUME, formerly manager of the gas engine department of the Fairbanks Company, Pittsburg, is now connected with the Switchboard Equipment Company, of Bethlehem, Pa., as sales manager.

MR. CLARENCE H. MACKAY, president of the Mackay Companies, sailed last week for Scotland, to be gone some little time, but Mrs. Mackay stays behind and is taking part in the social gayeties of Lenox, Mass.

MR. P. G. WATMOUGH, JR., consulting electrical engineer, 59 Pearl Street, New York City, has been engineer for the lighting installation now near completion, put in by the famous old Seamen's Savings Bank on Wall Street.

MR. WILLIAM E. MITCHELL, formerly with the Sao Paulo Tramway Light & Power Company, has accepted a position as electrical engineer [illegible] has taken over the old Siemens & Halske electric tramway, and is completely renovating and extending the system.

MR. H. R. BAILEY, in charge of the electrical work of the New York and Long Island Railroad Tunnel (under Forty-second Street, [illegible] and chain last Monday. The gift is the expression of the feeling cherished by the men under his direction in the electrical department of the work.

MR. W. [illegible] Chief of the Division of Statistics and Accounts for the New York Public Service Commission in the Second District, at a salary of $5,000. Mr. Meyers is now assistant to Prof. Henry C. Adams, Chief of the Division of Statistics and Accounts of the Inter-State Commerce Commission.

MR. E. J. RICHARDS, superintendent of the electrical department of the Newburgh Light, Heat & Power Company of Newburgh, N. Y., has resigned his position to take effect Sept. 1. Mr. Richards will take a similar position with a light and power company in New Orleans, La. Mr. Richards has rendered valuable service to the local company since his connection with it, and has been largely instrumental in bring- [illegible] tion of electricity for lighting and power purposes throughout the city and adjacent territory. He will take with him to New Orleans the best wishes of many Newburgh friends.

MISS JESSIE MAY HAZELRIGG, eighteen years old, daughter of Mr. and Mrs. Scott F. Hazelrigg, of Tompkinsville, S. I., has been chosen Queen Titania VII., to rule at Asbury Park, N. J., over the events of Carnival week, Aug. 23 to 30. Miss Hazelrigg's summer home is at No. 708 Seventh Avenue, Asbury Park. She is a graduate of Hollins Institute, Virginia, and is a close companion of her father, who is vice-president and general manager of the Richmond Electric Light & Railroad Company of Staten Island; president of the Atlantic Coast Electric Railway, Asbury Park; president of the Midland Beach Railway, and is connected with several other railway enterprises.

MR. JOHN C. OSTRUP, M. Am. Soc. C. E., has been appointed to fill the Chair of Structural Engineering at the Stevens Institute of Technology, Hoboken, N. J. Prof. Ostrup is a graduate of the Polytechnic School in Copenhagen, and later took a post-graduate course at the Chicago Engineering School, and has had a large and varied experience in important work extending over 17 years. He was for five years in charge of the office work and design of the Lake Street, the Northwestern and the Union Elevated railroads in Chicago during their construction, and afterwards designing engineer of the Boston Elevated Railroad during its building. Upon the completion of this he went into private practice for [illegible] the American Bridge Company of New York.

MR. R. L. DEAN.—Mr. Robert L. Dean, president and electrical engineer of the Dean Rapid Telegraph Company, of Kansas City, is at the Waldorf, New York. His system has been in actual operation between Kansas City and St. Louis for about two months past transmitting daily business telegrams and press matter for newspapers. Mr. Dean's object in coming to New York at this time is to purchase additional equipment to further extend his system. He proposes to enlarge operations so as to reach various important points throughout the country, employing [illegible] telegraph system maintains a speed of 350 words a minute over a phantom circuit between Kansas City and St. Louis, in connection with [illegible]

MR. EDGAR C. BRADLEY has been elected vice-president and general manager of the Pacific Telephone & Telegraph Company. According to officials of the company the change has no special significance. President Scott still retains his official title, although yielding practical direction of affairs to the new officer. Mr. Bradley does not displace any one, but becomes a third vice-president, the other two being Louis Glass and E. J. Zimmer. His connection with the American Bell Telephone parent company, it is stated, has been severed and he will henceforth devote himself solely to the local company. Mr. Bradley was formerly third vice-president of the Postal Telegraph Company. He resigned that place to become assistant to F. A. Pickernell, who was assistant to the president of the American Telephone & Telegraph Company. His duties, it is understood, were a general supervision of the subsidiary companies embraced in a certain district and he went to San Francisco in pursuance of those duties.

Trade Publications.

THE SPRAGUE ELECTRIC COMPANY, of New York City, is mailing to the electrical trade and architects an attractive eight-page circular describing in detail new types of galvanized and enamelled stamped steel boxes and covers, and box fittings.

PITTSBURG TRANSFORMER COMPANY, of Pittsburg, Pa., has issued for August a very interesting folder relative to transformer behavior under, and results following, strokes by lightning. It is well worth reading. It also issues a pretty August calendar.

INSULATOR SUPPORTS.—The Electric Controller & Supply Company, Cleveland, Ohio, has issued a very neat little illustrated pamphlet as to its "Universal" insulator supports made under the McFeater patent. These are ingenious appliances specially devised for wiring in steel frame work of all kinds. No wood is required, and no holes need be drilled.

"BUSY."—The New York Telephone Company has issued a neat little brochure as to the manner in which a telephone subscriber by the addition of one or two extra lines can reduce the "busy" reports on his service to the minimum, and thus avoid blockade of business. Data are given of the subject from actual installations.

THE SPRAGUE ELECTRIC COMPANY, 527-531 West 34th Street, New York City, has recently issued a handsomely printed new bulletin, No. 507, treating of flexible-armored hose for steam or compressed air. This hose is adapted for the transmission line in drilling or chipping, and is extensively used by railway companies for air brake and signal line work.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, of Plainville, Conn., has recently published a new bulletin of its type "A" switches, which shows a large extension to the line. Many changes and improvements are made. The bulletin covers 34 pages, and represents a most complete line of switches. Four-pole switches are listed, also new Code fused switches with high fingers for fuses, both on the hinge and the handle end, and a complete line of switches for alternating current from 15 to 2000 amperes. The bulletin will be gladly sent upon request to all those interested.

MOTOR DRIVEN PUMPS.—The Luitwieler Pumping Engine Company, Los Angeles, Cal., has issued a catalogue dealing with its non-pulsating pump. It is claimed that the efficiency of the pump is unusually high on account of the entire absence of back lash and water hammer. The pump is provided with two cylinders, each of which is driven through a cam mechanism from a shaft running at constant speed. The cams are of such design that they move the cross heads and the piston at a fixed rate of speed, and just before one cam reaches the end of its travel the other cam takes the water load and moves it along as before. Thus there are no dead centers and no periods of rest, and the water is delivered in one pulseless volume.

A MESSAGE FROM THE GOVERNOR.—This is the title of an illustrated brochure gotten out by the Holyoke Machine Company of Worcester, Mass. The cover design is particularly attractive, being in legal form, tied with ribbon [illegible] the company's improved governor for water [illegible] and points out its advantages. The governor has now been on the market five years, and during that time has been well tried under all conditions. The friction clutches which operate the water-wheel gates are thrown in and out of engagement by a hydraulic piston into which water or oil is admitted under a pressure of 25 to 30 lbs., by a valve on top of the cylinder; the valve being operated by govern[illegible] the driving pulley.

BRISTOL PYROMETERS.—Prof. W. H. Bristol, 45 Vesey Street, New York, has just issued Catalogue No. [illegible] in large quarto size. It contains a general description and a classified price list of the different groups and styles of his beautiful low resistance pyrometers, for both indicating and recording all ranges of temperature up to 3000° Fah. Prof. Bristol has also included in the catalogue illustrated descriptions of several ways in which the instruments can be applied in commercial service. A long list of names is given of users of these instruments, covering a wide range of industrial application. Copies of this very interesting catalogue, which is practically a short treatise on thermo-electric pyrometry, can be obtained on application. The large size is favorable to the exact reproduction of the curve charts reproduced of records taken by the instruments.

WARD LEONARD.—The Ward Leonard Electric Company has issued a catalogue, No. A-12, covering self-starters, showing its ALS type, comprising a self-closing switch, a self-starting rheostat provided with no-voltage and overload release and protective interlock, preventing the automatic closure of the self-closing switch, except when the rheostat is in its initial position. It is controlled by two push buttons—a starting push button and a stopping push button. The resistance is in the form of Ward Leonard enamelled resistance units. It also shows its AS type self-starting rheostat with plain no-voltage release, for use in connection with Ward Leonard self-closing main line switch or float switch, etc. The resistance of this type is also of Ward Leonard enamelled resistance units. In either case it is simply necessary to close the circuit and the machine does the rest. This catalogue is complete with specifications covering the features of design.

THE AMERICAN INSTRUMENT COMPANY, Philadelphia, Pa., has just published a new catalogue, No. 65, and is distributing it to the users of electrical measuring instruments. It is beautifully printed, profusely illustrated with half-tones, and deals in a very comprehensive way with their complete line of high-grade instruments of both switchboard and portable types. The valuable improvements found in "American" instruments are interestingly set forth, emphasis being placed on the interchangeability of the shunts and multipliers, and the excellent magnetic shielding qualities of the drawn soft steel cases used on switchboard types. Complete lines of round pattern and "long-scale" switchboard voltmeters and ammeters are listed with full data as to range and prices. Numerous diagrams give the dimensions required for drilling switchboards, etc. The well-known "American" portables are shown in the latter half of the book, together with a new line of standard voltmeters and ammeters for the most exacting laboratory work. Portable relays and galvanometers are also illustrated. Throughout the catalogue 65 is quite in keeping with the high-grade instruments it describes and illustrates. It is up to date, and contains 56 pages of useful instrument data. Every engineer should have a copy and keep it for handy reference.

Business Notes.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburg, Pa., has opened a branch office in Charlotte, N. C., where a distributing house will be maintained.

ARROW ELECTRIC COMPANY.—Owing to the similarity of the names of the Perkins Electric Switch Manufacturing Company, of Bridgeport, Conn., and of the Perkins Corporation, of Hartford, Conn., and the confusion which naturally arises from that similarity, it has been decided to change the name of the Perkins Corporation to the Arrow Electric Company, and to change the trademark from "Arrow P" to "Arrow E." [illegible] Arrow Electric Company [illegible] the Perkins Corporation.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED [illegible]

862,127. CENTRIFUGAL SWITCHING DEVICE; C. B. Auel, Wil[illegible]

[illegible]

[illegible] TROLLEY [illegible] which moves to trip and drop the pole when the [illegible]

[illegible] James, Pittsburg, Pa. App. filed Nov. 13, 1905. A system of contactors for an induction motor by which resistance may be gradually [illegible] increases.

862,191. TROLLEY WHEEL; P. M. Orlopp, Indianapolis, Ind. App. filed July 12, 1906. The trolley wheel has double springs for spokes [illegible]

862,192. CONTROLLING MEANS FOR ELECTRIC MOTORS; W. A. [illegible] controller for an electric motor designed to work through predetermined limits of movement as in operating a gate valve.

[illegible] [illegible] Cal. [illegible] signals or calls from any number of stations are indicated by figures [illegible] dicated.

862,211. INSULATOR-SUPPORT; Wm. Steiner, Muskegon, Mich. App. filed March 24, 1906. A frame for grouping insulators around a base. The frame is built up in quadrants organized together by supporting bolts.

[illegible] [illegible] TEMPERATURE REGULATOR FOR RE-VOLUBLE DRYING APPARATUS; H. F. Westphal, Milwaukee, Wis. [illegible] the temperature of a drying apparatus, particularly for grains, etc. Has a vessel filled with liquid and a diaphragm connected to the circuit closing device.

862,226. MOTOR-REGULATOR; G. H. Whittingham, New York, N. Y. App. filed July 16, 1903. Electro-mechanical means for controlling and regulating the starting and operation of electric motors.

862,272. FIELD REGULATORS FOR DYNAMOS; G. S. Neeley, St. Louis, Mo. App. filed June 18, 1906. A voltage regulator for alternating current generators adapted to automatically maintain a constant voltage in the circuit regardless of the demands for current.

862,273. VOLTAGE REGULATOR FOR DYNAMO ELECTRIC MACHINES; G. S. Neeley, St. Louis, Mo. App. filed Nov. 30, 1906. Relates to modifications of the above.

862,274. VOLTAGE REGULATOR FOR DYNAMO ELECTRIC MACHINES; G. S. Neeley, St. Louis, Mo. App. filed Nov. 30, 1906. Relates to modifications of the above.

862,277. SPRING FOR TROLLEYS AND HARPS; R. E. Noble, Chicago, Ill. App. filed Jan. 13, 1905. A spring for trolley harps, comprising a bent strip of spring metal having a loop at one side and having perforations adapted to engage with the pin or axle of the trolley harp.

862,329. SPARKING DYNAMO AND GOVERNOR; A. P. Griebel, Woodstock, Ill. App. filed Sept. 11, 1906. A spark dynamo for use with gasoline engines designed to have a constant speed by varying frictional connection with the engine fly-wheel.

862,333. METHOD OF CREATING A VACUUM; P. C. Hewitt, New York, N. Y. App. filed July 1, 1904. The method of creating a high vacuum in an inclosed chamber, which consists in introducing aluminum and mercury so that they amalgamate and absorb gases.

862,361. ELECTRICAL APPARATUS; W. H. Thompson, Wilkinsburg, Pa. App. filed July 17, 1905. A means for varying the strength of magnetization of an iron core which has parts thereof in the form of rollers from which flexible magnet wire can be wound from one to another.

862,380. ADJUSTABLE BOX FOR SWITCHES AND THE LIKE; M. D. Baron, New York, N. Y. App. filed Feb. 24, 1906. Relates to wall boxes for use in house wiring. Provides a complete fireproof inclosure for electric connections in conduits in the wall of a building.

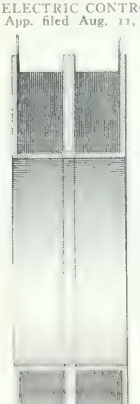
862,397. ELECTRIC-LIGHT CLUSTER; L. Hruska, Chicago, Ill. App. filed March 25, 1907. A multiple cluster socket for incandescent lamps having a swivel connection with a supporting base so as to be removed without disturbing the circuit connections.

862,402. PRINTING TELEGRAPH; C. L. Krum, Chicago, Ill. App. filed Oct. 6, 1904. Complete electrical and mechanical features of a printing telegraph machine.

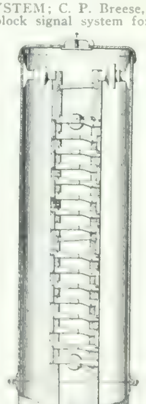
862,409. TREATING SHEET METAL BY ELECTROLYSIS; J. Muller, Austria-Hungary. App. filed April 18, 1906. The herein described process of electroplating a plurality of individual sheets or plates, which consist in temporarily connecting the edges of said plates to form a continuous band and then passing the band continuously through the electrolyte, substantially as described.

862,423. TELEGRAPHIC TRANSMITTER FOR THE MORSE SYSTEM; T. C. Van de Stadt, Aardenburg, Netherlands. App. filed April 2, 1907. A typewriter or keyboard transmitter for telegraph systems having inset conductors in a revolving cylinder which are engaged by brushes.

862,441. ELECTRIC CONTROLLING SYSTEM; C. P. Breese, Norfolk, Va. App. filed Aug. 11, 1902. A block signal system for electric trolley roads having a sectional trolley conductor and relay magnets operated by the passage of current thereto from the mains.



[illegible] Induction-Coil Unit



[illegible] High-potential Circuit Breaker

862,442. ELECTRIC CONTROLLING SYSTEM; C. P. Breese, Norfolk, Va. App. filed [illegible] Relates to [illegible] the above.

[illegible] WIRE HOLDER; [illegible] App. filed [illegible] [illegible] support for telephone wires having two horizontally journaled grooved rollers between which the conductor is led.

[illegible] HOOK-SWITCH; [illegible] Craft, Chicago, Ill. App. filed Apr. 9, 1906. A hook-switch comprising a mounting plate, a lever pivotally supported upon the rear of said plate and projecting through an opening therein, a finger carried by said lever behind said plate, and switch springs supported upon the rear of said plates, one of said springs projecting beyond the remaining springs into position for operation by said finger to actuate said springs, said spring forming a restoring spring for said lever.

[illegible]497. HOLDERS FOR TELEPHONE RECEIVERS; W. J. Mogridge, Spokane, Wash. App. filed Nov. 16, 1906. Attachment for ordinary desk 'phone by which receiver can be supported at ear when talking into transmitter.

862,506. INDUCTION-COIL UNIT; Carl A. Pfanstiehl, Highland Park, Ill. App. filed Dec. 27, 1906. Comprises a pair of outer spool heads formed with central orifices and annular necks which project towards each other. An intermediate head is formed with a corresponding orifice and a small passage adjacent to the orifice.

862,513. HIGH-POTENTIAL CIRCUIT BREAKER; Laporest G. Robinson, Pittsburg, N. Y. App. filed Dec. 12, 1905. Comprises a pair of insulating bars, a rocker arm for supporting the bars and imparting a relative motion thereto, and two series of contact springs, respectively joined to the bars so as to break contact with one another when the bars are moved.

862,520. ELECTRICAL ROSETTE; James S. Stewart, New York, N. Y. App. filed July 21, 1906. Provides a positive and unyielding abutment to receive the strain on the depending extension walls from a rosette. Has other features, including a casing of stone or enameled iron ware which is strong and light and insulating in character.

862,532. ELECTRIC TRANSFORMER; Isaac Anderson (2), Tacoma, Wash. App. filed April 29, 1907. The core of the transformer has air gaps therein through which air may be circulated to keep the transformer cool.

862,542. CABLE-TERMINAL AND SYSTEM OF PROTECTION; F. B. Cook, Chicago, Ill. App. filed Jan. 18, 1906. A cable terminal, a circular base therefor to which the terminal is mounted, suitable vertical brackets secured to the said base and adapted to be secured around the top of a pole, and suitable holes in the said base spaced so as to give the said brackets various mountings to enable them to fit different sizes of poles.

862,543. CABLE TERMINAL; F. B. Cook, Chicago, Ill. App. filed May 28, 1906. Modifications of above.

862,551. VALVE APPARATUS; J. H. Gardner, Newport, R. I. App. filed July 18, 1906. Relates to valves through which a fluid is supplied, and means for operating an indicator or alarm when said valve is open or partially open, the alarm being inoperative when the valve is closed.

862,580. RELAY; F. R. McBerty, New Rochelle, N. Y. App. filed July 16, 1906. The combination with a magnet, of an armature therefor, an adjustably-mounted screw having an unthreaded end portion passing through said armature to prevent the same from being unseated, and a shoulder on said end portion acting as a stop for said armature.

862,582. TROLLEY SWITCH FROG AND POLE; A. Neubert, Elizabeth, N. J. App. filed Feb. 15, 1906. The trolley switch frog has a pair of laterally projecting rollers which slide on the under surface of flat plates adjacent the trolley wire at a fork or turnout.

862,589. AUTOMATIC ELECTRIC SIGNALING DEVICE; A. J. Roy, Providence, R. I. App. filed March 9, 1906. A semaphore signal positioned by a circuit which is closed by a mechanical tappet adjacent the track rail.

862,616. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Sept. 3, 1901. The combination with a telephone line, of a line relay, a signal controlled thereby, a battery in the line, a jack for the line, and a cut-off relay adapted to be connected in a bridge of the line between the line relay and the jack and to open said battery connection when a conversational circuit is established with the line.

862,618. COUPLING FOR LEAD-COVERED ELECTRIC CABLES; J. J. Dossert, New York, N. Y. App. filed Jan. 19, 1904. A means for joining together stranded cables used in underground work so as to make a properly conducting insulated waterproof joint.

862,660. ROSETTE FOR ELECTRICAL WIRING; W. F. Ritter, Cincinnati, Ohio. App. filed Oct. 28, 1906. A rosette formed of insulating material with an opening for the passage of a circuit conductor and surrounded by an enlarged socket on the rear face of the rosette.

862,701. TROLLEY WHEEL; W. H. Bradt, Schenectady, N. Y. App. filed Dec. 5, 1906. A trolley wheel made of two halves spring pressed together to make better contact with the wire.

862,713. TELEPHONE EXCHANGE SYSTEM; M. S. Conner, Rochester, N. Y. App. filed May 28, 1904. Complete diagram multiple exchange circuit.

862,723. ANNUNCIATOR SYSTEM; W. E. Ebert, St. Louis, Mo. App. filed May 19, 1906. Mechanical construction of annunciator in a hemispherical casing having a target member pivoted coaxially with the casing.

862,740. ELECTRIC CONTROLLING DEVICE; M. Kallmann, Berlin, Germany. App. filed June 1, 1905. Features of a Wheatstone bridge apparatus having novel features.

862,758. INSULATOR; A. A. Pratt, Los Angeles, Cal. App. filed Oct. 25, 1906. Construction of insulator having a transverse opening through which passes a conducting rod held in the insulator by insulating conical bushings.

862,776. DYNAMO-ELECTRIC MACHINERY; W. L. Waters, Milwaukee, Wis. App. filed Dec. 9, 1905. Construction of a squirrel-cage armature for induction motors.

862,781. ELECTROTHERAPEUTIC APPARATUS; [illegible] Lima, Ohio. App. filed May 28, 1906. A therapeutic apparatus having a vessel or tank which can be applied to the desired portion of the body so as to supply current thereto.

862,783. ELECTROLYTIC CELL; E. A. Allen, Rumford Falls, Maine. App. filed July 17, 1905. An electrolytic cell for aqueous solutions comprising a tank having decomposing and oxidizing compartments, a mercury cathode therein, an anode in the decomposing compartment, a return-flow conduit for amalgam extending between opposite portions of said tank, and means for imparting heat to the amalgam in said return flow conduit.

862,842. RHEOSTAT; E. F. Northrup, Philadelphia, Pa. App. filed May 3, 1907. A rheostat having a circular grooved block in which is contained a spiral resistance element over which swings a contact arm [illegible] coaxially with the block.

Electrical World

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NEW YORK, SATURDAY, AUGUST 24, 1907.

CONTENTS.

GARBAGE DISPOSAL.

The question of the disposal of the garbage of a great city like New York is a very serious one, and is apparently far from being answered. There was a time when the stuff was dumped in the sea and littered all the bathing beaches in a most disgusting manner. Relief from this was promised a couple of years ago when a municipal plant was started to consume some of this garbage and thereby light Williamsburg Bridge electrically at a cost of less than nothing, instead of paying good money to the lighting companies. Nobody had any particular objection to raise to this and the incinerator plant went into action with a great flourish of trumpets, particularly on the part of the yellow, socialistic press that wants everything municipalized.

Last week we gave the results and details. The plant has proved an absolute failure, and a large part of its machinery is garbage itself, fit only for the dump and scrap heap. This apparatus cost, with the building, about $170,000. Of course the land cost nothing, as it belonged to the city—and, ergo, had no value. While running, the plant cost to operate, without allowance for rental, $31,418. The allowance for depreciation was 5 per cent, but as much of the plant is wrecked, 50 per cent would evidently have been near the mark. To operate with coal, the plant would cost $57,000 a year. The New York Edison has taken the supply over and is giving a much better service for $25,000. Now there is some talk of a larger plant, as the old one burned only one-eighth of the rubbish gathered—but, after all, would it not be well to let bad enough alone?

Milwaukee, which has just been talking about a municipal lighting plant, has had a similar experience with its garbage plant, that ought to be another lesson—but won't be. The city built the plant two years ago when it cost twice the estimates. It was then found that twice as many men as estimated would be required to run it. Now it is found that the plant is falling to pieces, and that while it costs the city $1.80 per ton to dispose of the garbage itself, private contractors have been eager to get the work at 85 cents a ton. "The works have been a municipal scandal for some time, and it has now been decided to abandon them." That has a familiar sound.

ILLUMINATION PHOTOMETERS.

Mr. Preston S. Millar's paper on this topic is valuable in bringing sharply to attention the need of extreme care in illumination measurements and the very common failure of illumination photometers to give reliable results. It is certainly true that an instrument must be a good photometer before it is a good illumination photometer, if the two functions are expected in combination. But it by no means follows that the best form of ordinary photometer is the best instrument for measuring illumination. For this purpose an instrument must be

[illegible] if one is used, but the nature of the surface observed and its relation to the sources of light is of far more importance than any other one consideration. The fact is that no known diffusing surface, opaque or translucent, obeys Lambert's law for all planes and angles of incidence. In any event, the chief difficulty is the failure of any surface to integrate correctly according to Lambert's law, the total incident light. For extreme precision, the errors must be known and allowed for either instrumentally or in computation.

After all, there is still some doubt whether, if a correct integration could be had, it would really measure correctly the useful effect. As light is practically employed, it is not received on theoretically exact diffusing surfaces, nor does one customarily work with his head and shoulders below the plane of illumination. For example, take a large and rather low room. If lighted from the ceiling, lamps with reflectors, i. e., with main flux from above and coming in the main from a few lamps for any one point, one does not have to deal with large angles of incidence and the illumination at any one point is not difficult to determine. If the lighting were from a row of lamps around the wall, there would be a large proportion of light at very oblique incidence and in practice one would get his working illumination at any one point from but a portion of the sources theoretically available. Such a room would be a difficult subject for theoretical illuminometry, and the theoretical figure, if obtained, would be deceptively large. The fact is that the useful illumination involves factors which are not proportional to the light flux as integrated at any point. Bearing this in mind, one comes to a realizing sense of the difficulties of illumination measurement. As Mr. Millar has pointed out clearly enough, it is no task for a tyro even with a good instrument, certainly not with a poor one. The next few years will be prolific in careless and inaccurate work in illuminometry. It is the man behind the photometer that counts. Good judgment and a knowledge of the errors will lead to good results even with indifferent apparatus, while it seems very doubtful whether any kind of photometer can be made fool-proof. Results obtained with any of the instruments now available should be received somewhat cautiously, especially where any color differences are involved, and the attempted elimination of color difference is likely to lead to constant errors of serious magnitude. One of the most urgent needs in modern photometry is if not a precise, at least a conventional method of dealing with color differences.

Circular Current Loci of the Synchronous Motor.

On page 309 of our issue for last week, we commented at some length upon the paper by Prof. Morgan Brooks, dealing with the graphical representation of the performance of synchronous motors and generators, an abstract of which was published in our report of the Niagara convention of the A. I. E. E. Our present issue contains an article by Dr. A. S. McAllister describing certain simple loci of the synchronous motor which, while similar to those of Prof. Brooks in that they are circular in form, differ therefrom in that they deal with the measurable current taken by the motor rather than with the internal counter e. m. f. of the machine. It is interesting to note that the current locus for a certain constant excitation of the motor—that is, under normal operating conditions—is similar to the circle diagram of the induction motor. A comparison of the current locus of the induction motor with that of the synchronous motor will show that the lagging wattless component of the current taken by the induction motor has a positive value at any load whatsoever, and that it increases continuously with increase of load; while the wattless component of the current taken by the synchronous motor decreases as the load is first increased from its minimum value, and it may have either a positive or a negative value; that is, it may become leading if the excitation is above a certain percentage for each load.

As in the case of the circular current locus of the polyphase induction motor or that of the single-phase induction motor, the construction is based on the assumption of constant local impedance of the circuits carrying the load current. It is well known that in no case is the reactive component of the impedance constant. In the polyphase induction motor the change in the impedance from its assumed constant value leads to an error that is quite small in comparison with the error due to ignoring the change in the main magnetizing current taken by the motor. In the single-phase induction motor the neglect of the actual change in the circuit impedance produces an error that is negligible in comparison with the large error when both the "speed field" exciting current and the "transformer field" exciting current are considered to be constant, since, as a matter of fact, the latter actually varies about 50 per cent and the former 100 per cent. In the synchronous motor the "synchronous reactance" is far from being constant, and any treatment based on the initial assumption of constant "synchronous impedance" is liable to indicate results which do not accord with facts. It is customary in mathematical treatments to assume a constant value for the synchronous impedance, and it is equally as permissible to assume the same constant value in a graphical treatment. The advantage of the graphical method over the purely mathematical resides in the fact that with the former method results may be obtained quickly, and the student-reader is forced to keep constantly in mind the phenomena involved; while in transposing mathematical equations he frequently loses sight of the physical facts in a maze of symbols which to him may be almost meaningless.

An Anachronistic Experiment.

We learn with interest that a surface-contact electric railway system is to be given a trial in London on a line between Adgate and Bow, and recently there has been an attempt to float the stock of a highly-capitalized surface-contact system in Austria. It is a long time since we have heard much about surface contact and its reappearance at this juncture comes with something like the same shock that would accompany the announcement of a street railway changing from electricity to cable traction. The surface-contact has appeared in many forms, some of them highly ingenious, but it never seemed to have filled any long-felt want. Little has been heard of it in this country since Edison announced his famous low-voltage contact system, which some wag immediately proposed to improve by reducing the working voltage below that necessary for the electrolysis of water, thereby solving once for all the insulation difficulty. Abroad there has been a better field, since foreign municipal authorities have at times had a very absurd amount of prejudice against the overhead trolley, and

have been willing to go to great lengths in trying to avoid it. The fact is that an overhead trolley system properly installed for city service, with all the feed wires underground and the trolley wire carried on suitable iron poles not too closely spaced, is practically less objectionable in many cases than even a slotted conduit, and is certainly more reliable. The conduit road should be confined to lines in very crowded streets with extremely dense traffic.

The surface-contact system is, to apply the old piscatorial saw, "Neither fish, flesh, nor good red herring." It is considerably more expensive and less reliable than a trolley system, and has complications that make the slotted conduit system look like a haven of rest. It is not always easy to say just why a given surface-contact scheme will come to grief, for if one could accurately make prognosis of its failings there would be a fighting chance of finding a remedy. Yet no such system has done more than to demonstrate that it can be kept in operative condition most of the time by a sufficient amount of hand work. A surface-contact line necessarily has a very elaborate series of automatic switches to keep the exposed parts "dead" except when in actual use, and most experienced engineers have learned that automatic devices need watching to an extent that belies their name. First, an automatic device, then another to show that the first has worked, then a tell-tale to indicate whether the second has told the truth about the first, and finally an attendant with an auxiliary normal device to keep the three in order and turn the trick himself if necessary. We do not see the good to be gained by a surface-contact line when the more dependable overhead system can be installed for a much smaller figure. It is an interesting experiment to see tried at some other fellow's expense, so we do not repine at the action of the London authorities. And if the line can be kept in operation at reasonable expense it will do their assiduity infinite credit. Seriously, even if it shall make a passable success, what great gain will be made? It is bad enough to have a car equipped for both trolley and conduit service; it would certainly be no better if it had to be fitted for contact working in an intermediate zone. But it will give some interesting experience.

Flux of Light.

One of the proposals at the recent Illuminating Engineering Society convention that is likely to have its influence on future methods of handling illuminating engineering problems is the proposition advanced by Dr. Clayton H. Sharp in his presidential address that we should change our present common conceptions of light so as to consider the flux or flow of luminous energy from a source of light rather than the candle-power. Up to the present time it has been customary for the illuminating engineer to deal with such units as candle-power and foot-candles, taking the candle-power of the source at the angle under consideration and calculating from that the foot-candles of illumination falling on a surface; repeating this process for various points. Likewise in considering the total amount of light emitted from a source, it has been customary to take the mean spherical candle-power. In other words, we are generally in the habit at the present time of considering intensities of light at different points around a source rather than the flux or flow of luminous [illegible] Dr. Sharp maintains that our present conceptions are unduly complicated and that when we begin to think of light as a flow of luminous energy it will simplify matters. Undoubtedly it will. The conception is especially helpful when considering the total amount of light obtained from a large number of lamps in a large room. Thus, instead of going through the most laborious process of calculating the amount of light received on various points of the working plane from a large number of sources, we would simply add up the flux of light delivered by the lamps and reflectors in the direction of the working plane, and this divided by the area would give the average intensity of illumination over that plane. To carry out this method exactly, to the extent of determining just what lumens fall on the working plane from each lamp, is somewhat complicated, but a practical approximation in large rooms is easy.

The system of units and terms suggested is simple. If the candle-power be taken as the unit of light and the foot as the unit of length, the total flux of light from a lamp in lumens would equal the mean spherical candle-power multiplied by 12.57, the latter figure being the number of unit solid angles in a sphere, and the unit flux of light being that in one unit solid angle. A lumen of light flux would be further defined as the amount of light falling on a plane surface one foot square a foot distant from a lamp of one candle-power. The average foot-candle intensity of illumination falling on a plane multiplied by its square feet area would equal the number of lumens flowing towards the plane. Conversely, the number of lumens directed by lamps and reflectors toward the floor divided by the square feet floor area will give the average foot-candle intensity. Instead of that clumsy, but useful standard of comparison, foot-candles per watt per square foot, we would substitute its numerical equivalent, lumens per watt.

Now as to the practical working of this system in engineering calculations, we have already said the conception of flux of light rather than intensity at numerous points is likely to be helpful. As to just how much saving in engineering calculation may be made it is yet too early to predict. If the engineer is to be in a position to figure rapidly the lumens falling on a given plane in any room from pendant lamps, he must have not only the photometric measurements at various angles of the lamp to be used, but the number of lumens flowing in the direction of the given plant. This can be determined from the Rousseau diagram of the lamp more quickly than can the mean zonular candle-power which we are sometimes in the habit of considering. The total lumens directed towards the working plane by all the lamps in a room is then simply a matter of addition. This, when used in a rough, practical way, is unquestionably easier than the usual calculations using the illumination curve of each lamp, and in many cases will answer all practical purposes when used with judgment. It readily gives the total or average results. It will not, however, give the maximum and minimum value of illumination, which is often of importance to know if the engineer is not previously familiar with the degree of uniformity of illumination that is obtainable with the proposed installation. It is a short cut that can be used like many other engineering short cuts when the user fully undestands its limitations.

Montreal Meetings and Exhibition.

[illegible] will hold [illegible] Headquarters will be at the Windsor Hotel, but the meetings will take place in the rooms of the Canadian Society of Civil Engineers, which has offered the use of the rooms to the association. The lecture hall is provided with curtains for darkening the room in the day time, so that the lantern can be used. The society owns a very fine lantern. The Candian Electrical Association have prepared a good list of papers, also a "Question Box." A very large attendance is anticipated. The entertainment committee has arranged a very fine program for the members.

The fall meeting of the Montreal Jockey Club takes place during the first two weeks in September, so that between the races and the program outlined by the entertainment committee, the electrical show and the convention doings, it looks as though the members of the association would have to "work" overtime.

The electrical show will be very complete and will include the wireless telegraph, an electric fountain, dancing skeletons, etc., etc. The Electrical Exhibition Company is furnishing the railings for the entire show, which will be uniform, of a neat design and perhaps the first of its kind on so large a scale.

The Canadian Street Railway Association will also hold its meeting in Montreal, Sept. 12 and 13. The headquarters will be at the Windsor Hotel, and the following is the list of officers of the association: President, Edw. A. Evans, general manager and chief engineer of the Quebec Railway, Light & Power Company, Quebec; vice-president, J. E. Hutcheson, superintendent and purchasing agent, Ottawa Electric Railway Company, Ottawa, Ont.; secretary-treasurer, Acton Burrows, managing director the *Railway and Marine World*, Toronto, Ont. Executive committee, D. McDonald, manager Montreal Street Railway Company; C. B. King, manager London Street Railway Company; A. M. Grantham, superintendent of construction and purchasing agent, Toronto Railway Company and Toronto & York Radial Railway Company.

German Wireless Telegraph Development.

The German official system of wireless telegraphy, the Slaby-Arco method, includes, it is stated, 20 stations in the United States. From Chemnitz, Germany, U. S. Consul Thomas H. Norton reports as follows regarding the system:

"The number of stations equipped with apparatus of this system is now 641, or 41 per cent of the entire list of existing wireless telegraphic stations, numbering 1550. These have all been installed by one Berlin company, which controls a variety of patents in the leading countries on machines and accessories. These 641 stations are scattered over the territory or vessels of 31 different countries. Of these some 174 are located on land. They usually command a radius of 125 miles. In several cases this is extended to 310, 435 or even greater distances. Germany's own quota is 36, mostly located on the coasts of the Baltic and North Seas. It includes the great experimental station at Nauen, which commands a radius of 1860 miles. In the United States are 20 stations, including Fire Island, Washington, New Orleans, San Francisco and San Juan, P. R. Russia has 17 stations. That of Vladivostok is the most important, commanding a range of 620 miles. Austria-Hungary has 10 stations; Denmark and Spain, each 7; Holland, 6 (that of Scheveningen reaches 435 miles); Norway and Sweden, each 5, etc.

"In non-European lands the system has 4 stations in Argentina, 6 in Brazil, 5 in China, 8 in Cuba (that of Havana commanding 930 miles), 6 in Mexico, 2 in the Philippines, 1 in the Sandwich Islands (at Honolulu). The majority of these land stations are government property and under the control of the postal, naval or lighthouse service.

[illegible] are on Dutch and German steamers, while 389 are on warships. They include vessels of the following nationalities: German, 140; Russian, 126; American, 43; Swedish, 19; Austrian, 17; Dutch, 10; Norwegian, 8; Argentinian, 6; Danish, 5; Brazilian, 5; Spanish, 5; Greek, 3, and Indian, 2.

"Fifty-four mobile military stations have been installed in several countries, more particularly in Germany, 14; in America, 8; in China, 5; in England, 4; and in Austria-Hungary, 4.

Long-Distance Transmission by Means of Direct Current.

In the United States, everyone thinks of three-phase alternators and step-up transformers when it is proposed to transmit energy over many miles electrically, but in Europe, as we have frequently noticed in these columns, there is a direct-current system that has been in use for this purpose almost 20 years, namely, the Thury constant-current system, which is in competition with the standard polyphase equipments for all European long-distance transmissions, and has many advocates among electrical engineers.

The longest and highest-voltage Thury direct-current system is the one at Lyons, France, but this has not been operating a sufficient length of time to enable reliable conclusions to be obtained from it. Its immediate predecessor, the Lausanne system, has, however, now been in continuous operation for about six years, and although much shorter and of lower tension, one is able to draw deductions from its service. The energy is obtained from the rapids of the River Rhone, near the little Swiss village of St. Maurice, and is transmitted electrically to Lausanne on Lake Geneva, a distance of 56 kilometers (35 miles) at a substantially constant direct-current strength of 150 amperes and a voltage which varies with the load up to a maximum of about 22,000 volts with 2000 volts drop in the transmission. A detailed description of both the above systems appeared in our pages shortly after operations began.

In broad outline, the Thury direct-current transmission system resembles the ordinary constant direct-current arc-light system, except that instead of lamps, motors are operated in series, and instead of a constant current of 8 or 10 amperes flowing under a pressure of a few kilovolts, there is a constant current of 150 amperes under a pressure of many kilovolts. To supply this pressure, a variable number of 2200-volt generators are connected in series at the generating station, and a similar number of 2000-volt motors are connected in series at the receiving station.

The current is carried on a pair of copper cables supported on a pole line like any other two-wire pair of conductors. Except that the porcelain insulators are about twice the size of the ordinary telegraph insulator and the cables are about 300,000 circular mils in cross-section, there would be little to distinguish the transmission line from an ordinary telegraph or telephone pole line across country. Of course, if the voltages were 60 or 80 kilovolts instead of 20, the appearance of the pole-line would probably be distinctive. At the generating station, each of the turbines drives two direct-current dynamos on its horizontal shaft, through insulating couplings. Each dynamo is series-wound for 2200 volts and 150 amperes at the rated load of 330 kilowatts. The brushes are all definitely fixed in position, and the voltage of each machine is regulated entirely by varying its speed through the control of the turbine connected thereto. In order to distribute the load evenly among the generators, all of the turbines are connected mechanically to one and the same electromechanical governor, so that all the turbines tend to rise or fall in speed simultaneously, unless prevented from doing so individually by independent manipulation. Otherwise, a greater share of the load would tend to fall on those generators whose turbines opened their gates [illegible]

taneously controlled, there might be an oscillatory shifting of the speed and load from one turbine to another.

The first salient contrast between the direct and alternating-current transmission generator plant is in the speed of the various units. With alternators, the speeds of all are the same, and the machines are tied together in synchronism. With direct-current generators, the speeds are all variable, and must be controlled simultaneously. With the alternators, the current-strength and phase determine the load. With the direct-current machines, the speed and voltage determine the load. When the load comes on at Lausanne, the tendency is to diminish the line current. This affects the relay mechanism in the main circuit at the generating station at St. Maurice, and automatically opens the gates of all the turbines so as to increase their speed. The speed of all the generators thus increases until the correspondingly increasing total voltage restores the line current to the normal strength of 150 amperes. If the speeds and voltages required exceed the normal, the attendant at the switchboard introduces another pair of direct-current dynamos—that is, another turbine unit—into the circuit.

Each generator is carefully insulated from its neighbor by rubber padded couplings, and from the ground by a flooring of asphalt, above which each machine is supported on porcelain insulators. If these precautions were not taken, it is clear that the full voltage of the system might be thrown on the insulation of one armature winding or commutator. By taking these precautions, the individual commutators are not subjected to serious excess of voltage beyond that generated within each armature winding. This constitutes a second salient difference between the direct-current and the alternating-current, long-distance transmission generator system. In the former, the generators must be carefully insulated from each other and from ground. In the latter, the insulation is confined to the step-up transformers, and the generator frames are ordinarily grounded.

At the receiving station in Lausanne, each motor is directly connected through an insulating coupling to a generator of some kind for supplying the distributing system, and all the motors are series-wound, and in simple series with the line. The generators are ordinary three-phase alternators for the lighting and power distribution, and 600-volt direct-current railway-generators for the city traction. All of these generators are constant-speed and constant-potential machines, so that all of the motors run at substantially constant speed between no load and rated load. For this purpose, the counter e. m. f. of each motor is regulated by varying the position of the brushes. As the load on each motor increases, thereby tending to lower its speed, the speed-governor regulates to restore constant speed, by moving the brushes on the commutator towards a diameter of greater counter e. m. f. Each motor operates constantly with a current of 150 amperes and varies its counter e. m. f. with the load up to a maximum terminal e. m. f. of 2000 volts at rated load. Here again occurs a marked difference between the direct-current and the alternating-current receiving station, which is in regard to speed regulation. In the latter, the motors operate at constant speed and require no auxiliary mechanism to maintain synchronism. In the former, the motors require governing mechanism in order to maintain constant speed.

A principal source of trouble with the direct-current transmission system considered is from lightning on the overhead lines. This is, however, a source of trouble with almost all transmission lines in Switzerland, and there seems to be no reason for supposing that the trouble is increased in the case of a direct-current system. On alternating-current systems transformers are frequently burned out when suffering injury from lightning, while on direct-current systems the armatures burn out. In each case, line insulators are likely to be destroyed.

The strong points of the direct-current system for long-distance transmission are that, leaving surges out of consideration, the maximum e. m. f. that the system must withstand is the working voltage, as indicated by the line voltmeters; where- [illegible] alternation to 40 per cent more than that shown by the voltmeters. Moreover, the pressure regulation is better because there is no inductive drop and the power-factor is always 100 per cent. All of these advantages relate particularly to the line and have less weight in relation to the power houses and the machinery therein.

The weak points of the direct-current system for long-distance transmission are that the commutation limits the size of the generators and motors to comparatively small units, which are relatively expensive and troublesome. Also the system is not adapted for distribution, but only for the transmission of energy in bulk. Alternating-current systems always admit of being tapped locally, at the mere cost of installing a stationary step-down transformer; but the direct-current system requires a motor-generator and men to watch it. The efficiency of the direct-current system is thus naturally lower than that of the corresponding alternating-current system, even allowing for the losses in the transformers peculiar to the latter.

Summing up, it would seem that as the art of line insulation advances, whereby a good factor of safety can be maintained on the transmission line without excessive cost, the direct-current system cannot compete with the alternating-current system for long-distance transmissions. If, however, the voltages of transmission should press closely upon the means of subsistence—that is, if the insulation along the line could not be commercially maintained with an adequate margin of safety—then the direct-current system is capable of becoming a dangerous rival of the alternating-current system. It looks at present, however, as though the line insulation problem could be satisfactorily dealt with in the future, and thus the alternating-current system is not likely to lose prestige as the best means of transmitting electrical energy.

Mme. Curie on Radium.

A special cable dispatch from Paris of Aug. 17 says: Mme. Curie has just made one of her rare utterances on radium. She resisted all endeavors to obtain her opinion on Sir William Ramsay's reported transmutation of copper into helium, but she has written an interesting reply to François Laur, the French scientist, who questioned Lord Kelvin's assertion before the British Association that radium was a compound body comprising previously known elements. Mme. Curie writes:

"Concerning the formation of helium through radium emanations, I am inclined to share the opinions of Profs. Ramsay, Rutherford and Soddy. I think it probable that radium is an unstable element composed of atoms which undergo spontaneous transformation, and that helium is one of the products of this transformation. Nevertheless, it is possible that helium is produced from gases which surround radium and never are completely removed even in vacuum.

"In either case there is an atomic transformation, but in the second case the radium does not diminish, but acts only by its energy as the determining cause in the transformation. In any event, I do not think there would be any utility in combating Lord Kelvin's opinion. There is no reason why scientific ideas should not be discussed from various points of view.

"My final conclusion is that the outcome of the variety of investigations which are encouraged by discussion every year adds to our knowledge."

In a postscript Mme. Curie adds:

"Radium is a distinct chemical element in the sense attached to the word by chemists. It is unlikely that Lord Kelvin considers radium a compound analogous to other molecular combinations. The discussion probably related more to words than ideas, it being likely that all atoms are complex—formed out of the simpler elements of nature, which are still almost unknown."

M. Laur, in publishing Mme. Curie's letter, contrasts her calm, liberal philosophy with Lord Kelvin's positiveness of [illegible]

Electrical Exhibition in France.

Mr. John C. Covert, U. S. Consul, calls attention to the fact that the Agricultural, Scientific and Industrial Society, of Lyons, France, is to hold an electrical exhibition in that city in May, 1908. The circular states that the water power of the various mountains in France, the Dauphine, the coast of the Mediterranean, the basin of the Loire, the Eastern Pyrenees, and Auvergne offers over 300,000 horse-power, all tributary to Lyons and all in the neighborhood of a rich agricultural country. The aim of the promoters of the exposition is to discover means of making this immense reserve power accessible for daily use on farms and in the various industries in the cities and villages of all the Midi or south of France, nearly half of the national territory. A similar exposition held in May, 1906, displayed many new electrical exhibits, principally made by Frenchmen.

It is desired that the exposition to be held next year shall include a display of electrical inventions from American exhibitors. An interest in the project has already been manifested in Germany, Italy and England, and it is expected that the exhibits will display in a small space all the progress that will have thus far been made in electrical inventions applicable to the workshop, the field and the household. The circular classes the appliances to be exhibited as follows:

There will be seven main classes of exhibits: Group 1, electrical material for use in farming; group 2, applications to textile industry; group 3, mechanical appliances; group 4, electric lighting; group 5, chemical and thermal apparatus; group 6, production, transformation and distribution of electricity; group 7, diverse applications and telephony. Each of these classes is subdivided.

The grouping given is intended as a suggestive outline and may not be strictly adhered to. Exhibits of an industrial character that may be applied on the farm, in workshops, or in any useful channel will be received, though they may not be directly specified in the circular. The exhibition of this nature given last May in this city was participated in by but few persons outside of France. The promotors of the forthcoming exhibition request Americans to take part in it, and they hope to see the electrical industry of the United States well represented in this city in 1908.

President Roosevelt on Conditions and Corporations.

At Provincetown, Mass., at the laying of the Cape Cod Pilgrims' Memorial Monument on August 20, President Roosevelt made a notable speech, in which he pledged the remainder of the term of his administration to obtaining honest observance of the law of the land in regard to trusts and predatory combinations of capital, against which national legislation has been directed. Mr. Roosevelt intimated his belief that the present sharp decline in the value of securities was due in some degree to deliberate action on the part of those whom the government had brought to book, and he reaffirmed the determination to "punish certain malefactors of great wealth." One of the passages on this point is as follows:

"I wish there to be no mistake on this point. It is idle to ask me not to prosecute criminals, rich or poor. But I desire no less emphatically to have it understood that we have undertaken and will undertake no action of a vindictive type, and above all, no action which shall inflict great or unmerited suffering upon the innocent stockholders and upon the public as a whole.

"Our purpose is to act with the minimum of harshness compatible with obtaining our ends. In the man of great wealth who has earned his wealth honestly and used it wisely, we recognize a good citizen worthy of all praise and respect. Business can only be done under modern conditions through corporations, and our purpose is to heartily favor the corporations that do well.

"The Administration appreciates that liberal but honest profit for legitimate promoters and generous dividends for capital employed, either in founding or continuing an honest business venture, are the factors necessary for successful corporate activity, and, therefore, for generally prosperous business conditions.

"All these are compatible with fair dealing as between man and man and rigid obedience to the law. Our aim is to help every honest man, every honest corporation, and our policy means in its ultimate analysis a healthy and prosperous expansion of business activities, of honest business men and honest corporations."

After the delivery of the speech there was a notable recovery and firmness in stock quotations.

Tremendous Indictment of an Electrical Union.

A sensation has been caused in the electrical field in New York City by the report to the Supreme Court of Mr. W. J. Kenney, the receiver, on the management of the New York Electrical Workers' Union, an organization which has managed to inflict infinite loss and annoyance on those having do with electrical construction on Manhattan Island. The report, which is voluminous, declares that "thousands of dollars have been taken by the officers and other members of the union, in disregard of the law of the state." In suggesting a remedy, Mr. Kenney says of these officials and members: "It seems to me useless to pursue them in the civil courts. They are now dependent upon what they earn from day to day. Judgments against them would be worth nothing." Mr. Kenney proposes that a meeting of the union be called for the second Wednesday in September for the election of a new set of officers and directors, the affairs of the union to be put into their hands, as those at present existing are not, according to the report, "in number or qualification, fitted to disburse the money of the union under the law."

The report goes on to say that the union from its start headed for disaster, there being no attempt made to comply with the law which provides for the appointment of a trustee to keep a duplicate record of money received by the financial secretary. No trustee was ever appointed. The record of this union is one remarkable personal treachery and dishonesty. Within a year there was a revolt against its president. He was charged with dishonesty, and indicted, but was acquitted about a month ago. Then there were two factions in the union, both of which collected money from the members.

"After resigning his presidency," Mr. Kenney says, "this indicted ex-president was employed in 'special representation' of the union and spent hundreds of dollars of the union's money. He was lavish in expenditures, but saving in itemization." Dealing with the financial end of the union, Mr. Kenney says: "In September, 1905, Webster H. Storer became treasurer of the union, and C. A. Krause financial secretary. Both remained in office until they were put out by order of the Supreme Court last April. After three months of mutual accountancy they opened a new set of books, starting without a cent to the credit of the union, apparently. Mr. Krause says the quarred of the factions had reduced the union's income to nothing. Mr. Storer says nothing. He has disappeared. So have the books.

Analyzing the accounts, Mr. Kenney finds that from the date of the opening of the new books until March, 1907, $39,835.50 was collected from members. Of this, $35,712.21 was paid out, $19,298.20 being paid to "functionaries of the union who did, or pretended to do, work for the union." The principal amounts paid were: John J. Maddocks, president, $3,374.29; Carl A. Krause, financial secretary, $3,177.67; Richard Kirwan, agent, $2,381.80; M. J. Heller, special agent, $2,413.03, and Webster H. Storer, treasurer, $978.42. Outside of this $10,298.20, an additional $4,746 was paid to O'Neil & [illegible] Mr. Kenney

says: "The president of the union is entitled to $100 a year. John Maddocks, the ousted president, from December, 1905, to March, 1907, received $3,374.29."

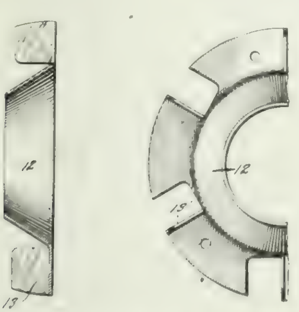
The report gives in detail a number of similar incidents, and then goes on to tell of the efforts made by Mr. Kenney to locate Storer. "Treasurer Storer ought to explain discrepancies between himself and Secretary Krause which appear," adds Mr. Kenney, and he concludes his report by saying: "The business of this union was pursued without system. Its money was handled by persons who had no right to touch it."

Toledo Convention of the O. E. L. A.

During the present week from Aug. 20 to 22, the 13th annual convention of the Ohio Electric Light Convention is being held at Toledo, Ohio. The session on Tuesday forenoon was devoted to the presentation of the presidential address by Mr. W. P. Engle, the discussion of papers on factory lighting by Mr. A. P. Biggs, and Mr. J. Kermode, and the reading of the report of the committee on uniform accounting by Messrs. F. E. Crawford and D. W. Low. During the afternoon session on Tuesday, the paper by Mr. H. P. Grabhill was read and discussed, and the report of the committee on electric heating devices was heard. For Wednesday forenoon arrangements were made for the reading of a paper, by Mr. J. Robert Crouse, on co-operative commercialism in the electrical field, and a paper by Prof. F. C. Caldwell, on the best form of power for stations of 500-kw capacity or less. The afternoon session on Wednesday was to be devoted to the reading and discussion of the report of the committee on high-efficiency lighting units and the report of the committee on cost determinations, and to the presentation of papers on help to a solicitor, by Mr. Frank Munsell, Mr. J. D. Kenyon and Mr. A. S. Miller. In addition to the reading of the report of the secretary and treasurer and the election of officers, the presentation and discussion of four papers on the best way to meet gas and gasoline competition were arranged for Thursday morning. The last official meeting was to consist of an executive session on Thursday.

Forced Cooling of Dynamos.

Although the fact that the load which a certain motor or generator can carry continuously is limited largely by the facilities for cooling with which the machine is supplied, has been known even from the days when the first machines were being constructed, yet only within relatively recent years have



FIGS. 1 AND 2.—SIDE AND END VIEWS OF FORCED DRAFT FANS.

manufacturers appreciated the great value of employing forced ventilation for such machines. The present trend of thought in this direction is well illustrated by a patent recently issued to Mr. Henry G. Reist, of Schenectady, N. Y. The inventor equips the rotating member with large outwardly extending fan blades for producing an adequate circulation of air throughout numerous ducts within the rotating and stationary cores. Two views of the ring carrying the fan blades are given in the accompanying illustration.

CURRENT NEWS AND NOTES.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—Subject to revision, the fall meeting of the American Electro-chemical Society will be held in the building of the Chemists' Club, New York, on Oct. 10, 11 and 12. The programme will comprise several papers on the electrometallurgy of iron and steel, including one by Dr. Haanal, who has made a thorough study of the subject for the Canadian Government. Among the topics for discussion will be the subject of the corrosion of iron and steel considered from the electrolytic standpoint.

RESTRICTING SECURITY ISSUES.—The Public Utilities Commission has formulated and given out rules applicable to the issuance of stocks, bonds, notes and other evidence of indebtedness by public utilities corporations in New York state. The object apparently is to prevent "stock watering," and the path is made a difficult one to pursue. A company has to throw open its books and prepare a variety of minute statements even to secure a hearing as to any proposed increase of capital. These rules have immediate effect, and will determine the result of several applications from electric traction and lighting corporations.

ROBERT FULTON CELEBRATION.—The first trip of Robert Fulton up the Hudson from New York to Albany, Aug. 17, 1807, in the tiny paddle-wheeler *Clermont*, was duly celebrated on the Hudson River, on the anniversary, last Saturday; but there will be more elaborate and formal exercises next month in New York and at the Jamestown Exposition. All the Albany Day Line boats had ceremonies in honor of the occasion. One hundred and thirty engineers of the Robert Fulton Association of the N. A. S. E., sat down to a memorial banquet on the evening of Aug. 11 at King's Retaurant, Chicago. Speakers of the evening dwelt upon Fulton's work, hailing his gift to the world as one of the greatest in history. Mr. Royal D. Tomlinson, ex-president of the National Association and supervising operating engineer and condenser expert for Allis-Chalmers Company, responded to the toast, "Engineers, Then and Now." Mr. John W. Lane, editor of the *National Engineer*, spoke on "Robert Fulton;" George N. Carmen, director of the Lewis Institute, responded to "One Hundred Years of Steam," and Charles W. Naylor, chief engineer for Marshall Field & Co., had for his subject, "A Look Into the Future."

THE TELEGRAPH STRIKE.—The telegraph strike has now got well into its second week, and the companies have steadily been increasing their forces and the numbers of offices reopened. So far as can be judged from practical experience there is now little if any delay on the lines, and to an outsider in the great cities there would appear to be no strike at all. The Government has declined to intervene in the matter. President Small, of the telegraphers' union, is trying to raise a strike fund of $10,000,000 and to stir up an agitation for government ownership of telegraphs. In the meantime, the strikers are beginning to talk about arbitration, and Samuel Gompers, of the American Federation of Labor; John Mitchell, of the United Mine Workers, and Daniel J. Keefe, of the International Longshoremen's Union, have been appointed arbitrators for the Commercial Telegraphers' Union, provided the companies can be persuaded to arbitrate the questions which were the prime cause of the strike. Unless conditions vitally change, these gentlemen will not have much to do, as the representatives of the companies have repeatedly stated that they would not arbitrate, having no question on which to arbitrate. In fact there has not yet been any public statement of grievances.

OKLAHOMA [illegible] [illegible] the Independent [illegible] [illegible] of Oklahoma were held at the Lee Hotel, Oklahoma [illegible]. The following officers were elected: [illegible] president; J. W. Wilson, of Oklahoma City, vice-president; L. D. Spencer, of Pauls Valley, secretary and treasurer. The next meeting will be held in [illegible].

THE BEST BURGLAR PROTECTION.—The Chicago central-station companies have, in their recent advertisements, quoted a statement recently made by Chief Shipply, of the Chicago police force, to the effect that a lamp constantly burning in the house is the best protection against burglars. The turn-down type of electric lamp is, of course, suggested as the one with which it is easiest to carry out this plan, as it cannot blow out when turned low as will gas and it is very economical to operate.

ATLANTIC WIRELESS.—It is announced from London that the Marconi Wireless Telegraph Company will be prepared for a wireless telegraph service between Ireland and Canada in September. This was confirmed at the offices of the company in this city. The company lately has made great improvements in its station at Glace Bay, which has been moved to a more favorable situation and much enlarged. The station at Clinton has also been improved in order to meet the situation. The first stations erected were found to be too small for the purpose, and therefore the improvements. For some time past the company has had communication across the Atlantic, and exhaustive tests have been carried on which have been entirely satisfactory. Mr. Marconi, when here some months ago, was confident of the fact that the establishment of the commercial service would soon take place, but at that time no announcement was made, as he wished to have the result of the test first. The company's ordinary rate will be 5d., and the press rate 2½d., plus land charges. The present rate by the ordinary cable companies is 25 cents per word.

N. E. L. A. BULLETIN.—President Farrand, of the National Electric Light Association, has signalized his new administration by the issuance of a handsome eight-page bulletin, the first number of which has just appeared. It will be devoted to the promotion of intercourse between the officers and the members, particularly in cases where information is desired from standing committees. The objects of the bulletin are admirably defined in two editorial articles of an explanatory character and inviting co-operation. A large part of the issue is, and will hereafter be, assigned to the "Question Box," so as to make it of current, continuous value, and Mr. Alex. J. Campbell, of New London, Conn., the editor, presents two pages of live topics. Answers will be printed usually two months after the topic has been made a subject of inquiry. This issue contains also Mr. W. H. Blood, Jr.'s, review of the New York fire insurance decisions. The bulletin is printed in excellent type, and is altogether worthy of the high standard reached by the Association in its other publications. We can readily believe that it will be found an extremely useful medium for disseminating Association intelligence and securing new members.

THE MILWAUKEE MUNICIPAL PLANT.—A lively fight is being waged in Milwaukee over the building of a municipal electric light plant. The plant has been under consideration for some time, and in fact the city went so far as to have plans and estimates made. In the meantime the city closed a five-year contract with the Milwaukee Electric Railway & Light Company at $65 per lamp per year. The company offered to furnish light at $60 per lamp per year or cheaper, if the municipal plant at Detroit could be shown to be furnishing light for less than $60. In short, for a ten-year contract, the company offered to duplicate any price that Detroit might set in its municipal plant. The city having made a satisfactory contract with the electric light company, many citizens formerly in favor of the municipal ownership movement considered that the municipal movement had outlived its usefulness and that the project of building a plant should be dropped. There is still a radical element which is trying to build the plant at an expense of $1,500,000, and is blocking all other improvements that are demanded by the public. Comptroller Bechtner has come out against the plant and refuses to countersign any of the orders.

ELECTRICAL COMMUNICATION.—Mr. Charles A. Conant, the financial expert, has in an article in the *Bankers' Magazine* some interesting data and references with regard to the use and value of electrical communication in the financial world. It was said that New York brokers were paying as much as $1,000,000 per year for London dispatches with the installation of the first working cable in 1866. Twenty words to London then cost $100, as compared with $5 to-day. At present it is the estimate of cable officials that fully 95 per cent of all messages sent are in code, and that 1000 messages come from the financial district daily. On land the electric telegraph has contributed its share in bringing together the markets of the world. The system of stock tickers, now installed in nearly all the brokerage offices and in leading hotels and other places where men gather throughout the country, has made the news of transactions on the Stock Exchange as nearly instantaneous as the advance of present day science permits. In addition to Stock Exchange quotations, which are carried to nearly 2000 tickers in Greater New York and Jersey City, there are 100 machines reporting the grain and produce quotations, and there are additional hundreds in Chicago and other leading cities of the country. The telephone has doubled and perhaps trebled the working efficiency of all those classes of men who decide important questions by a word and leave the details to their subordinates. On the Stock Exchange alone business aggregating over $100,000,000 per day is transacted by telephone.

WIRELESS FOR FRUIT STEAMERS.—Advices from Washington state that officials and representatives of the United Fruit Company, a Boston concern, controlling a large part of the trade in West Indian fruits, have had a meeting by appointment with Secretary Taft in furtherance of their application for permission to erect a wireless telegraph station at Point San Antonio, on the extreme westerly end of Cuba. They stated that they were operating one hundred vessels between the United States and the West Indies and Central America, and from the nature of their business, involving the handling of vast quantities of perishable fruits, it was essential that the ship captains should be in constant and immediate communication with headquarters. Already the company had established a number of wireless stations, in the gulf and Caribbean waters, including those of Port Limon, Costa Rica, Bocas del Toro, Columbia, Bluefields, Nicaragua, and Gracios a Dios, and Puerto Cortez, in Honduras, and Belize, Yucatan. A station at Point San Antonio was necessary to secure full benefit from many of these other stations, as a relay was essential to the operation of the longer circuits. It appears that the application for the permit was originally made to the present Government in Cuba, but its approval had been withheld for the reason that that Government has projected a general system of wireless stations on the coast of Cuba, including one at Pinar del Rio, only sixty miles distant from the point selected by the United Fruit Company as a site for its station, and it was feared there would be "interference" to an extent that would make the Government station valueless. Secretary Taft, after hearing the arguments, decided that he would issue to the company a revocable license, subject to the approval of Gov. Magoon, so that the station might be discontinued at any moment if it interfered with the Cuban Government station.

PEKIN TROLLEYS.—The bulletin of the U. S. Department of Commerce and Labor states that a plan for the construction of a tramway line at Pekin elaborated by a Japanese has been presented to the Bureau of Foreign Affairs by the Japanese minister at Pekin. He demands a monopoly of ten years, after which the concern may be bought by China

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GOVERNMENT WIRELESS.—It is stated that, foreseeing possible dangers to the Government in time of conflict of a general strike of telegraph operators, officials of the War and Navy Departments have begun to formulate a plan for extending the wireless system of the navy and the development of a complete system in the army, including army posts across the continent as well as on army transports. It is expected that a meeting of the joint army and navy board will be called soon to consider the proposition and make recommendations for its being carried out.

POWER FOR NEW YORK.—In an interview in London, Comptroller Metz is credited with the following statement: "As for the water supply, I am convinced that New York will sooner or later have to filter its water or sterilize it in some way. In Germany I studied the process of ozonizing water electrically. This is now done successfully in several towns, but on a much smaller scale than will be necessary in New York. By utilizing the fall of water at the Croton Dam, however, it is estimated that the city will have 700,000 horse-power at its disposal, and this will furnish enough electricity to ozonize all the city's water and furnish plenty of light, too. The problem of engineering is one which I shall study on my return home."

TARIFF REVISION is being taken up in some unexpected quarters. The National Association of Manufacturers, an organization of some 2700 manufacturers, with a combined capitalization exceeding $15,000,000,000, publishes in the current issue of its official organ, *American Industries,* a tariff "creed" emphasizing the resolution in favor of immediate tariff revision, unanimously passed at a recent convention. The association holds that present tariff schedules are unequal, and demands the immediate appointment by Congress and the Executive of a non-partisan, non-political commission, composed of men thoroughly competent to equalize present schedules.

VICIOUS POLES.—The subjoined item is funny, but appears to have been published in good faith. Some people feel that the way in which poles "get up and go for" automobiles is a crime that must be punished and stopped. "Telegraph and telephone poles are becoming absolutely dangerous to automobilists, and a national agitation for the removal of the poles from the roadside is not at all unlikely. The papers of the country report daily accidents to motorists caused by the poles. Cars break steering knuckles and escape the control of their drivers, or they escape by other means, and the telegraph or telephone pole is usually their finish. With the poles removed it is not improbable that the fatalities in automobiling would be decreased by half or more."

CANADIAN TELEPHONY.—The second annual convention of the Canadian Independent Telephone Association will be held at the City Hall, Toronto, on Wednesday, Sept. 4. An interesting programme is being prepared, and the following are expected to address the convention, viz.: Theo. Garey, of Missouri, president of the International Telephone Association; J. B. Ware, secretary, Michigan Independent Telephone Association, Grand Rapids, Mich.; J. A. Harvey, secretary, International Telephone Association; Dr. J. F. Demers, National Telephone Company, Quebec, and others. Matters affecting the independent interests will be discussed, including those of legislation, exclusive agreements, the formation of provincial or district associations after the Ohio plan, etc.

TO CONSIDER TRUSTS.—Questions affecting the relations between State and National governments and corporations will be discussed at a national conference on combinations and trusts to be held in Chicago on Oct. 22, 23, 24 and 25. This conference will be held under the auspices of the National Civic Federation. It is announced that 41 governors of states and the commissioners of the District of Columbia have appointed delegates to attend the meeting. Many governors have signified their intention of attending the conference in person. The delegations as appointed are made up of representative citizens of the various states, including senators, congressmen, attorneys-general, ex-governors, members of state railway commissions, newspaper editors, attorneys, college presidents, labor leaders, manufacturers, farmers, cattle growers, merchants and bankers.

INSULATING MATERIAL FOR RHEOSTATS.—A patent issued Aug. 13, to Mr. H. Ward Leonard, describes certain combination materials that are stated to be particularly advantageous for supporting the resistor in a rheostat or electric heater. One suitable composition consists of three parts of fluorspar ground to about 60 mesh, and four parts of a vitreous material made by fusing together two parts of red lead, two parts of borax and one part of flint, the vitreous material being ground to a fine powder. The fluorspar of the composition has a coefficient of temperature expansion higher than that of cast-iron and higher than the coefficient of a resistor made from an alloy of substantially 60 parts of copper and 40 parts of nickel. The vitreous material of the composition has a coefficient of temperature-expansion less than that of cast-iron or of the copper-nickel alloy.

A SCHOOL FOR TELEGRAPHERS.—With the object of supplying a sufficient number of railway telegraphers to enable the Pennsylvania Railroad to comply with the new national law, under which railway telegraphers are permitted to work only nine hours a day, that company has announced that it will establish a school of telegraphy at Bedford, Pa. The students of this school will be instructed in the duties ordinarily performed by station agents. They will acquire a knowledge of practical railroading while pursuing their studies in telegraphy. Train orders and other telegrams handled often over railway telegraph wires will become familiar to these operators before they attempt actual work on the railroad. The Pennsylvania Railroad east of Pittsburg and Erie employs over 3000 operators, and it is estimated that 700 additional telegraphers will be required before the company will have enough men to comply fully with all the requirements of the new law, which goes into effect March 1, 1908.

RADIUM CURES.—U. S. Consul Thomas H. Norton, of Chemnitz, reports that the growing importance of radium as a therapeutic agent has led the management of the Imperial Uranium Works, in St. Joachimsthal, Bohemia, to construct a special laboratory for the industrial production of radium compounds. The consul continues: "The uranium ores of this locality contain higher percentages of this mysterious element than any other known deposits thus far investigated. The ores and the residues from the uranium extraction have hitherto been treated chiefly at Paris, where the method for isolating the minute traces of radium was perfected by Madame Curie and her lately deceased husband. There will be manifest advantages in carrying out the extraction at the place of origin, in view of the enormous amounts of rock required for the production of a tiny fragment of a radium salt. Interesting, likewise, is the fact that an extensive sanatorium is being erected in the same locality, where patients can take baths in the water pumped from the uranium mines. This water seems to be sufficiently charged with radium compounds in solution to exert a distinct therapeutic action, and physicians have already begun to prescribe its use."

MISSOURI TELEGRAPH LAW.—At Chillicothe, Mo., on Aug. 17, the Burlington Railroad Company was found guilty of violating the eight-hour telegraphic law and was fined $200 by Justice Crall. An appeal was taken. This is the first conviction obtained under the law passed at the last session of the Legislature and which the railroads declare conflicts with federal statutes.

THE HOPKINSON METHOD.—With regard to the recent interesting correspondence in our pages, as to early knowledge and publication of the Hopkinson method of charging for electrical energy and service, our attention has been called to the fact that at the Cincinnati convention of the National Electric Light Association, in 1902, Mr. Arthur Williams gave a brief and succinct description of the system. It will be found on pages 443 and 444 of the volume of transactions of that year, and was headed "The Hopkinson Method." Mr. Williams also supplemented this by a pertinent discussion of rates.

CHILEAN TELEGRAPHS appear to be in an active condition and the state lines show a gain in 1906 over 1905, the messages sent having been 1,926,285 and 1,505,483, respectively. The receipts were about $274,617 United States gold for 1905, and $367,793 for 1906, a gain of $93,176. The average cost of a telegram was about 19 cents United States gold. The Government made a liberal appropriation for the betterment of the service for 1907. There are but few private lines in the country. The international telegraph line between Chile and Argentina showed a gain of $18,502 over 1905. A new cable is being put in over the Andes, 3 to 4 feet deep in the ground, to protect the line from the severe storms and snow-slides. All the telegraph and telephone supplies are imported, even to the poles, a large number of which are iron.

PARIS OMNIBUS SERVICE.—According to cable dispatches from France, the Municipal Council of Paris has decided to let the omnibus service of the city, provided the concessionaire will employ electric carriages, charge 10 or 20 centimes (2 or 4 cents), according to distance, appoint fixed stopping places, and pay the city 4½ per cent of its gross earnings. Moreover, the new concessionaire must give its employees a share in the profits, but not by way of an increase in salary. The share is to be paid into two funds, the sick and benefit fund, and the pensions fund, the former of which will also receive contributions from the company of 6 per cent of the total wages paid, and from the employees of 2 per cent of the wages received. Salaries are to be paid by the month. The minimum wage is fixed at $30. Each employee is to have four holidays a month and ten consecutive days' leave each year.

ELECTRICITY ON A MODERN STEAMSHIP.—The latest addition to the North German Lloyd Steamship Company's twin-screw express fleet plying between New York and Bremen, Germany, is the "Kronprinzessin Cecilie." The electrical equipment of this modern and fleet ocean greyhound consists of five 100-kw, 100-volt generators which supply the electricity for 3100 incandescent electric lamps and other electrical apparatus on board. The smoking rooms and cafés contain electric cigar lighters, and the state rooms are provided with plugs and connections for small electric fans and curling irons. In addition all of the outside rooms as well as suites and cabines de luxe are heated electrically. A complete telephone line connects the bridge, the engine room and after bridge, the bridge and look-out on the mast, the captain's room, all the officers' and chief steward's rooms, the pantry and all suites and cabines de luxe. When at the wharf the telephone system is connected with the land telephone system so that local and long distance calls may be made from the telephones on board the ship. The steamship is in addition equipped with a long distance wireless telegraph outfit.

POST OFFICE MANAGEMENT.—The New York Post Office is understood to be well managed, but that complications of an expensive character occur is indicated by the following from the New York *Times*: "The New York Post Office is particular in the conduct of its huge business, and particularly so in regard to money matters. To give just one instance in proof of this it may be said that a daily report of business done is sent from all the branch offices in the city to headquarters downtown. Should a mistake be detected in the financial statement in the way of a shortage or a surplus, the office from which it emanates is notified of the fact by telephone. It makes no difference if a shortage, say, should amount to only one cent or even a mill; the branch responsible is promptly called up by 'phone—and every ring-up, be it remembered, costs Uncle Sam 7 cents—and the error adjusted. Errors in the financial statements, however, are, as a rule, surprisingly few, and the sums concerned usually small. Rarely, indeed, is the shortage or surplus above ten dollars. It has happened on at least one or two occasions that after all such errors in the daily financial reports had been adjusted, the expense of the telephone calls totaled up to a little more than the entire amounts involved."

FORCING PLANT LIFE.—A special cable dispatch from London says: "A series of important experiments destined to revolutionize the production of crops of fruit and flowers under glass, and enable the gardener to obtain both in a much shorter period of time, as well as at a considerably less cost than heretofore, have just been begun in the Royal Botanic Gardens, Regent's Park. By means of a powerful arc lamp moving automatically along a trolley wire overhead, light is diffused over the plants directly the solar light fails. This movable lamp is surrounded by water, so that the rays may resemble those of the sun both in quality and movement. Besides, no part of the plant is entirely in the shade. By means of earthenware pipes connected with the engine, moist air, containing the carbonic acid required for the sustenance of the plants, is diffused in carefully regulated quantities through apertures into every part of the house, while in iron pipes heat is also diffused to maintain the desired temperature. But more important still is an electrostatic machine which is made to supply electrical energy to the soil to convert insoluble nitrates into soluble nitrates, and otherwise enable the roots of the plants to have an abundance of food prepared in a form capable of ready assimilation. A Mr. Thwaites is the inventor of the process."

PRODUCTION OF MICA.—In an advance chapter from the "Mineral Resources of the United States, Calendar Year 1906," Douglas B. Sterrett, of the United States Geological Survey, reports the production of sheet mica in the United States for 1906 as 1,423,100 pounds, valued at $252,248, and of scrap mica as 1489 short tons, valued at $22,742. These figures show an increase over those for 1905 of 498,225 pounds in quantity and $91,516 in value for sheet mica, and of 363 tons in quantity and $4,886 in value for scrap mica. The imports of mica into the United States in 1906 were the largest ever recorded, the value being considerably more than twice as great as in 1902 and 1905, the years that formerly held the record. According to Mr. Sterrett, the total quantity imported and entered for consumption in 1906 amounted to 3,066,738 pounds, valued at $1,042,608. The total production and consumption of sheet mica in the United States in 1906 was 4,489,838 pounds, as against 2,519,445 pounds in 1905, an increase of about 78 per cent. A comparison of the import figures with those of the home production shows that there is a wide field for the extension of the industry in the United States, and indeed the industry is expanding rapidly to meet the demand. Deposits carrying mica in commercial size are found in many parts of the United States, from the Atlantic coast to the Pacific, and new developments are reported each year.

Kern River No. 1 Power Plant of the Edison Electric Company, Los Angeles—III.

At the time work on the Kern River No. 1 plant was commenced five years ago, no plant of its size had been constructed for impulse wheel work. Units exceeding 2000-kw in output were extremely rare and for a long time it was supposed that 2500-kw units would be selected for this station. When, however, specifications were issued, many larger units were in successful operation and prices were requested on machines of 4000 and 5000-kw normal output. No difficulty was anticipated, nor was any experienced in securing generators of this size, but the water-wheel equipment presented a more difficult problem. Some manufacturers were willing to undertake the building of wheels having an output of 10,000 horse-power from a single nozzle, but the large size required, and the extremely crowded placing of the buckets rendered necessary if the unit was to be of reasonable dimensions, seemed to the officials to indicate that such a construction would be less efficient than the arrangement finally employed.

WATER WHEELS

The water wheels selected for the Kern River No. 1 plant are of the impulse or tangential type. There are eight wheels installed, two for each of the four generators. The two wheels for each unit are overhung, one on each end of the generator shaft, the unit being of the two-bearing type. The water is projected onto the buckets of the wheels through deflecting nozzles of the needle-valve type mounted at the end of the 28-in. branch pipes. By means of these deflecting nozzles and needle valves the discharge from the tip of each nozzle can be accurately regulated without altering the form of the jet to any appreciable extent.

The wheels are designed to run at 250 r. p. m., and the two wheels on each unit are guaranteed to deliver a total of 10,750 horse-power to the generator shaft. Regulation of the wheels is obtained by means of self-contained oil-actuated hydraulic governors of the Escher Wyss type working under 125 lb. pressure. The rotary oil pump immersed in the oil reservoir of each of these governors is operated by a Morse silent-running chain driven from the generator shaft. The governors act on the nozzles and deflect the stream off from, or onto, the buckets of the wheel as the load on the generator is decreased or increased. The governor for each unit is placed midway between the two nozzles and is connected to a common rock shaft which, in turn, actuates the two nozzles by means of rocker arms. These shafts are below the main floor and are accessible through a longitudinal shaft alley or tunnel 5 ft. wide and having a clear head room of 6 ft. 9 ins.

The nozzles are equipped with needles for adjusting the size of the stream by hand. For convenience in construction and to permit of balancing them for backthrust, the needles are straight-backed, running through a guide sleeve of their full diameter into a balancing chamber supplied with water from the pressure side. The needle then reduces to a steam and passes through a second stuffing box, beyond which the control links are attached. The needles are torpedo-shaped, being 8 ft. long, 12 ins. in diameter at their full diameter and 8½ ins. in diameter at the stem. The tip is about 25 ins. long and is carried down to a blunt point on straight lines. The needle is operated by means of a hand-wheel on the main floor, the wheel stand also supporting a pressure gauge connecting with the nozzle and the two pipes connecting the two sides of the nozzle body with the balancing chamber of the needle. Each nozzle throws a jet 7⅝ ins. in diameter at full opening.

The nozzle casting is bifurcated, the design being adopted to permit of bringing the needle stem out without offsetting the nozzle as is done in other types of deflecting needle nozzles. The strain on the ball-joint bearings is equalized in this construction. The nozzle is a heavy steel casting, the Y portion weighing 15 tons. A counterbalancing plunger is located at the lower end of each operating lever below the nozzle. The needle stems and part of the tips are of steel. Some cast-iron tips have, however, been supplied and it is expected that they will wear as satisfactorily as the steel ones.

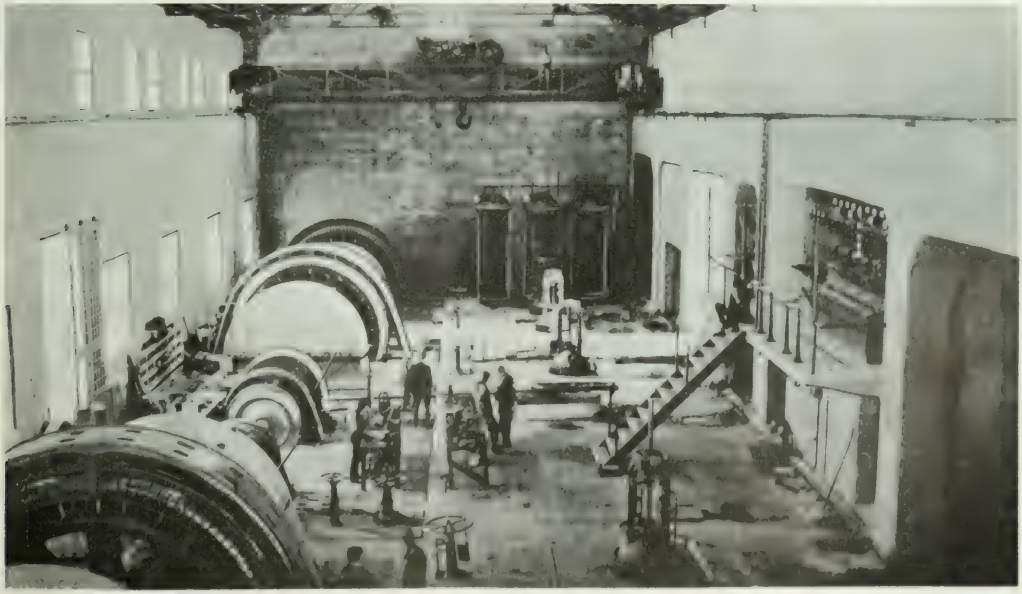


FIG. 22.—INTERIOR VIEW OF POWER HOUSE SHOWING THREE MAIN UNITS AND ONE OF THE EXCITER UNITS.

Each of the revolving elements of the wheels is 9 ft. 8 ins. in diameter, and consists of a cast-steel rim to which are bolted 18 bronze buckets. These buckets are 27½ ins. wide and are not radically different in form from modern buckets used elsewhere on the Pacific Coast, being in general of an ellipsoidal shape.

[illegible] that the [illegible]

The housings of the wheels are of cast iron with graceful lines, and where the shaft enters are fitted with compound baffle plates or water guards to prevent water escaping from the housing.

The mechanical and hydraulic design of these wheels was carefully checked by the engineers of the Edison Electric Com-

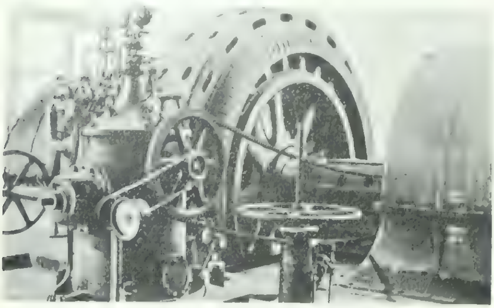
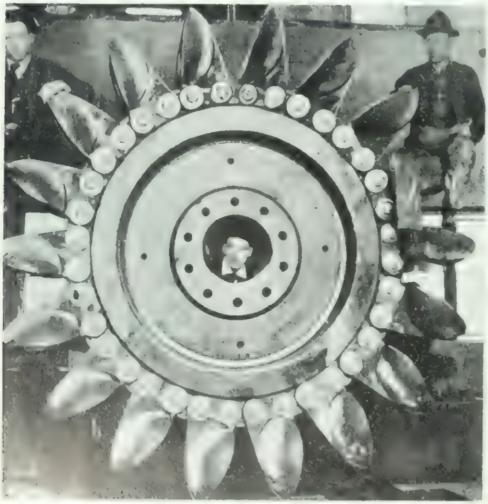


FIG. 23.—5000-HP WATER WHEEL GENERATING UNIT.

pany before the manufacturers were allowed to proceed with their construction. The combined moment of inertia of the revolving element in the two water wheels and generator of each unit is $WR^2 = 1{,}800{,}000$ lbs. ft.^{2}, by means of which regulation at 100 per cent load variation is obtained within less than 8 per cent when the units are carrying 50 per cent overload, and within less than 5⅓ per cent variation of speed when running at normal load. The guarantee requires that the water wheel proper shall develop an efficiency at rated load of 82½ per cent, which guarantee is to be substantiated by tests conducted by the company.

GOVERNORS

When the governor arrangement for the water wheels was



[illegible] 5000-HP WATER WHEEL.

designed, the leading idea was to have each turbine with its respective governor form an independent unit. Although the available operating water pressure of 370 lbs. from the force main is ample to operate governors, it was preferred to substitute oil pressure. This precaution is fully justified, as long years of experience in operating hydraulic governors has proven that the safety is rather questionable, and the wear and tear of the parts of regulating valves causes a constant expense for repairing and replacing parts, which necessitates shutting down the respective units. It was also deemed preferrable not to feed the governors with oil pressure from a central system, but to make each governor absolutely self-contained. The oil pressure used is 125 pounds per sq. in.

Special attention was paid to the safe operation of the units, eliminating from the beginning any tendency to run away. For this purpose, the arrangement of the generator, as well as the exciter governor, was made in such a manner that the jets will be automatically deflected from the buckets whenever the oil pressure in the governor should fail.

The weight of the two deflecting nozzles for each unit is partly carried by a hydraulic balancing piston placed midway between the nozzles, which receives water pressure directly from the force main. The governor arm connects by means of a link to a common rock shaft, which, in turn, actuates the two nozzles by means of rocker arms. The design of the connection is such that as soon as the oil pressure in the governor fails, the nozzle will lower on account of the unbalanced weight, and thus deflect the jet from the buckets. The same result is accomplished with the deflecting hood of the exciter wheels, which is connected to a hydraulic water piston, tending always to insert the hood and thus deflect the jet.

Each governor is driven by a Morse silent-running chain from its wheel shaft. The connections between the operating pistons and the deflecting nozzles or hoods consist of levers, pins, links and shafts. The use of gears or racks has been avoided, thereby preventing jars which would result in lost motion and wear and tear.

Attention may also be called to the fact that all constituent parts, as well as all accessories, are attached or combined with one main casing, the advantage being that each governor can be assembled and thoroughly tested in the factory, and shipped completely assembled to its final destination. The main casing contains the main operating cylinder with piston and mechanical hand-regulating device.. The oil pump is attached to the casing and immersed in the oil reservoir. It is of the rotary type, having no valves which are often the cause of failure of oil pressure. The main pump shaft also carries the bevel gear which drives the fly balls operating the pilot valve over the regulating lever. The pilot valve is self-contained between opposing pressures, and any reaction upon the fly balls is eliminated. It is evident that this is a principal condition for exact regulation. The pilot valve distributes the oil pressure in the regulating cylinder. The motion of the regulating piston is reversedly transmitted to the regulating valve by

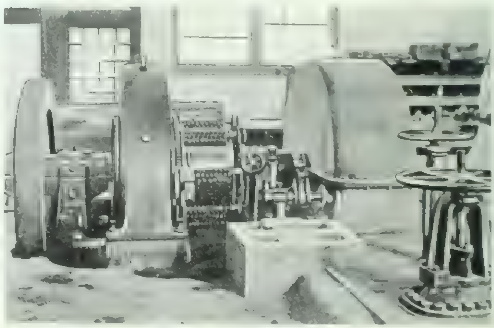


FIG. 25.—EXCITER UNIT.

means of a combined compensation. The leverage of this compensation is adjustable, so that the governor may be set for any load-speed characteristic, from 16 per cent to absolutely constant speed.

The governors are equipped with four regulating devices

which can be used at any time. 1. Mechanical hand regulation (without oil pressure). 2. Automatic regulation with fly balls. 3. Hand regulation with oil pressure (fly balls disconnected by a clutch coupling inserted between pump shaft and fly ball shaft). 4. Hand regulation with oil pressure and electric motor operated from the switchboard. (Synchronizing attachment.)

The exciter governors are of similar design, except that they are not provided for electric hand regulation.

There are two exciter units, each being of the two-bearing type, with an impulse water wheel on one end and a heavy flywheel designed to give the unit close regulation on the other end of the shaft. The exciter wheels are operated from stationary needle nozzles, the needles being of the same straight form used on the main wheels. Regulation is obtained by oil governors of the Escher-Wyss type, which operate stream deflectors that are pulled up into the stream from below as the load on the unit decreases, thus deflecting a part or all of the stream into the tail race. The exciter wheels are of a construction similar to the large wheels, having 20 bronze buckets 9⅜ ins. wide bolted to the rim of the runner. All the water wheel equipment mentioned above was supplied by the Allis-Chalmers Company.

The Lombard Governor Company has furnished for the plant one of its type N governors for operating one of the main units and a type Q governor for one of the exciters. These governors are of the vertical oil-pressure type and the order includes the necessary reservoirs, pumps, etc. The Edison Electric Company has used Lombard governors in its other hydroelectric plants and is desirous of determining the relative performance of the two types of governors in its Kern River No. 1 plant.

GENERATORS.

The main generators are of General Electric manufacture and have a rated output of 5000 kilowatts each. The stationary armature is bar-wound for 2300 volts, three-phase, 50-cycles. Each main unit is provided with two 16 in. x 48 in. babbitted bearings, each fitted with six oil rings. In the pedestals the oil is cooled by means of water coils. Each bearing also has in its lower portion a number of small openings which are connected to a triplex motor-driven pump, capable

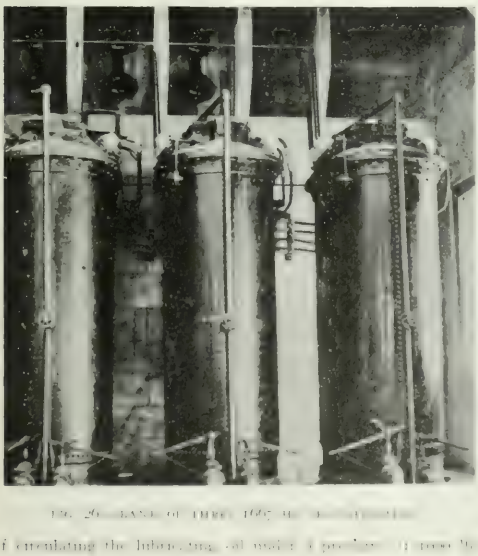


FIG. 26.—BANK OF THREE 1667-KW TRANSFORMERS.

of circulating the lubricating oil under a pressure of [illegible] lbs. to the square inch.

The generator shaft is turned out at each end to form a flange to which is bolted the wheel disk. The shaft is also enlarged at the center to carry the cast-steel pole rim and spider. This latter is a single casting weighing 26 tons. The pole pieces are wedged to the exterior of this rim.

The exciter units are standard 225-kw, direct-current machines, generating at 125 volts, flat compounded, running at 430 r. p. m., and have ordinary self-adjusting bearings. Sufficient space has been left between the two exciters to permit the installation of a large induction motor at some future time if it should be found necessary. This motor would be designed

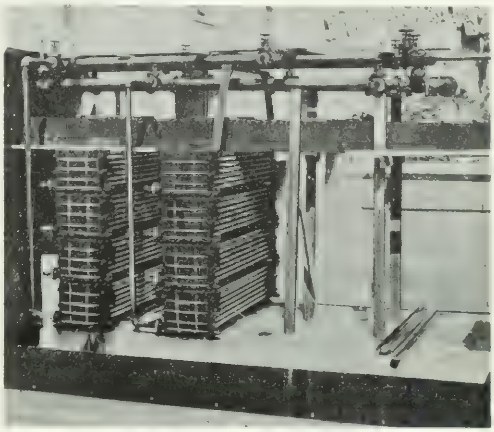


FIG. 27.—COOLING COIL FOR CIRCULATING TRANSFORMER OIL.

for good speed regulation and arranged so that it could be connected by means of a pair of clutches to either of the exciters.

OUTPUT OF THE PLANT.

The normal rated output of the Kern River No. 1 power plant is 20,000 kilowatts. The machinery is tested to operate under 50 per cent overload for peak load service, thus making the maximum capacity of the installation 30,000 kilowatts.

TRANSFORMERS.

The station contains 13 50-cycle, 1667-kw oil-filled, shell-type oil-circulated one-phase transformers in boiler-iron cases. These transformers are grouped in four banks of three each with one spare to receive power at 2300 volts delta from the generators, and to supply it to the line at 75,000 volts Y. Taps are also provided for the intermediate voltages of 56,250 and 37,500.

These transformers, instead of having internal water cooling coils, are so built that when the oil is supplied to them under a slight pressure, it will automatically distribute itself throughout their windings and return itself by gravity to the waste pipe. The piping and connections for this circulation, which are placed in the basement of the power house, consist of a 4-in. supply line, a 6-in. return line, and a 4-in. waste. These principal pipes are placed in a tunnel 7 ft. 9 ins. wide and 11 ft. high, extending the length of the building.

The oil coming from the transformers enters a receiving drum from which it is drawn by two 5-in. centrifugal pumps, driven by 15-hp variable-speed, shunt-wound, direct-current motors. Either pump can supply oil to the entire equipment of transformers in an emergency. These pumps force the oil through a set of boiler-tube coolers, set over the tail race, consisting of a series of 2-in. pipe, 10 ft. long, made up in four sections containing 1008 tubes, and having a total area of 4500 sq. ft. Only two of these sections are at present installed. From these cooling coils the oil returns to the pressure line from which it is supplied to the transformers.

This system has been carefully laid out with strainers, by-passes and other auxiliaries so that the entrance of any foreign substances into the oil will not cause trouble. As the system is under pressure from the time the oil enters

[illegible] possibility of water leaking into the oil, as is the case where the water coils under pressure are placed in oil-filled transformers. The oil is specially refined. Another advantage of a system of this kind is that the cost of installation is somewhat less than for a similar installation using water cooling.

Water for the cooling sections is by-passed from one or both of the exciter tail races into a flume built across the top of the coolers.

[illegible]

The generator leads pass through ducts, under the station floor, to the generator switches, and from thence to the low-tension side of the transformer banks. The station is not equipped with a complete 2300-volt bus-bar system. There are, however, motor-operated oil tie switches placed between adjacent machines and equipped with double-throw switches in such a manner that in case of necessity any generator can be transferred by means of this transfer line to any single transformer bank, or in case of absolute necessity, run in multiple with some other generator on a single transformer bank, or, if desired, the entire station can be tied together by means of this transfer bus and operated as a single unit.

The transformer banks connect on their high-tension side through knife-blade switches to a single bus-bar, which is sectioned in the middle. The two outgoing transmission circuits are tapped off this bus-bar between adjacent transformer banks through motor-operated oil switches. These switches are remote-control, non-automatic. By use of them and the section oil switch, all high-tension power switching can be handled without the use of air-break switches. At the same time, the investment for high-grade switching is reduced to a minimum. The 2300-volt oil switches are installed in cells with concrete barrier walls and tops. The disconnecting switches for them are also separated by barrier walls where possible. The 75,000-volt oil switches are not only installed in concrete cells in accordance with standard practice, but each of

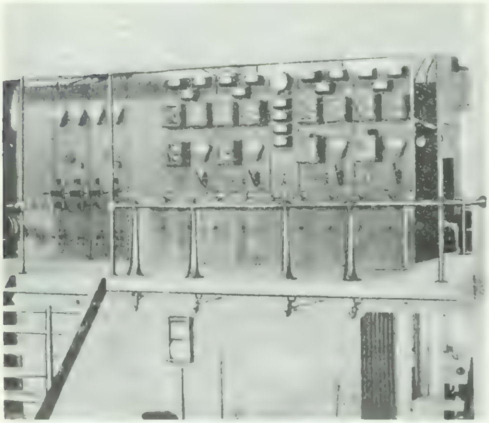


FIG. 28.—CONTROL SWITCHBOARD.

them is enclosed in a separate concrete room containing no additional apparatus except lightning arresters.

The control switchboard is mounted on a gallery overlooking the machine room. It is built of black slate and is a combination bench and panel board, consisting of nine divisions. The first panel on the left controls the station auiliaries, the feeder for which is taken off the two center sections of the 2300-volt bus through solenoid-operated oil switches and then through two solenoid-operated oil switches to the panel.

The second and third panels are equipped for handling the exciter circuits, and each is provided with a Thomson Astatic ammeter, a voltmeter and two single-pole, double-throw knife switches for connecting the exciter to either of the two exciter buses. The panel also has two double-pole, double-throw switches for connecting the exciter bus to the station lighting circuit and to the operating buses which control the oil-switch motors, the lamps on the control board and other auxiliaries.

Panel No. 4 is blank, while Nos. 5, 6, 8 and 9 are generator panels. Each of the latter is equipped with three Thomson ammeters, a field astatic ammeter, a curve-drawing ammeter, a curve-drawing voltmeter and a curve-drawing wattmeter.

The seventh panel is the auxiliary feeder, bus-sectionalizing and station panel. It contains a synchronism indicator and two

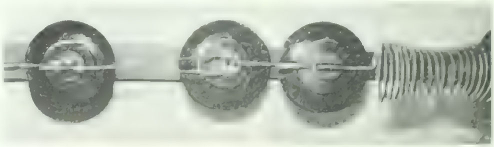


FIG. 29.—HIGH-TENSION LINE DISCONNECTING SWITCH AND CHOKE COIL.

voltmeters on the synchronizing bus, an ammeter on the ground circuit and an ammeter on the auxiliary feeders.

The bench of the switchboard has controlling switches with red and green signal lamps for each of the four generators, and there are also provided control switches for each of the two 2300-volt feeder switches, for the switches on the 2300-volt bus sections and for the 75,000-volt outgoing line switches. The base of each generator bench panel has one governor control switch and a double-pole, double-throw control switch for operating the two 28-in. valves on each water-wheel unit.

On the six-panel rear switchboard are mounted five Thomson polyphase watt-hour meters, break switches and disconnecting switches on the field circuits. A curve-drawing frequency-registering meter, driven by a ¼-hp motor is also installed.

All of the electrical equipment in the station, including generators, exciters, transformers, lightning arresters, oil switches, switchboards, etc., was supplied by the General Electric Company.

The high-tension wiring is run in 4-ft. square ducts throughout, no open wiring being permitted except connections from transformers to the wall through their disconnecting switches, and from the lightning arresters disconnecting switches to the lightning-arrester banks.

The lightning arresters are of multiplex type, consisting of alternate carbon spark-gaps and resistance. The circuits are equipped with choke coils, consisting of 20 turns, of hard-drawn copper. The lightning arresters are, as stated above, mounted in concrete wall cells, and are so completely isolated from each other by the intervening main-line ducts that an arc starting on any single arrester could not by any possibility be transferred to a second bank.

The leads, after passing the choke coils and taps for the lightning arresters, pass out of the south wall of the building through rectangular openings located immediately below the eaves. To prevent the drip from the long run of roof from falling on the wires, a gutter extends for a few feet across the roof above each entrance. From the eaves of the building, the leads converge on to the first tower of the transmission line.

TRANSMISSION LINE ROUTE

From the power house the transmission line runs in as near as may be a straight line to the mouth of the Kern River Canyon, 2½ miles distant, where it sweeps off to the left across the Cottonwood Hills, and then takes a due south course across the edge of the Bakersfield plains. The line then enters the mountainous section through Tejon Canyon, follows across the end of Castaic Lake, and crosses the Coast Range divide immediately above German Station.

This is the steepest portion of the transmission line, as the

drop from the top of the hill to the road below is over 1000 ft. in 3500 ft. From here south the transmission line follows the waters of Piru Creek and its tributaries, the character of the country changing gradually from low, rounded hills with grassy slopes, to deep narrow gorges walled with precipitous shale cliffs capped with sandstone ledges.

A section here of about 5 miles involved very difficult work. Heavy angles, both vertical and horizontal, were necessary in a district where no permanent wagon road could be maintained, and where the tower footings were mostly in loose shale. One U-bend of the river was crossed by means of a 2250-ft. span between the main supports, guided by an entirely unloaded tower at the bottom of the sag. This heavy work was mostly executed in the middle of winter to the considerable disadvantage of the work.

Leaving the Piru Canyon, the line passes in an almost straight line across about 15 miles of rocky land covered with scattered oaks and chaparral. After reaching the last crest of this district, the line falls away rapidly to the open country surrounding Newhall. Across this entire district it was necessary to construct a permanent wagon road to haul supplies and permit of patrolling the line during operation. The maximum

FIG. 30 — MAP OF TRANSMISSION LINE

grade facing the heaviest haul was held down to 10 per cent, whereas the maximum grade in the opposite direction was allowed to become 20 per cent in one special case. The ruling grades in both directions are much lighter, not averaging over 5 per cent.

One bridge having two 48-ft. spans was constructed at the head of Violin Canyon (Palomas) to avoid making an extensive fill. Piru Creek, which is subject to extreme floods on occasions, was crossed by a number of fords so located as to be readily repaired after freshets, it not being considered desirable to maintain a permanent wagon road in this locality.

In the Newhall district, the line crosses the San Fernando Mountains directly west of the long tunnel on the Southern Pacific. Beyond this point it is in sight from the railroad track most of the way to Los Angeles, and throughout the greater portion of the route the line is erected in the open country, so that in case of necessity the line can be repaired without excessive delay.

Electric Locomotive of the New York, New Haven & Hartford Railroad.

OUR issue for Aug. 10 contained a complete review of the reasons assigned by Mr. E. H. McHenry, vice-president of the N. Y., N. H. & H. R. R., for the selection of single-phase, high-potential locomotives for hauling trains throughout the "electric zone" of New York City. There also appeared a description of the details of the catenary line work for supplying energy to the locomotives. The locomotives were discussed in our issue for April 14, 1906. We are pleased to be able to give below some additional information concerning the service requirements for which the locomotives were designed and the numerous constructive details embodied in the locomotives which are in successful use at the present time.

In the adaptation of electric traction to the New York, New Haven & Hartford Railroad, a number of features were presented by the problem which required months of study, and which practically fixed the system which should be adopted, and to a large degree decided the design of both the locomotives and the line construction. Aside from the innumerable details which had to be considered, broadly speaking, the problem called for:

A system, the first cost and maintenance of which would not be prohibitive; a system which would permit of large extensions with a high degree of efficiency at a reasonable cost, and locomotive equipments which would be capable of operating over the direct-current lines of the New York Central Railroad.

After a most exhaustive study of the problem from all points, the single-phase alternating-current system was decided upon

FIG. 1 — VIEW OF NEW HAVEN LOCOMOTIVE WITH PANTOGRAPH TROLLEYS IN USE.

as being the only existing system which would successfully meet all of the conditions imposed.

The alternating-current system was primarily selected on account of its facilities for transmission and transformation, and single-phase was decided upon because the characteristics of the single-phase motor make it eminently suitable for railway work, and also on account of the simplicity of the line construction.

SERVICE REQUIREMENTS.

The specifications under which the locomotives were sold require that each of them shall be able to handle a 200-ton train in the most severe schedule on the present time-table, corresponding to the local express which stops about every 2.2 miles and operates on a schedule speed of over 26 miles per hour. This service requires a maximum speed of about 45 miles per hour. The locomotive is also to haul this weight of train at [illegible] 65 to 70 miles per hour and a 250-ton train [illegible]

[illegible] or more of the locomotives together and operating them on the multiple-unit system.

[illegible]

The design of the locomotives was largely dictated by certain requirements: (a) gearless motors having a flexible drive and with all the weight carried on springs were desired and finally adopted as the most desirable form, and (b) operation on 600 volts direct current necessitated the use of four motors in order that they might be operated in the usual series-parallel relation.

Having these two requirements in view, the mechanical design of the locomotive follows as a natural consequence. The bogie truck type was adopted after very careful consideration as the one best adapted to meet the conditions imposed. It is well known that its riding qualities are of the best and it offers the least resistance in taking the curves in the line.

LOCOMOTIVE FRAME.

The mechanical parts of the locomotives, which are entirely of steel, were built by the Baldwin Locomotive Works from designs developed with the co-operation of the Westinghouse Electric & Manufacturing Company and the New York, New Haven & Hartford Railroad Company engineers. The locomotive measures 36 ft. 4 ins. over bumpers, and weighs approximately 90 tons.

The longitudinal members of the frame consist of deep plate girders reinforced at the top by channels and at the bottom by heavy angles and plates. To these frames are riveted plate cross members, one over each truck, forming the transoms for the transmission of weight to the center-pin. These transoms are further braced by gusset plates riveted to the bottom flanges of both sets of channels, which transmit the tractive power from the center-pin to the side frames. The side girders are placed outside the wheels as low down as the wheels and drawhead will permit and are braced and squared by substantial steel flooring plates, which are riveted to the top flanges. The draw-bar effort is transmitted to the side frame through deep box girders joining the frames at the ends of the locomotive.

The cab is built up on a framework of Z-bars which are riveted to the side girders. This whole design forms a very light but extremely strong construction, able not only to transmit large draw-bar pulls, but to resist heavy shocks in bumping.

TRUCKS.

The running gear consists of two trucks, each mounted on four 62-in. driving wheels. The trucks have side frames of cast steel to which are bolted and riveted pressed steel bolsters which carry the center plates. A very strong construction is secured without excessive weight by the use of bolsters 30 ins. wide at the center plate and extended to nearly double that width at the ends, which are bolted to the side frames. Center bearings 18 ins. in diameter transmit the tractive effort to the frame. They are well lubricated to permit free motion on curves. The weight on the journal boxes is carried by semi-elliptic springs. Under the ends of the equalizer bars are small spiral springs to assist in restoring equilibrium. The distance between truck centers is 14 ft. 6 ins.

ELECTRIC AND MAGNETIC CIRCUITS OF THE MOTORS.

As mentioned in our issue for April 14, 1906, the propelling motors of the locomotives are of the conductively-compensated single phase, series type. For the direct purpose of improving the power factor, the magnetomotive force of the current in the armature is counterbalanced by an equal magnetomotive in stationary coils placed in the field core structure through which the armature current is required to pass. If the so-called compensation were complete, then the armature circuit and the stationary compensating coils as a unit would form a non-inductive circuit consisting of a certain resistance and no reactance. Due, however, to the magnetic leakage between the armature and the compensating coils the combined circuits contain a small reactance component in addition to the resistance.

It is noteworthy that by far the largest portion of the reactance of the motor circuits is found in the main field coils. As a rough approximation, it may be stated that at synchronous speed the tangent of the angle of lag (of which the cosine is the power factor) is equal to the ratio of the effective field turns to armature turns, and it decreases inversely with an increase in speed. Hence, with well designed armature and compensating coils, the power factor can be rendered quite high by using a small ratio of field to armature turns and operating the machine at a speed which is high in comparison with synchronism.

The requirements for obtaining a high power factor are well met when the field is made magnetically very weak and the armature correspondingly strong, and a large number of poles is used. The improvement in the power factor by using a weak field will be appreciated when it is remembered that for a certain field current the field flux varies as the first power, and the field reactance as the square of the field turns. The advantage of using a large number of poles resides in the fact that the magnetomotive force for producing the field flux is distributed throughout a large number of coils of few turns (and hence having a small reactance) rather than concentrated in a few coils having a much larger total reactance.

Incidentally, when a large number of poles is used, "synchronous" speed occurs at a low rotative speed. If an increase in the number of poles did not, from mechanical considerations, entail a corresponding decrease in the rotative speed it would be possible to improve the power factor of the motor by changing the ratio of the operating speed to the synchronous speed. It is to be noted, however, that, except insofar as an increase in the number of poles may allow a smaller pole-pitch or a higher peripheral speed to be used, no improvement in power factor is obtained from a change in the ratio of the operating speed to synchronism, because no such change takes place.

The motors on the New Haven locomotive are provided with 12 poles, so that the synchronous speed for 25-cycle current corresponds to 250 r. p. m. Since the locomotive drivers are 62 ins. in diameter, 250 r. p. m. corresponds to a locomotive

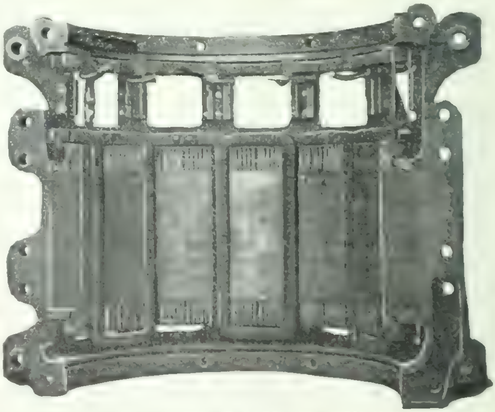


FIG. 2.—[illegible]

speed of 4060 ft. per minute, and at synchronous speed the locomotive runs at 46 m. p. h.

It is instructive to note that if the motor had 14 poles, and the drivers were 72 ins. in diameter, synchronous speed would again correspond to 46 m. p. h. with 25-cycle current; if, however, the frequency were lowered to 15 cycles, synchonous speed would occur at 27.7 m. p. h. Moreover, if the same motor were used for 15 cycles as for 25 cycles, at synchronous speed in each case, the tangent of the angle of lag would be the same; at the same locomotive speed in each case the tangent of the lag angle would be reduced in the ratio of 25 to 15, or as 1 is to .6.

It should not be inferred from the statements made above either that there could be any very considerable improvement made in the operating characteristics of a motor by changing from 25 to 15 cycles, or that the performance at 25 cycles is unsatisfactory. The fact of the matter is that the power of a 25-cycle motor is so high that even a very great reduction in the tangent of the lag angle produces a relatively small effect on the operating characteristics. Assume, for example, that at a certain speed the power factor for 25 cycles is 90 per cent; the angle of lag is 26 degs. and its tangent is .483. If the same motor is operated at the same speed with 15-cycle current, the tangent of the lag angle is .289, the lag angle is 16 degs., and the cosine (the power factor) is .96. Thus, the power factor has been increased by only 6.7 per cent. In any event, whether the motor is operated at 25 cycles or 15 cycles, its power factor will be better than that of a corresponding induction motor.

It will be noted from the facts discussed above that the prime object in compensating the armature magnetomotive force is to improve the power factor, and not to prevent sparking during alternating-current operation (as is frequently stated). At a certain speed and field strength the sparking depends upon the amount of current to be commutated, so that an improvement in the power factor, which results in a reduction in the current required for a certain power at a certain e. m. f. does to a limited extent improve the commutation; but the minute reduction in sparking is of secondary consideration. During direct-current operation of the motors the current in the compensating coils prevents a distortion of the field by the armature m. m. f., and hence it removes a portion of the cause for sparking at high speeds. To the extent that the alternating-current motor possesses the disadvantageous sparking characteristics of a direct-current motor, the compensation improves the commutation. Since the sparking in the alternating-current commutator motor is largely attributable to the transformer action of the field flux which is surrounded by the armature coil under the brush, it may be stated that in the prevention of sparking in such motors the compensation of the armature m. m. f. plays an unimportant part. The means for the prevention of sparking, which are confined to the armature itself, will be discussed below.

A view of one-half of the field core structure, with both the compensating and the main field coils in place is given in Fig.

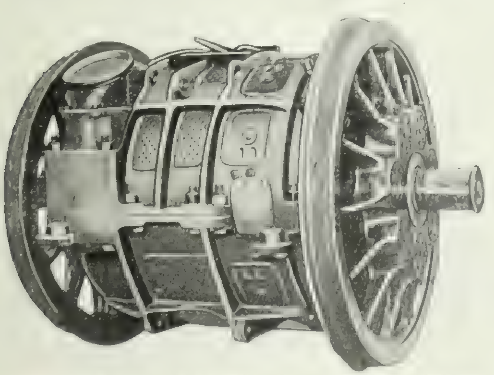


FIG. 3.—MOTOR COMPLETE, SHOWING THE VENTILATING ARRANGEMENT.

2. It will be noted that there are five complete field poles and two half-poles. Thus the field core structure is divided through the middle of two field poles, and not between certain adjacent poles, as is done with the ordinary four-pole direct-current railway motor. The object in thus arranging the divisions is attributable to the existence of the compensating coils whose conductors are embedded in the pole faces and whose end connectors pass between the adjacent poles.

It will be noted that there are 12 slots in each pole face; the conductors in six slots of each pole are joined directly to the conductors in the nearer six slots in the adjacent pole. To have divided the motor between adjacent poles would have necessitated the unsoldering and resoldering of 24 connectors in the compensating coil circuits. By dividing through the center of two poles, only a single connector of the compensating winding need be disturbed.

The splitting of the field core structure through the pole face has rendered desirable a slight change in the arrangement of the main field winding in order to minimize the disturbance to this winding when the two halves of the field structure are separated. Only one-half of the projecting pole cores are surrounded by main field coils, the magnetic poles at the other cores being of the "consequent" type. Thus only one connector in the main field circuit is disturbed when the field cores are separated.

Such an arrangement as the one here indicated might prove objectionable if the magnetic density over the pole area reached the saturation point of the core material. The field is magnetically very weak, however, and very little unbalancing of the poles takes place. Even when the field is strengthened for direct-current operation, the unbalancing is in itself of no great consequence. Moreover, the armature winding is connected at various equipotential points to "balancing rings," such as are commonly used in direct-current machinery, and no detrimental effect can be produced by a tendency to considerable unbalance in the magnetic fields.

ARMATURE.

The most striking feature of the armature is its appearance of compactness and stability. It differs from the ordinary direct-current armature in that the main winding is completely closed on itself, and connections to the commutator segments are made through resistance leads. The leads are tapped to the armature winding at the end of each turn, so that there is one armature turn per commutator segment. The object in inserting resistance between the armature coils and the commutator segments and in using only one turn per coil, is to overcome the sparking.

Each armature coil in its mechanical position when its commutator segments are under the brush is electromagnetically in the relation of the secondary circuit of a stationary transformer of which the primary circuit is the main field coil; there is generated by transformer action in each secondary turn an e. m. f. proportional to the product of the main field flux and the frequency. The advantages of using a single turn per armature coil, a weak magnetic field and a low frequency will be noted at once. The e. m. f. generated in the single armature turn under the weak magnetic field at 25 cycles is low in value, but in an armature of the ordinary design it would produce a large value of current locally in the circuit including one armature coil, two commutator segments and the double-brush contact. The resistance of the leads, however, serves to limit the short-circuit current to an allowable safe value and to prevent detrimental sparking at the commutator.

As the preventive resistance leads are arranged so as to be non-inductive, the short-circuit current is approximately in time-phase with the transformer e. m. f. in the armature coil, or in time-quadrature with the main armature current; moreover, the current in the coil undergoing commutation can be reversed most readily when the circuit of the coil is non-inductive. It will be seen, therefore, that the preventive resistance leads are well adapted to minimize the causes for sparking.

Since the main line current passes through two resistance leads in parallel, it is evident that some loss is occasioned by the presence of the leads. An excess of resistance would cause an enormous loss due to the main current, but would reduce the short-circuit current to an insignificant value; a deficiency of resistance would render the loss due to the main line current negligible, but the short-circuit current loss would be excessive.

The resistance of the leads used on the motors of the New Haven locomotives is so selected that neither the loss due to the short-circuit current nor that occasioned by the main line cur-

[illegible] reduced to a [illegible]

The resistance leads are covered with insulating material similar to that used on the main armature winding and are placed in slots beneath the armature winding proper.

Although, as stated above, the armature structure is very compact, ample provision has been made for ventilation and cooling. Experience has shown that the most effective method of cooling dynamo-electric machinery is to embed the insulated coils snugly and compactly in the mass of iron and then to keep the iron cool. Iron is an excellent thermal conductor, and it serves to extract the heat from the coils through the insulating [illegible] possible when air is depended

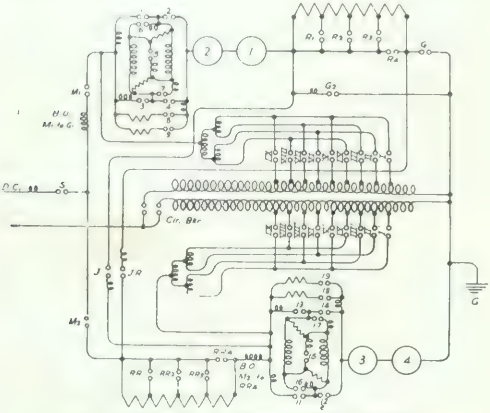


FIG. 4.—DIAGRAM OF MOTOR-CONTROL CIRCUITS.

upon to draw the heat from the coils. Advantage is taken of the knowledge of this fact in the arrangement of the coils and core of the motor armature. Numerous ducts are provided throughout the armature core structure through which air is forced for cooling the iron to which the heat is conducted from the armature coils and preventive leads. The air also passes through and around the commutator and serves to remove from it both the heat produced there by friction and I^2R losses and that thermally conducted to it from the resistance leads.

A view of the completed motor, indicating the means employed for cooling, is given in Fig. 3. The circular opening at the top is normally connected through a canvas hose to a source of supply of air under a pressure of several ounces per square inch. In entering the motor structure the air is required to pass through a filtering screen and to the openings in the armature spider, from which place it flows outward around the commutator and through the ventilating ducts of the armature and along the air-gap to the openings to the outer atmosphere, shown as perforations in sheet metal plates on the field core in Fig. 3. The forced-draft method of cooling has proved extremely effective. To guard against the remote possibility of clogging of the air ducts or some enforced stoppage, an electrical pyrometer with its thermo-elements in the motor structure and its indicating mechanism in the locomotive cab is used for showing continuously the temperature within the motor. By means of the pyrometer the motorman can ascertain when the service is too severe for the equipment or when the supply of air has been interrupted.

CONTROLLER CIRCUITS.

A schematic diagram of the motor-control circuits for both direct-current and alternating-current operation is given in Fig. 4. It will be noted that the armatures of the four motors are arranged in two groups, the two armatures of each group being connected permanently in series and controlled as a unit. During direct-current acceleration the motor units are connected in series and then in parallel, while during alternating-current operation each motor unit receives power at variable voltage from a separate auto-transformer.

Although not indicated on the diagram, the various switches are so inter-locked that the circuits used exclusively for alternating current cannot become active during direct-current working, and those intended solely for use during direct-current operation are inactive when alternating current is used. It is sufficient for present purposes, therefore, to discuss the direct-current and the alternating-current circuits separately, without any relation to each other.

DIRECT-CURRENT CONTROL CIRCUITS.

During direct-current operation switches 5 and 3, 2 or 1, 4, according to direction of travel, of one motor unit, and switches 15 and 12, 13 or 11, 14, according to direction of travel, of the other motor unit are kept closed so that the main field circuits of each motor unit are connected at all times in series with the respective armatures. At the moment of starting, switches S, M and JR are closed, thus connecting the two complete motor units in series with each other and with eight sections of resistance. As the speed increases, switches R_1, R_2, R_3 and R_4 of one motor unit, and switches RR_1, RR_2, RR_3 and RR_4 of the other unit are closed in succession, thereby increasing the voltage impressed on each motor unit until the two units are in series across the line without resistance. Switch 8 of one unit and switch 18 of the other are then closed simultaneously, thus placing a resistance in shunt to the field windings and thereby increasing the speed by weakening the magnetic fields. The motors being of the compensated type permit of an enormous weakening of the fields at the commutators. The fields are further weakened by the simultaneous closing of switches 9 and 19, and the speed becomes accelerated to considerably more than one-half of the normal running value.

The next movement of the controller handle opens switches 8, 9, 18 and 19 (thereby increasing the strength of the fields); closes switch J; opens switch JR, and closes switches G_1 and M_2, thus subjecting each motor unit in series with four resistance sections to the full value of the supply potential. It will be noted that the transfer from full series to multiple connection is accomplished without opening any motor circuit, and without short-circuiting either motor unit. Higher speed points are obtained by closing switches R_1, R_2, R_3 and R_4 and switches RR_1, RR_2, RR_3 and RR_4 in pairs successively until the full multiple position of the controller is reached.

ALTERNATING-CURRENT CONTROL CIRCUITS.

During alternating-current acceleration no resistance whatsoever is used, the speed changes being obtained by impressing

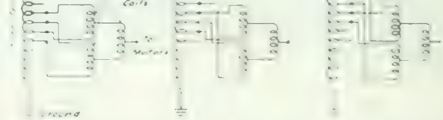


FIG. 5.—SIMPLIFIED DIAGRAM OF AUTO-TRANSFORMER CIRCUITS.

variable voltages obtained from auto-transformers directly upon the terminals of the motor units. There are two electrically and mechanically distinct auto-transformers, one for each motor unit. Referring again to Fig. 4, it is to be noted that when alternating current is used the main line high-tension circuit breaker and switches 6, 7 and 1, 4 or 3, 2, according to direction of travel, of one motor unit, and switches 16, 17 and 11, 14 or 12, 13, according to direction of travel, of the other motor unit are kept closed during operation. It will be seen, therefore, that the

main field circuits of the two motors of each motor unit are placed in parallel; thus the field magnetism per armature ampere is less during alternating-current operation than during direct-current operation (neglecting the fact that at times the field circuits are shunted for extra acceleration with direct current).

There are six running points with alternating current, each corresponding to a certain voltage impressed upon the motor circuits. For changing from one voltage point to another on each auto-transformer, use is made of three small so-called "preventive coils." These preventive coils are essentially auto-transformers, having a ratio of 2 to 1. It will be observed that the motor unit receives current from the middle connection of one preventive coil whose outer terminals are joined to the middle points of the two other preventive coils; the outer terminals of the latter preventive coils are connected to certain taps on the main auto-transformer. In shifting from one running point to another, the lower tap (No. 1) would be opened and connection would be made at a tap four points higher (No. V.). The successive changes are clearly shown in Fig. 5. There are a total of six running points with alternating current; at no time is the motor circuit opened or a transformer winding short-circuited. The current fluctuations are well limited and the acceleration is extremely smooth.

The various switches indicated in Fig. 4, and all of the switches in the circuits of the propelling motors, and of the auxiliary equipment are operated by air under a pressure of 80 lbs. per sq. in., the supply of which to the switch valves is controlled by electromagnets which receive current from a 20-volt storage battery. The switches are arranged in groups that are conveniently located along each side of the center aisle of the locomotive. The groups on one side belong to one motor unit and those on the other side to the other unit. Moreover, the main auto-transformer, the three preventive coils, and the four resistance units for each motor unit are placed on the side of the locomotive devoted to that particular unit. There are two independent sets of storage batteries, each consisting of 10 cells, rated at 40-ampere hours. The batteries are charged by an induction motor-driven direct-current generator.

UNIT-SWITCH GROUP.

A unit-switch group is shown in Fig. 6. Each unit switch, of which there are 11 in the group illustrated, is of the electro-pneumatic type, with which our readers are familiar. An in-

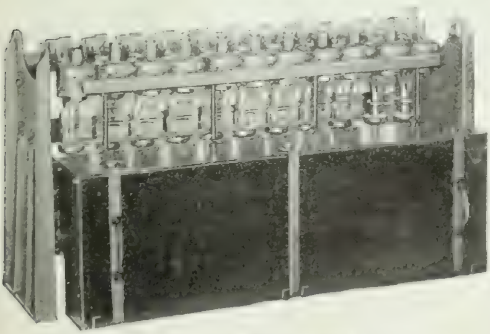


FIG. 6.—UNIT-SWITCH GROUP.

teresting feature is found in the means employed for "interlocking." The switches are interlocked electrically in such a manner that when one switch is closed the circuits to the electromagnets of the other switches which should not be operated are either held open or kept closed, as the case may require, by means of contacts controlled by the piston of the switch valve. These contacts are shown in Fig. 6. All of the motor circuits and switch wires are run in metal conduit along the lower portion of the locomotive, while all of the low potential battery control circuits are arranged in metal conduit along the roof of the locomotive.

As intimated above, only the wires of the battery and electromagnet circuits pass into the controllers. These same wires are run overhead from each end of the locomotive, where they terminate in three contact plugs, taps being taken to each controller and to each unit switch along the route as desired. Thus the locomotive may be operated from either end, and two or more locomotives may be electrically interconnected through "jumpers" and controlled from a single point.

Fig. 7 gives a top view of a master controller, of which there are two on each locomotive. The controller is of the drum type, the drum shaft being revolvable by means of a handle closely resembling the throttle lever of a steam locomotive. The reverse lever, which is detachable, is mechanically interlocked with the operating lever of the controller, so

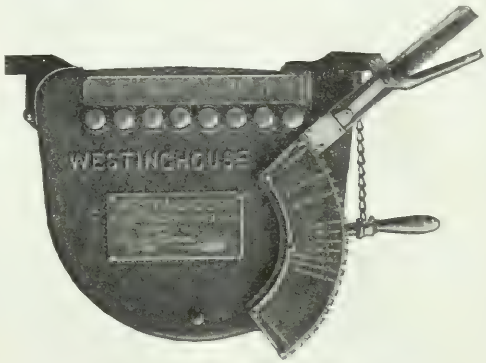


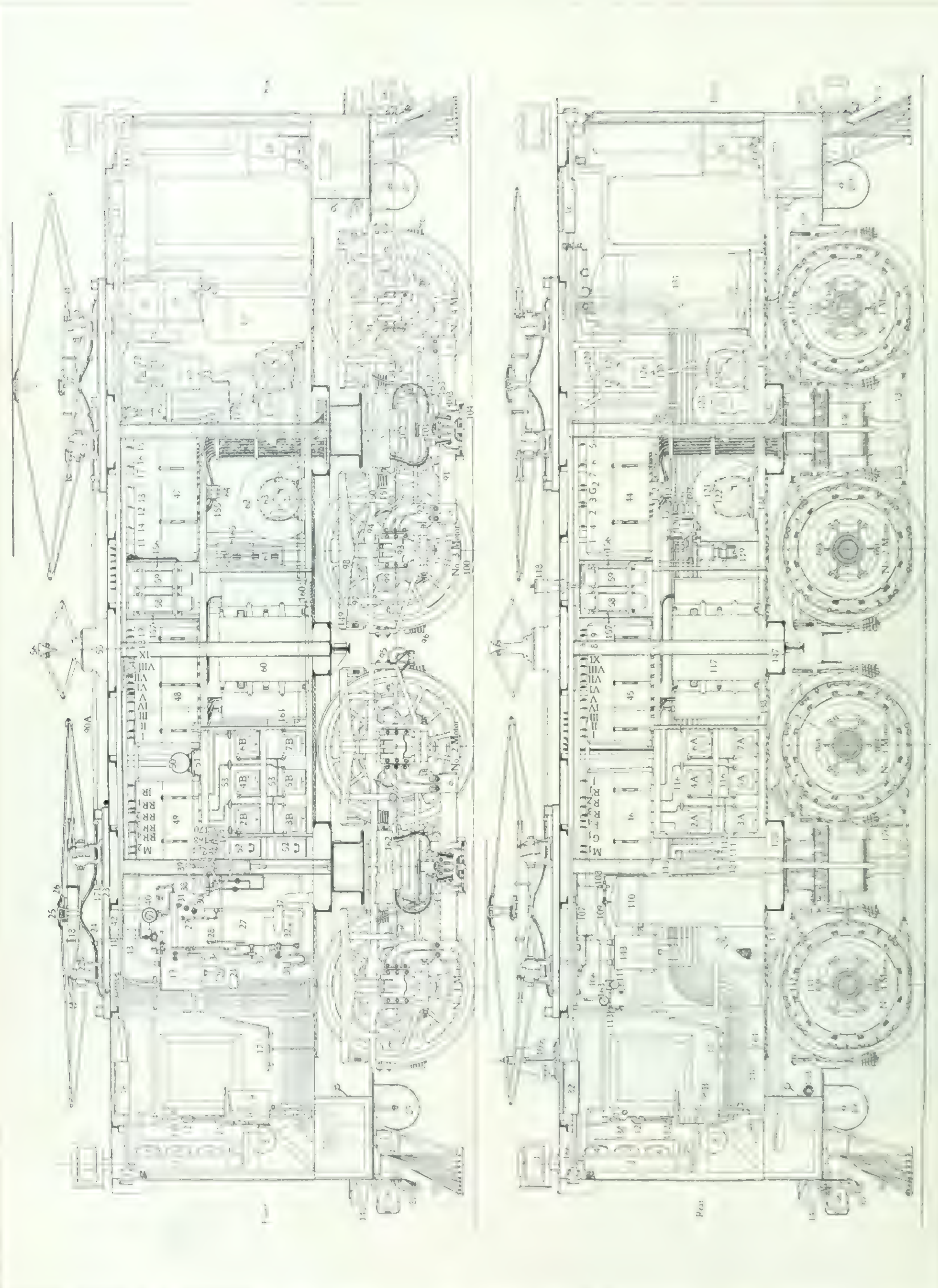
FIG. 7.—TOP OF MASTER CONTROLLER.

that all control circuits must be dead before the reverse lever is thrown from one position to another, and the main lever cannot be moved when the reverse lever is in the neutral position. The row of knobs seen along the rear of the top of the controller are push buttons for performing certain duties not associated with the main controller lever or reverse handle, such as pulling the alternating-current trolleys down, pushing the direct-current trolley up, releasing the hooks which hold the alternating-current trolley down and the third-rail shoes up, pushing the third-rail shoes down, resetting the main line circuit breakers, operating the front and rear track sanders and ringing the bell. All of the above-mentioned duties are actually performed by compressed air, the eight push buttons serving merely to complete the circuit from the storage battery to the proper air valve magnets.

A front view of the master controller in place in the motorman's corner of the locomotive is given in Fig. 9. For the convenience of the motorman the electromagnets for operating the bell and the front and rear track sanders can be controlled by three pedals in addition to three push buttons. The motorman has an unobstructed view of the air-pressure gauges, a speed indicator, a direct-current ammeter, an alternating-current ammeter, and an electrical pyrometer. The pyrometer, which indicates the temperature of the propelling motors, has been described. The speed indicator is an instrument which registers the voltage produced by a magneto-generator driven by one of the locomotive wheels; it is calibrated to show the locomotive speed in miles per hour. For the purpose of preventing the condensation of moisture on the under side of the steel roof of the locomotive the surface is covered with ground cork, which is then given a coat of white paint.

ARRANGEMENT OF APPARATUS ON THE LOCOMOTIVE.

Fig. 8 shows two views of the interior arrangement of the apparatus on each side of the locomotive, as seen from the center aisle in each case, and indicates that, with the exception of such devices as are not in duplicate, the equipment on each



locomotive is so placed that interior view is the same from one end or side of the locomotive as from the other. Thus the weight is uniformly distributed over the drivers. The different devices, as designated by the numerals, are as follows: 1, headlamp; 2, train line receptacles; 3, instrument board; 4, speed indicator meter; 5, direct-current ammeter, motors; 6 alternating-current ammeter, motors; 7, temperature indicator meter; 8, equalizing reservoir, air brake; 9, No. 1 master controller; 10, No. 1 automatic motorman's brake valve; 11, No. 1 independent brake valve; 12, duplex gauge main res. and train line; 13, whistle handle; 14, straight air brake gauge; 15, 3-way snap switch in lamp circuit; 16, No. 1 junction box; 17, motorman's seat; 18, No. 1 alternating-current pantagraph trolley; 19, No. 2 oil circuit-breaker; 20, overload trip; 21, oil tank on circuit breaker; 22, insulators for pantagraph trolley; 23, support for alternating-current trolley; 24, high-tension cable from alternating-current trolleys; 25, alternating-current trolley shoe; 26, alternating-current trolley lock cylinder; 27, steam heating boiler; 28, gauge air pressure on burner; 29, water gauge; 30,

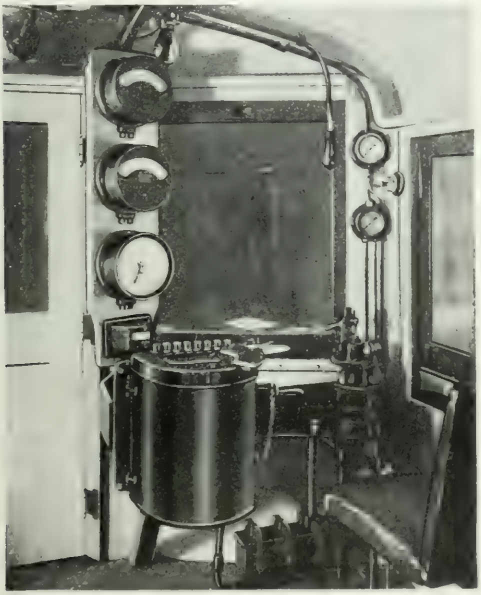


FIG. 9.—MOTORMAN'S CORNER OF THE LOCOMOTIVE.

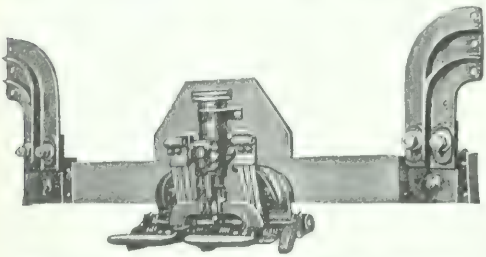
drain cup; 31, try cocks; 32, fire door; 33, burner; 34, Gold Car Company regulating valve; 35, Mason regulating valve; 36, steam line from boiler; 37, air inlet to fire box; 38, water feed regulator; 39, hand brake wheel; 40, steam gauge; 41, safety valve; 42, stack for boiler; 43, high-tension conduit from oil switch to transformer; 44, switch group No. 1; 45, switch group No. 2; 46, switch group No. 3; 47, switch group No. 4; 48, switch group No. 5; 49, switch group No. 6; 50, motor generator set for battery charging; 51, base for motor generator set; 52, storage battery; 53, No. 2 set of resistance grids; 54, alternating-current watt-hour meter; 55, base of direct-current trolley; 56, direct-current trolley; 57, No. 2 alternating- current pantagraph trolley; 58, preventive coil, 100 volts, 250 amperes; 59, preventive coil, 50 volts, 500 amperes; 60, No. 2 transformer; 61, main direct-current switch; 62, No. 2 blower motor fan casing; 63, No. 2 blower motor; 64, permanent direct-current field coil shunting grid No. 2; 65, hand air pump for unlocking alternating-current trolley; 66, No. 2 air compressor; 67, No. 2 air compressor motor; 68, magnet valves, type 386-D; 69, No. 2 fuse box; 70, canopy switch for No. 2 blower motor; 71, canopy switch for No. 2 compressor motor; 72, No. 2 motor control cut-out; 73, No. 2 alternating-current, direct-current change-over switch; 74, relay box; 75, snap switch for cab lights; 76, snap switch for head lights; 77, single-phase, double-throw switch light circuit; 78, control reservoir; 79, cover for resistance grid; 80, oil tank; 81, slide valve, reducing valve; 82, No. 2 junction box; 83, signal valve; 84, sand box; 85, electro pneumatic sander; 86, coupler; 87, hose couplings; 88, pilot; 89, main air reservoir; 90, hook for safety chains; 90-A, cable connecting alternating-current trolleys; 90-B, No. 2 master controller; 90-C, No. 2 automatic brake valve; 91, third rail shoe beams; 92, third rail shoe bracket; 93, journal box; 94, truck frames; 95, magneto for speed indicator; 96, motor suspension springs; 97, spring hanger; 98, elliptical springs; 99, wheel pocket cover; 100, main driving wheel; 101, third rail shoe cylinder; 102, third rail shoe fuse box; 103, main casting for third rail shoe; 104, third rail shoe.

In the lower half of Fig. 8, will be noted the following additional devices: 105, bell; 106, alternating-current, direct-current change-over switch, heater circuit; 107, fuse box, heater circuit; 108, governor valve for emergency control reservoir; 109, three-way cock emergency control reservoir; 110, emergency control reservoir; 111, slide valve, reducing valve; 112, balancing transformer (back of single-throw and double-throw switches); 113, combined strainer and drain cup; 114, double-throw switch, No. 1, heater circuit; 115, single-throw switch, heater circuit; 116, No. 1 set resistance grids; 117, No. 1 transformer; 118, whistle; 119, governor—air brake; 120, distributing valve; 121, No. 1 blower motor fan casing; 122, No. 1 blower motor; 123, No. 1 air compressor; 124, No. 1 air compressor motor; 125, permanent direct-current field coil shunting grid No. 1; 126, No. 1 fuse box; 127, canopy switch for No. 1 blower motor; 128, canopy switch for No. 1 compressor motor; 129, No. 1 motor control cut-out; 130, No. 1 alternating-current, direct-current change-over switch; 131, water tank; 132, air connection to motors; 133, motor leads for No. 1 and No. 2 motors; 134, axle of main driving wheels; 135, upper torque rod; 136, center pin; 137, lower torque rod (long); 138, trap doors over motors; 139, heater circuit leads; 140, air brake piping; 141, motor armature; 142, motor field core frame; 143, No. 1 oil circuit-breaker; 144, bus line socket heater circuit No. 2 end; 145, bus line rocket heater circuit No. 1 end; 146, quill; 147, tool box; 148, bumper block; 149, motor suspension cradle; 150, spring hanger; 151, equalizer spring; 152, brake shoe; 153, steam heating line; 154, equalizer bar; 155, series transformer for alternating-current ammeter No. 3 and No. 4 motors; 156, preventive coil 100 volts, 250 amperes (back of No. 59); 157, field shunting resistance (back of No. 58); 158, series transformer for alternating-current ammeter No. 1 and No. 2 motors; 159, armature spider; 160, air inlet to transformer; 161, air inlet to resistance grids; 162, third rail shoe leads; 163, gauge—control line pressure; 164, support for motorman's seat; 165, direct-current wattmeter; 166, blind lights; 167, double-phase, double-throw switch for battery; 168, double-phase, double-throw switch for battery; 169, single-phase, single-throw switch for motor generator set; 170, snap switch for motor generator set; 171, insulators supporting alternating-current trolley cable; 172, shunt for direct-current ammeter motors, No. 1 and No. 2; 173, lower torque rod (short); 174, motor suspension hanger; 175, steam hose coupling; 176, brake cylinder; 177, foot push button switches; 178, air circuit; 179, shunt for direct-current ammeter motors No. 3 and No. 4; 180, motor leads for No. 3 and No. 4 motors; 181, double-throw switch, No. 2 heater circuit; 182, independent brake valve No. 2; 183, third rail shoe unlock cylinder.

Fig. 1 is an exterior view of a locomotive with the alternating-pantagraph trolleys in contact with the wire; the third-rail shoes are drawn up, as shown more clearly in Fig. 11. The appearance of the third-rail shoes when in the operative position is indicated in Fig. 10. The small trolley seen over the center of the locomotive in Fig. 1 is connected to the circuits of the third-rail shoes and is intended for use only in case the locomotive should come to rest at some point where

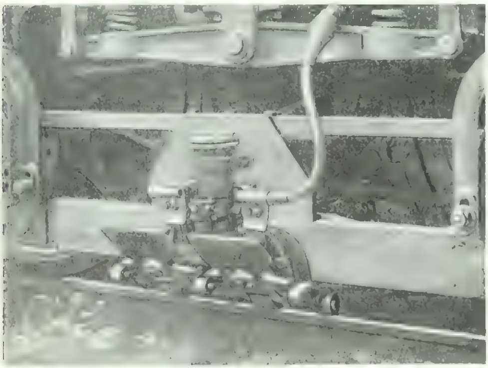
the third rail had been omitted and an overhead conductor had been substituted therefor. The contact bows of the large trolley, which are made of galvanized steel, are 4 ft. in length. Each bow is given an upward curvature at the center and is provided throughout its whole length with a single trough for containing the lubricating material which consists of a mixture of graphite and grease.

The design of the third-rail shoe mechanism represents a solution of a number of difficult problems. The shoes must be held by spring pressure downward against an over-running rail, or by spring pressure upward against an under-running rail. They must be lifted so as to clear any ordinary obstruction along the track when a third rail is not used. The shoes are hinged from a framework, which, in turn, is hinged from [illegible]



[illegible] THIRD-RAIL [illegible] IN THE OPERATING POSITION [illegible]

thrown outward in a horizontal plane, or drawn upward to an angle of about 45 degs. from the horizontal by means of a toggle-joint mechanism, which is operated electropneumatically. When the framework is in the horizontal position, each shoe is held in place by means of a spring, which resists motion in either the upward or the downward direction. The valve-control circuits of the magnets for the shoe mechanism are electrically "interlocked" with those of the alternating-current trolleys, so that when the trolleys are up, the shoes are up also, and when the shoes are let down, the trolleys come down also; the trolleys can, however, be pulled down while the shoes are up. It is noteworthy in this connection that the "interlocking"



[illegible] DETAIL OF THE SHOE MECHANISM

is not depended upon for safety to the motor equipment and control circuits. As a matter of fact, it is a physical impossibility for direct current to reach the motors from the third rail while alternating current exists in the auto-transformers, because the "throw-over switch" either connects the motor circuit directly to the third rail and disconnects them from the high-tension circuits, or it joins the motor circuits to the auto-transformers and thoroughly isolates them from the third-rail shoes.

[illegible]

Although the locomotives have as yet not been placed in actual continuous service on the New Haven Railroad, they have been subjected to tests duplicating in many ways actual service conditions. The track upon which the tests were made is equipped both with a third rail for the supply of direct current at 600 volts, and with an overhead catenary trolley wire for alternating current at 11,000 volts. The track is 2.2 miles in length, and contains several curves and slight grades. During a recent series of tests a locomotive was required to make a schedule speed of 26 m. p. h. with 45-second stops at each end, the maximum speed reaching 45 m. p. h.; the total weight of train and locomotive being 294 tons. Watt-hour meters placed in the supply leads read at three-hour intervals showed that during direct-current operation the consumption was 44 watt-hours per ton-mile, and that the consumption for alternating current working was 42.5 watt-hours per ton-mile. The values given represent the total energy received by the locomotive, including all losses in the control apparatus. Although the running efficiency was undoubtedly somewhat less for alternating than for direct current, the rheostatic losses during acceleration with direct current were much greater than the transformer losses during alternating-current acceleration, and hence the locomotive was operated more efficiently with alternating than with direct current. It is evident, however, that for longer hauls with less frequent stops, the advantage with respect to the efficiency of the locomotive as a unit would be with the direct-current working.

Circular Current Loci of the Synchronous Motor.

By A. S. McAllister.

Although the characteristics of the synchronous motor have been familiar to electrical engineers even longer than have those of the induction motor, yet considerably more has been written concerning the performance of the latter machines than of the former. Doubtless a large portion of the difference in the attentions paid to these two types of machines is due to the relatively greater commercial importance of the induction motor, but at least a small part of the difference may be attributed to the fact that the polyphase induction motor possesses characteristics similar to those of a constant-potential stationary transformer and of a shunt-wound, direct-current motor, and its performance can easily be explained by analogy to persons familiar with these two types of electrical apparatus, while the characteristics of the synchronous motor are essentially different from those of any other machine. On account of its constant-speed features the synchronous motor is becoming of increasing importance for frequency converter work, while its control of the wattless component of the current taken by it from the supply system will probably lead to its frequent use hereafter as a "synchronous condenser."

In view of the facts just stated, it is believed that a description of certain simple circular current loci of the synchronous motor which allow its characteristics to be determined equally as readily as does the circular current locus of the induction motor, will prove of interest at the present time.

Several articles on this same subject have recently appeared in technical publications. The writer wishes to call attention especially to two, namely, one by Prof. Morgan Brooks in the June, 1907, issue of the *Transactions* of the American Institute of Electrical Engineers, and one by Prof. H. H. Norris, in the issue of the *Sibley Journal* for June, 1907.

The article by Prof. Brooks, treats the synchronous motor as an alternating-current generator having a negative load, as is done below; the treatment differs from the present one in that the circle diagrams deal with the internal counter voltage of the motor, rather than with the current taken by the motor. The article by Prof. Norris gives an excellent circular current locus of the synchronous motor, but the arrangement employed,

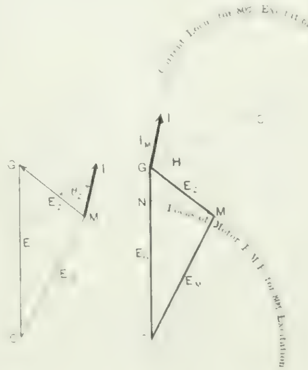
being based on the "opposition" method of representing the vectors of the supply voltage and the internal counter e. m. f. of the synchronous motor, renders necessary the construction of an entirely new set of vectors and a new locus for each valve of the excitation of the synchronous machine.

It is believed that the method outlined below combines the advantageous features of the two methods mentioned above, and eliminates all unnecessary complexity. Moreover, the current loci being similar in many respects to the well-known "circle diagram" of the induction motor allow the characteristics of this machine and those of the synchronous motor to be directly compared with entire simplicity.

For the purpose of most readily developing the current loci used below, consider first the simple familiar case of two alternating-current generators of equal rating and exactly similar in all respects. Assume these two machines to be electrically connected in parallel and mechanically driven by two similar and equal prime movers. The active voltage of each machine will at each instant be equal to that of the other machine; the two alternators will supply equal amounts of power to the external circuit, and there will be no cross-flow of current between the two machines. If the exciting current of one machine is increased while that of the other is unchanged and no change is made in the adjustment of the driving engines, then a certain amount of cross-current will exist between the machines, but they will continue to supply equal amounts of power to the external circuit. That is to say, the power component of the current of each machine will be equal to that of the other; there will exist, however, a certain component of wattless current which traverses only the local circuits including the two generators. The latter current lags 90 electrical time-degrees behind the e. m. f. of the over-excited generator and leads the e. m. f. of the other generator by 90 electrical time-degrees. Thus it tends to demagnetize the field of the former generator and to increase the field magnetism of the latter. Stable conditions are reached when the decrease in the generated e. m. f. of the former and the increase in the generated e. m. f. of the latter alternator are such that the difference between the two is just sufficient to force through the local impedance of the two armatures and their inter-connecting circuits that amount of current required to produce the necessary change in the field strength of the two machines. It is seen, therefore, that the value of the cross-current for a certain change in exciting current depends upon the ratio of the number of turns in the field coils to the number of turns on the armatures, and upon the local impedance of the armature circuits; that is to say, it depends upon "armature reaction," armature resistance and local magnetic reactance of the armature. The "armature reaction" refers exclusively to the effect of the armature current upon the field magnetism. The change in the generated e. m. f. is roughly proportional to the cross-current, so that the armature reaction may, with a fair degree of accuracy, be expressed in ohms as the quotient of the change in the generated volts divided by the cross-amperes. Although the results obtained are not strictly in accord with facts, it is customary to consider that the armature reaction in ohms can be treated as an addition to the ohms of "local magnetic reactance" of the armature circuit, the sum of the two being designated as the "synchronous reactance" of the armature circuit. The quadrature vector sum of the synchronous reactance and the resistance of the armature is known as the "synchronous impedance" of the armature circuit, designated herein as Z_m. It should be carefully noted that the synchronous impedance is a fictitious, composite quantity. It has no real existence; of its three components, only one, namely the armature resistance, is constant; both the local magnetic reactance and the armature reaction depend upon the electrical space position of the armature at the instant when the armature current reaches its maximum.

Referring again to the two similar alternators in parallel, assume that, with the field strengths of the two alternators adjusted to equality, the supply of steam to one engine is gradually decreased. [illegible] will tend to decrease its speed, but it continues to operate at the same number of revolutions per minute as the other alternator. What actually does occur is that it lags behind the other alternator in electrical space position, such that its generated e. m. f. is out of phase in electrical time-degrees from the generated e. m. f. of the other alternator such that the vector difference between them forces through the "synchronous impedance" of the two armatures and their interconnecting circuits an amount of current such that its vector product with the e. m. f. of each alternator represents the power transferred to or from this alternator from or to the other machine. It will be noted, therefore, that the gradual conversion of an alternator from a synchronous generator to a synchronous motor, electrically considered, is accompanied by a mere change in the electrical time-phase position of its e. m. f. with respect to the e. m. f. of the system to which it is connected.

The vector representation of the phenomena of synchronous motors is rendered extremely simple when such representation is based on the well-known facts discussed above. In Fig. 1, *O G* is the e. m. f. of the supply system, E_g; *O M* is the e. m. f. of the synchronous motor E_m; *G M* is the "resultant" e. m. f. E_z which produces the current *M I* in the synchronous impedance of the motor circuits Z_m. The angle *G M I*, θ_z, is that angle whose cosine is equal to the quotient of the arma-



FIGS. 1 AND 2.—VECTOR DIAGRAM OF CURRENT AND E. M. F. OF SYNCHRONOUS MOTOR, AND CIRCULAR LOCI OF ARMATURE CURRENT AND MOTOR COUNTER E. M. F.

ture resistance divided by the synchronous impedance of the motor; for simplicity this angle will hereafter be considered constant. The vector product of *O G* and *I M* is the electrical power received from the supply system while the vector product of *O M* and *I M* is the mechanical power delivered to the motor shaft, including magnetic and frictional losses; the difference between these two (equal numerically to the vector product of *G M* and *I M*) is the power absorbed thermally in the armature resistance. The value of *I M* depends solely upon the value of *G M*: *O G* varies directly with the e. m. f. of the supply system, while *O M* depends solely upon the field strength of the motor.

Assuming a certain constant value for *O G* and assigning a value to *O M*, it will be noted that the locus of the point *M* as the load is varied is the arc of a circle whose center is at the point *O*. For convenience the vector of the current may be plotted from the point *G*, as shown in Fig. 2; this construction is particularly advantageous in that it permits of the direct representation of the time-phase relation of the two quantities that are most easily measurable, namely, the e. m. f. of the supply system and the armature current. The locus of the point *I* as the load is varied is the arc of a circle whose center is on a line between which and the line *O G* (prolonged) there is an angle θ whose cosine is equal to the quotient of

[illegible]

[e]xact location of the center of the circular arc, for a certain definite synchronous impedance depends solely upon the e. m. f. of the supply system. That is to say, the value $G C$ is found by dividing the e. m. f. of the supply E_g by the synchronous impedance of the motor Z_m. The radius of the circle is determined solely by the field strength of the motor, or more properly, by the internal counter generated e. m. f. of the motor E_m. Thus the length $C H$ is equal to the motor e. m. f. E_m divided by the synchronous impendance of the motor,

Since $C H$ is proportional to $O M$, it will be noted that the diagram may be simplified and rendered more convenient without loss of accuracy by omitting $O M$ entirely and allowing $C H$ to represent its relative value (but not its time-phase position). Application of the above considerations leads to the simplified diagram of Fig. 3, which is the complete operating current and e. m. f. diagram of a synchronous motor.

In the diagram of Fig. 3 $O G$ is the e. m. f. of the supply, and $O I$ is the current taken by the motor, in both its true value and time-phase position with reference to the supply e. m. f. The distance $O C$ is equal (in amperes) to the value obtained by dividing the supply e. m. f. E_g by the synchronous impedance of the motor Z_m. The angle $G O C$ $(= \Theta_2)$ is such that its cosine is equal to the quotient of the resistance of the armature by the synchronous impedance. It will be [illegible] the line OC represents both in value

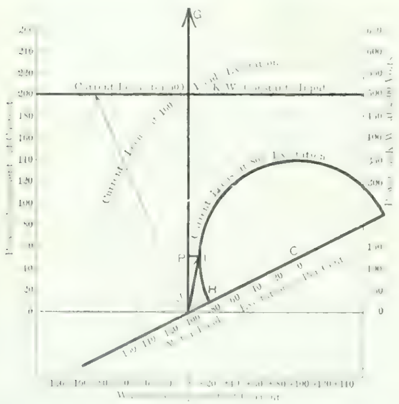


Fig. 3.—[illegible]

and time-phase position the current taken by the armature when subjected to the full supply e. m. f., but without any counter e. m. f. The line CH has the same significance as in Fig. 2, being the value (in amperes) obtained by dividing the counter e. m. f. of the motor E_m by the synchronous impedance Z_m. When the motor e. m. f. E_m is equal to the supply e. m. f. E_g CH becomes equal to OC; under any condition of excitation CH bears to OC the ratio of the motor e. m. f. E_m to the supply e. m. f., E_g.

Referring now to any point I on the heavy circular arc of Fig. 3.

OI is the input current to the motor

OP is the power component of the current

$$\frac{OP}{OI} = [illegible]$$

$OP \times OG = I_m \cos \Theta \, E_g =$ input watts

$I_m E_g \cos \Theta -$ losses $=$ output watts

$$\frac{\text{output watts}}{\text{input watts}} = \text{efficiency}$$

$OC =$ "short circuit" current (at full speed, without excitation)

$$\frac{CH}{OC} = \frac{\text{motor e. m. f.}}{\text{supply e. m. f.}} = \text{percentage excitation}$$

$OH =$ minimum possible armature current.

In Fig. 3 the heavy circular arc shows a single current locus for a definite field excitation of the motor. Referring to Fig. 1, it will be recalled that the radius of the circular locus of the point M of the motor e. m. f. vector depends solely upon the field excitation of the motor. Hence the radius of the circular locus to the point I of the current vector in Figs. 2 and 3 likewise depends solely upon the field excitation of the motor. Thus for each value of field excitation there is a definite circular current locus, the center of which remains always at the point C (in Fig. 2 or Fig. 3). The current locus passes through the point O when the field excitation of the motor is such that the counter e. m. f. E_m is equal to the e. m. f. of the supply E_g. For convenience this value of motor field excitation may be designated as 100 per cent, and other values may be compared therewith on the percentage basis. Thus for the current locus represented by the heavy circular arc in Fig. 3 the motor excitation is 80 per cent (HC being equal to .80 OC). Other circular current loci for various excitations are shown by broken lines.

It is to be noted especially that the above discussion of the circular current loci of Fig. 3 relates exclusively to the input to the synchronous motor. For any chosen value of input the corresponding output can be obtained by calculation when the losses are known. The problem of determining the friction and the hysteresis and eddy current losses of the armature and the field circuit copper loss can be solved only when accurate information is obtainable concerning the construction of the machine and the exact conditions under which it is operated. The determination of the copper loss of the armature is, however, a comparatively simple matter. As the latter loss varies with the square of the current, quite independent of its time-phase position, it is convenient to plot for each value of current the corresponding loss directly to the same scale and on the same diagram as used for plotting the input power. The scales chosen in Fig. 3 and the subsequent diagrams have been based on a constant supply e. m. f. of 2500 volts, an armature circuit resistance of $R_m = 10$ ohms and a magnetic reactance of $X_m = 20$ ohms. Thus the impedance of the armature circuit $Z_m = \sqrt{R_m^2 + X_m^2} = 22.36$ ohms and the short-circuit current (the length OC in Fig. 3) is 2500 volts $\div$ 22.36 ohms = 111.8 amperes. The angle GOC has a cosine $(\cos \Theta_2 = \frac{R_m}{Z_m})$ of .4472.

The loss for each value of current can conveniently be found as follows: Referring to Fig. 4 select any value of current, such as OI, taken here as 80 amperes; the loss occasioned by this current in a resistance of 10 ohms is $10 \, (80)^2 = 64{,}000$ watts, or 64 kilowatts. From the point M (at 80 amperes) erect the perpendicular MN equal to 64 kilowatts (to the scale corresponding to the supply e. m. f. of 2500 volts). Quite independent of its time-phase position, a current of 80 amperes causes a loss of 64 kilowatts in the armature circuit. At a certain definite phase position, such that the power component of the current is just equal to the value corresponding to 64 kilowatts (25.6 amperes at 2500 volts), all of the power received by the synchronous motor is dissipated thermally in the resistance of the armature circuit; this position is found at the point P, where a horizontal line from N intersects the 80-ampere current arc IPM. Consider now a current of 140 amperes; the armature loss is 10 × (140)² [illegible] 196 kilowatts at $M'N'$. The point P', at the intersection of the 140 ampere current arc and the horizontal line from N' shows the position of the extremity of the 140-ampere current vector when the power input is just equal to the loss in the resistance of the armature circuit. A sufficient number of points having been located by the method used with points P and P' and a curve being drawn through these points, there is obtained the current locus OPP' for "zero mechanical power" meaning

that value of input power that is just equal to the power dissipated thermally in the resistance of the armature circuit. From the method employed in its location, it may be shown that this locus is a true circle which passes through the point *C*—the "zero excitation" point—and has its center on the e. m. f. vector *OG*. It will be noted therefore that the locus for "zero mechanical power" is known immediately when the point *C* is located. It is interesting in this connection to note that the diameter of the "zero mechanical power locus" expressed in amperes (the maximum current which the machine can possibly obtain from the supply system and just overcome its own armature copper loss) is equal to the quotient of the supply

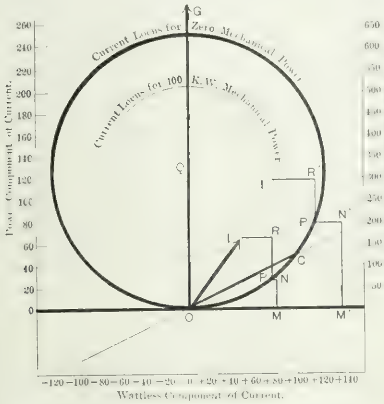


FIG. 4.—CIRCULAR CURRENT LOCI FOR VARIOUS MECHANICAL LOADS.

e. m. f. divided by the resistance of the armature circuit; it is greater than the "short-circuit" current at zero motor excitation in the ratio of the synchronous impedance to the armature resistance. These statements need no proof, for they will be appreciated at once from a study of Fig. 4.

By the use of the "current locus for zero mechanical power" one can readily determine the effective mechanical power delivered to the shaft of the synchronous motor. In Fig. 4 assume that with an armature current of 80 amperes the power input is 164 kilowatts; the armature copper loss is 64 kilowatts (*MN*), hence the mechanical power at the shaft is 100 kilowatts (*RP*). By the method outlined above the point *I* of the "current locus for 100 kilowatts mechanical power" is located at the intersection of the horizontal line *RI* with the 80-ampere circular arc, *MPI*. With an armature current of 140 amperes, the input must be 296 kilowatts to supply mechanical power of 100 kilowatts. A second point *I'* on the "current locus for 100 kilowatts mechanical power" is found at the intersection of the horizontal line *R'I'* (corresponding to 296 kilowatts input) and the 140-ampere circular arc *M'P'I'*. A curve drawn through points located as have been *I* and *I'* gives the complete "current locus for 100 kilowatts of mechanical power" delivered to the armature shaft—including all losses except that of the armature copper. It may be shown from the method used in its construction that this locus is a true circle concentric with the circular "current locus for zero mechanical power," therefore the locus for any possible value of mechanical power is known at once when one point, such as *I*, is located on its circumference. The locus for the maximum mechanical power which the machine can deliver to its own shaft is a circle, contracted to a point, at *Q*. This power is delivered at a power factor of 100 per cent and an electrical efficiency of 50 per cent; the current corresponding thereto is equal to the quotient of the supply e. m. f. divided by twice the resistance of the armature circuit. These facts are well illustrated in Fig. 4.

A comparison of Fig. 4 and Fig. 3 will show that both when the excitation is left constant and the load is changed, and when the load is left constant and the excitation is changed, the locus of the armature current is a true circle; in the former case the circle has its center at the point of zero excitation, while in the latter the center is at the point of maximum load. By finding the intersections of various constant-input circles with certain constant-load circles, one may readily determine the ordinates and abscissae for the familiar so-called "V-curves," showing the relation between the armature current and the excitation of a synchronous motor at various loads. Such a set of V-curves and a convenient method for determining the points on the curves are shown in Fig. 5. The ordinate *HI* of the V-curve for a load of 100 kilowatts at an excitation of 3500 volts is equal in length to the vector *OI*, whose extremity lies at the intersection of the 100-kilowatt current locus with the 140-per cent excitation current locus; there are two points of intersection of these two loci, so that there are two abscissae for each ordinate on the V-curves. Moreover, there are two ordinates for each abscissa, both the V curves and the current loci being closed curves. The ordinate *H'I'* at an excitation of 2500 volts is equal in length to the vector *OI'* of the 100-per

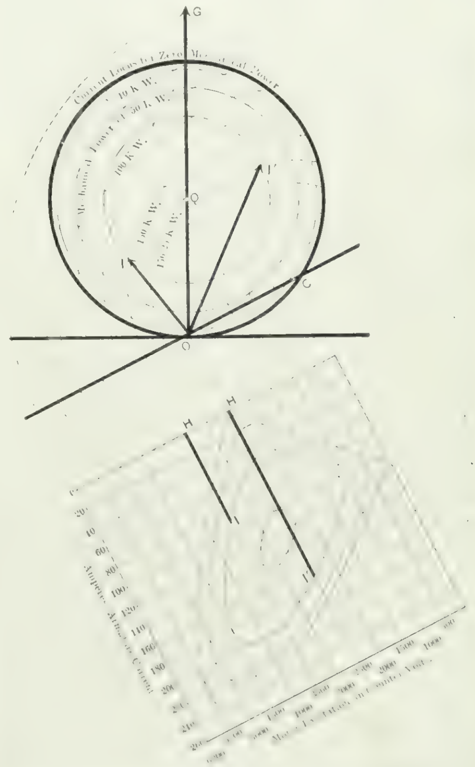


FIG. 5.—CIRCULAR CURRENT LOCI, O CURVES AND V CURVES.

cent excitation current locus. The construction of the complete set of V-curves should be obvious from the above brief reference to Fig. 5.

By inverting the diagram of Fig. 5 it will be noted that the V-curves are the same in every respect to the set given in Dr. C. P. Steinmetz' "Alternating Current Phenomena*," the constants used in the above synchronous motor problems having been taken directly from that book. As thoroughly discussed by Dr. Steinmetz, the calculation for the V-curves have been based on certain simplifying assumptions that do not correspond accurately to facts in nature. Thus the "synchronous reactance" has been considered a constant while in reality it varies throughout a considerable range; moreover, the change

*Third edition, page [illegible]

in the [illegible] of the motor has been [illegible] simplifying assumptions have been made in the present treatment and the results are subject to the same errors. The results obtained by the present method are identical in every respect to those obtained by the more usual mathematical treatment, within the limits of the errors in measuring lengths on a graphical diagram; the latter errors are much smaller than those attributable to the incorrect initial assumptions. So far as reliable results are concerned the graphical method is equally as good as the analytical, while it possesses the advantage of allowing the reader to follow the solution step by step without losing sight of the involved electro-magnetic phenomena. The circular current loci of Fig. 5 in themselves contain all of the information imparted by the V-curves, and in addition thereto they show the time-phase relation of the supply voltage and the armature current, and they indicate the maximum and minimum limits and the critical points to much better advantage than do the V-curves.

The treatment outlined above has been based on single-phase work and single-phase apparatus. It is almost unnecessary to call attention to the fact that the same treatment without any modification whatsoever is directly applicable to the operation of polyphase apparatus, provided equivalent single-phase values are used for the current, resistance, synchronous reactance and synchronous impedance of the armature and supply circuits.

Self-Excitation of Unipolar Generator.

In the operation of unipolar generators it has been found that the ohmic drop at the brush contacts forms a large part of the full-load voltage drop in the machine. Moreover the brush resistance is somewhat variable and unsteady. When the field winding of the generator is connected across the machine terminals in the usual manner, the ohmic drop at the brush contacts as the load increases results in a decrease in the voltage impressed upon the field terminals, and consequently impairs to a certain extent the regulation of the machine. Prof. Elihu Thomson recently obtained a patent for an arrangement for supplying current to the field winding from auxiliary brushes independent of the armature circuit. With the arrangement proposed the current passing through the brushes supplying the field winding is constant for all loads of the machine and the excitation of the machine is unaffected by the ohmic drop in the armature circuit due to brush contact resistance. The auxiliary brushes are placed on collector rings connected to opposite ends of a single conductor. This conductor is one of the regular conductors connected in the armature circuit, but it is given a somewhat greater cross-section than the other conductors in order to enable it to carry the exciting current without overheating. In some cases a separate conductor is employed for supplying current to the field winding.

New Telephone Patents.

SUBSCRIBER STATION APPARATUS.

Every once in a while a false signal is sent in from a desk telephone due to the receiver being lifted by resting upon some raised object upon the desk. This occurs usually in a way almost unnoticeable. To avoid the trouble, G. L. Blackburn, of Greensboro, N. C., has devised a guard to be clamped to the stem of the stand just below the normal position of the receiver. This guard will protect the receiver from accidental upward pressure.

For party lines, A. H. Beng has planned a signal device to notify calling parties of the number of the stations responding. He links a code bar to the switch lever and arranges a bell to be rung by it mechanically. This bell is enclosed in the set. Each answering party rings in his code on his bell, and this is picked up and transmitted to the line by his transmitter.

There have recently been patented two antiseptic devices of the sheet-of-paper type. G. E. Grim, of Philadelphia, forms up a sheet metal device, comprising two leaves joined together at the top by a cylindrical spring hinge. This latter serves as a roll holder, the paper being led down between the leaves. The leaves are perforated and one carries means for gripping the mouthpiece of the transmitter.

The other device consists of two roll holders and a clamp. This latter grips the mouthpiece and holds the device in such position that a strip of paper stretched from roll to roll will lie across the mouthpiece. A crank and spool serve to wind up the used end of paper into one roll holder from the other.

August Schaffer, of East Columbus, Ohio, has invented what he calls an anti-buzzing device. This is a novelty in the form of a built-up lozenge adapted to be clamped under the cap of a receiver to prevent sympathetic buzzing of the diaphragm. A disk of wire screen with a paper-covered center is surmounted by an annulus upon which lines a concavo-convex disk. The whole is clamped together at the edges and forms a spring cushion.

S. C. Houghton, of Rome, N. Y., has obtained a patent for an improvement for a telephone support described in an earlier patent, and F. B. Cook, of Chicago, has patented a novel substation protector. In this latter, the tubular fuses, heat coils and carbons are all enclosed within a porcelain block. This block has apertures for receiving these parts and the necessary connecting springs, etc.

NEW SWITCHBOARDS.

Usually in the working out of the two-wire common battery switchboard, the successful operation of the signals is obtained with the use of but one battery voltage. Messrs. J. W. Lattig, of West Bethlehem, Pa., and C. L. Goodrum, of Philadelphia, in their joint invention have resorted to the equivalent of three. As a matter of fact, taps from one battery supply these differ-

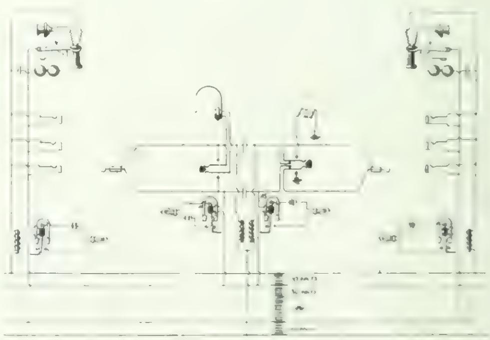


FIG. 1.—LATTIG AND GOODRUM TWO-WIRE MULTIPLE TELEPHONE SYSTEM.

ent currents and the circuits are so designed as shown in Fig. 1 that the current reverses in the polarized signal relays to change the indication of the signals. It will be noted that because of the points of connection of the current supply leads to the buses, when the plug is inserted in a jack the high-power operating current in the line relay becomes a low power reversed current. Similarly the opening of the circuit at the sub-station causes a reversal in the supervisory relays, the non-operating current being the low power one as before.

H. P. Claussen, of Chicago, has invented a circuit arrangement by which the ringing is controlled automatically. The operator starts the ringing, the ringing key becoming locked magnetically until the response. The rising of the subscriber's hook completes the circuit of an auxiliary relay, which through its contacts short-circuits the locking coil. The circuit of the auxiliary relay includes a grounded battery, one side of the

line and a path through the hook switch and bell back to ground.

PARTY-LINE SYSTEMS.

A lockout step-by-step system forms the subject of a patent granted to U. S. Jackson, of Ossipee, N. H. The usual selective apparatus is provided at each station and these may all be moved forward under control of any station, and each angular position corresponds to one station. The instruments at all stations are short-circuited except when wanted. A release lever enables the user to restore the line to zero at the end of a call.

W. D. Watkins, of San José, Cal., has invented the selecting device shown in Fig. 2. It will be seen that a slight teetering of the armature rotates the switch arms, as its pin travels between the bent leaves, each one of which is bent to deflect it in

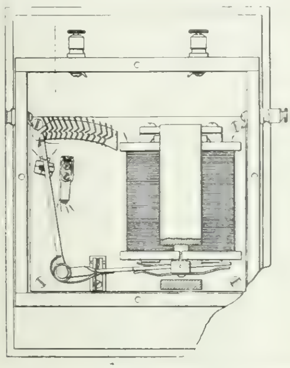


FIG. 2.—WATKINS TELEPHONE SELECTING APPARATUS.

the proper direction. The connecting switches at the various stations are spaced below the leaves as shown. If the arms be depressed at any instant one in the proper position, will operate the switch springs. After the conversation, a further application of current draws the pins below the guide leaves and the arms return to the initial position.

A party-line system invented by D. H. Wilson, of Chicago, contemplates a line with a constantly impressed potential, and one limb of the line looped into each station, and through a relay at each. Bells are normally bridged across the line, but through the contacts of the relays. Whenever a conversation is going on, current flows through all the relays and the bell bridges are all severed, thus relieving the line.

LETTERS TO THE EDITORS.

Graduates from Electrical Courses.

To the Editors of Electrical World:

SIRS:—I have read with interest the article and editorial in your issue of July 27, on "Graduates from Electrical Courses in the United States," and am yielding to a temptation to write a few lines regarding them.

The statement in the editorial that "The technical graduate is ideal raw material from which to recruit every branch of an industry," etc., is certainly well put, and something that cannot be too well kept in mind by those who arrange the work comprised in engineering courses.

When, in the article, the statistics are reached, it is clear that some sort of classification among all the schools offering courses in electrical engineering was necessary and desirable. As I read the articles, however, I am wondering what the one who wrote them means by a "high-grade" course. Does he mean one which takes most time to complete it, or which has highest scholastic requirements for entrance, or which reaches furthest into the realm of theory and practice, or which includes the greatest amount of what is commonly known as liberal culture work? I do not believe I am far wrong in assuming that some or all of these have been the criteria for the classifications made.

If I have made a fair guess, I can go on to say that there are many wrong ideas of engineering education abroad, especially in reference to the newer courses and those not laid on "standard" lines.

A great many people who write on educational topics in our technical papers are influenced more than they know by preconceived notions. These are partly due to their having had a "standard" course themselves and partly to the fact that they have closest acquaintance with people in engineering education who conduct standard courses. The courses offered by colleges and state universities are, for the most part, at least, so hedged about by other courses, by traditions, and by the fact that the guiding spirits in them have grown up amid ideas handed down from past generations, that the condition of affairs I refer to is most natural.

I have often wondered that some enterprising periodical did not make an investigation of the merit or demerit of various courses now offered which are of a newer and perhaps of a peculiar sort while they profess to be really of engineering character, in order that the truth about their professions might come out.

Is it not a curious thing that the great manufacturing companies who receive and even seek graduates from "high-grade" courses never assume such men to have any practical or laboratory knowledge when they enter their employ? And, from the kind of study facilities they offer them in their apprenticeship period, it would seem that they very greatly discount the theoretical knowledge which such men have received as students.

DREXEL INSTITUTE, PHILADELPHIA. ARTHUR J. ROWLAND

[We fail to find in the article or editorial any reference to a "high-grade course." The following quotation from the article gives the criterion applied in allotting schools to Class I: "In Class I are included the schools of which the electrical courses enjoy the highest standing, which have the completest equipment for teaching and whose degree confers more or less prestige on the graduate. Naturally, this list includes many of the schools which early established electrical courses."

An investigation of the relative merit of electrical engineering courses now offered by our schools would, without doubt, be of some interest; but such an investigation, to be fair to the faculty, who would have to bear the onus of imperfections brought to light, should take into account the non-educational influences which so largely determine the character of the curricula. In this country, with perhaps a few exceptions, the character of college courses, and particularly of technical courses, is largely influenced by what may be termed commercial considerations. That is, if a "standard" course, even though possessing ideal merit, did not conform with respect to qualifications for admission, to the prevailing public school standard of finished secondary education, or to the views of parents as to the relative money value of theory and practice, customers for the kind of education offered would be few; and a falling off in the number of students entering an institution would, under present conditions, be much more fatal to prestige than a lowering of the value of its course. In short, competition among schools and the necessity of the modern college president making favorable showings as to attendance in order to secure satisfactory legislative appropriations or attract endowments, so largely influence the character of higher educational courses in this country, that a comparison with respect to their real educational value would be of little more than academic interest.

As to the position of manufacturers taking on graduates, to our mind it indicates their opinion of the high value of the "theoretical" training of the graduate and the worthlessness of any "practical" training in courses of school.—ED.]

Synchronous Motor Compensation for Lagging Currents.

[illegible]

[illegible] "[illegible] Motor Compensation for Lagging Currents," which was published in your issue for Aug. 10, there appeared certain errors to which I wish to call your attention. The first sentence in the fourth paragraph of the first column on page 283, which ends: "and let OY represent to the same scale the magnitude and direction of the armature reactance and the resistance, which is not absolutely [illegible] the magnitude and direction of the armature impedance drop," should end as follows: "and let OY represent to the same scale the magnitude and direction of the armature reactance drop, and then XY by its magnitude and direction may be taken to represent the armature impedance drop." The last sentence in the second paragraph of the first column on page 284 should read "the counter e. m. f. of the motor * * * measures approximately 1100 volts," instead of "1200 volts." The sentence in the first paragraph in the second column on page 284 which reads: "The resultant of the total line current will therefore be represented by the vector sum of $X'X'$ and $X'X'$," should end as follows: "The vector sum of XX' and $X'X_1'$."

[illegible], PA. [illegible]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

[illegible] Motors.—[illegible].—The first part of a paper read before the German Association of Electrical Engineers on the properties of various types of single-phase motors considered from a common point of view. The paper is to be continued.—*Elek. Zeit.*, July 25.

Motor.—E. DANIELSON.—An illustrated translation of his German article on a combined single-phase and direct-current series and compensated repulsion motor, which has already been described in the Digest.—Lond. *Elec.*, July 26.

Determining the Temperature of an Electric Machine.—F. LOPPE.—An article describing a graphical method by means of which it is possible to estimate the final temperature of a machine by plotting the curve of the increase of temperature as a function of the time during the first hours of operation.—*L'Industrie Electrique*, July 25.

[illegible] Rapidly Rotating Machinery.—M. KROLL.—An article illustrated by diagrams on the necessity of balancing the part of a machine which revolves at a very high speed on account of the forces and torque caused by any lack of balance. He also discusses simple devices for measuring these forces.—*Elek. und Masch.*, July 28.

Direct-Current Dynamo.—F. LOPPE.—An elementary article on the calculation of a direct-current dynamo.—*L'Industrie Electrique*, July 10.

Lamps and Lighting.

Efficiency of Lamps.—H. LUX.—A continuation of his illustrated serial. In the present installment he discusses the separation of the visible radiation from the invisible radiation. The only exact method for doing this is to determine the energy of radiation for each single wave length by bolometric methods and then to plot the results in the form of a curve. The part of the curve between the wave lengths 0.4 and 0.8μ represents the visible radiation. In this way the following [illegible] were found for carbon-filament lamps and Nernst lamps:

	Carbon-filament	Nernst
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

The figures show that Wedding's figures are all wrong: the latter had found the value 0.2 per cent for carbon incandescent lamps and 0.8 per cent for Nernst lamps for the ratio of light radiation to consumed energy. The figures in the above table contain an apparent paradox. According to them, in order to produce the same candle-power, the Nernst lamp requires less than one-half the energy of the carbon-filament lamp, while the figures for the ratio of light radiation to consumed energy are 2.74 and 3.85. The explanation is that in determining the candle-power, the physiological effect of the different wave lengths counts, while in measuring the energy of the different wave lengths by bolometric methods the physiological effect is not taken into account. The carbon-filament lamp is much richer in dark red rays than the Nernst lamp. Almost one-half of the total "visible radiation" of the carbon-filament lamps is in the region between 0.72 and 0.8 [illegible] for the Nernst lamp only one-fifth of the total visible radiation is in this region, in which the waves have a very small physiological effect.—*Zeit. f. Beleucht.*, July 20.

Osram, Tungsten, Zirconium Lamps.—J. T. MORRIS, F. STROUDE AND R. M. ELLIS.—The first part of a paper on an extended investigation carried out with a number of lamps about which particulars are given in the following table:

[illegible]	
Carbon, 16 cp., C_1	15.5
[illegible]	
Tantalum, 25 cp., T_1 1.83 watts per horizontal cp.	4.5
[illegible]	[illegible]
Tantalum, 25 cp., T_3 1.94 watts per horizontal cp., 1,850°C.	4.8
Osram, 50 cp., O_3 1.27 watts per horizontal cp.	3.45
[illegible]	
Osram cp., 50 O_3 1.27 watts per horizontal cp.	3.45
Osram, 50 cp., O_4 1.23 watts per horizontal cp.	.....
Osram, 50 cp., O_5 1.23 watts per horizontal cp., 2,000°C.	.....
Tungsten (Just), 40 cp., W_1 1.29 watts per horizontal cp., 2,000°C.	.....
Tungsten, 40 cp., W_2 1.13 watts per horizontal cp.	3.45
Zirconium, 35 cp., Z_3 1.35 watts per horizontal cp.	.....
Zirconium-tungsten, 35 cp., Z_1 1.46 watts per horizontal cp., 2,000°C.	.....
Zirconium-tungsten, Z_2 1.42 watts per horizontal cp.	3.7

The marks C_1, T, etc., are those used in the following diagrams. The table gives, besides the specific consumption of the lamps, the working temperature of the filament, and in the last column the percentage voltage at which the filament is just visible in the dark. The authors first investigated the effect of voltage variation, the lamps being supplied with direct current. The results are given in Fig. 1. In metallic

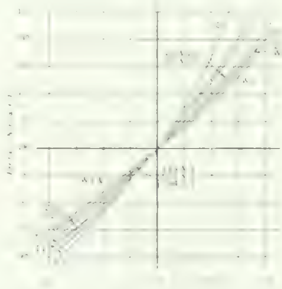


FIG. 1.—[illegible]

filament lamps a variation of [illegible] per cent in voltage produces about 4 per cent change of candle-power, as compared with the 7 per cent change in carbon filament lamp. Fig. 2 shows curves connecting voltage and resistance. These curves were used to determine the theoretical ratio of the starting current to the final current. The same ratio was also determined by means of a Duddell oscillograph. The values obtained by the latter method are always lower than those found from the resistance curves. This is due to the combined effects of the inductance of the circuit and the inertia of the oscillating parts of the oscillograph. It is interesting to note from the oscillo-

graph that after subjecting a metallic-filament lamp to normal voltage, the current remains distinctly above its final value even after two or three minutes have elapsed. Fig. 3 gives curves connecting voltage and watts per candle. To estimate

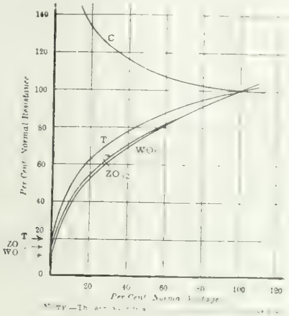


FIG. 2.—VOLTAGE RESISTANCE CURVES.

the temperatures of the filaments the authors determined first the expansion of the filament and also applied Stefan's law. The values found are given in the above table. From the last column in the same table it is seen that the metallic filament is still visible in the dark at a much lower voltage than the

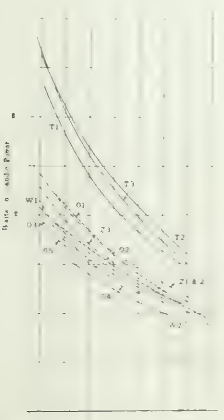


FIG. 3.—VOLTAGE [illegible]

carbon filament; the average figures, expressed in per cents of the working voltage, being 4 per cent for the metallic and 16 per cent for the carbon. These experiments were carried out [illegible] July [illegible]

Enclosed Arc Lamp.—An illustrated [illegible] arc lamp made by Kolben & Company. It is an enclosed arc lamp for direct current or alternating current for voltages between 100 and 150, and for currents between 3 and 8 amperes. The life of the upper carbon is from 40 to 50 hours with direct current and from 20 to 30 hours with alternating current. The rest of the upper carbon can be used again as lower carbon. The specific consumption without the globe is 0.465 watt per mean hemispheric hefner candle; with a frosted globe, through which the arc is no longer visible, the consumption is 1.026 watts per hefner candle; but such globes are required only for interior lighting, in offices, etc., while under ordinary conditions, with a less absorbing globe, the specific consumption is between 0.6 and 0.8 watt per hefner candle. The special feature of the lamp is that it is perfectly air-tight and [illegible] July 21.

Mercury Arc.—J. POLAK.—The conclusion of his articles, in the last instalment of which he discusses the use of the mercury arc for rectifying purposes.—*Elek. Zeit.*, July 25.

Power.

French Power Transmission System.—E. GAISSET.—The first part of an illustrated description of the electric power transmission system of the Société Méridionale. The company has a three-phase network with a frequency of 50 in the cities of Carcassonne and Narbonne and a direct-current, three-wire distributing system, with a voltage of 220 between the outers. The three-phase network consists of a double feeder at 20,000 volts, 65 kilometers length and three lines at 17,000 volts with 5000-volt branches and a total length of 600 kilometers. The 5000-volt branches supply electricity to 150 towns. There was formerly only one hydroelectric generating station, while lately a steam station and a second hydroelectric station have been installed. The article begins to describe in detail the equipment.—*L'Eclairage Electrique*, July 27.

Producer Gas.—W. A. BONE AND R. V. WHEELER.—An Iron and Steel Institute paper on the use of steam in gas-producer practice. This paper contains the results obtained at trials on two Mond producers. Varying the temperature by altering the proportions of air and steam in the blast causes the quality of the gas to deteriorate if the saturation temperature exceeds 65 degs. The thermal efficiency and other considerations show the best saturation temperature to be about 60 degs. —Lond. *Elec.*, July 26.

Induced Draught.—A. J. CAPRON.—An Iron and Steel Institute paper on induced draught, with hot-air economizers, for steel works and blast-furnace boilers. The author describes a system of induced draught in connection with hot-air economizers, which utilize the waste heat from the boiler by heating the air required for combustion. Examples of the adaptation of this system to various types of boilers and some comparative figures are given. The efficiency is much increased.—Lond. *Elec.*, July 26.

Cranes.—A very full, illustrated description of various direct-current cranes made by a British company.—Lond. *Elec. Rev.*, July 19.

Electric Pumps.—An illustrated account of tests of a centrifugal pump installed in a mine in Germany and driven by a three-phase motor.—*Elek. Zeit.*, July 25.

Starting Gas Engines.—To start a gas engine which drives a direct-current dynamo, L. Neu makes use of the booster which serves for charging the battery.—*L'Industrie Electrique*, July 25.

Steam Turbines.—[illegible] NIETHAMMER.—An article on steam turbines and turbo-dynamos and their reliability in practical service.—*Elek. und Masch.*, July 21 and 28.

Rolling Mills.—H. ALEXANDER.—A summary of the work done by the Allgem. Elek. Ges. in recent years with respect to electric equipment of reversing rolling mills.—*Elek. Zeit.*, July 25.

Traction.

Mountain Railway.—An illustrated description of the new electric railway from Muenster to the "Schlucht." A trolley system at 750 volts is used. The line is a combined adhesion and rack road. The four-axled motor car is provided with four 85-hp motors, two of which drive the running wheels in the usual manner, while the remaining two are permanently connected to the gearing which engages in the rack. On the adhesion section only the two motors are in use, and these drive the wheels through a single reduction gear in the ordinary way. The other two motors are not then in use. On the rack sections, however, all four motors are employed. The rack motors work with a double reduction gear, and the adhesion motors are kept in series to run with a high torque at a low speed. All four motors are controlled by a single controller. Series-parallel control is employed.—Lond. *Elec. Eng'ing*, July [illegible]

Glasgow.—An abstract of the annual report of the municipal tramways of Glasgow which shows a substantial surplus on the year [illegible]

[illegible] which is brought up to 20.612 cents by the addition of all capital charges. The cost of energy works out at 2.112 cents per "unit" supplied, including a proportion of management and capital charges.—Lond. *Elec. Eng'ing*, July 18.

Railway Electrification Proposals in Italy.—A general article discussing the advantages of electrification of railways with reference to a recent article of C. R. King and to the criticisms which have been made that for improvement of the whole service it would be more economical to build new lines and retain steam traction than to change to electric traction.—Lond. *Elec. Eng'ing*, July 18.

Installations, Systems and Appliances.

Interrupter for House Installations.—An illustrated description of a device of Zambelletto and Ballerini for cutting off the supply to a house when the current passes beyond the value

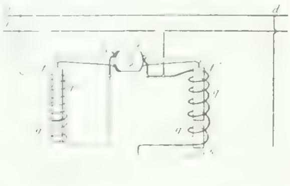


FIG. 4.—INTERRUPTER FOR HOUSE INSTALLATION.

agreed on by contract. In Fig. 4 the conductors of the network are represented by *a, b,* while the house installation is represented by *c, L, d,* and *L* represents lamps, etc. The interrupter consists of two coils *p, q,* the former of thin wire, the latter of thick wire. The coil *p* is connected across the line, while the coil *q* is in series with the lamps *L*. *f* and *g*, and f^1 and g^1 are pieces of iron. Variations of the voltage in the network are without effect on the equilibrium of the system, but if the current consumed in the lamps *L* increases beyond the predetermined value, the iron piece, *h*, mounted on the lever *m* is attracted and the contact *m v* is broken.—*L'Industrie Electrique*, July 10.

Fallacies of Free Wiring.—G. B. BARHAM.—The author states that the greatest fallacy in "free wiring" is the term "free." The methods of charging under the usual systems of free wiring lead to dissatisfaction and to an eventual decrease in energy consumption. The system does not encourage long-hour consumers, and a fixed charge per lamp per year is not an attraction.—Lond. *Elec.*, July 26.

Wires, Wiring and Conduits.

Electric Conduit Fittings.—An illustrated description of a design of conduit fitting devised by W. Schmahl. The distinctive feature is that shoulders are provided against which the rough ends of the conduit butt, and are thus removed from possible contact with the wires.—Lond. *Elec. Eng'ing*, July 18.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—F. HOWLES.—A paper in which the author gives a review of the principles of the electrothermic combustion of atmospheric nitrogen and presents an outline of the various technical methods which have been suggested. A yield of 650 kilos of nitric acid per kw-year represents the greatest output so far realized. Two ways of improving matters are possible, either by increasing the flame temperature or by more rapidly removing the gas mixture from the arc by means of greater air velocity without increased dilution. The author then discusses the absorption of nitric oxide and the preparation of nitric acid. Some figures on energy cost are given.—Lond. *Elec.*, July 19.

Electrolytic Refining of Bismuth.—A. MOHN.—An illustrated article. The parting of a Mexican lead-bismuth bullion was carried out by a combined process, including, first, electrolytic refining of lead by the Betts' process; second, purification of the slimes; third, electrolytic refining of bismuth; and, fourth, electrolytic refining of silver and gold. The apparatus for the refining of bismuth is analogous to that used in the Balbach silver refining process. The electrolyte is a solution of bismuth chloride and free hydrochloric acid. Electrolysis is carried out with a cathodic current density of 20 amperes per square foot, while the current density at the anodes is three times this amount. The voltage at the terminals of the cell is 1.2.—*Electrochem. and Met. Ind.*, August.

Ammonia Gas by Means of the Electric Arc.—E. BRINER AND E. METTLEN.—A brief account of an experimental investigation of the influence of pressure on the synthetical formation of ammonia gas by the action of an electric-spark discharge on a mixture of nitrogen and hydrogen.—Lond. *Elec.*, July 26.

Sterilization of Water by Ozone.—G. ERLWEIN.—A brief paper on the Siemens ozonizing apparatus and the use of ozone for the sterilization of drinking water.—Lond. *Elec.*, July 26.

Hydrates in Solution.—Four different papers presented before the Faraday Society on the subject of hydrates in solution, namely: By W. R. Bousfield and T. M. Lowry on "Thermochemistry of Electrolytes"; by J. C. Philip on "Hydrates in Solution"; by G. Senter on "Methods for Determining the Degree of Hydration," and by A. Findlay on the "Stability of Hydrates."—Lond. *Elec.*, July 26.

Units, Measurements and Instruments.

Photometer.—J. S. DOW.—An abstract of a (British) Physical Society paper on a form of photometer in which the cosine law is utilized. In this form it is unnecessary to move either the photometer or the sources of light. The adjustment of the illumination of the photometrical surfaces is carried out in the photometer itself by the rotation of a Ritchie wedge about the boundary line between the photometrical surfaces as axis. The ratio of the candle-powers of the two sources of light compared can then be read off on a suitably calibrated scale attached to the photometer. This type of instrument is very convenient. Attention is drawn, however, to the possibility of "angle-errors" and the means of avoiding them. This instrument can be used on the equality of brightness principle, or by utilizing an oscillating lens, as a flicker photometer. The results of using these two photometrical methods are, in this case, in very good agreement. An experiment was then shown illustrating the behavior of the "rods" and "cones" as regards flicker. At strong illuminations, when the cones are predominant, the perception of form and color is most acute when the central portion of the retina is utilized; but at low illuminations, when the rods are in action, visual acuteness is best when the outer region of the retina is used. In the same way the perception of flicker was demonstrated to be most acute over only the portion of the retina removed from the center of the eye when a weak illumination is employed. A distinction must be drawn between "rod-flicker" and "cone-flicker." Some experiments were then shown illustrating the detail revealing powers of red and green light. A green or blue surface loses in luminosity as the image of it fades more and more towards the center of the retina. But apart from the question of luminosity, the red end of the spectrum gives the best definition in the case of distant vision and the blue end in the case of very close vision. This arises from the want of achromatism of the eye. Two exactly similar patches of red and blue light were thrown upon a screen on which a black and white chessboard-pattern had been traced. The black and white squares were then seen to be more sharply defined when illuminated by the red light, in spite of the fact that the illumination due to the blue light was much the brighter of the two. The red end of the spectrum is, therefore, in general the most effectual portion for the illumination of clocks, shop signs and objects which must be viewed from a distance.—Lond. *Elec.*, July 19.

Hot-Wire Oscillographs and Hot-Wire Wattmeters.—J. T. IRWIN.—An abstract of a (British) Physical Society paper. The principle of the author's hot-wire oscillograph has already been described in the Digest. In the present lecture he showed the following experiments with the oscillograph. The

from a rotary converter with the ripples due to sparkling damped out by resistance in the condenser circuit; with the ripples shown at their proper size with critical damping; with the ripples very much exaggerated owing to want of damping. He also showed the periodic discharge of a condenser through a self-induction, first, with a small resistance in circuit and, therefore, an oscillatory discharge, and second, with a large resistance in circuit and the oscillations damped out. He then showed the p. d. across the stator of an induction motor and the current in the rotor below, above, and at synchronous speed, when running as a two-phase machine and as a single-phase machine. The current through and the p. d. across the armature of a single-phase commutating compensated motor run up to and above synchronous speed was then shown, first, with the auxiliary brushes short-circuited showing the current and p. d. in phase with each other at synchronous speed, and second, with the auxiliary brushes open-circuited showing the p. d. and current differing by nearly 90 degs. in phase. The lecturer then showed a circle and a straight line produced by combining, by means of a beam of light, the vertical harmonic motion of a mirror with a simple harmonic motion of the oscillograph due to a sine wave of current, the circle being produced when the two movements were at 90 degs. difference in phase, and the straight line when the two movements were in phase. Finally a hysteresis loop was demonstrated for glass-hard steel wire, showing the rounding off of the tips at a frequency of 40 per second. He also showed a new type of synchronous motor which he has invented and which can be run easily at synchronous or half-synchronous speed. This motor consists essentially of a series motor with laminated field cores and with two points on the commutator, 180 degrees apart short-circuited.—Lond. *Elec.*, July 19.

String Electrometer.—C. W. Lutz.—Einthoven's string galvanometer is used either with direct or with alternating currents. It can also be adopted to electrometry. The author describes a new way of doing this. The quadrant electrometer suffers from the disadvantages of a large capacity and inertia, and a lack of portability. The electroscope, on the other hand, is not very sensitive, has a small range, and cannot be made self-registering. The author uses two insulated brass plates mounted in an earthed magnalium frame. Between these plates a Wollaston wire, 0.001 mm in diameter and 10 cm long, is stretched, and its position is read by means of a micrometer microscope. The instrument is kept dry by means of sodium bulbs. There are four different methods of connection. With an auxiliary potential there is either a "string" method or a "plate" method. In the former the string is charged to the unknown potential, and the plates are given equal and opposite known charges, derived from a battery of 50 small accumulators. In the "plate" method one plate is earthed, the string is positively charged, and the other plate charged to the unknown potential. Without an auxiliary potential there is the "double" method in which one plate is earthed and both the string and the remaining plate are charged to the unknown potential, and the "influence" method in which one plate is removed some distance from the string, both plates are earthed, and the induction of the nearer plate deflects the charged string towards it. The author claims simplicity, portability and precision for this instrument. No damping is required. There is great portability, range and sensitiveness. Insulation is very high, and optical projection and self-registration easily secured. In the last two methods the deflection is independent of the position. The capacity ranges from 5 cm to 15 cm, according to the method used.—Lond. *Elec. Eng'ing*, July 25.

Miscellaneous.

Transmission of Pictures.—Blondin.—An abstract of a paper read before the International Society of Electricians in Paris, in which he described a new method of picture transmission, due to Carbonnelle, in which selenium is not used. After experimenting with various selenium arrangements, the inventor abandoned this method for another which seemed to promise more success. This system, which, since March 1, has been submitted to official tests on the telegraphic circuit between Brussels and Antwerp and back (a total distance of about 57 miles) is very simple. There are two cylinders revolving synchronously, one at the transmitting and one at the receiving end. On the first is wound a sheet of metal on which is written or photographed by a special process the messages or other matter which is to be reproduced. On the second is a layer of some plastic substance, such as wax or of some soft metal, such as lead, or even sheets of white paper, separated by carbon paper. A metallic style, which is connected to one pole of a battery, presses on the surface of the conducting sheet carrying the message. This latter is connected to earth through the support. The other pole of the battery is connected to the line. The metal style has a lateral motion along the axis of the cylinder. At the receiving end is a telephone connected to the line and to earth. This receives a current varying with the movements of the transmitting cylinder. A graver fixed to the diaphragm traces a groove in the wax or lead, or draws lines on the sheets of white paper. The action is as follows: When the transmitting style passes over an insulating part of the message, no current passes to the line and the receiving point presses on the surface of the receiving cylinder. When, on the contrary, a current flows, the style is raised. A reproduction in wax, in lead or in black lines on white paper, is thus obtained. It is claimed that, as regards the speed of transmission, this apparatus is superior to that of Korn. In the Carbonnelle system a photograph measuring 9 cm x 18 cm was transmitted in 80 seconds. By Korn's method it takes about 12 minutes to send a photograph 13 cm x 18 cm and to get a reproduction 6 cm x 10 cm. To obtain the various degrees of light and shade one of the following methods is employed, either a special reticulation of gums or gelatine bichromates, or a heliograving process, or base of metallic salts obtained by a special method, or those obtained by the carbon process. In the first two methods the thickness of the layer is proportional to the degree of light and shade and the current varies in the same proportion. In the case of metallic salts the thickness of the layer is the same all over, but the strength of the salt is different at different places. When carbon is used the layer is again of varying thickness.—Lond. *Elec.*, July 19.

High-Speed Wireless Telegraphy.—The large Poldhu station of the Marconi Company still signals to Atlantic liners at the rate of about 15 words per minute. With such a comparatively slow speed wireless messages are very costly and it is of great importance to develop high-speed working. Results obtained in tests of the British Post Office are promising and indicate that Wheatstone working is a practical possibility. In these experiments the received oscillations actuated a wireless receiver, which, in turn, acted on a syphon recorder, causing the Morse signals to be written in a continuous wavy line.—Lond. *Elec. Rev.*, July 19.

Pilot Wires and Electric Light Cables for Telephone Lines.—R. Hiecke.—An illustrated translation of his German paper, mentioned before in the Digest, and describing a method of telephony between the generating station and chief sub-stations by using the pilot wires and the electric light cables themselves as telephone lines.—Lond. *Elec. Eng'ing*, July 25.

BOOK REVIEWS.

L'Electricité Considérée Comme Forme de L'Energie. By Lt.-Col. E. Aries. Paris: A. Hermann. 58 pages. Price, 2.50 francs.

The purport of this pamphlet is to call attention to the part played by the real, material medium rather than by the hypothetical ether of space. Electric potential and quantity; the causes of electrostatic phenomena, energy transformation and Carnot's cycle are all considered in this effort to explain the unknown by means of the known and the invisible by the visible.

[illegible]

Paris: Ch. Beranger. 362 pages. Price, 3.50 francs.

As usual, this yearly volume contained brief notices of electrical occurrences, activities and achievements. Electrochemistry, atmospheric electricity, wireless telegraphy, radiography and the applications of the electric current to curative medicine receive due attention. The volume closes with a seven-page obituary notice of the late Prof. Pierre Curie (b. [illegible]

Lifting Electromagnets.

The accompanying illustrations show several forms of lifting electromagnets brought out by the Cutler-Hammer Clutch Company, of Milwaukee, Wis. These are made in sizes from a 10-in. magnet for lifting plates, rails, small castings, etc., up to a 50-in. or 52-in. magnet designed for handling pig iron, scrap, etc., and capable of lifting a 10-ton "skull-cracker." A 50-in. magnet weighs about 5000 lbs. It consists of a hollow steel casting in which the magnetized coil is placed. This coil is built up of alternate layers of copper and asbestos and is insulated from the cast-steel frame by thick sheets of mica. Under test the coils of these magnets have been heated to 470 degs. Fahr. without injury. The corrugated form of construction shown serves two useful purposes; it provides a greater surface for heat radiation and also forms niches to protect the heads of the bolts which fasten the removable pole piece to the magnet frame from injury. As a further aid to heat radiation the magnet frame is cast with a central aperture through which air may freely circulate. The lifting capacity of the electromagnet depends, of course, on the nature of the material handled. Under favorable conditions a 50-in. magnet will lift as much as 20,000 lbs., while under adverse conditions the same magnet may not lift more than 1000 lbs. or less. Various

[illegible]

forms of material also require various forms of magnets. For handling plates, rails, tubes and material of a similar nature the magnets are usually made rectangular in form and are preferably operated in pairs, the two magnets being placed on a balancing bar to which the crane hook is attached. Magnets for handling pig iron, scrap, "skull-crackers," etc., are, as a rule, circular in form and are constructed with much greater lifting capacity. A 75-lb. magnet is shown in Fig. 3 lifting an 800-lb. electric car lighting generator. Lifting magnets of large size, designed for use with pig iron, scrap, etc., are made concave on the under side, since this form is best adapted for handling material of irregular shapes. These magnets may be easily adapted for handling large masses of metal with plane surfaces by inserting in the central aperture an auxiliary pole piece so proportioned as to extend the inner pole downward to the level of the outer pole, thus insuring immediate contact of both poles with the object to be lifted. Pole shoes are fitted to all the lifting magnets and these are secured by through

[illegible]

bolts. The removable pole piece and the through bolts that fasten it to the under side of the magnet frame are clearly illustrated in Fig. 1, where the electromagnet is shown handling steel stampings. In this case the magnet was not lowered onto the stampings, but was brought to within about 3 ft. of them when the perforated steel plates rose to the magnet as shown.

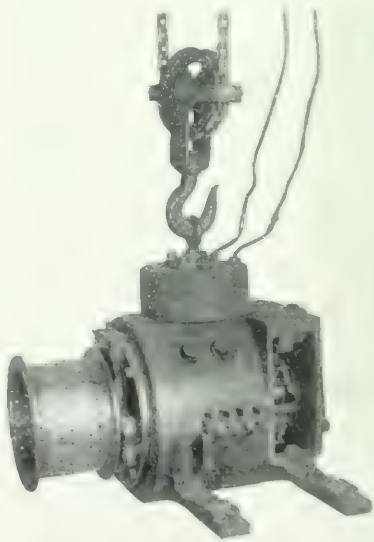
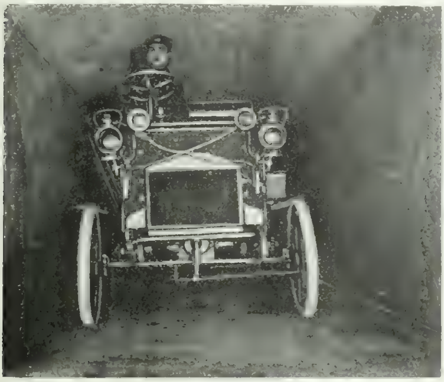


Fig. 3.—[illegible]

The magnets will be found serviceable wherever pig iron; metal plates, tubes, rails, beams, scrap or heavy castings of iron or steel are to be handled. All that is necessary in work of this sort is to lower the magnet on to the material, close the circuit and lift the magnet. In foundries and rolling mills magnets may be utilized for lifting and transporting metal too hot to be touched with the hand.

Automobile for Temporary Freight Haulage in Water Conduits.

On page 280 of our issue for Aug. 10 mention was made of the use of automobiles as traction locomotives for hauling freight through the water tunnel of the Kern River plant of the Edison Electric Company, Los Angeles, Cal. An illustration of one of the two automobiles is shown herewith. The

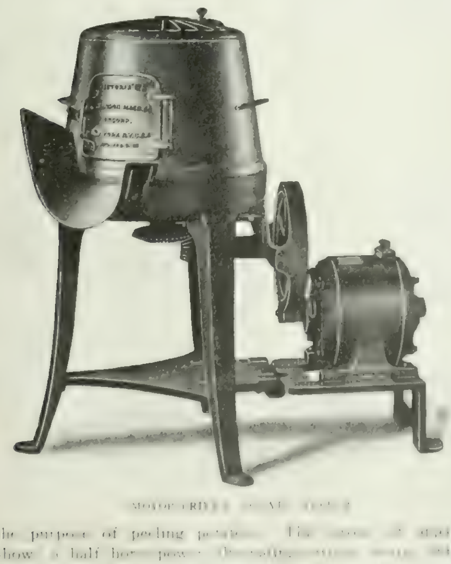


AUTOMOBILE IN TUNNEL.

tunnel through which these machines acted as locomotives when the surface roads were impassable have a total length of about 8 miles, the average haul being about 5.5 miles. The two machines accomplished a total freight locomotive traffic of 2750 ton-miles. The automobiles were of the Lambert friction drive type, each being equipped with a 20-hp gasoline motor. The wheels were fitted with heavy, solid rubber tires.

Potato Peeling by Electricity.

An ingenious application of electric motor drive is shown in the accompanying illustration of an equipment devised for



MOTOR-DRIVEN [illegible]

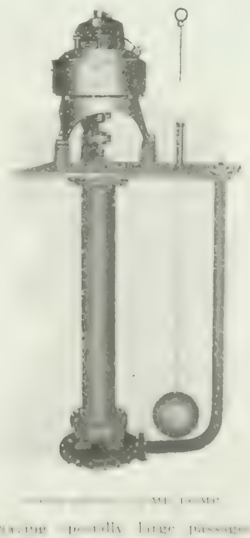
the purpose of peeling potatoes. The [illegible] shows a half horsepower [illegible] motor [illegible] the Century Electric Company, of St. Louis, [illegible] to a Victoria vegetable paring machine, made by the Robinson Machine Company, of Newark, N. J. This device will peel and wash a barrel of potatoes in about five or six minutes, while turnips, carrots or beets can be pared at equivalent rates of speed. The problems involved in working out such a device were not easy of solution, but Mr. H. Robinson appears to have placed in public service a highly ingenious and practical apparatus, affording great economy of time and labor.

The peeling in the machine is done by the principle of rotating and agitating the potatoes inside of the machine, against rough, abrading surfaces, while a stream of water plays on them, discharging the waste into the sewer. It may be naturally deducted that the peeling is accomplished with about one-fourth of the waste on the potatoes when done entirely by hand, as the machine only removes the outer thin skin of the potatoes, leaving all the most nutritious part on the potatoes to be cooked and eaten.

These machines are driven either by a power belt or direct connected with a motor, and the availability of electrical circuits renders the use of motors very popular in this respect. It is stated that no fewer than 40 of these machines have already been installed in the U. S. Navy, where instead of a big gang of men sitting around a long time at the job, two or three jackies in 15 minutes can do all the potato peeling necessary for a whole day's meals.

Vertical Sump Pump.

The accompanying illustration shows a useful machine made by the Tacony Iron Company, of Philadelphia and New York, for sump pit drainage. It is a specially designed centrifugal pump supported from the under side of a bedplate by a pipe through which the shaft runs; the vertical motor and the thrust bearing to carry the weight of the moving parts are mounted on the upper side of this bedplate. Being designed to have the pump proper entirely submerged in the water, no troubles from lack of priming occur and because of this no valves of any kind need be used, so that there can be no trouble or annoyance due to solid matter lodging in such devices. A pump of this type arranged to stop and start automatically by means of a float and special electric switch makes an admirable device to drain water from cellars or pits. The company also



[illegible] PUMP.

makes pumps having specially large passages for pumping sewage, and single and multi-stage turbine pumps for house tank service or other use.

Helmet Type of Reflector.

A new reflector [illegible] recently brought out by the National X-Ray [illegible] Company, of 24 Jackson Boulevard, Chicago, [illegible] "Helmet" reflector. It was scientifically designed to meet the requirements of lighting high and shallow windows; the majority of windows at the present time being of this class. It is suited to the lighting of all windows where the depth of the window is not over one-half the height of the lamps above the bottom of the window, where the lamps are as high above the level of the top of the back of the window as the window is deep. This meets the conditions in the great majority of show windows. It is intended to produce an approximately uniform illumination over the goods as ordinarily placed in show windows. This reflector is claimed to mark a decided advance over anything heretofore offered for lighting the class of windows mentioned for the following reasons:

In the first place, it is designed to utilize a 125-watt Gem incandescent lamp; thus giving the customer at once the advantage of a 25 per cent increase in efficiency over the old style carbon filament lamp. It has the further advantage that it is also adapted to a 105-watt tungsten lamp; so that the user can install these very high efficiency lamps as soon as they are placed on the market. Later improvements in incandescent

FIG. 1.—HELMET WINDOW REFLECTOR.

lamps have therefore been anticipated. Fig. 1 shows the external appearance of this reflector. It has one side partially flattened and extended down lower than the rest of the reflector. This flat side is placed next to and parallel with the window pane, and is designed to avoid as far as possible the wasting of light on the sidewalk and detracting from the value of the window illumination by exposing the lamp to passers-by. The reflector is unusually large, being about 12 ins. in diameter and 11½ ins. high. This size was necessary to secure high efficiency of window illumination, by catching as much of the light as possible and reflecting it in useful directions. Another important reason for the unsymmetrical design of the reflector was to make it easy to install without mistakes. The makers realized in adopting this design that many excellent reflectors of conical form are commonly misused in window lighting because the average person who installs and uses these reflectors does not understand the importance of pointing them at the proper angle. This new reflector was therefore intended to be as nearly "fool-proof" as possible, and it was designed so that the lamps point straight down. Efficient installation is a very simple undertaking. Furthermore, by having the lamps pendant, use can be made of the new tungsten lamp, which would not be the case if the lamps were at an angle.

The efficiency of this reflector for window illumination for the size of windows for which it is intended, is remarkably high, as can be seen from Fig. 2, which shows photometric curves plotted from tests made by the Electrical Testing Laboratories, of New York. In these tests the reflector was equipped with a 125-watt clear-bulb Gem lamp, giving 50 mean horizontal candle-power. The reflector was held in a position as used in practice with a standard 3¼-in. holder. The lamp was placed in such a position that the plane parallel to the loops of the filament made an angle of 45 degrees with the flat side of the reflector. In one curve of Fig. 2 is shown the apparent candle-power at various angles in a plane at right angles to the flat side of the reflector, and in another curve is shown the apparent candle-power at various angles in a plane parallel to the flat side of the reflector, or, in other words, the sidewise distribution, as it would be installed in a window. From Fig. 2, it is seen that over 200 candle-power is given for a distance of 40 degrees to the left of vertical in the direction in which it is most useful in window lighting; while for a few degrees the candle-power is over 400. The maximum candle power is directed so as to give high illumination on the goods placed in the bottom and front of the window. As elevated goods—*i. e.*, those on higher levels—are usually placed further back in the window, a lower intensity is needed; and these

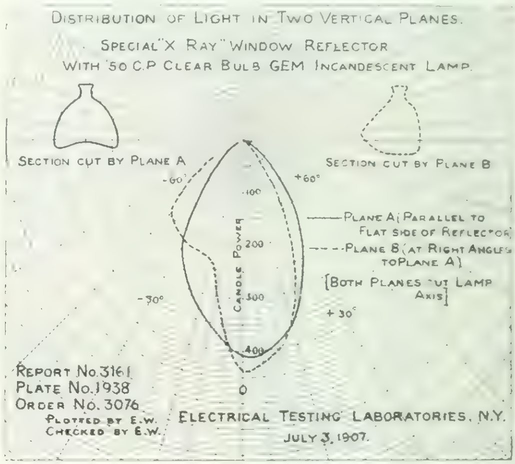


FIG. 2.—LIGHT DISTRIBUTION WITH A HELMET REFLECTOR.

requirements are met by the reflector. A very small amount of light is thrown outside the window on the sidewalk.

Besides window lighting a number of other useful applications of this reflector will suggest themselves to illuminating engineers, most notably the lighting of audience rooms of all kinds where the lamps themselves are concealed behind ground glass skylights or beams, and where it is desired to throw the light sidewise and forward and have as few rays directed back into the eyes of the audience as possible.

For the lighting of high, shallow windows, the makers are putting out this reflector with the claim, based on these photometric curves, that one 125-watt Gem lamp with this reflector will give the same results as three 55-watt common incandescent lamps used in the most efficient window reflectors for high, deep windows that had been offered up to the time this reflector was designed, while in many cases where reflectors unsuited to the window have been heretofore used, one 125-watt Gem lamp will give the same results as four or five common 16-cp, 55-watt lamps. With tungsten lamps, having twice the efficiency of Gem lamps, the saving would be of course even more marked. The makers claim the honor of being the first to put out a window reflector designed for the new large high-efficiency incandescent lamps.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The trade conditions of the whole country appear to be excellent, and manufacturers and merchants are well satisfied with the volume of orders. In New York, it is said, forward dry goods orders for the spring have been exceptionally good, and other textile lines of all kinds feel a brisk demand. Warmer weather in August has helped to move things and to clean up summer stocks. There are some lines of production more responsive than others to the declines in Wall Street, and they have experienced depression—such as automobiles and jewelry—but these do not bulk very big in the national consumption even of luxuries. The state of the crops is cheerful, as the conditions have nearly everywhere improved, as to wheat and corn; while the cotton outlook is very favorable. The iron and steel market has been slightly duller, but the business is in excess of 1906, and some slowing down was inevitable, if not indeed desirable. Copper has continued to head slowly toward lower prices, and electrolytic has even been quoted at 18 cents. Bank clearings for the week ending Aug. 15 aggregate $2,761,355,000, 4 per cent over last week and 6 per cent over this week last year. Outside of New York exchanges amount to $1,045,997,000, about one-tenth of 1 per cent under last week, but 10 per cent over the week last year. Business failures for the week ending Aug. 15 number 146, against 157 last week, 143 in the like week of 1906, 147 in 1905, 203 in 1904 and 166 in 1903.

THE PAWLING & HARNISHFEGER COMPANY, of Milwaukee, large builder of traveling cranes of every description, has twice been obliged, due to the increase of business, to enlarge its original plant, built only a few years ago. The second addition to be made is now practically completed. The main building, housing and bridge, erecting, assembling, machine, electrical and stock departments, is 260 ft. x 355 ft. The addition is 100 ft. wide and extends the entire length of the main building, or 355 ft. It is built of brick and steel, with a saw-toothed roof, and when it is occupied the entire floor space will be 127,800 sq. ft. New machinery will be installed in the addition, and the crane runways and sprinkler system of the main building will be extended. In consequence of the increased floor space and the necessary new machinery for it, it has been necessary to make corresponding additions to the power plant. An Allis-Chalmers cross-compound Corliss engine of 150 horse-power and electrical generator of 100 kilowatts capacity, together with a 400-hp Heine boiler and a Hawley down-draft furnace, have been added to the existing equipment, which also includes Allis-Chalmers engines. With these additions the aggregate boiler capacity will reach 1000 horse-power and the generating capacity 700 kilowatts.

BELL TELEPHONE STATISTICS.—It is stated from Boston that President Vail, of the American Telephone & Telegraph Company, has decided to discontinue issuing the monthly statements of instrument output and to substitute in their place a statement which will show the actual gain in new subscribers from month to month. The monthly statement has shown the movement of instruments between the parent company which owns them and the associate or licensed companies which rent them. The actual gains or losses in subscribers' stations from month to month, which, of course, measure the earning power of the Bell system, are not shown by the monthly figures of instrument output. In recent months the instrument statements have required constant explanation and it has been deemed better policy to abandon them entirely and put out figures which give actual results. Formerly every station was counted as two instruments, one transmitter and one receiver, which also led to confusion and mistake.

TELEPHONY IN AUSTRALIA.—Tenders are invited by the Commonwealth of Australia until Jan. 8, 1908, for the supply and delivery of [illegible] subscribers' telephones. Full particulars, specifications, bid forms, etc., may be obtained from the office of the Postmaster-General, Melbourne, Australia, or the Commonwealth Offices, 72 Victoria Street, S. W., London, England.

EXPORT TRADE FIGURES.—The chief of the Bureau of Statistics, Department of Commerce and Labor, reports the foreign trade of the United States for July and for the seven months ended July as follows:

July	[illegible]	1906	[illegible]
Imports	[illegible]	$107,621,490	[illegible]
Exports	[illegible]	[illegible]	107,950,421
Excess exports	[illegible]	[illegible]	[illegible]
Seven months ended July			
Imports	$876,043,246	[illegible]	[illegible]
Exports	[illegible]	[illegible]	[illegible]
Excess exports	[illegible]	[illegible]	[illegible]

It will be seen that while there was a splendid expansion in exports the great increase in imports kept the trade balance in our favor down to a small figure.

STEAM TURBINE PLANTS.—Contracts have recently been closed with two municipalities for Allis-Chalmers turbine units, one for Columbus, Ohio, and one for Dunkirk, N. Y. The turbine for Columbus is a 1000-kw machine direct-connected to a 1000-kw alternator of the same design wound for 60 cycles, three-phase, 2300 volts. The Dunkirk unit is to be a 500-kw turbine direct-connected to a 500-kw Allis-Chalmers alternator wound for 60 cycles, two-phase, 2300 volts.

OPENING FOR PLANT.—Mr. P. J. Fulcher, secretary and treasurer of the Grottoes Board of Trade, Grottoes, Va., states in a letter just received that the town has no electric lamps, but needs them. The town is open, he says, to a proposition from some one who would like to put in the plant as a promising investment and he invites correspondence on the subject.

Financial Intelligence.

THE WEEK IN WALL STREET.—General conditions of demoralization were in evidence in Wall Street last week, and a remarkable decline in values took place. The strike of the telegraphers was not much of a factor, but the receivership for the Pope Manufacturing Company, which was unable to renew its loans, created a very uneasy and dispirited feeling, as it was inferred and even rumored that other industrial concerns might be in the same state. The scarcity of money was reflected in the failure of New York City to sell its $15,000,000 of bonds, and the actual tightness abroad was indicated by the increase in the Bank of England rate to 4 per cent. In fact, while the attitude and action of the government and state authorities in this country toward "bad trusts" and the railroads have done much to bring securities to their present low level, it is seen that the depression in stocks and the financial stringency are world wide, although our own market seems more sensitive than the others. Yet there are some good signs in the situation and in a quiet way many purchases of good securities are being

NEW YORK

	Aug. 13	Aug. 20		Aug. 13	Aug. 20
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	[illegible]	[illegible]
Allis-Chalmers Co. pfd	[illegible]	[illegible]	Hudson River Tel.	[illegible]	[illegible]
Am. Dist. Tel.	[illegible]	—	Interborough Met. com.	[illegible]	[illegible]
American Locomotive	[illegible]	[illegible]	Interborough Met. pfd	[illegible]	[illegible]
Amer. Locomotive pfd	[illegible]	101	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable	—	[illegible]	Mackay Cos. pfd	[illegible]	[illegible]
American Tel. & Tel.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	[illegible]	[illegible]
Electric Boat	—	[illegible]	N. Y. & N. J. Tel.	[illegible]	—
Electric Boat pfd	—	[illegible]	Western Union Tel.	[illegible]	—
Electric Vehicle	—	—	Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd	—	—	Westinghouse pfd	[illegible]	[illegible]

BOSTON

	Aug. 13	Aug. 20		Aug. 13	Aug. 20
American Tel. & Tel.	[illegible]	—	Mass. Elec. R. pfd	[illegible]	[illegible]
Cumberland Telephone	[illegible]	—	Mexican Telephone	—	[illegible]
Edison Elec. Illum.	209	208	New England Telep.	—	108
General Electric	—	[illegible]	Western Tel. & Tel.	—	[illegible]
Mass. Elec. R.	[illegible]	[illegible]	West. Tel. & Tel. pfd	[illegible]	[illegible]

PHILADELPHIA

	Aug. 13	Aug. 20		Aug. 13	Aug. 20
American Railways	[illegible]	—	Phila. Elec.	[illegible]	[illegible]
Elec. Co. of America	[illegible]	[illegible]	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery	[illegible]	—	Phila. Traction	[illegible]	[illegible]
Elec. Stor. Battery pfd	[illegible]	—			

made at the present range of prices. Railway gross earnings still advance notably, and a gain of not less than 11.4 per cent was shown for July, the Pacific roads reaching a gain of not less than 19.4. Of course the net is relatively not so great because of higher wages and increased expenses, but it is clear that the roads are doing a business that taxes their capacity. Crops, moreover, have improved in prospect generally, and the treasury will relieve the monetary strain during the crop movement. The range of prices is indicated by our table of quotations.

MERGER IN NEW JERSEY.—The announcement has been made officially that a merger of the street railway companies controlled by the Public Service Corporation will be made in a corporation known as the Public Service Street Railway Company, with a capital of $38,000,000, consisting of 380,000 shares at a par value of $100 in cash. The securities of the various trolley companies now owned by the Public Service Corporation will be turned over to protect the new street railway company, which will be subordinate to the present Public Service Corporation. The parties to the plan are named in an agreement, dated July 30 last, as the North Jersey Street Railway Company, the Jersey City, Hoboken & Paterson Street Railway Company, formed by the merging of the Paterson Central Electric Company, Saddle River Traction Company, Palisade Railroad Company, White Line Traction Company, Paterson, Passaic & Rutherford Electric Railway Company, Jersey City, Hoboken & Rutherford Electric Railway Company, and Paterson Horse Railroad Company, and the United Street Railway Company of Central New Jersey, formed by merging the Elizabeth & Raritan River Street Railway Company and Elizabeth & Plainfield Central Jersey Railway Company. The officers of the consolidated company, who shall hold their respective offices for the first year or until others are chosen in their places, are: President, Thomas N. McCarter, Rumson, N. J.; vice-presidents, Charles A. Sterling, East Orange; Albert B. Carlton, Elizabeth; John J. Burleigh, Merchantville; secretary, Frederick Evans, New York; assistant secretary, Henry C. Stevenson, Newark; treasurer, James P. Dusenberry, Newark; assistant treasurer, Robert D. Miller, Jersey City.

THIRD MISSOURI DAM.—A special telegram from Helena, Mont., of Aug. 15, says: "The return of ex-Gov. S. T. Hauser from New York with the announcement that funds had been provided for the building of a third great dam across the Missouri River, and the further statement that part of the electric power thus developed would be utilized for the Helena-Butte electric line, means much for the mining industry of central Montana. Not only will cheap power be furnished for the immense district between the two cities, but also transportation to smelters for mineral output will be available at a nominal cost. This will apply to both East Helena and Butte, but as the one commercial smelter in the latter city is over taxed with Senator Clark's output, East Helena will be the chief beneficiary. So crowded are the Anaconda and Great Falls smelters that there is reason to believe the Amalgamated will build a third plant on the shores of Lake Hauser, created by the backwaters of the second dam. Amalgamated interests are largely behind the three dams and also the Butte electric road. Another reason for selecting the Lake Hauser site is found in that a perfect and perpetual dump would be found in the Missouri River, thus obviating all lawsuits for damaged property, as was the case at Anaconda and Boulder. That stream would furnish the power to haul the ores to the smelter and take care of all refuse matter and at far less cost than railroad transportation. Gov. Hauser said this matter was in abeyance and not ripe for definite statements as yet. That it will be ultimately built, however, admits of no doubt. The new electric line will tap Corbin, Boulder, Basin, the Eva May and many other well known districts."

MILWAUKEE FRANCHISES.—A special dispatch from Milwaukee of Aug. 17 says: "Suit to annul the franchises that were granted the Milwaukee Electric Railway & Light Company was begun yesterday by the state against the company, the city of Milwaukee, the North American Company, its officers and the members of the 1900 Common Council who voted for the franchise. Among the defendants are John I. Beggs and Charles F. Pfister, of this city; Silas W. Burt, W. N. Cromwell, George R. Sheldon, Charles W. Wetmore, all of New York, and directors of the street railway company; former Mayor D. S. Rose and members of the Council of 1900. The suit has been commenced on allegations of District Attorney McGovern, of this city. On the strength of it the attorney-general makes an affidavit that the franchises were obtained through corrupt practices; that the directors of the company expended sums of money in corrupting Mayor Rose and the Council, and the court is asked to suspend the officials of the street railway and the North American Company from office and compel them to return the sums to the treasury of the companies and then to annul the franchises. Similar actions have been started by the same persons back of the suit during the past few years, but they have invariably failed. In addition to beginning the suit an order has been issued by Court Commissioner Donnelly compelling the defendants to appear before him on Aug. 26 and answer all questions as to how the franchises were obtained. The books of the North American Company and the street railway company are also demanded."

U. S. INDEPENDENT TELEPHONE.—The reorganization committee of the United States Independent Telephone Company, of Rochester, and of the Independent Telephone Securities Company made announcement last week that they had completed their plan for a readjustment of the finances of both concerns. The mortgages securing the bonds of both companies will be foreclosed and a new corporation organized under New York laws to take over the securities purchased. The new company will be capitalized at $6,000,000, and will execute a mortgage to secure a bond issue of $5,000,000, which will have a sliding scale of interest, 4 per cent for the first year, 5 per cent for the second year, and 6 per cent thereafter. Of these bonds $3,250,000 will be issued, which will be secured by the pledge of all the securities owned by the United States Independent Telephone Company and now subject to its mortgage, except the stock of the New York Independent Telephone Company. In addition to these all the stocks and bonds of the Independent Telephone Company of Syracuse and the Home Telephone Company of Utica now held by the Independent Telephone Securities Company will go to further secure the mortgage. Each bondholder who desires to participate in this plan must subscribe to bonds of the new corporation to the extent of 20 per cent of his present bond holdings. The new bonds are convertible into stock at par, and the bondholders will have the right to select the majority of the directors of the new company for an indefinite period.

DIVIDENDS.—Directors of the London Metropolitan District Railway have declared a dividend of 1⅝ per cent for the last six months on its 4 per cent guaranteed stock. Up to 1899 the full 4 per cent was regularly paid, but since that time the yearly rate has ranged from 2⅜ per cent in 1901 to 15-16 per cent in 1905. The regular semi-annual dividend of $3 per share has been declared on the preferred stock of the Northern Texas Electric Company, of Fort Worth, Tex., payable Sept. 3, 1907. Directors of the Georgia Railway & Electric Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable Aug. 20. Directors of the Galveston Electric Company have declared the regular semi-annual dividend of $3 per share on the preferred stock, payable Sept. 3. Directors of the Kansas City Railway & Light Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable Sept. 2. Directors of the Terre Haute Traction & Light Company have declared the regular semi-annual dividend of $3 per share on the preferred stock, payable Sept. 1.

CONSOLIDATED GAS.—The Consolidated Gas Company, of New York, has sold to N. W. Harris & Co. $5,000,000 of one-year 6 per cent notes. The money is to be used for general corporate purposes, to complete the first unit of the gas plant at Astoria and for additional equipment for the electrical department of the business. It is understood that practically all the issue has been placed with investors at 99. On the Stock Exchange yesterday Consolidated Gas stock broke 3½ points, to 104, partly on account of the news of the loan. In 1904 the stockholders subscribed for $20,000,000 of 6 per cent debenture bonds to supply funds for the Astoria plant.

NORTHERN OHIO EARNINGS.—With the year ending July 31 the Northern Ohio Traction & Light Company earned 3 per cent on its capital stock. After deducting the bond interest and the interest on the floating debt, the surplus for stock was $241,000, which is a little over 3 per cent on $7,938,000 stock outstanding. It is believed that the company will earn 4 per cent on the capital stock during the calendar year.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has filed a blanket mortgage for $25,000,000 in favor of the Old Colony Trust Company, of Boston, Mass., the proceeds to be used for retiring the outstanding securities and the enlargement and extensions of its railway system, power plant, etc. The first work will be the building of a large power house north of the city on a site purchased last year.

CLANTON, ALA.—The Electric Light Company of this city is working on its plant, and it is its intention to have lights all over town in a very short time.

CLARESHOLM, ALA.—The electric lighting plant of the Claresholm Milling & Elevator Company was destroyed by fire. This plant supplied electricity for lighting and power purposes for the entire town. The plant will be rebuilt.

GOODWATER, ALA.—The new electric light plant was put into operation Aug. 9 for the first time. The plant is owned by the city and run by water power.

ONEONTA, ALA.—The Oneonta Telephone Company has sold its line from this city to Hunt, via Rosa, Cleveland and Blountsville, to the Blount County Consolidated Telephone Company.

SEWARD, ALASKA.—The Seward Light & Power Company is contemplating installing a 100-hp engine in its plant. A. P. Dickinson is secretary and manager.

BEEBE, ARK.—We are informed that there is some talk here of constructing water works and an electric light plant, but nothing definite has yet been done.

HOT SPRINGS, ARK.—The City Council has granted to Atwood Benton, representing the Consumers' Electric Company, a franchise for an electric light plant to be completed within a year. The cost of the plant is estimated at about $135,000.

HOT SPRINGS, ARK.—According to announcement just made, a new electric power plant, to cost over $135,000, is to be commenced within 60 days by Atwood Benton. Mr. Benton says that the rate for electricity will be from 12 to 7 cents per kw-hour. A franchise fixing the price as above has been granted by the City Council. The Webster Gas Engine Company, of Kansas City, is said to be behind the project.

CALISTOGA, CAL.—The Board of Trustees of the village has advertised the application for the sale of franchise made by Henry Brown. The period of the franchise is 50 years, and the purpose is to erect poles and wires for transmitting electricity and for constructing a general electric light system.

FRESNO, CAL.—The City Council has refused the application of the Mutual Electric Light Company for a franchise in Chinatown and on certain streets of the city.

LODI, CAL.—Owing to some trouble with the flumes of the American River Electric Company this city has been without electricity, save for two or three hours at night, for a number of weeks. These troubles have now been remedied and electricity is being supplied as usual.

OROVILLE, CAL.—Temporary restraining orders were issued Aug. 6 by Judge Van Fleet in the United States Circuit Court setting aside the ordinances passed by the Oroville trustees, which fixed the light and water rates in Oroville. The company in a suit filed Aug. 6 maintains that the rates fixed in the ordinances were too low, and charges that the trustees in passing the ordinances were influenced by the platform of the Independent Municipal League.

SACRAMENTO, CAL.—W. H. Devlin has made an amended application and ordinance for a 50-year franchise for a railway by the Sacramento Southern Railway Company. The Western Pacific Company also put in the amended petition for a 50-year franchise. The latter company proposes to grant an easement over its subway embankment to the Northern [illegible]

SAN FRANCISCO, CAL.—Work has already been begun on the electrification of the lines of the Southern Pacific Railroad in Alameda. A new power house is now being built at Fruitdale.

SAN FRANCISCO, CAL.—The City Electric Company has filed a [illegible] 30 year bond issue, [illegible] fornia.

[illegible] tion of a complete [illegible] East Kentucky Street. The plant will have sufficient boiler capacity for the packing house, refrigerating machines and electric power plant. Plans may be seen at the office of [illegible] trical engineer.

SAN FRANCISCO, CAL.—The Board of Supervisors has passed an ordinance calling for the burying of all electric light, telegraph, telephone and street railway wires within eighteen months, under a penalty of not less than $200 or more than $500 for each day any poles, wires, cables or apparatus remain overhead after that time.

SANTA CLARA, CAL.—The work of running a branch of the Interurban railroad from the Meridian to the Santa Clara depot will be commenced.

SAN JOSE, CAL.—The franchise to erect poles and wires for transmitting electricity, petitioned for by J. A. Belloli, is offered for sale. Bids will be opened Sept 16.

STOCKTON, CAL.—The Stanislaus Electric Power Company, which has spent many millions in the erection of vast power plants and reservoirs on the Stanislaus River, will supply this city with electricity by the first of next February. The company is now securing right of way for a pole line to San Francisco, crossing through the southern part of San Joaquin County. Steel towers 50 ft. high and set 1000 ft. apart will be used for the transmission line. The company's plant on the Stanislaus River, east of Vallecito, will supply 30,000 horse-power, and as soon as this is in operation a duplicate plant will be built.

WILLOWS, CAL.—The Snow Mountain Power Company has been granted a franchise by the Board of Supervisors to erect poles and string wires in this county. A party of surveyors of the company is now at work laying out the location of a pole line. This is the company which has tunneled Eel River for its water power, and will be in the field as a rival to the California Gas & Electric Corporation, which now has a monopoly of the light and power business in Petaluma, Santa Rosa, San Rafael, Napa and a dozen other cities.

LA JUNTA, COL.—The Arkansas Valley Traction Company has been organized with a capital stock of $100,000 to construct an electric railway here and to run an interurban line to Rocky Ford, and to give Rocky Ford a local street car service.

CANAAN, CONN.—The Berkshire Power Company has completed its transmission line to Millertown, N. Y., from the plant near Canaan for the purpose of lighting the town with electricity.

HARTFORD, CONN.—The United Telephone Company is contemplating making improvements to its system, which will involve an expenditure of about $10,000. The greater part of the work will be at Huntington and Bluffton. The company intends, it is said, installing three new systems in this county.

SOUTH MANCHESTER, CONN.—The Glastonbury Power Company is changing its system from 2-wire to 3-wire, by means of which it expects to give better service.

WILMINGTON, DEL.—The Street and Sewer Department is reported to be considering the question of building a system of conduits for city wires, the space to be sublet to companies using wires.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Aug. 27, to furnish at the navy yards and naval stations a quantity of supplies as follows: Naval Academy, Annapolis, Md., schedule 166—turbo-generator, etc. Washington, D. C., schedule 213—motors. Norfolk, Va., schedule 208—electrical instruments, battery cells, electrical supplies, etc.; schedule 215—electric spares; schedule 218—electrical wire and cable, volt-meters, etc. Charleston, S. C., schedule 165—rotary shear; schedule 215—motor drive. Applications for proposals should designate the number desired. E. B. Rogers, Paymaster General, U. S. N.

JACKSONVILLE, FLA.—The Town Council, at a recent meeting, passed to its final reading the ordinance granting an electric light franchise to Charles Isted and associates.

ATLANTA, GA.—The municipal electric lighting plant, now under construction at Edgewood, will be completed by Sept. 15.

ATLANTA, GA.—The bill introduced by Senator Farmer authorizing water power corporations to exercise the right of eminent domain over the [illegible]

AURORA, ILL.—The City Council is considering the question of making improvements to the electric light plant.

CHANDLERVILLE, ILL.—The city has granted a 10-year franchise to an electric light company headed by F. P. Schaafer.

CHURUBUSCO, IND.—A new alternator will be installed in the plant of the Churubusco Water & Light Company this fall. Miss J. Kingdon [illegible]

CLAY CITY, IND.—At a recent town meeting the Town Council was [illegible] electric light plant, to take the place of the plant destroyed by fire in May.

[illegible] Light & Power Company [illegible] taken over the Columbus Street Railway & Light Company without the exchange of a dollar. The owners of the local property will take stock, [illegible]

[illegible] The new company [illegible] improvements and extensions.

HUNTINGBURG, IND.—[illegible] Brothers Company [illegible] hp in its plant [illegible]

INDIANAPOLIS, IND.—The Board of Trustees of Woman's Prison will receive bids at the office of R. P. Daggett, 804 Lemeke Building, until Aug. 28 for the installation of a heating and lighting plant in the Woman's Prison. Faunce McKee is president of the board.

LEBANON, IND.—The Citizens' Electric Light & Ice Company is contemplating increasing the capacity of its plant, and will install a 175-kw. [illegible]

LOWELL, IND.—The Lowell Light & Power Company, recently organized by Clifford Wiley, of Chicago, Ill., and which purchased the local electric light plant, is making arrangements to build an entirely new plant, work on which will begin within a short time. The equipment of the plant will consist of two 150-hp boilers, with heaters and connections, a 125-hp engine and a 125-kw alternating-current generator.

MARTINSVILLE, IND.—The citizens are contemplating making improvements to the municipal electric light plant, which include the installation of a new dynamo, engine and new lamps. [illegible] manager.

RATHDRUM, IND.—The Rathdrum Electric Company is contemplating erecting new transmission lines and installing new transformers. H. R. Saunders is manager.

WELEETKA, I. T.—The Weleetka Light & Power Company is contemplating extensive additions and improvements to its water works system, and may install a 200-kw dynamo. D. F. Campbell is manager.

AVOCA, IOWA.—The Avoca Electric Light & Power Company is planning to increase its capacity by installing another 35-kw unit.

BURLINGTON, IA.—The Burlington Electric Light & Power Company is making arrangements to install a 60-hp gas engine and alternator in its plant.

CARROLL, IA.—The Carroll Electric Light, Heat & Power plant was sold to George H. Long, of Grand Rapids, Mich.

GRANT, IA.—The Grant & Elliott Telephone Company has purchased the Vetter line and will rebuild it.

GUTHRIE CENTRE, IA.—Plans are being made by the Guthrie Centre Electric Light Company to increase the capacity of its plant this fall. An engine, generator and two transformers will be installed.

NEW LONDON, IA.—The citizens are contemplating extending the municipal electric lighting system to Danville to supply the village with electricity for lighting purposes. Gilbert Johnson is manager.

SIOUX CITY, IOWA.—The contract for lighting the streets by electricity has been awarded to the Sioux City Gas & Electric Company. The contract is for 10 years and the price is $75 per arc lamp and $20 for 32-cp incandescent lamps per year.

ST. ANSGAR, IA.—The Wood Working Company is planning to change its electric plant from steam to water power. C. H. Miller is manager.

ANTHONY, KAN.—The Anthony Electric Light, Power & Fuel Company will soon install an ice plant. F. L. Bassett is manager.

CANEY, KAN.—The Caney Electric Light & Power Company is considering the question of installing a [illegible]-kw, 1100-volt generator. [illegible] Heckman, of Coffeyville, is manager.

GARNETT, KAN.—The Garnett Electric Light Company is contemplating establishing a fan circuit. G. B. State is manager.

GARNETT, KAN.—The Garnett Electric Light Plant was sold on the 15th of this month to satisfy the claims of creditors. The equipment was in fairly good shape, and with some needed improvements should make a profitable proposition.

IOLA, KAN.—Extensions and improvements are contemplated to the municipal electric light plant, which will include the installation of a 150-hp tubular boiler and a 100-kw, alternating-current, 2200-volt, 60-cycle generator. W. E. Rutledge is superintendent.

DANVILLE, KY.—The Danville Light, Power & Traction Company is considering the construction of an electric railway in this city and an interurban line, taking in Lancaster, Stamford, Hustonville, Junction City and Harrodsburg. Representatives of the Westinghouse Company have been in the city in the interest of the company to prepare estimates of the cost of building the proposed system.

LONDON, KY.—Plans are being made to install a new engine in the plant of the London Electric Light & Power Company. W. F. Raymer is manager.

[illegible] The [illegible] Water & Light Company is contemplating an extension of four miles to its street lighting service.

PADUCAH, KY.—Southern Electric Railroad Company capital increased from $50,000 to $1,000,000. The company proposes to build an interurban line through west Kentucky.

PARIS, KY.—The Paris Electric Light Company is contemplating increasing the capacity of its plant, and establishing a day service. The company will install an engine and boiler to provide for the day service. [illegible] Allen, manager.

PRINCETON, KY.—The Princeton Light & Power Company is contemplating installing 47 additional arc lamps. G. G. Flower is manager.

RICHMOND, KY.—The Richmond Electric & Power Company is planning to install a 150-hp boiler in its plant. A. J. Forbes is manager.

STURGIS, KY.—The West Kentucky Coal Company is contemplating adding new machinery to its electric power plant. W. A. Chandler is manager.

UNIONTOWN, KY.—The Uniontown Light & Power Company is contemplating the installation of an additional boiler in its plant. G. F. Cecil is manager.

LAKE CHARLES, LA.—The Lake Charles Ice, Light & Water Works Company is contemplating installing a 100-kw Westinghouse-Parsons turbo-generator set and a 300-hp boiler in its plant in September. T. J. Bird is manager.

BELFAST, ME.—The water wheel at the plant of the Belfast Gas & Electric Company on the east side has been permanently set, and the new 225-hp boiler installed and other improvements made.

ELLSWORTH, ME.—The new power house of the Bar Harbor & Union River Power Company has just been commenced. The coffer-dam on the east side of the river is nearing completion, and in a short time the buttresses will be under construction.

GLEN COVE, ME.—Work on the new power house extension is progressing rapidly. The addition, which is about 20 x 42 ft., is being built of concrete.

NORTH VASSALBORO, MAINE.—The town of North Vassalboro is now supplied with electric street lamps of 32 candle-power. The electricity is furnished by a small station built by Edward Chase at Shoddy Hollow.

PORTLAND, ME.—Bids will be received until Sept. 3 by the Board of County Commissioners for an engine, generator and electric wiring for the County Building.

SHAWMUT, ME.—Arrangements have been made for lighting the streets with electricity, the power to be furnished by the Waterville & Fairfield Railroad & Light Company.

SOUTH BERWICK, ME.—The Berwick & Salmon Falls Electric Light Company is contemplating about 20 miles of extension to its lines. F. E. Proctor, of Wakefield, Mass., is manager.

BLACKSTONE, MASS.—The town has won its fight against the Blackstone Electric Light Company for lower rates. The decision of the State Commission establishes the price to be paid on and after Sept. 1, for street lighting, as follows: For arc lamps burning all night and every night in the year the price shall not exceed $130 a lamp per year; incandescent lamps of 32-cp shall not exceed in price $30 per year; and when each of these lamps is burned until 1 o'clock the price shall not exceed $117 and $26 per year respectively. This makes a reduction of 4.4 cents per lamp per night for arc lamps and 1.8 cent for incandescent lamps.

EAST BRIDGEWATER, MASS.—The structural work at the new Edison plant will begin in about a week. The cement foundations have practically been finished and the steel work is being carted to the grounds.

EASTHAMPTON, MASS.—The Gas and Electric Light Commissioners have given notice of their decision to go over the franchise which the Selectmen of Easthampton had granted to the Easthampton Electric Company. The commissioners state in their report that there is not sufficient business for two [illegible] Company being already in the field.

HAVERHILL, MASS.—The G. W. J. Murphy Company has installed electrical apparatus for its machinery, which will hereafter be operated by electricity. The S. C. Pease & Sons Company has purchased machinery for wood working purposes, and will also operate its plant by electricity.

FALL RIVER, MASS.—The new station of the Fall River Electric Light Company is nearing completion, and it is hoped that it will be in operation by Sept. 1.

FALL RIVER, MASS.—The Southern Massachusetts Telephone Company has petitioned for permission to place its wires underground in this city.

FRANKLIN, MASS.—Owing to a defect in the boiler of the electric light station the town was without [illegible] two [illegible]

MILFORD, MASS.—The Milford Electric Light & Power Company has petitioned the Selectmen for permission to erect a transmission line through Elm Street from Main to South Main and to the Hopedale town line. The company proposes to light the highway from the Hopedale line to South Milford.

NEWBURYPORT, MASS.—The Newburyport Gas & Electric Light Company is installing a new engine at its power house on Beacon Avenue.

NORWOOD, MASS.—The city streets were lighted for the first time in 30 years by electricity. The town owns the poles, wires and, in fact, the whole distribution system, but the electricity is supplied by contract. F. S. Barton is superintendent.

ORANGE, MASS.—The electric lighting plant, after having been disabled for a number of days, is again in operation.

PROVINCETOWN, MASS.—The [illegible] Light, Heat & Power Company has [illegible] Board of Gas and Electric Light Commissioners

for permission to issue $25,000 in bonds, of which $14,000 is for the payment of the cost of extending its service to North Truro, Truro and South Truro.

CRYSTAL FALLS, MICH.—Robert Munns, city clerk, writes that the contract for building an addition to the power station has been awarded to the Falkenau Electrical Construction Company, of Chicago, Ill.

MUNISING, MICH.—Announcement is made of the sale of the holdings of the electric light and power company of this city from T. R. Belknap to M. A. Doty.

PONTIAC, MICH.—The Oakland County Telephone Company has been granted permission by the City Council to lay its wires in underground conduits on Saginaw Street and Oakland Avenue in this city.

TRAVERSE CITY, MICH.—At an election to be held soon the citizens will vote on the proposition of granting a franchise for a street railway in this city. The Carter Construction Company has applied for a 70-year franchise.

TRENTON, MICH.—The City Council is making arrangements to call a special election soon to vote on the proposition to sell the village electric light plant and purchase electricity from a private company, or to rebuild the municipal plant. Through a decision of the Supreme Court the village must move the lighting machinery out of the water works building.

DAWSON, MINN.—The village has bought the old local plant and will put in new machinery. The plant will require about 80-kw capacity, with a 90-hp engine and two boilers of 70 hp each. Mr. T. W. Miller has been the manager of the plant.

ST, PAUL, MINN.—It is reported that the Northwestern Telephone Company will erect two new branch stations, one on the West Side and the other on Payne Avenue.

HATTIESBURG, MISS.—The Union Electric Company, of Hattiesburg, has applied for a charter. The capital of the company is $5,000, and A. N. Sexton and C. J. Sutherland, of Hattiesburg, are reported interested.

BROOKFIELD, MO.—The electric plant of the Brookfield Electric Light & Power Company, which was recently destroyed by fire, is being rebuilt according to plans designed by Percy Markham. A new boiler and a three-phase generator will soon be installed, and other improvements are contemplatd. R. L. Wheeler is secretary.

SPRINGFIELD, MO.—A new telephone line will shortly connect this city and West Plains. Citizens of West Plains and Willow Springs are interested in the new enterprise.

STEVENSVILLE, MONT.—Geo. I. Walters, of Victor, is reported interested in the development of water power here and the installation of an electric light plant.

HELENA, MONT.—It is announced that the building of a third dam across the Missouri River near here will shortly be consummated. The dam will cost approximately $1,000,000, and with the two dams already built will develop upward of 50,000 horse-power. This will be utilized to a great extent in the mines, smelters, street car and lighting systems, etc., between Helena and Butte.

ELY, NEV.—The Nevada-California Power Company is planning the construction of a transmission line to Ely, which, it is claimed, will be the longest transmission line in the world and will carry the highest voltage—100,000 volts—from its power house at Bishop, Cal. The company has entered upon an era of construction work which will supply practically all the mining camps of Southern Nevada. It expects to spend $15,000,000 in the next ten years. The power company now owns one-third of the taxable land of Alpine County, Cal.

TEKAMAH, NEB.—The citizens have voted to issue bonds for the construction of an electric light plant.

UNIVERSITY PLACE, NEB.—R. E. Shelley, City Clerk, writes that the contract for constructing an electric light plant has been awarded to Bicker & Lowell, of University Place, for $3,890.

WOOD RIVER, NEB.—D. D. O. Kane, village clerk, writes that the contract will probably be let in about 30 days for the construction of water works and an electric light plant.

LACONIA, N. H.—The Laconia Electric Company has installed a new 750-kw generator, the output from which will be used for lighting circuits.

CAMDEN, N. J.—The Consolidated Lighting Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are William C. Haines, Theodore B. Fryer and Winfield Haldwell.

ELBERON, N. J.—S. J. Ludlow, Jr., and E. S. Hill were appointed receivers of the New Jersey Consolidated Water & Light Company, a corporation recently formed to take over the plant and assets of the Elberon Water & Light Company. It appears that the defendant company is virtually a reorganization of the old Elberon company and supplies a number of seaside places adjacent to Deal.

BROOKLYN, N. Y.—Bids will be received until Sept. 4 at the Bureau of Yards and Docks (R. C. Hollyday), Navy Department, Washington, D. C., for furnishing [illegible] motor generator sets and [illegible] for the Brooklyn Navy Yard as per specification No. 1560. The estimated cost is $[illegible].

DUNKIRK, N. Y.—The Buffalo & Lake Erie Traction Company is reported to be considering the construction of a branch line from North East to Findlay Lake.

HARMONY, N. Y.—The Panama Power Company, capital $4,000, has been incorporated by Walter Tanner and others.

LITTLE VALLEY, N. Y.—M. L. Ansell, village clerk, writes that bids will be received on Aug. 30 for improvements to the electric light plant. Probable cost of work, $10,000. G. S. Boller, of Little Valley, is engineer.

NEWARK, N. Y.—The Gas & Electric Development Company, of Philadelphia, Pa., has consummated a sale of the New Light, Heat & Power Company, of Newark, N. Y., to Messrs. Lothrop & Milldram, of Boston, Mass. The new owners expect to make extensions and increase the capacity of the plant.

NEW YORK, N. Y.—C. B. J. Snyder, superintendent school buildings, New York City, has awarded contracts to T. Fred Jackson, Inc., 592 Columbus Avenue, for installing electric equipment in School 66, Manhattan Borough, at $11,785, and School 19, Richmond Borough, $2,120, and to Griffin & Company, 150 Nassau Street, for School 91, Manhattan Borough, $15,394.

SODUS, N. Y.—Materials have arrived for the transmission line which the Sodus Gas & Electric Light Company will soon build to Williamson. The local plant in Williamson will be abandoned as soon as the line is completed.

ROCKY MOUNT, N. C.—Bids will be received until Sept. 1 by W. L. Thorp, Mayor, for $135,000 water, light and street improvement bonds.

TRYON, N. C.—We are informed that the plans for the proposed development of the Tryon Electric Light & Power Company have been changed. A larger plant is now under contemplation, and the probable outlay will be $110,000.

VALLEY CITY, N. D.—Additional machinery, to cost $12,000, has been ordered for the electric light plant.

BERBERTON, OHIO.—The City Council has decided to advertise for bids for lighting the streets. The Northern Ohio Traction & Light Company now has the contract, which will expire soon. Some of the Councilmen are in favor of establishing a municipal plant, but no action has been taken to that end as yet.

BUCYRUS, OHIO.—It is reported that preliminary plans are being prepared for a municipal electric light plant.

COLUMBUS, OHIO.—A. S. Metcalf has filed his report with the Uniform Bureau of Accounting on the electric light plant at Ashtabula. Allowing 7½ per cent depreciation, the net earnings were $2,322.44. The present value of the plant is $71,109.03.

MARION, OHIO.—The Columbus Northern Railway, Power & Equipment Company has amended its charter, giving it authority to operate an electric railway system in connection with its power plant. The company was organized to build and operate the power plant, which serves the Columbus, Delaware & Marion Railway Company, of Columbus.

NELSONVILLE, OHIO.—According to the report of Examiner Leslie Smith, of the State Bureau of Public Accounting, the cost of lighting street lamps here under the municipal plan is $88.14 each. It is shown that the expenditures for the plant some months were much larger than the receipts.

OKLAHOMA CITY, OKLA.—The City Council granted the Oklahoma City Street Railway Company the right to build its $180,000 power house at Bell Isle, which is outside the city limits.

WALTER, OKLA.—The Walter Electric Light & Power Company has been granted a franchise to construct an electric light plant at an estimated cost of $25,000.

BEND, ORE.—The city contemplates purchasing the present electric light plant, and also contemplates installing a gravity water system. H. C. Ellis is the City Recorder.

EUGENE, ORE.—Geo. N. Miller, of Eugene, writes that it is proposed to construct a power plant at Swisshome, to cost between $50,000 and $100,000.

LEBANON, ORE.—N. R. Lang has appropriated 400,000 cubic inches of water from the south fork of the Santiam River. Canals and flumes will be built above Waterloo. The canals will be 10 feet deep and 40 feet wide.

PORTLAND, ORE.—Plans have been practically completed for the erection of a $1,000,000 power plant on the head waters of the Sandy River, a few miles east of this city, to furnish electric power for the United Railways, which is building an interurban line between Portland and Salem.

PORTLAND, ORE.—The Portland General Electric Company, the subsidiary lighting corporation of the Portland Railway, Light & Power Company, has filed plans with the city engineer for a plant costing $200,000 to furnish steam heat to the business section of the city. Many of the largest business houses and office buildings have contracted for heat, and it is expected that the system will be in operation before cold weather sets in.

ALTOONA, PA.—The Citizens' Electric Light, Heat & Power Company is making arrangements to place its wires underground in the central part of the city. The company has recently placed an order for two 800-hp Keeler boilers, which will be installed in about 30 days

WOONSOCKET, R. I.—A sub-station is being built by the Rhode Island Company in Limerock to furnish electricity for operating the Providence & Burrillville Railway, which is at present supplied by the [illegible] Company. The contract cal[illegible]

[illegible] will be equipped with two 500-kw rotary converters.

GARY, S. D.—The Council is reported to be considering the utilization [illegible]

RAPID CITY, S. D.—Within another year the Black Hills will have a third power plant. The latest company to enter this field is the Dakota [illegible]

BRISTOL, TENN.—The syndicate that proposes to expend $600,000 in developing the water power of Holston River at Fish Dam for electrical purposes has obtained a 30-year franchise for lighting in Bristol, Va., and will secure a similar franchise in Bristol, Tenn. About 7000 [illegible]

CHATTANOOGA, TENN.—The Chattanooga Electric Company has been given the contract to put in an electric light plant at the county jail.

KNOXVILLE, TENN.—It is authoritatively stated that W. J. Oliver, of Knoxville, will receive the contract to construct the dam and power house on Little Tennessee River for the Knoxville Power Company. The estimated cost is about $2,500,000.

PARK CITY, TENN.—The City Council has passed on second reading an ordinance granting the Knoxville Railway & Light Company, of Knoxville, a franchise to light the streets of the city.

EL PASO, TEX.—The City Council has accepted the recommendation of the Mayor to revoke the franchise of the Southwestern Telegraph & Telephone Company, and the city clerk has been directed to notify the officers of the company at Dallas and the local officers of such action. The officers of the company will have 30 days to answer the allegations.

SEGUIN, TEX.—The Trustees of the electric light and water works system have decided to equip the power plant of both the electric light and water works with steam power. It was voted to issue $5,000 for a boiler and engine to be installed in the electric light plant. K. von Boeckman is manager.

TEMPLE, TEX.—Judge Calhoun, of the District Court of Calhoun County, has appointed E. A. Glass, of San Antonio, as receiver for the Bell Telephone Company, which operates independent telephone exchanges at Temple and Belton.

DAVENPORT, WASH.—The Washington Water Power Company, under the name of the Big Bend Light & Power Company, will invade the Big Bend country and will furnish power and light to the different cities and town of this section. Power will be ready for delivery by Jan. 1, 1908. W. C. Sivyer will be at the head. Surveyors are out laying out the pole line. Capital stock of the company is $300,000.

WASHBURN, WASH.—The Common Council on Aug. 7 passed an ordinance bonding the city for $15,000 to purchase the outside electrical equipment of the Washburn Electric Light & Power Company. The city expects to lease from the lighting company its power plant until such time as the city can construct its own power plant on the Sioux River near here.

WHEELING, W. VA.—It is reported that the owners of the Red Bord Mine near Tiltonsville will soon erect a power plant of its own. The company now secures its power from the Wheeling Traction Company.

ASHLAND, WIS.—The only bid received for the construction of the municipal electric light plant was submitted by W. E. Ule, of Stevens Point, for about $130,000. It is stated that new bids will be called for.

MILWAUKEE, WIS.—R. W. Hunt & Company, engineers, have presented an estimate on the cost of the first work proposed on the municipal electric plant under the specifications they have prepared. The estimated cost of the gas producer plant is $100,000 and of the engines $400,000.

VANCOUVER, B. C.—Hon. A. B. Aylesworth has advised the Department of Marine that there is nothing in the terms of the agreement with the Marconi Company to prevent the Government from erecting wireless stations and equipping them with other instruments. Consequently the Government has proceeded to establish and operate wireless stations on the Pacific Coast.

TORREON, MEX.—The Torreon & Laredo Electric Light Company closed the contract for the purchase of $200,000 worth of new electrical equipment to be installed both in this city and Gomez Palacio.

New Industrial Companies.

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., has filed a certificate increasing its capital stock from $250,000 to $350,000.

THE BAKER MOTOR VEHICLE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000. The directors are F. R. White, G. H. Kelly, Cleveland, Ohio, and Nathaniel Platt, of New York, N. Y.

THE BATTERY LIGHT & POWER COMPANY, of Milwaukee, Wis., has been incorporated with a capital stock of $5,000,000. Among the incorporators are Fred D. Underwood, F. G. Rice, A. W. Trenholm and E. H. Johnson. J. W. Wegner, of Milwaukee, is president of the company, and Frank G. Curtis is secretary.

THE SPLITDORF LABORATORY, of New York, N. Y., has been incorporated with a capital stock of $500,000. The directors are: Henry [illegible] New York, N. Y. The company will deal in electrical specialties.

Obituary.

MR. EDWIN ROGERS, of Boston, Mass., died at his summer home at York Beach, Me., on Aug. 16. Mr. Rogers is said to have invented the electric push button. He was 65 years old at the time of his death and is survived by a widow and daughter.

MR. L. L. DAVIS.—The death of Mr. L. L. Davis, of Springfield, Mass., occurred on Aug. 13 at Laconia, N. H. He had been ill for two years with a complication of diseases. Mr. Davis, who was about 60 years old, had of late made his home regularly at Laconia, where he had been accustomed to stay a good deal of the time. He was the proprietor of the Davis Level and Tool Company and the Davis Electric Manufacturing Company. He leaves one daughter.

MR. DAVID E. EVANS.—Advices from Baltimore, Md., of Aug. 15, state that Mr. David E. Evans, president of the Maryland Telephone Company, died there on that day of peritonitis. He was prominent as a consulting electrical engineer and as a builder of railways. He was born in Wales fifty-seven years ago. While a young man there he won the praise of Queen Victoria for his heroic rescue of a party of miners cut off below ground by a rush of water. He became connected at a very early date with the old Brush Electric system of Baltimore, under Mr. Frank J. Morrison, and helped in the upbuilding of the modern central station industry.

Personal.

MR. E. M. HERR, vice-president of the Westinghouse Electric & Manufacturing Company, has sailed for Europe.

MR. C. A. COFFIN, president of the General Electric Company, sailed for Europe last week and is not expected to return before the fall.

MR. EDWARD D. ADAMS returned recently from a trip to Europe much benefited by the change, this vacation being the first in some three years.

MR. J. D. GABOURY has resigned as manager of the Gadsden, Alabama City & Attalla Street Railway, of Gadsden, Ala., and also as manager of the lighting and ice plants of the same company.

MR. BION J. ARNOLD has been visiting New York City and, it is rumored, may assist the Public Service Commission in its proposed appraisal of traction properties in Greater New York. He saw members of the Commission while here.

MR. GEO. S. HALEY, who has been superintendent for several years of the Rutland City Electric Company, has been appointed general manager of the Rutland Railway, Light & Power Company, vice David Fox, resigned.

MR. GEORGE A. BROTHERS, of Hookset, N. H., has been appointed manager of the municipal electric light plant at Hudson, Mass., to succeed Mr. J. C. Norcross, who resigned. Mr. Brothers has been connected with the Manchester Traction, Light & Power Company for ten years.

MR. HENRY M. HUXLEY has resigned from the manager's staff of the Worcester District of the American Steel & Wire Company to become assistant general manager of the Duplex Metals Company, manufacturers of the Monnot copper-clad wire and sheets. Mr. Huxley will be located at the New York office, 208 Fifth Avenue.

MR. L. S. MONTGOMERY, who has until recently been at the head of the sign department of the Mobile Electric Company, of Mobile, Ala., and who is well known through his contributions to the National Electric Light Association proceedings, has left the central station business to travel for the Western Electric Company in Alabama.

MR. R. C. SMITH.—Effective Sept. 1, Mr. Richard C. Smith, formerly of the American Steel & Wire Company and the National Wire Corporation, has been appointed sales agent of the Safety Insulated Wire & Cable Company, to take the place of Mr. Avery P. Eckert, resigned. Mr. Smith has appointed as his assistant, Mr. R. C. Wilson.

MR. DAVID FOX, who has been general manager of the Rutland Railway Light & Power Company, of Rutland, Vt., which company controls the Chittenden Power Company, the People's Gas Company and the Rutland City Electric Company has tendered his resignation and will leave Rutland early in September for Mexico, whither business interests have called him.

MR. C. H. MERZ.—U. S. Consul-General John P. Bray, of Melbourne, writes that the government of the State of Victoria, Australia, has engaged the services of Mr. Charles H. Merz, one of the leading English consulting electrical engineers, to report on the suggested electrification of the suburban railways of the city of Melbourne. Mr. Bray states that Mr. Merz will arrive in Melbourne in November.

MR. GEORGE ALFRED DAMON, managing engineer of the Arnold Company, of Chicago, is the subject of an extended biographical sketch by Prof. Mortimer E. Cooley in a recent issue of the *Michigan Technic*, published semi-annually by the University of Michigan Engineering Society. Mr. Damon is justly one of the electrical engineering graduates [illegible]

MR. KEMMANN, city engineer of Berlin and engineer of the Elevated & Underground Railway of that city, and Mr. Paul Wittig, general manager of that company, are on a visit to this country. Their purpose is to investigate the development of subways and underground electric railways here, particularly the latest methods of construction, as their company has some important extensions under contemplation. They are planning to visit New York, Brooklyn, Boston, Philadelphia, Buffalo and Chicago.

MR. F. B. MALTBY, who has been connected with the Panama Canal work as principal assistant engineer to Mr. J. F. Stevens, has resigned to go with Dodge & Day, engineers and constructors, of Philadelphia, in the capacity of chief engineer. He is a graduate of the University of Illinois, class of 1882, and in 1907 received an honorary degree from the same institution. He has had a long experience in railroad construction work, municipal engineering and irrigation work, and been connected at various times with the Wisconsin Central, Missouri Pacific, Great Western and Illinois Central railroads. He had charge for the United States Government of all the dredging operations in the lower Mississippi River, and designed and built the lock and movable dam on the Osage River in Missouri for the Government. He has been connected with the Panama Canal for the last 2½ years, having had charge of the construction work of railroads, docks and wharves, shops and dredging. He constructed a cold storage plant, laundry and bakery in Panama. Mr. Maltby has designed over $1,250,000 worth of dredging plant for the canal work, and the preliminary plans and construction work for the Great Gatum lock and dam were done under his direction.

MR. GEORGE WESTINGHOUSE sailed for Europe last week. The New York *Times* quotes him as follows: "Mr. George Westinghouse, before sailing for Europe last week, spoke optimistically of the business outlook. He said the July business of the companies of which he is the master spirit was the largest on record. The cheerful tone of his talk, coming at a time when nearly every industrial executive is voicing some apprehension of the future, is characteristic of the inventor. He is always an optimist. Last spring, when his company was about to offer new securities to its stockholders at a time when all other industrial concerns were having a hard time to get new capital even by paying a high premium, Mr. Westinghouse scorned to apply to banking interests for underwriting. He was certain that the stockholders of his concern, who have been rewarded with an enormous aggregate of dividends, would not fail to take the utmost advantage of the opportunity to get more stock, regardless of temporary market conditions. The securities were not all taken, but it it safe to say that a larger proportion of stockholders subscribed than would have come in under similar conditions in a less 'personally conducted' enterprise. Mr. Westinghouse carries the same keen enthusiasm into all the affairs of his business. Stockholders of the Westinghouse Electric & Manufacturing Company received last month, in addition to an annual report, a supplementary circular which expressed the president's superabundant feelings on the peculiar fitness of his fellow-administrators of the company."

Business Notes.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, has removed its San Francisco sales offices from the temporary location at 11 Hawthorne Street, San Francisco, to the Crocker Building, that city, where they will be permanently located.

STONE & WEBSTER.—The Stone & Webster Engineering Corporation, constructing engineer, announces that on Aug. 19 it will begin occupation of its own building, 147 Milk Street, Boston, corner of [illegible] Street.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. 13, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

862,871. PROCESS OF REDUCING METALLIC SULFIDS; E. L. Anderson, St. Louis, Mo. App. filed Feb. 23, [illegible]. In the reduction of sulfid ores, the process of subjecting the ore to the action of an electric current flowing from an insoluble anode to the ore serving as a cathode, in an electrolyte capable of dissolving the metal constituents of the ore when freed of its sulphur, then reversing the current whereby the salt solution thus formed is decomposed and the metal [illegible] deposited on the [illegible] cathode substantially as set forth.

862,891. TROLLEY POLE SUPPORT; H. W. Fellows, et al., Hollywood, Cal. App. filed April 13, [illegible]. Has a link support for the trolley pole. One of the link members is very heavy so as to move slowly, and in case of rapid [illegible] of the pole its slow movement causes its disengagement.

862,916. ELECTRICITY MOTOR METER; G. Hookham, Birmingham, Eng. App. filed Nov. 6, 1906. Foucault brake meter having a single powerful magnet with a pair of poles, one on each side of the armature disk and provided with means for reducing fluid friction and for preventing the passage of current through the metal of the poles.

862,934. TROLLEY CATCHER AND RETRIEVER; J. L. Perkins, Springfield, Mass. App. filed Feb. [illegible]. A [illegible] of the type having a spring reel which is normally restrained against winding movement by a latch or detent.

862,935. APPARATUS FOR WINDING INDUCTION COILS; C. A. Pfanstiehl, Highland Park, Ill. App. filed Dec. 27, 1906. Has a [illegible] individual unit windings, the wire being drawn through a parrafine bath.

862,938. METHOD OF MAKING COMPLETE FUSE STRIPS OF SAFETY FUSES; F. D. Reynolds, Hartford, Conn. App. filed June 16, 1906. The method of making safety fuses which consists in clamping the terminal wires to be joined to the fuse wire, wrapping the ends of the fuse wire, and then soldering the wrapped ends.

862,9[illegible]. BRUSH HOLDER; [illegible] App. filed Dec. 5, 1904. A commutator brush having a rock arm grooved to guide the brush in a longitudinal movement toward and from the [illegible] mit such movement.

[illegible] SAFETY DEVICE FOR THE IGNITION OF [illegible] MATCHES; [illegible] mines or pits. Covers detail features of construction.

[illegible] PROCESS OF [illegible] [illegible]

[illegible] ELECTRICAL MEASURING [illegible] ner, Birmingham, Eng. App. filed Oct. 19, 1905. Relates to instru- [illegible]

[illegible] METHOD OF CHARGING ELECTRIC [illegible] FOR PRODUCING CARBID [illegible] AND CARBON; [illegible] Peterson, Alby, Sweden. App. filed Oct. 3[illegible], 1906. The process of producing carbid which comprises introducing carbid forming base and carbon in separate contacting columns into an electric furnace, passing an electric current through the column of carbon to heat the same to reacting temperature at the surface of contact between the two columns.

863,109. INDICATOR FOR ELECTRICAL MEASURING INSTRUMENTS; F. G. Simpson, et al., Seattle, Wash. App. filed April 29, 1904. Relates to indicators which may be installed with or attached to instruments for measuring direct pulsating or alternating currents, and aims to prevent tapping of the circuits by maliciously disposed persons, and also the detection of grounds and defective insulation.

863,148. RAILWAY SIGNAL; W. W. Brown, Schenectady, N. Y. App. filed Feb. 14, 1906. Mechanical features of construction of an arrangement whereby a single operating means may be employed to move a home and distant semaphore signal successively.

863,152. HOIST; J. H. Clark, Schenectady, N. Y. App. filed March 10, 1904. Has an electrical hoisting motor and current supplying means of smaller capacity than said motor, whereby said motor may be installed without injury to the system.

863,163. PROTECTIVE DEVICE FOR SERIES TRANSFORMERS; C. E. Eveleth, Schenectady, N. Y. App. filed Nov. 12, 1904. Has means for automatically short-circuiting some of the turns of a transformer winding when the e. m. f. exceeds a certain amount.

863,165. CIRCUIT CONTROL APPARATUS; R. Fleming, Lynn, Mass. App. filed Dec. 5, 1905. Has a pair of flexibly supported normally stationary contact members, a floating contact between said normally stationary contacts, and electro-magnetic means for moving said normally stationary members toward each other whenever the floating contact engages either of them.

863,175. INDUCTION COIL; J. O. Heinze, Jr., Lowell, Mass. App. filed March 18, 1907. Pancake construction of induction coil having the partitions between the pancakes slotted to receive connecting wires.

863,177. AUTOMATIC TRIPPING SAFETY DEVICE FOR ELECTRIC MOTORS; A. Herath, Schenectady, N. Y. App. filed Aug. 7, 1905. Provides a device for swinging by supporting the motor upon the driving axle, whereby the motor may be thrown out of gear when the motor is disconnected for any reason.

863,185. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; T. I. Jeffries, Pittsfield, Mass. App. filed Nov. 22, 1904. Has a single coil so arranged that it controls two movable members, one opened with a time limit device and the other without. Thus a single coil takes the place of the two coils which have sometimes been employed before.

863,188. MOTOR CONTROL; C. B. Larzelere, Schenectady, N. Y. [illegible] a pair of series motors from series to parallel which consists in connecting halves of [illegible] field of each motor, and employing these half fields to connect the motors directly to the current source without opening the circuit. Is especially adapted for electric automobiles in which two motors are used for [illegible]

863,201. MEANS FOR PROTECTING DYNAMO ELECTRIC MACHINES; C. T. Mosman, Schenectady, N. Y. App. filed Feb. 6, [illegible]

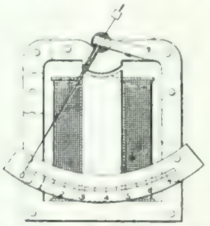
[illegible] FIELD COIL TERMINAL CONNECTION; [illegible], Milwaukee, Wis. App. filed Oct. 18, 1905. Has means for guiding the [illegible]

[illegible]

[illegible] TELEPHONE REPEATER CIRCUIT; H. E. [illegible] [illegible] telephone apparatus, a reinforcing circuit, and a balancing circuit, the said main, reinforcing and balancing circuits being all in inductive [illegible]

[illegible] MECHANISM FOR CONTROLLING POWER OPERATED APPARATUS CONNECTED WITH RAILWAY SWITCHES AND SIGNALS; J. D. Taylor, Wilkinsburg, Pa. App. filed Oct. 26, 1905. [illegible] nected with railway switches or signals. Covers means for automatically moving a lever to final position after electrical locks have been actuated to release the levers.

[illegible] INDICATION APPARATUS FOR SWITCH AND LOCK MOVEMENTS; Louis H. Thullen, Edgewood Park, Pa. App. filed March [illegible] 1906. Relates to indication apparatus used in interlocking [illegible]



[illegible] Electrical Measuring Instrument.

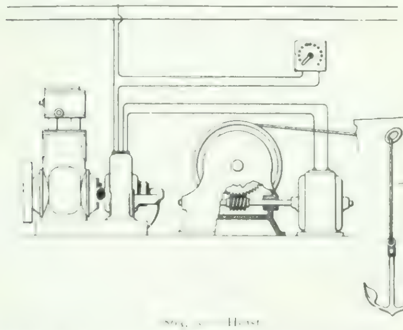
[illegible] the operation of the indicator is only effected by an alternating current of predetermined frequency.

863,247. METHOD OF AND APPARATUS FOR TRANSMITTING ELECTRICAL ENERGY; W. C. Yeatman, Chicago, Ill. App. filed Feb. 7, 1903. The method of transmitting electrical energy [illegible] consists in impressing an alternating high frequency potential upon a conductor consisting of a central core of high conductivity directly surrounded by a thin and longitudinally continuous sheath of magnetic material, substantially as described.

863,252. ELECTRIC SIGNALING DEVICE; John A. Baker, Galveston, Tex. App. filed Nov. 30, 1906. Electric signaling apparatus by which the lowering of a shelf containing a writing pad effects the transmission of the signal used by watchmen, etc.

[illegible] TELEPHONE RECEIVER; W. R. Barklead, [illegible], Wash. App. filed Nov. 17, 1906. Bipolar telephone receiver having a diaphragm form one pole.

863,263. RAILWAY SIGNAL MECHANISM; John P. Coleman, Edgewood, Pa. App. filed March [illegible]. Semaphore signal apparatus [illegible]



[illegible] Hoist.

making use of liquid carbonic acid gas and having electrically controlled valves by which the gas is admitted to the operating cylinders.

[illegible] TREATMENT OF ALBUMINOUS SUBSTANCES; R. [illegible], Lyon, France. App. filed Nov. [illegible] 1906. Process for the treatment of albuminous substances consisting in diluting same with a solution of chlorid of sodium and submitting the product to an electro[illegible]

[illegible] ELECTRIC RESISTANCE DEVICE; H. W. [illegible], [illegible]ville, N. Y. App. filed March 21, 1905. The combination of a relative conductor, and an infusible composition embedding the conductor, said composition containing fluorin and containing only insoluble materials as essential ingredients when applied to the conductor.

863,296. ELECTROMAGNET; David L. Lindquist, Yonkers, N. Y. App. filed May 9, 1905. An alternating current magnet in which the [illegible] prevented from moving into contact with the pole by a [illegible]

[illegible] MEANS FOR SECURING AN ELECTRIC LAMP RECEPTACLE TO A SUPPORT; Robert P. Schriver, Philadelphia, Pa. App. filed April 19, 1907. The porcelain of the receptacle is flanged [illegible]

[illegible] ELECTROMAGNETIC SOUNDING APPARATUS; W[illegible] F. Seidel and Ernesto Sassenhoff, Elkhart, Ind. App. filed Sept. 1, 1906. Patentee has a horn or whistle through which air is impelled by a [illegible] electromagnet.

[illegible] ELECTROMAGNETIC APPARATUS FOR RAILWAY PURPOSES; Louis H. Thullen, Edgewood Park, Pa. App. filed Mar. [illegible] magnets and co-acting armatures constructed to be operable at small or medium potential and adapted to control the circuits through which [illegible]

[illegible]3,334. ELECTRIC INSTALLATION PIPE CAP; Wheeler H. Vibber, New London, Conn. App. filed [illegible] two half cones adapted to be clamped upon the upper end of a pipe, and [illegible]

[illegible] SLOW SPEED CIRCUIT CONTROLLER; [illegible] lace, New York, N. Y. App. filed Dec. 13, 1906. Circuit controller of the type in which the circuit cannot be closed after once being opened until the movement of a mechanism through a predetermined [illegible] plete rotation to move the switch lever.

[illegible]3,338. TELEPHONE TRUNK CIRCUIT; C. S. Winston, Chicago, Ill. [illegible] a telephone line terminating at its central office in a three-point jack, of a telephone line having a central source of current for the actuation of incoming signals terminating at its central office in a two-point jack, means to connect said lines for conversation, and means to supervise said connections, substantially as described.

[illegible]3,339. ELECTRIC SELF-WINDING CLOCK; Aloys Wirsching, Brooklyn, N. Y. App. filed Nov. [illegible] and means for rotating the same in one direction and means for transmitting the motion to time mechanism.

[illegible] DYNAMO CONSTRUCTION; [illegible] [illegible] dynamos driven by [illegible] to produce uniform voltage under varying speed conditions.

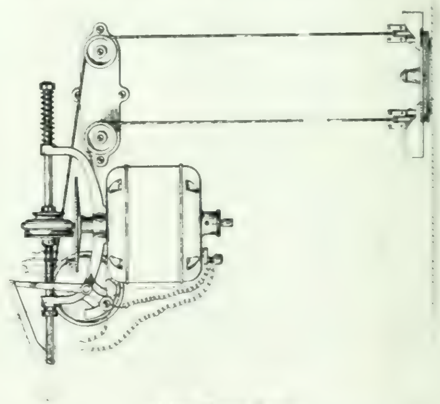
[illegible]3,418. RAILWAY SIGNAL; Nicola M[illegible] and [illegible], New York, N. Y. App. filed March [illegible]. Railway signal apparatus by which trainmen are notified in case [illegible] has been made by a train [illegible] track. Has special trolleys or conductors adjacent the track rails which are engaged by brushes depending from the locomotive.

[illegible]3,419. CIGAR LIGHTER; Thomas B. Murray, Newport News, Va. App. filed April 24, 1906. A vertical standard carries a wick and supports a tilting lever having a brush which moves adjacent the wick and which also carries a cover to normally prevent evaporation.

[illegible]3,454. ELECTRIC HEATING ELEMENT; George J. Schneider, Detroit, Mich. App. filed July 9, 1906. Resistance element stamped of sheet metal to produce a zigzag path for the current flow and having openings for clamping rods, the openings of adjacent plates being out of alignment to prevent short circuiting.

[illegible]3,455. ELECTRIC SAD IRON; George J. Schneider, Detroit, Mich. App. filed July 9, 1906. Electric heater comprising a body having an open recess, a heating element insertable in the recess, and resilient means for electrically coupling said element automatically upon its insertion.

[illegible]3,478. DENTAL ENGINE; Wallace W. Williamson, Syracuse, N. Y. [illegible]



[illegible] Dental Engine.

[illegible]

[illegible],509. ELECTRIC RAILWAY SIGNALING SYSTEM; Charles M. [illegible] [illegible] and means for completing [illegible] to the trains for automatically operating the train controller.

[illegible] RAIL BOND; [illegible] ends of which are re[illegible]

[illegible] SIGNAL MECHANISM; [illegible]

[illegible] ELECTRIC ARC LAMP; [illegible]

[illegible] TRAIN CONTROLLING APPARATUS; [illegible]

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN

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NEW YORK, SATURDAY, AUGUST 31, 1907.

CONTENTS.

THE OHIO AND MICHIGAN CONVENTIONS.

Both the Ohio and Michigan state electric light conventions were held last week. It was the thirteenth convention for the Ohio Electric Light Association and the fourth for the Michigan Electric Association. Ohio is much better favored as to number of central-station companies in the state than is Michigan, and consequently in point of numbers is much the larger association. The Michigan convention, however, did equally as good work in a less ostentatious way. The Michigan association takes in men connected with municipal electric lighting plants, in this respect being unlike most other state associations; but this apparently has little influence on the attendance and membership, as those engaged in operating any of the 100 municipal plants in the state must usually go down into their own pockets to meet convention expenses, with the result that they seldom attend. In the case of many municipal plants also, there is no one connected with the undertaking, owing to their small size, who could take an intelligent part in a convention of this kind. In Ohio the record of only 51 companies outside of the association, from a total of 180 in the state, is a remarkable one, and speaks well for the energy, tact and persistence of the officers as well as for the substantial benefits derived from membership. The Ohio convention program this year marked a radical departure from those of several years past, the change being along lines which we advocated at the close of last year's Ohio convention—namely, a reduction in the number of papers, in order to permit discussion, and having these papers mainly written by central station men. This made the discussion the most prominent feature this year, as it should be in any convention. This, together with a convenient and accessible meeting place like Toledo, and active work by the officers, brought about an attendance which was a source of congratulation all around.

HOW ABOUT WIRELESS?

The strike of telegraphers now in progress, with the sending of messages seriously interfered with and the need, real or supposed, of guarding thousands of miles of lines against interference, shows that an inquiry as to the exact status of wireless telegraphy would now be particularly pertinent. There are divers companies with manifold installations, and at least a dozen kinds of alleged syntonic devices, and yet save for customary reports of incoming steamers, there is wonderfully little doing of which the public hears. Every little while the press reports tell of the marvellous apparatus of Prof. Dr. Von Pumpernickel by which the messages can be made to do figure-skating all over the empyrean, always dodging into the right window at the end of their stunt, yet somehow the steady work-a-day side of the matter still remains in the background. Some attempts at serious commercial transmission of messages over rather moderate distances have signally failed, and on the whole the last two or three years have been

singularly unproductive except in prospectuses. Of these there have been many copies per wireless message sent unless we are sadly misinformed. Along the seaboard there has been some reasonably successful work, and occasional striking feats bear evidence that behind all the dubious experiments and more dubious financiering lies something that the world really needs.

There is a great possibility lurking in the future, which has been hidden behind a sad lot of noisy humbug. It is high time that the serious workers in the field sunk their differences, scrapped their pet theories and came down to solid business. We know of no really great advance which has had so hard a lot. Of course, there are many inventors with systems to protect and theories to defend, both here and abroad, but the solemn truth is that they are industriously cutting each others' throats instead of advancing the art. It is a case where the greatest good can be attained only by working in harmony. Some steps have already been taken toward a consolidation of some of the various interests which should be productive of great good if carried far enough. There are many outstanding questions to be settled and an enormous amount of work to be done before the art gets fairly upon a commercial basis. Fighting will not bring the day of success an hour nearer. We are disposed to read the riot act to the whole contingent. Here we have one of the biggest things of the new century, a record of some wonderful achievements in long-distance transmission of messages, an almost unlimited field for marine usefulness and an unknown faculty for general work, which has failed of its mission thus far for petty and none too creditable reasons. Some day wireless telegraphy will come into its own. Just now perhaps the best work is being done under the auspices of various Governments for their own purposes. The Navy Department in this country has succeeded admirably within a particular sphere of operations, and is steadily extending the scope of its experiments. It really seems as if the private enterprise had fallen to the rear and governmental activity had pushed to the front. We hope for better things and wait patiently, but the period of exploitation seems indefinitely prolonged, and the procrastination grows tiresome.

Depreciation of Illuminants.

These are the days when those who are about to invest in electric illuminants will, if they are wise, figure carefully on the probable depreciation of the illuminant that is to be installed, bearing in mind the new illuminants that are about to come into the field. At the present time there is the practical certainty that there will soon be important advances in both the incandescent and the arc lamps on the market, but that does not help out the person or the central station that must make an installation at once without waiting for the newcomers to "arrive." With such it is a question of putting in that illuminant which will involve the least expenditure for initial investment plus operating cost for the next two or three years, when more efficient lamps will be generally available. Where lamps are turned on many hours per day the cost of energy to the consumer is so large per year that it is usually best to install the most efficient illuminant that can be found, because the saving will be so great that the installation can be thrown on the scrap pile in two years and still leave the user ahead of the game. Where the lamps are to be used only a short time each day, the cost of changing the installation in two or three years becomes a much larger proportion of the total cost, and it may figure out that it is best to put in an uneconomical system now which will involve low cost of future change rather than to save on operating expenses at present. Each case presents its own problems. This question has been coming up with great frequency lately and we know of some important contracts that have hinged upon it.

Municipal Bonds.

It deserves note that New York City has been unable to sell its bonds at the old rates of interest, and is now compelled to offer 4½ per cent, the highest rate, it is said, ever paid by the city. There is encouragement over the financial situation in the statement that a Morgan syndicate will take $40,000,000 at that figure, probably to place them abroad; but the real significance lies in the price and in the fact that the city had exhausted its credit on any lower basis of return to the investor. It will be something to be spared the spectacle of a great city hawking its bonds among its creditors and humble contractors, at a discount virtually, in place of cash, but the recent episodes have a bright side in the necessary implication that higher rates of interest must act automatically as a check on municipal ownership investment. New York does not stand alone in this impaired financial condition, and as our cities must now pay more for their loans they will be less inclined to plunge headlong into costly and foolish experiments of which the Williamsburg Bridge garbage destructor lighting plant is only a typical example.

Climbing the Alps.

The important announcement is made elsewhere in our pages this week that it is seriously proposed to equip electrically the Sacramento Division of the Southern Pacific Railroad, and that Mr. Frank J. Sprague has been retained as consulting engineer by the Southern and Union Pacific systems, to investigate and report on the project. The attitude of Messrs. Harriman, Kruttschmitt and Babcock is favorable, which means a great deal, but the real obstacles and difficulties are physical and lie in the fact that the task is that of handling electrically the business of a trunk line over an Alpine range of mountains. In this respect the new work differentiates itself sharply from that which has been done, for example, on the New York Central, with its four tracks and absence of grades; and a wholly new set of conditions has to be encountered and overcome. Mr. Sprague has never yet failed in anything he has attempted, his methods of attack are always brilliant, and intense interest will follow him into this latest field of study and effort.

That such a gigantic task should be attempted, with the belief of the owners of the property and its engineers that electricity is adequate, is indeed a most striking sign of the times and of the manner in which, slowly—very slowly, perhaps, but none the less surely—the main lines of railroad in this country are becoming and will be electrified. It is a coincidence of a very impressive nature that we are able, also, to print this week a brief statement of the plans of the authorities of Chicago for the electrification of all the trunk roads entering that city, thus following the worthy example of New York and hastening similar decision in all the other great urban centers of population.

THE INVERTED MANTLE.

The appearance of the Welsbach burner in the inverted form is one of the most interesting recent improvements in the materials of illumination. From Mr. T. J. Litle's Illuminating Engineering Society convention paper we should judge that the earlier difficulties with this form of burner had been in the main overcome, although the thermostatic arrangement still looks a bit shaky to those familiar with such devices. However this may be, the inverted mantle is apparently with us to stay and one can hardly doubt that it will be an important factor in competition between electricity and gas. Viewing the subject broadly, this competition improves business all along the line, and in the long run it is a good thing however annoying it may at times be. The inverted burner is not quite so efficient in total light emitted as the usual form, although it delivers much more useful light. It extends the field of competition by the readiness with which it can be applied in cases to which the ordinary Welsbach is ill fitted. If it can aid in forcing those who deal in electric light into paying a little more attention to domestic lighting and other classes of small consumers, it will in the end prove a capital thing for the electrical business, and will certainly stimulate the improvement of electric lamps and their applications. The inverted burner is extremely well adapted for domestic use on account of its convenient form.

It has, however, the same difficulty that inheres in the whole class of mantle burners, that is, a peculiarly offensive color when the mantle is beyond the first freshness of youth. Of course, it has not the graveyard suggestions of the mercury arc, but it is, to put it mildly, trying to a delicate complexion. From time to time within the last few years we have heard of "our new type Z mantle, that gives a pure white light." We have hunted high and low for that mantle, but it can be located only in the eternal about-to-be. All the mantles which are to be purchased at the mantle-monger's degenerate after a brief period either into the familiar bluish-green or into a singularly evil-looking yellowish-green. There were produced for a few years since some pinkish glass shades which gave rather good results on the Welsbach mantles, but of late either the process of making them has proved too troublesome or the "Type Z" will-o'-the-wisp has proved too alluring, and they have disappeared.

Until the Welsbach contingent succeeds either by improvement in mantles or by other means in correcting the color of the light, the electric lighting interests have small reason to tremble. For one-half of humanity is feminine and that half will not put up with any of the present brands of mantle save under stress of necessity. In this particular the inverted burner merely changes the place and keeps the pain. The time is rapidly coming, however, when the use of mantles on gas systems will become the general rule and when the small mantle burners now common abroad will be brought into use here. A 20-cp burner on a very small gas consumption would put an entirely new phase on existing conditions. It certainly behooves lamp manufacturers to look ahead a bit and busy themselves with the metallic filament lamps, especially for moderate powers. One cannot adhere to the present policy of keeping up the consumption of energy and raising the candle-power, against the competition of cheap gas and burners which do not give twice the light that is necessary.

MAGNETIC STEEL ALLOYS FOR TRANSFORMERS.

Much attention has been devoted in recent years to the improvement of sheet steel for transformers, whereby the losses in hysteresis and eddy currents might be reduced. The outcome of this study has been a marked improvement in the magnetic quality of the steel ordinarily employed, not only in regard to core losses of transformers, when first assembled, but also in regard to the absence of age effect, or increasing loss with time. It seems unlikely that the end of such improvement has yet been reached, seeing how little is yet known about the nature of magnetism in iron, and still less about the influence of other substances on the magnetism of iron alloys. As an evidence of future possibilities in the further reduction of transformer core losses, we have the special alloy-steel that has been produced in Germany, reference to which has already appeared more than once in the Digest. The alloy referred to is a silicon-steel alloy, said to contain about 3 per cent of silicon with very small amounts of carbon, sulphur and phosphorus. This alloy has, according to tests published by R. Pohl, a low hysteretic coefficient, a high resistivity, and a high permeability for flux-densities not exceeding 10 kilogausses. Above that flux-density the permeability falls off rapidly, as compared with ordinary transformer steel. The hysteretic coefficient appears to be about 1.2×10^{-3}, or 40 per cent less than that of ordinarily good transformer steel, while the reluctivity from the tests above quoted is 60 microersteds per unit magnetizing force. The weak point of the alloy is its cost, which is quoted as 150 per cent in excess of that of ordinary transformer steel. It is claimed that even at this extra expense it will pay to use this silicon-steel alloy in the construction of transformers, because of the higher flux-density which may be employed, and the corresponding reduction in the size and weight of the core. The advantage is the greater, the lower the flux-density ordinarily employed. For very large transformers, with cores worked at a relatively high flux-density, there would be no commercial advantage in the use of such an alloy at the above price; but for smaller transformers, employing a relatively low flux-density, an argument may be made for the alloy. According to the tests published in the *Elektrotechnische Zeitschrift* for June 13, the core-loss per pound, at 60 cycles per second, would be about the same at 9 kilogausses with the alloy, as at 6 kilogausses with ordinary steel.

Whatever the economic facts may be, in detail, as to the use of this particular alloy, the general deduction may be drawn that there remains a good field for commercial research in the metallurgy of steel for transformers, either as to finding alloys of better electromagnetic properties, or as to reducing the cost of their production, or as to both. As regards sheet steel for the construction of armature cores, there is not so good a prospect. Any great advantage gained in the production of transformer sheet steel would probably benefit armature sheet steel also, but since it is customary to work armature cores at a much higher flux-density than transformer cores, a good permeability at these high densities is very important. So far as has yet been determined, pure iron has the highest permeability at densities approaching saturation; or to put the matter in another way, the introduction of foreign substances into alloys with iron has thus far been found to reduce the permeability near saturation; although it may not have a bad effect at low flux-densities.

Electric Traction on the Pacific Coast.

[illegible] seaboard have barely been solved, or dealt with, before the scene shifts to the far Pacific slope, where questions of equal magnitude loom up and press for settlement. The methods and apparatus for the trunk systems ending in New York are still in the early stages of newness, and one might almost say, uncertainty, when the growing volume of traffic on a road at the other side of the continent compels a serious consideration of the advantages that electricity may offer as a means of doing that which must be done, but which steam appears unable to perform. The Southern Pacific Company, through Vice-President Kruttschnitt, Director of Maintenance and Operation of the Harriman Lines, has, the ELECTRICAL WORLD learns, requested Mr. Frank J. Sprague to associate himself with Mr. A. H. Babcock, the electrical engineer of the company, in a study of all the data bearing upon the question of the feasibility of electrifying a part of the Sacramento Division of the Southern Pacific system, *i. e.*, the section from Rocklin to Sparks; to prepare a general plan of electric traction, and to submit this to a board which is to deal with the subject broadly. Mr. Sprague has also been invited to serve on this board, and it seems that in the event of the adoption of electricity he is to remain with the company as its consulting engineer, without hindrance, however, to any other professional work in which he may be engaged. When interviewed last week as to the truth of the above, Mr. Sprague confirmed it, adding that he was about to assume his duties and was already in consultation with Mr. Babcock.

It will be admitted that this is news of extraordinary importance, and that electric traction in one of its most distinguished representatives has now presented to it a problem which in various respects is more difficult than any of those preceding. The Sacramento Division of the Southern Pacific, running over the Sierra Nevada Mountains, is really a vital link in interocean travel. The enormous growth in trans-continental traffic over the Union Pacific and Southern Pacific, east and west, is far from being realized, although the immense earnings of the system serve as an indication. The road passes over the Sierras at an elevation of 7000 ft., at Summit, on the section between Rocklin on the west slope and Sparks on the eastward one, and all eastbound freight has to be lifted nearly 7000 ft. in a stretch of 83 miles of road. The line is single track, and very tortuous, with frequent grades of 1½ per cent. and a maximum of nearly 2½ per cent. The distance from Rocklin to Sparks across the range is 136 miles, and it is on this section that the enormous grades occur. But these are not the only adverse physical conditions. There are over 31 miles of snowshed and rock tunnel to encounter; and all the ordinary difficulties of summer are aggravated in winter by overwhelming falls of snow.

The present service of traffic, both passenger and freight, is maintained by means of very powerful oil-burning locomotives of the best type extant, with which good results are obtained; but, although the road is kept up to a high degree of efficiency, it is only with difficulty that the traffic is maintained, and at times there is absolute blockade. Moreover, at some periods the traffic is so great that it has already reached the limits of the present capacity of the system. The problem that has been before the management for years is how to increase the capacity—to double track, to build an additional line, or to try a change of motive power. Rebuilding or new building of lines would involve tremendous outlay and delay, and meantime the traffic is growing swiftly, and must be taken care of ad interim. Mr. Harriman, in a memorable interview in the New York *Times* some months ago, expressed openly his conviction that the problem of increased capacity on trunk lines in general would be solved ultimately and satisfactorily by the adoption of electricity.

For some three years past, Mr. Babcock has been devoting his attention to these problems, while the engineers of the great [illegible] study of the subject. In the selection and appointment of Mr. Sprague, who, as a member of the New York Central Electric Traction Commission for four years, has been largely responsible for that road's terminal equipment; the matter has now taken definite shape, involving a new investigation of the conditions, and a new study of the problem in all its bearings. Mr. Sprague, when seen, said he was not prepared in any way to make a statement on the subject, other than confirm the news of his appointment, which he had accepted. He believed it altogether feasible and possible to operate the division electrically, but as to methods applicable to the unique conditions involved—operating heavy trunk service over Alps—he approached the subject with an open mind, and the best solution of the problem would naturally depend upon the existing or probable development of the art when details were taken up. The first and vital questions were the broad ones whether existing and probable traffic would warrant the cost of an electric equipment, and whether the adoption of electric operation would solve the problem of increase of capacity more satisfactorily than some other method.

Convention of the Ohio Electric Light Association.

The thirteenth annual convention of the Ohio Electric Light Association, held at Toledo, Ohio, Aug. 21 and 22, was the most successful one of this association for many years. The registration went over the 300-mark, and the secretary announced at the close of the convention that only 51 out of 180 central station companies in the state were outside of the association. Eighteen active members were elected at this meeting. The headquarters and sessions were in the new Boody Hotel.

The secretary's and treasurer's report showed total receipts for the year to be $1,107.56 and expenditures $906.01, leaving a balance of $201.55. The souvenir programme issued this year brought in a gross revenue of $1,600 from advertising; of this about $450 was profit, which was used for the entertainment fund instead of asking contributions from manufacturers and central station companies as in previous years. It was voted, at the suggestion of associate members, to increase the dues of associate members—that is, manufacturers and supply companies from $5 to $10 per year. The secretary's salary was increased from $200 to $350 per year.

The members were taken by electric cars to Toledo Beach Tuesday afternoon, where supper was served by the association. For Wednesday evening the association chartered the steamer *Greyhound* for a trip on Lake Erie. Many ladies were in attendance, as has been usual at Ohio conventions for several years past, and the list of handsome and expensive prizes offered by electrical manufacturers for the winners in ladies' card parties, guessing contests, bowling, etc., was longer than ever, there being 27 such prizes this year. At the close of the convention, Mr. J. C. Martin, chairman of the resolutions committee, presented resolutions, which were unanimously passed, expressing appreciation of the courtesy of the Toledo Railways & Light Company, F. Bissell Company, W. G. Nagel Company, the Toledo Chandelier & Manufacturing Company, Western Gas Fixture Company, and the advertisers in the souvenir programme for their part in making this convention successful.

On Wednesday morning there was an exchange of greetings with the Michigan Electric Association, then in session at Battle Creek, Mich.

The officers elected for the coming year are as follows: President, Mr. Frank M. Tait, of the Dayton Lighting Company; vice-president, Mr. E. H. Beil, superintendent, Youngstown Consolidated Electric Light & Gas Company; secretary, Mr. D. L. Gaskill, president, Greenville Electric Light & Power Company. Executive committee: Messrs. W. P. Engle, Defiance; D. W. Low, Alliance; W. [illegible] Wauseon; J. C. Rothery, East Liverpool.

Following is the constitution of the principal committees: Advisory committee: Messrs. Samuel Scovil, Cleveland: C. R. McKay, Toledo, and D. L. Gaskill, Greenville. Publicity committee: Messrs. W. J. Hanley, of Cleveland: Samuel Rust, Greenville, and J. Kermode, of Cleveland. Finance committee: Messrs. W. E. Miller, Mt. Gilead: T. D. Buckwell, of Toledo, and G. N. Clapp, of Littletown.

Frank M. Tait, president-elect, was born in Catasauqua, Pa., attending the local schools there until 1889 when he graduated from the High School with honors. After a short period of work in the wiring business, he obtained the position of night engineer of the electric light plant in the puddle and bar iron mills of Catasauqua, which was held for over a year, after which employment he became secretary to the president of the Davies & Thomas Company, of Catasauqua, a large producer of cast-iron tunnel rings, underground yoke castings for street railway work, heavy cast-iron structural work, etc. In 1894, the Catasauqua Electric Light & Power Company's plant was

PRES. F. M. TAIT.

placed in his charge as manager to rehabilitate and bring up to a paying basis, and after a number of years of hard work this was accomplished. In the meantime, the Catasauqua Gas Company was purchased and merged with the electric company into the Catasauqua Gas & Electric Company, which he directed until early in 1899, when he associated himself with the Somerville (N. J.) Gas & Electric properties, and rebuilt and rearranged the steam, water power and gas plants into a merged concern known as the Somerset Lighting Company, which supplied all of the gas and electricity used in Raritan, Somerville, Finderne, N. J., and all the gas in Bound Brook, N. J. This company is now a part of the Public Service Corporation of New Jersey.

In 1902, Mr. Tait became identified with the New London, Conn., properties, and the gas and electric plants, as well as a first-class general machine shop, were developed into a company well known in New England as the New London Gas & Electric Company. Jan. 15, 1905, he became interested in the Dayton Electric Light Company, and since that time has been engaged as manager in waging a vigorous campaign for upbuilding and thoroughly modernizing the company, now known as the Dayton Lighting Company. For rapidity of development in a city occupied for years by a lighting company, the work at Dayton has no parallel. Mr. Tait, besides managing the Dayton Lighting Company, is frequently called on to examine and report on gas and electrical properties, particularly those requiring the pointing out of correct methods of producing quickly the profitable results desired by the financial interests that control them.

The meeting was opened on Tuesday morning by the address of President W. P. Engel, of Defiance, Ohio. In referring to the importance of the association, he pointed out that Ohio has about 180 central stations, representing an investment of $70,000,000. While in the early days the problems coming up in the central station were purely mechanical and electrical, the industry has moved forward so rapidly along these lines that it has nearly reached the ideal. While continuing to give due regard to engineering problems, to-day every management places stress on the commercial development, and rightly so, as it is the source of revenue and in the highest sense affects the relations of the new central station with the general public. After paying a compliment to Mr. J. Robert Crouse and the Co-operative Electrical Development Association, President Engel directed attention to the work of the National Electric Light Association as to uniform specifications for street lighting, and suggested that steps be taken by the Ohio Association to inform its members as to the methods most satisfactory to the public and to the central station with respect to specifications for street lighting and plans for charging for electricity. Public opinion should, he said, be carefully studied and the central station management should all be ready to meet it courteously. Central station men are able personally, and with the aid of subordinates, to make public opinion favorable or unfavorable, what is sown will be reaped.

Following the address of President W. P. Engle, papers on "Factory Lighting" were read by Mr. A. P. Biggs, of the Edison Illuminating Company, of Detroit, and by Mr. J. Kermode, of the Cleveland Electric Illuminating Company, abstracts of which appear below. Tuesday afternoon, Mr. H. P. Grabill, of Ashland, Ohio, presented his paper on "Luminous Arcs From the Standpoint of the Central Station," which is abstracted elsewhere.

The "Report of the Committee on Electric Heating Devices," by Mr. M. E. Turner, of Cleveland, was presented, but the author was prevented by illness from being at the convention. Mr. F. M. Tait presented the subject of "Co-operative Commercialism in the Electrical Field," acting on behalf of Mr. J. Robert Crouse, of the Co-operative Electric Development Association. The final paper of the session was that of Prof. F. C. Caldwell, of Ohio State University, which is reprinted elsewhere, on the "Best Form of Power for Stations of 500 Kilowatts Capacity or Less."

On Wednesday afternoon the committee report on "High Efficiency Lighting Units," by Mr. C. C. Collins, superintendent of the Columbus Railway & Light Company, and Mr. A. N. Cope, superintendent of the Columbus Public Service Company, were submitted. An abstract will be found below. Under the head of "Helps to a Solicitor," two papers were taken up, one by Mr. A. S. Miller, of the Dayton Lighting Company, on "What 50 Cents' Worth of Electricity Will Do": the other by Mr. J. D. Kenyon, vice-president of the Sheldon School, Chicago, on "Scientific Salesmanship." Abstracts of these follow.

The final session was held Thursday morning and was given mainly to the subject of "The Best Ways to Meet Gas and Gasoline Competition." Papers on this subject, abstracted below, were presented by F. H. Golding, of the Dayton Lighting Company: Samuel Rust, of the Greenville Electric Light & Power Company: W. E. Russell, of the Massilon Light, Heat & Power Company: Arthur Pomeroy, of the Cleveland Illuminating Company: E. T. Selig, of the Mt. Vernon Electric Light Company, and W. C. Anderson, of the Canton Light, Heat & Power Company, the latter being read by the secretary in the absence of the author.

In his paper on factory lighting, Mr. A. T. Biggs stated that an electric lighting company cannot afford to take on all factory lighting offered to it. It is compelled, however, to take a certain amount that is inherently unprofitable. The unprofitable lighting should be minimized (1) by advising the customer how to reduce his demand by utilizing light to best advantage: that is to say, by good illuminating engineering: (2) by advocating the transfer to daylight hours any motor load that may be dispensed with during the evening hours, and (3) by passing over to the gas company such factory space light-

[illegible] for electricity the long-hour localized lighting.

The paper by Mr. J. T. Kermode brought out the fact that industrial plants can be lighted by electricity in a satisfactory manner and at an expense that would compare favorably with any other source of illumination, provided the equipments consist of high-efficiency units installed according to modern practice. Mr. Kermode stated that electricity supply companies should devote more time to the practical demonstration of the benefits to be derived from the use of high-efficiency units, with the idea of introducing a more intelligent mode of factory lighting as a valuable factor in securing and retaining motor business.

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Messrs. C. C. Collins and A. N. Cook presented a paper with the above title, giving the results of a canvass of central stations as to their experience with high-efficiency illuminants. A form containing 22 questions was sent out to 65 central stations, and the authors confess that the response was unsatisfactory, both as to number of replies and information communicated. Of the 19 companies heard from, five had experience with the flaming-arc lamp, but only to a limited extent, the total capacity in use being only 38 kilowatts. The magnetite arc lamp is used by two companies, to whom it is giving satisfaction. The Cooper Hewitt lamp is used by five companies, in photograph galleries, printing offices and machine shops. Twelve companies are using the Gem lamp, the total kilowatt capacity connected by 11 companies being 834, nearly 90 per cent of which is in lamps of 100 watts or more. Two companies are using the tantalum lamp and one company has adopted the tungsten lamp in order to meet competition. Eleven of the companies are using the Nernst lamp, 1334 kilowatts being connected, the average number of glowers per lamp being three. The replies to one question indicated a life for the magnetite lamp of 500 to 600 hours, and for the Nernst lamp 600 to 700 hours. Answers to another question show that the units are generally put on the lines at cost and free renewals given. Nernst lamps are, in some cases, loaned, but this is found to run up a very large investment. The cost of renewals per kw-hour was returned as one-half cent for the Gem and Nernst lamp; the authors state that this is not high as compared with the carbon filament lamp. Every company replying stated that an increase in revenue has followed the introduction of high-efficiency units.

HELPS TO A SOLICITOR.

In his paper on "Helps to a Solicitor," Mr. A. S. Miller showed that with 50 cents' worth of electricity an ordinary stable can be lighted with three 16-cp lamps for one month; it will do the washing eight times for an ordinary house; it will pay for the energy consumed in two weeks' ironing; it will operate a drying fan for one month; it will serve for operating a sewing machine for two weeks; it will operate a porch lamp for two months; it will pay for the energy consumed in a hot-water bottle three hours per night for 30 nights. In operating a hoist, 50 cents' worth of electricity will raise 2,000,000 bricks for the ordinary house. Information of the above character is of great value to a solicitor.

The paper by Mr. J. D. Kenyon showed that that solicitor is best equipped for his business who has received the training of a scientific salesman. Such a salesman must not trust to natural conditions or to the natural development which will come from ordinary contact with the world, but he must be a trained man in order to meet successfully the strenuous competition of modern times. The scientific salesman should have an accurate knowledge of types, temperaments, motives and habits of people, in addition to a detailed knowledge of his business.

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Six papers were presented on the common subject of the best way to meet gas and gasoline competition. Mr. Samuel Rust suggested the following ways: Good service; prompt attention to complaints; maintaining friendly relations with the non-user of electricity; making of frequent calls and talks on methods of electric lighting; furnishing the best appliances for the customer's use, and reducing the cost of his lighting as much as is possible, consistent with good service. Mr. W. C. Anderson suggested the following ways: Making the rates for the long-hour user in proportion to the cost of long-hour service; developing decorative lighting to the fullest extent to which this can be developed; giving the customer the greatest possible amount of useful light for the smallest possible cost for electricity and maintenance. Mr. Arthur Pomeroy showed that an electric motor can be substituted for a gas engine with considerable economy, while the comparative noiseless operation of a motor and its perfect cleanliness are greatly in its favor. Mr. W. E. Russell called attention to the great credit due to the electric flat-iron for its effectiveness in giving a favorable impression of electric service. He emphasized the fire hazard of gas in any form. Mr. F. H. Golding showed that the most serious obstacle met with in gas competition is the expense of installing the electrical equipment. Plans for making the installation at the minimum cost and for allowing the customer to pay for the equipment in monthly instalments were outlined. Mr. E. T. Selig related the experience of the electric lighting company at Mt. Vernon, Ohio, where natural gas is sold at 13.5 cents per 1000 cu. ft. Such competition has been met by a system of free renewals of lamps, and improved service. By newspaper advertising users were shown that except in rare cases where a lamp might be broken, the customer's only cost for lighting was his electricity bill, while in some instances the cost of gas, together with the mantle and chimney renewals, amounted to more than the cost of the electric lighting. Many people who are attracted first by the cheap gas, soon become dissatisfied with it as a source of light and turn to electric lighting, although continuing to use gas for heating purposes.

Michigan Electric Association Convention.

The Michigan Electric Association held its fourth annual convention at Battle Creek, Mich., on Aug. 20, 21 and 22. The headquarters were at the Post Tavern, and the convention sessions were held at the very comfortable rooms of the Battle Creek Business Men's Association in the Post Building, across the street from the hotel. About 25 central station and municipal plant representatives were in attendance, besides about an equal number of supply men.

The sessions were presided over by Mr. William Chandler, of Sault Ste. Marie, president. He called the first session to order about 11 a. m., Aug. 20, and introduced Mayor C. C. Green, of Battle Creek, to welcome the convention. President Chandler, in his presidential address, called attention to the bad effect on the central station business of having interior wiring done by irresponsible parties. He thought the convention might well give consideration to the question of whether the proposed legislation requiring electric wiremen to be licensed might not be a good thing, and also whether the encouragement of more municipal inspection and regulation was desirable.

The report of Mr. E. F. Phillips, of Detroit, chairman of the committee on fire insurance, was heard. It contained some astonishing figures on the overcharges by insurance companies on electric light station risks. Among the companies from which figures had been obtained, about $59,000 had been paid in premiums the past five years, with about $4,000 losses. There was considerable discrepancy and inconsistency in the rates charged different companies reporting to the committee. Mr. Phillips suggested mutual insurance as one way out of the difficulty. This insurance question was discussed at length at the following afternoon session. It was brought out in the discussion that in many instances considerable reduction in insurance was possible by small changes. Insurance companies, however, take no pains to let customers know about such possible changes, and their effect on the rates. In fact, it was against the immediate financial interest of agents to reduce risks and

lower rates, as it meant decrease in their commissions, which are a percentage of premiums. The insurance committee was continued for another year.

Mr. F. E. Greenman, of Grand Rapids, read a short paper on "A Year's Operation at the Highest Working Voltage in the World, by the Grand Rapids-Muskegon Power Company." The 72,000-volt line of this company was briefly described, together with operating experiences. A part of this paper and the interesting discussion following it will appear in a later issue.

President Chandler opened the Wednesday morning session with a talk on "Experience With Tungsten Lamps at Sault Ste. Marie." After talking over with Mr. Alex. Dow, of Detroit, the question of the form of tungsten lamp which was most desirable for central station companies for the immediate future, they decided that something which would compete with gas arcs was the most desirable. A fixture was devised which would take four 28-volt, 25-watt tungsten lamps in series, on a 112-volt circuit. The first fixture had the lamps placed upright, but they had decided later that it would be better to use the lamp in a pendant position. Five stores are now lighted with series lamps. None of these series lamps had been broken in shipment. In one store, the series lamps had been burned singly in different locations. This plan involved a little more trouble and more expensive special wiring. Among these series lamps there had been no burn-outs due to defective filaments, but some to defective anchors. He did not think that the tungsten lamp would reduce central-station incomes, as he said customers would use more light than before and spend the same amount of money.

Mr. George C. Osborne, of the General Electric Company, addressed the convention on tungsten and tantalum lamps. The tungsten lamps now available, he said, are the street series lamps of 40 and 60 candle-power, designed to burn on 5.5, 6.6 and 7.5-ampere circuits, and also some for 4-ampere circuits to go in series with magnetite arc lamps. There is also on the market at the present time a 25-watt, 28-volt lamp, intended to burn four in series on ordinary incandescent circuits, as described by Mr. Chandler. These series lamps have a left-hand thread on the base, designed to screw into a special left-handed thread socket, so that they can not be accidentally screwed into common 110-volt sockets and the lamp destroyed. As to the series tungsten lamps, a trial 75-light circuit had been in commercial service 1800 hours and 30 per cent of the lamps were still burning, giving the same candle-power as in the beginning, but with some increase in wattage. Of those which had been replaced, 25 per cent had been broken by boys throwing stones. With the 110-volt tungsten lamps, the great trouble had been breakage in shipment. There had, however, been much improvement in this respect.

Taking up the tantalum lamp, he said that the policy of some central stations in giving them to the user at an extra cost of 30 to 50 cents per lamp discouraged the user from making use of them, as very few would pay the extra price. A new proposition was advanced for the handling of tantalum lamps, namely, that these lamps be rented to long-hour users at 5 cents per lamp per month instead of charging 30 cents or more per lamp. This would take care of the higher renewal cost of the tantalum lamp. Another plan suggested was to make a higher rate per kw-hour to users having complete tantalum installations, the central station company to furnish the renewals.

In the discussion which followed, inquiry was made as to whether some recent claims that the tantalum lamp had a satisfactory life on alternating current were valid. Mr. Osborne replied that the 44-watt tantalum lamp was of uncertain length of life on alternating current. Some lamps would make a very good showing and others would not. The 80-watt tantalum lamp, however, had given a life of over 500 hours on alternating current abroad, and it was reasonable to expect that eventually it would do as well here.

Mr. Chandler said that at Sault Ste. Marie the four-light series fixtures mentioned by him had been either sold to the customer or rented at 50 cents per month, the 50 cents per month being the same charge as was made by the gas company for the rental of "gas arc" lamps.

Mr. E. A. Harris, of the Westinghouse Electric & Manufacturing Company, read a paper on "Prepayment Meters" in general and the construction of the Westinghouse prepayment meter in particular. Mr. Harris stated that the prepayment meter appealed to the class of people used to handling small quantities of money and to spending a little at a time, as they go along. For the central station this meter had the advantage of reducing the cost of collecting bills and keeping accounts. These meters could be adjusted for different rates per kw-hour, so that when installed on the premises of a long-hour consumer, he could be given the benefit of one rate. They could also be used for electric cooking circuits, where the customer wanted to know his costs. For store window lighting it could be used as a time switch. Their cost is now only about 15 per cent higher than a common meter of the same capacity.

In the discussion which followed it was pointed out that the two-rate system could not be used with such meters. Mr. A. C. Marshall, of Port Huron, nevertheless thought that there was a good field for them in spite of this drawback. He found many customers actually wanted a prepayment meter, so that they would know how their costs were running, even though they lost the benefit of the differential rate.

Mr. E. F. Phillips, of Detroit, said that this loss of the discount of the two-rate system was no objection to the prepayment meter, even in cities where the two-rate or differential rate was in use. At the present low price there was a good field for them. Such meters had been too costly in the past to make them feasible. Mr. B. J. Denman, of Detroit, thought that the cost of keeping a customer's account would not be reduced, as there would be a customer's account and a collector would have to be sent after the coins, whereas ordinary customers come to the office to pay. Mr. John A. Cavanaugh, of Benton Harbor, said that they kept no accounts with prepayment-meter customers; it was simply a question of going and getting the money. President Chandler pointed out that some customers in small towns do not come to the office, and it is almost impossible to enforce the cash discount plan in small towns. Mr. Marshall suggested that where tenants changed frequently, prepayment meters could be left on the premises and save the cost of connection and disconnection. Very often the incoming tenant would use electric light if the prepayment meter was already installed ready for business, where otherwise he would not.

Wednesday afternoon, Mr. J. B. Foote, of Jackson, gave some experiences with the magnetite street arc lamp at Jackson. Three hundred of these lamps were put on the streets of Jackson three years ago. At first there was considerable globe breakage, due to the splattering from one of the electrodes. This had been rectified by the use of a solid copper electrode block, and now the globe breakage is no greater than on the other arc lamps operated by the company. The cost of electrodes, including magnetite sticks and copper blocks, is a little less than the cost of carbons for the enclosed arc lamp. The lamp burns about the same time between trimming as the enclosed arc. The lamp used takes 320 watts for four amperes, as against 525 for the lamps displaced. It was found that owing to the distribution of the light, a given size of type could be read twice the distance from the magnetite arc than it could from the 525-watt carbon lamp. He thought that future installations of street lamps made by his company would be of this type.

Mr. A. P. Biggs, of Detroit, read a paper on "Factory Lighting," which was also presented before the Ohio Electric Light Association the same week. Supplementing this a paper by Mr. J. Kermode, of Cleveland, on the same subject, presented before the Ohio association the day before, was also read. Mr. Biggs' paper, in which the practice was advocated of recommending the use of "gas arcs" for the general lighting of a factory in order to keep down the maximum demand of the factory, resulted in a long and animated discussion, the policy being attacked by many central station men and defended by

[illegible] of this discussion will appear in a later issue.

Thursday was largely taken up with informal discussion of results of new business campaigns in various cities, which will appear in a later issue. The following officers were elected: President, Mr. H. W. Hillman, manager, commercial department, Grand Rapids-Muskegon Power Company, Grand Rapids, Mich.; vice-president, Mr. J. A. Cavanaugh, superintendent, Benton Harbor-St. Joseph Railway & Light Company, Benton Harbor, Mich.; secretary and treasurer, Mr. A. C. Marshall, general manager, Port Huron Light & Power Company, Port Huron, Mich. Executive committee: Messrs. L. B. Schneider, Tecumseh; D. D. Dodge, Lansing, and A. J. Noble, Albion.

The entertainment features were well taken care of by Messrs. A. H. Mott, W. P. Stephens and Daniel H. Beardslee. The entertainment committee was backed by the Commonwealth Power Company and the Citizens' Electric Company. A theater party was given at the Bijou Theater on Tuesday evening, and after the session Wednesday special cars were taken to Gull Lake, where boating and fishing were enjoyed, followed by a dinner at the Allendale Hotel. The ladies were entertained during the convention sessions by various trips to points of interest.

CURRENT NEWS AND NOTES.

ELECTRICAL ENGINEERING GRADUATES AT SCHENECTADY.—The General Electric Company has taken on at its Schenectady works 248 of this year's graduates from electrical engineering courses.

PATENT OFFICE EXAMINERS.—The U. S. Civil Service Commission will hold examinations Oct. 16 and 17 for assistant examiners in the Patent Office at an entrance salary of $1,200 per annum. Forms of application, etc., can be obtained from the commission in Washington. The age limit is 20, and the examination is open to all citizens of the United States.

WHAT STRIKES INVOLVE is shown to some extent by the report of the Bureau of Labor and Commerce. It appears that from 1881 to 1895, inclusive, there were 36,757 strikes in the United States, 69 per cent of which were ordered by labor organizations. The strikers numbered, all told, 6,720,048, but as other workmen dependent upon them were forced into idleness, the real number thrown out of employment was approximately more than 9,500,000. The average duration of the strikes was 25 days. At one dollar per day, this would seem to involve a loss in earnings of about $250,000,000.

MUST RESUME SERVICE.—At Helena, Mont., on Aug. 8, Judge Bach, in the district court, issued a writ of mandamus to compel the Rocky Mountain Bell Telephone Company, whose operators are on strike, to resume operations. He declared that service must be resumed or the franchise would be forfeited. He said he would punish any one who attempts to interfere with the lines, but the mere fact that one person persuades another not to work and uses no threats or force does not justify the company in refusing to do its duty to the public. Judge Bach said he knew the company could get all the assistance needed if sufficient remuneration were held out.

MONTREAL EXPOSITION.—With regard to the coming exposition in Montreal, Mr. R. S. Kelsch writes us as follows, in regard to additional events: "We have received word that the Maritime Province Electrical Association will leave Halifax Sept. 7, and arrive in Montreal on the evening of Sept. 8, and open its convention in the Windsor Hotel, Montreal, Sept. 9, so that, during the week of Sept. 9 to 14, we expect to have about the liveliest time in Montreal that we have had in several years. The 'Sons of Jove' will also have an annual meeting in Montreal during the same week, so that with the two electric light associations, the street railway association, the Sons of Jove meeting, the fall meeting of the Montreal Jockey Club, etc., we expect to be extremely busy."

WIRELESS ON MOTOR YACHT.—The first motor yacht to be installed with "wireless" is the *Sea Otter* of the New York Yacht Club fleet, owned by Hugh L. Willoughby, of Newport, R. I. The Massie system which is used is installed in a very compact manner, one of the small cupboards being utilized for the purpose. Although the aerial is only 40 ft. in height, Mr. Willoughby, who has made a study of the art of wireless telegraphy and operates the apparatus himself, can easily read the Nantucket Shoal lightship from Newport Harbor, a distance of over 100 miles. The *Sea Otter* is 60 ft. long, [illegible] six-cylinder Standard motor. When running, a small dynamo is belted to the engine, current from which is used to charge storage cells, which in turn supply power for lights and fans, as well as the wireless outfit.

THE TELEGRAPH STRIKE continues with no apparent change in the situation. In general, the striking operators have been very well behaved, although frequent malicious interruptions and cutting of circuits are reported. In Ohio, the lines between La Carne and Camp Perry are being patrolled by U. S. infantry to stop the interference with the wires. The companies speak confidently and positively as to their ability to handle business and claim to have minimized delay. President Small, of the Commercial Telegraphers' Union, has been visiting New York, and attended a meeting, at which Mrs. Rose Pastor Stokes indulged in some socialistic talk. Commenting on this Superintendent Brooks, of the Western Union, remarks: 'I understand that Mrs. Stokes is an estimable woman, and takes a charitable interest in the working people on the East side. I understand that she worked once in a cigar factory, but that would not qualify her to be an expert in telegraphy. She says that the strikers in asking 15 per cent advance in wages ask for too little, and that the companies could afford to pay more. As a matter of fact she has no way of knowing anything about it. The operators are well paid and the company could not afford higher wages."

LIGHTING IN EUROPE.—In a long article on an interview with Mr. H. L. Doherty, and some of his work in this country, the London *Gas World* says: "There is at least one American gas engineer in this country this summer, and though he is here mainly for rest he has been looking around and taking notes. And one of these notes is not particularly flattering to us. He has not been favorably impressed with any of the show pieces of street lighting that we are sometimes inclined to boast about. The only consolation is that the faint praise he bestows upon English lighting is also extended to the lighting of Paris, to which we have been accustomed to turn for an example of how such work should be done. It is not so much the quality of the actual street lighting that our visitor is disappointed with as the little aid it derives from the outside lighting of shops and other premises. In the United States it is the practice of business people to light the exterior of their premises on a very lavish scale—the whole building being often outlined in points of light—and it is the general absence of this sort of thing in London and in Paris that has surprised our visitor. 'I could take you,' he remarked, 'to a little town in the wilds of Nebraska which is a perfect blaze of light.' 'I have seen nothing like it in my travels here,' he continued, 'and I only mention this town as an instance of the general practice in practically all the towns of the United States.' The street lighting of Paris, he admitted, is very [illegible] satisfy the eye of the man accustomed to American lavishness in this regard; and the gloom of the buildings both there and in London is a continual wonder to him."

SIBERIAN WIRELESS.—It is stated from Berlin that Japan and Russia are planning the establishment of wireless connection with Siberia. Japan is connecting Vladivostok and Tsuruga, on the west side of the Island of Hondo. It is proposed to lay the plans before the various Chambers of Commerce interested and also before the International Telegraphic Conference next April for indorsement.

LIVELY LIVE WIRE.—On the ground that she was almost completely disrobed by a live wire, Mrs. Maud S. Orr, prominent in Atlanta, has sued the Georgia Railway & Electric Company for $10,000 damages. Mrs. Orr was shopping on a street in Atlanta when the broken end of a guy wire which had been charged in some way, touched her feet. The current tore her belt off and also other portions of her attire until she stood almost completely nude in the crowded street.

ELECTRICAL ENGINEERING AT THE U. S. NAVAL ACADEMY.—The electrical course at the U. S. Naval Academy is being reorganized with a view to rendering it more practical in nature than in the past. To this end greater attention will be paid to practical work in the laboratory and to the actual handling, assembling and care of dynamos, motors, etc. The class-room instruction in electrical engineering will be confined to the two upper classes, which will have completed during their first two years the necessary preliminary studies in physics and mechanics. The course will be in charge of Lieut.-Com. W. H. G. Bullard, U. S. Navy.

MME. CURIE AND RADIUM.—A special cable dispatch from Paris, of Aug. 24, says: "Mme. Curie has communicated the results of her latest researches to the Academy of Science in a paper treating of the atomic weight of radium. With characteristic diffidence she refrains from absolute conclusions and merely puts the weight at 225, subject to further researches. Mme. Curie's paper, which is of a highly technical nature, will appear in the next issue of the academy's official publication. When asked what she thought of Sir William Ramsay's announcement of the transmutation of copper into lithium, Mme. Curie replied: 'I am not sufficiently acquainted with the effects of radium on metals to be able to give an opinion of any value. I agree, however, that the discovery will have important results if confirmed.'"

METER TESTING has already been taken up by the New York Public Service Commission of the first district, and now it is stated that various authorities are to appear this week before the Utilities Board of the second district in Albany to give expert opinion as to the testing of electric meters, which will be undertaken shortly by the board, in accordance with the provisions of the Utilities law. In an official circular, which has just been issued, the new commissioners have invited representatives of electric lighting companies in the state to meet them for an exchange of views on the subject. Representing the principal lighting companies of the state, the Empire State Gas & Electric Association is making an effort to furnish expert opinion and data to the commissioners at the Albany meeting.

[illegible] ington state that Brig.-Gen. James Allen, chief signal officer of the army, in his annual report urges a strengthening of the arm of the service in his charge. He says that it is now recognized by military authorities that the strength of an army [illegible] by the number rifles, guns and sabres it can put into co-operatively effective action at any one time. Although the late [illegible] this "military weapon" in advance of anything previously attempted, yet it is believed that by the development of the [illegible] perfect lines of information it would be possible for the commander who first utilizes it to the limit for tactical purposes to gain decisive victories. Gen. Allen points with regret to his inadequate forces, saying that there is a shortage both in officers and men throughout the service and submits a scheme for a general increase in the corps so as to have 1500 privates and a proportionate number of officers obtained in part by detail from the line.

STEAM LOCOMOTIVES IN CHICAGO.—As a first step in an investigation of the advisability of electrifying the Chicago terminal lines of the 23 trunk railroads entering that city, Mayor F. A. Busse and a party of Chicago officials arrived in this city last week and made an exhaustive examination of the newly electrified lines of the New York Central. In the party with Mayor Busse were Dr. W. A. Evans, health commissioner; Walter H. Wilson, controller; Milton H. Foreman, chairman of the aldermanic committee on local transportation; John M. Glen, secretary of the Illinois Manufacturers' Association, and J. E. Donnelly, chairman of the Chicago Smoke Commission. Almost an entire day was spent in the examination of the electric system. Vice-President W. J. Wilgus showed the men through the power houses and over the line. At the earnest solicitation of Mayor Busse and the others in the party, Mr. Wilgus has consented to go to Chicago and look over the situation there. He severs his connection with the New York Central on Oct. 1, and will go to Chicago then. It is very probable that if the electrification of the Chicago roads is taken up, Mr. Wilgus will be associated with the work.

OVERHEAD WIRES.—A bill is to be presented to the next New York Legislature, giving the necessary power to electors in the different boroughs of Greater New York to vote for the burial of all electric light, power, telephone and telegraph wires, within the next five years. The Tree Planting Association, of which Col. C. B. Mitchell is the head; the American Scenic and Historic Preservation Society, and the American Civic Association, as well as many organizations in the Borough of Queens, have taken up the matter energetically, all the more so since, it is alleged, in the wake of their agents have followed corporation canvassers who have promised citizens that the companies using wires will make such changes as will render the passage of the bill unnecessary. The bill provides that the work shall be done at the expense of the companies, which, it is argued, should defray the cost. A principal feature of the bill is that at the next general election the electors in each borough shall vote on the question whether the wires shall be buried, and if a majority are favorable, then the work shall be done. There is a provision that if a vote is not favorable it shall be repeated every second year for three times.

WIRELESS ON PACIFIC.—Arrangements have been completed whereby the war and navy departments will co-operate in the maintenance of wireless communication between Nome, St. Michael, Seattle and San Francisco. The signal corps of the army already has wireless stations at Nome and St. Michael, and next year will establish a station at Fort Gibbon. The latter station will be capable of communication with the navy wireless station to be erected at Valdez. The navy already has stations at Sitka and 800 miles from Valdez, at Tatoosh Island, about 100 miles from Sitka, and at North Head, Table Bluff and Cape Blanco. The distance between the three latter stations varies from 175 to 300 miles. Stations are to be established by the army this fall at Fairbanks and Circle City, and a land line is to be built from Tacoma to McCurdy. The war and navy departments have suffered considerable inconvenience since the telegraphers' strike began and the utility of the wireless is becoming better appreciated. The army cable ship Burnside is now in Alaskan waters making cable repairs. The cable between Sitka and Valdez may be diverted to Montague Island and pieces spliced in at that place at Katalla, which may become a railroad terminus.

CANADIAN LABOR.—The number of wage-earners employed in making electrical apparatus in Canada in 1905 was 4806, according to recent returns, with wages of $2,489, 905. Those employed in electric light and power plants were 2418, [illegible]

PUBLIC SERVICE COMMISSION.—There is a popular impression that the offices of the New York Public Service Commission are required to be open all the time, and the office hours are set forth as from 8 a. m. until 11 p. m. But the commission is not living up to its initial high ideals, if we may believe the *Evening Post,* but closes its office and goes off fishing—just like Tammany heelers and other municipal servants.

A SOFT ANSWER.—The following from the New York *Times* might well be put in every telephone girl's pay envelope or hung up in the rest parlors of the exchange: "An excellent thing in woman is a low voice, says the greatest of poets. An instrument to influence the fate of empires is a woman's voice, low of tone, well modulated, used with discretion. Such a voice, it seems, is possessed by a young woman of Blue Island, Ill., who earned her living as a telephone operator. One day lately a Chicago young man addressed harsh words to her over the wire, touching a delayed communication. Her well-considered reply was so charmingly delivered that he fell in love with her voice, and they are now married."

TELEPHONY FOR BROKERS.—A private telephone system to connect the offices of the various members of the St Louis Merchants' Exchange with the main floor is to be installed immediately. Each broker's office, whether in the Exchange Building or in neighboring buildings, will be connected directly with a private telephone booth on the floor. On the wall, in full view of the brokers, will be a large indicator board. At present, when the office wants to call its representative on the floor, it is necessary to call the exchange and send a messenger on to the floor for the broker. With the new system the man in the office will merely lift the receiver from its hook, which will cause the proper signal to be given on the indicator board and the broker steps into his booth and enters into conversation with the office. The New York Stock Exchange has practically the same system now in use.

PLANT FOR LEPER COLONY.—The leper settlement on the island of Molokai, H. I., is to be lighted by electricity within a few months. In the mountains back of the settlement there is an abundant supply of water. It has long been piped down for a water supply and for irrigation. A larger pipe line is now to be put in, which will bring down a supply for power as well as for other purposes. A head of about 400 ft. is available for power, with a reservoir high enough to force water to every part of the settlement and give adequate force for fire protection. It is expected to install incandescent lamps in every house in the settlement and arc lamps along the principal streets. In addition there will be electric power for the poi factory, the laundry and the ice and refrigerator works. Dr. Walter Brinckerhoff has charge of the United States Leprosy Experiment Station soon to be established at the leper settlement on Molokai.

STANDARD WIRING SYMBOLS.—The National Electrical Contractors' Association has just reissued the standard symbols for wiring plans as adopted by the association, the American Institute of Architects of the United States, the Supervising Architect's office, U. S. Quartermaster-General's office, United States Army, several municipal departments, many technical institutions, prominent architects and engineers and numerous individuals. Since the first edition was sent out there has been a change in the symbols for center and bracket outlets, and symbols for indicating gas only outlets have been added. Under the heading "Suggestions," standard heights of wall outlets have been enumerated. These changes and additions were made at the instance of the American Institute of Architects. Copies in the shape of wall-hangers and specification sheets can be had at low rates from the secretary of the association, Utica, N. Y.

THE CODE OF ETHICS.—In its September issue, the *Century* has the following comment: "One of the most gratifying incidents of the present era of ethical awakening in America was the recent agitation in favor of the adoption of an ethical code by the Institute of Electrical Engineers. It is true that at the recent annual meeting at Niagara the carefully prepared code, upon which a competent committee had unanimously agreed, met with delay, on mere grounds of technical procedure. The postponement of consideration by no means, however, implies rejection of the measure, and the present authorities of the Institute will doubtless carry the matter forward with all constitutional dispatch; for no member of this honorable profession, a profession yearly increasing in responsibility and importance, would be willing to go on record as permanently opposing so desirable a reform, and one which the press of the country hailed with such cordial and significant approval."

SIGNS IN BRAZIL.—U. S. Consul-General G. E. Anderson, of Rio de Janeiro, Brazil, sends some interesting information as to outdoor advertising in Brazil where generally all advertising is taxed. He says: "In the way of electric signs there is practically nothing to be seen in most Brazilian cities. I do not know of a single electric sign in Rio de Janeiro, but it is probable that as soon as the new electric light and power service is effective there will be a change and that regulations will be modified to meet changed conditions. In Sao Paulo, in some respects the most up-to-date city in Brazil, there is plenty of electrical energy to be had at comparatively low rates, and electric signs are commencing to appear, but apparently they are employed only in connection with daylight signs and are taxed at the same rate. The effect of taxation in this particular line is unquestionably beneficial from the standpoint of the general appearance of the city, not to mention revenue possibilities. There have been extensive and costly modern improvements made in Rio de Janeiro in the past four years, and the beauty of the city is the subject of never-ending favorable comment from visitors."

MUNICIPAL OWNERSHIP.—The American Street & Interurban Railway Association is making a committee inquiry into municipal ownership again this year. Its circular says: "At the 1906 convention of the association, held at Columbus, Ohio, a committee presented a report on the subject of municipal ownership. The officers of the association have seen fit to continue the same committee for this year, and have asked that another report on the same subject be presented at the convention to be held in October next. It has been deemed unnecessary in the making of this report to discuss to any great extent the question from an academic point of view. The literature on this subject has been so multiplied during the past year by the publication of the results of investigators of social economics, and by the reports of various committees who have made investigation of it, that the members of the association are undoubtedly quite familiar with the arguments for and against municipal socialism in any form, and especially as it would affect the interests of our particular industry. It does, however, seem desirable that the report should cover any progress made either for or against the movement in our respective fields, as well as some statement in regard to general conditions here and abroad, and to this end we are enclosing you a sheet covering a few questions designed to ascertain the condition of affairs with respect to municipal ownership in your immediate vicinity."

Kern River No. 1 Power Plant of the Edison Electric Company, Los Angeles—IV.

TOWERS.

The transmission line is carried on galvanized steel towers, there being 1140 of these towers. The tower heights range from 30 ft. to 60 ft. They are uniformly constructed of galvanized angle iron, bolted with galvanized bolts and held in shape by means of tension rods. There are no compressive braces except one pair in the upper portions of the sides, and between the cross-arms. The nine insulators are spaced on 6 ft. centers, five on the upper arm and four on the lower, the arms consisting of 9-in. 13¼-lb. channels.

All portions of the tower are figured to be safe under a wind pressure of 30 lbs. per square foot on the tower and the wire of a 700-ft. span. The towers will also withstand absolute failure of any single wire, even though none of the resulting strain is transmitted to adjacent wires.

Fig. 31 illustrates the construction of a standard 60-ft. tower, which is 12 ft. wide and 12 ft. across at the base. The uprights are formed of 4-in. angles and the cross braces of 2¾-in., 3-in. and 3½-in. angles, the diagonal rods being 11/16 in. and ⅝ in. in diameter. Four insulators for the telephone lines are mounted on the third cross-bar, 21 ft. above the ground. Forty of the towers were made extra heavy for use at points where the line changed its direction.

The foot plates of the towers are of cast iron, dipped in asphalt, and 24 in. in diameter. They are attached at the bottom to 4 in. x 4 in. foot posts, which are asphalted on top of the galvanizing. These posts are bolted as extensions to the corner posts of the tower, and set in the ground a depth of 6 ft. Tapered holes were dug for these foot plates and the earth was tamped back on them very carefully. No concrete

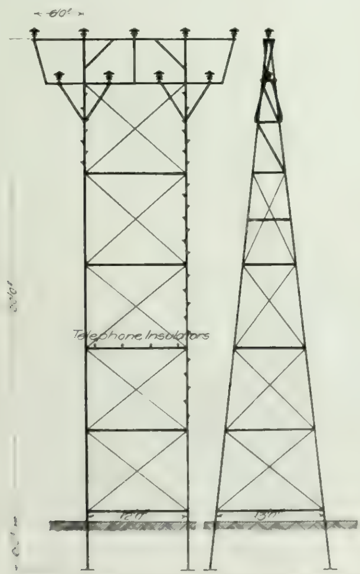


Fig. 31.—60-ft. Transmission Line Tower.

footings were used, except on some special work in the city of Los Angeles, where a great many of the tower heights exceeded 60 ft. The tower parts were made as light as was consistent with rigid construction. Under the extreme conditions mentioned above the factor of safety in any steel member is specified to be not less than two and one-half.

No cast iron was permitted in the construction, except in the foot plates. All connections are made with malleable iron castings with a factor of safety of 4. The insulator pins are of cast-steel and were furnished as a part of the tower. They are secured to the tower by four bolts and are cemented into the insulators. The towers and insulator pins were furnished by the U. S. Wind Engine & Pump Company, of Batavia, Ill.

The towers were shipped from the factory knocked down

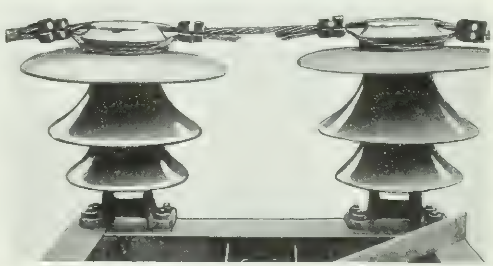
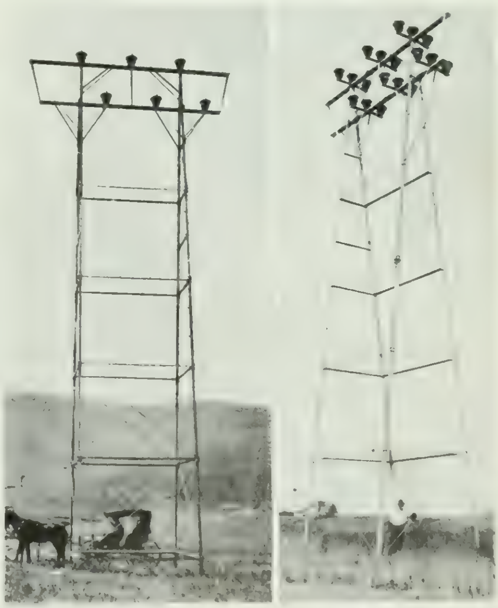


Fig. 32.—Double Insulator on Tower, Showing Method of Tying.

with their small parts boxed and were hauled to their respective locations by wagon. They were assembled lying on the ground and "kicked" into place by means of a gin pole. This method of erection was found to be very satisfactory for all sizes of towers, and only such towers as were located in rugged or inaccessible country were built up piece by piece.

In stringing out the wire, teams were used with usually four animals, although in limited spaces two horses on a tackle



Figs. 33 and 34.—Standard 60-ft. Tower and a Special 60-ft. Tower Near San Fernando Switching Station.

were substituted. Wherever possible, those wires which could be lifted on to the tower were strung out alongside and later on thrown into place.

LINE CONSTRUCTION.

The transmission line is designed to consist of three circuits with the wiring spaced symmetrically on 6-ft. centers. This wire is seven-strand, 4/0 hard-drawn copper, having an elastic limit exceeding 35,000 lbs. total and an ultimate strength of

[illegible] Electrical Works. About two and one-half million pounds of cable was used on the line.

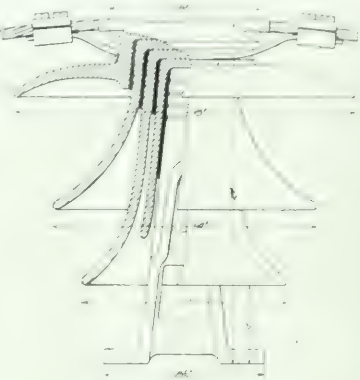
[illegible] purchased in shorter lengths for convenient use in the mountain section. No special difficulty was, however, experienced in handling full-length pieces even in the most rugged country.

[illegible] menting was done by the Edison Company's engineers on a special thousand foot span erected at Declez and equipped with a dynamometer and recording thermometer to obtain continuous readings of the variation in stress with changes of temperature and wind velocity. Curves showing the relation of the observed points to the calculated curve were then plotted. curves for aluminum were also prepared, the results used being those obtained by the Pittsburg Reduction Company on the line which it erected some years ago near its factory. From a comparison of these curves, it was evident that the calculation formulas were sufficiently accurate for commercial use, including all effect from elasticity, closure of strands upon themselves under increase of stress, and the slight difference in loading upon the different strands due to the center strand being straight while the others are spiraled about it and consequently have a somewhat greater length. From the formula, a conveniently arranged sag-temperature tabulation was made out and was supplied to the line-foreman in this form. These experiments were carried out under the supervision of Mr. R. J. C. Wood, acting electrical engineer for the Edison Electric Company. For convenience in checking the construction work, Mr. Wood made the slide rule illustrated in Fig. 35. By setting the required span at the index at the left, the sag will be read opposite the temperature chosen. For example, the illustration shows the scale set for a 900-ft. span, which gives a 27-ft. sag for copper at 50 deg. F. The scale is calculated for No. 0000 seven-strand copper and 344,000 c. m. 19-strand aluminum, with a maximum stress of 22,000 in copper and 10,000 in aluminum at 30 degs. F. in a 30-lb. wind.

As only six conductors were strung for the present line, it was desirable to leave the easiest circuits to be pulled in later. The threading of three cables through the tower was, therefore, desirable at this time. These were carried across rollers bolted to the arm, as were also the upper wires during tying in.

The type of clamp used is shown in Fig. 36. It is 2 ins. long, and is constructed of three pieces, the inner piece being shaped to conform to the two wires. The tie wires passing around the neck of the insulator are of No. 1 copper strand. [illegible] per. The tie wires fail in test at about 4000 lbs. The clamps [illegible]

50 lbs. The main contract, for 7500 insulators, or over 90 per cent of the total number, was placed with the Locke Insulator Manufacturing Company, and the specifications called for a glaze that would match the galvanized steel towers. The manufacturers were successful in producing an insulator with a light gray or slate-colored glaze which harmonizes very well with the hue of the towers. The resulting construction is comparatively inconspicuous on the transmission [illegible]



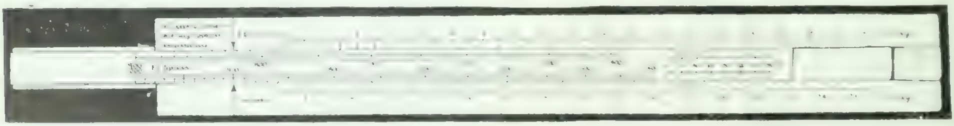
[illegible]

afford as prominent a target for malicious marksmen as do those of the ordinary brown glaze.

The insulators were all carefully tested at the factory by one of the Edison Company's engineers. The specifications called for a guarantee of a 100,000-volt test from the groove to the pin for half an hour under a precipitation of 1 in. in five minutes at an angle of 30 deg. from the vertical. The assembled insulator was required to withstand under a wet test a potential of 150,000 volts for 30 seconds, and the separate parts are guaranteed to withstand a voltage of 25 per cent in excess of the normal proportion of over-voltage test. A small quantity of brown insulators are used, they being supplied by the Thomas and Knowles factories.

The insulators are guaranteed to withstand a side strain of 4000 lbs. and actually fail at approximately 9000 lbs. The wire has an ultimate strength of 61,300, but its elastic limit, as noted above, will not much exceed 35,000. The normal failing point of the ties, 4000 lbs., is, therefore, sufficiently high for safe construction, while they are not so strong as to stand more than the wire or the insulators.

The transmission line, as stated elsewhere, is carried on spans as long as the character of the country would permit



[illegible]

[illegible]

The insulators used on the Kern River transmission line are the largest yet made for commercial transmission purposes. Insulators of a greater diameter have been constructed and are in use elsewhere for special purposes, but none so large have been made for a long-distance transmission system. The Kern River insulators are 18 ins. high and 8 ins. in diameter at the grooved top. The top section is 18 ins. in diameter and the two lower petticoats are, respectively, 14 ins. and 11 ins. in diameter. Each assembled insulator weighs

with towers not exceeding 60 ft. in height. This maximum height was determined upon as being that which would give the lowest total cost of construction. The sags for the different spans being determined, as stated above, and the telephone clearances from transmission wires being assumed at a [illegible] spacings with minimum safe ground clearances in the different portions of the line. In order to do this accurately, survey parties were sent over the entire line, taking tower locations [illegible]

vation of each tower, the height of the intermediate elevations and the important topography of the country. The parties designated the height of the tower while in the field, making their profile as they went along and checking the resulting line before leaving that section of the country. What changes have been made from these locations have been due entirely to causes other than incorrect location for clearance.

A telephone circuit is carried the entire length of the transmission line, being supported on the towers about 20 ft. above

FIG. 37.—SAN FERNANDO SUB-STATION.

the ground. Between towers the wires are held up by wooden poles, two poles being necessary between towers for an average 700-ft. span.

SWITCHING STATIONS

The transmission lines are carried through from one end to the other with transpositions only at switching stations. There are at present only three such buildings, at Tejon, Castaic and San Fernando, the latter two of which contain transformer sub-stations.

The switching station proper is equipped with two sets of oil break switches for each line and two sets of knife-blade disconnecting switches for each line. The oil switches are connected, one set after another, into a complete circle. After passing through the disconnecting switches, the incoming lines are tapped between alternate oil switches. From the vacant jumpers left after these lines have been tapped in, their corresponding outgoing circuits are taken, and after passing through the disconnecting switches, leave the building on the opposite side.

The switching station buildings are constructed of concrete in the most substantial manner. The circuits are isolated from each other by means of concrete barriers and floors. Individual leads of the same circuit are, however, run in the same compartment. In spite of the large number of crossings called for by the wiring diagram, the dimensions of the building are not excessive. The Castaic sub-station is 66 ft. long and 41 ft. 6 ins. wide, with a cross-partition wall forming the switch-room, 40 ft. wide, and the transformer room 26 ft. wide. Provision has been made to connect horn lightning arresters to the circuits at these sub-stations, if it is found necessary after the line has been operated for some time.

The two transformer sub-stations have in their switching houses an arrangement identical with that in the other stations, except that openings were made in the west wall, through which leads were taken into the adjacent transformer house. The two were built together under the same roof and with continuous sidewalls so that there is on the exterior little to indicate the difference between the two ends of the station. In the transformer house provision has been made for two banks of 2100-kw transformers from the transmission line at 60,000 volts and delivering to the distribution at 30,000. The high-tension leads are tapped from two of the out-going 60,000-volt circuits in the switching house, and after passing through oil switches join in a common bus from which the transformers can be separated by means of knife-blade switches.

This switching, with the exception of the transformer switches, is on a concrete deck forming a complete second story in the switching house, 18 ft. above the floor. On the under side of this floor, there are also mounted the insulators for the 30,000-volt circuits. The 30,000-volt oil switches are, however, placed on top of the floor. The lightning arresters for the 60,000-volt circuits are on the wall between the transformer and the switch house, and are separated from each other by 6-ft. barriers, while the 30,000-volt arresters are against the end of the sub-station immediately below the oil switches and the outgoing 30,000-volt circuits.

At Castaic there will be installed at present one bank of transformers, 2100 kw, oil-filled and water-cooled. These transformers will supply power to a 30,000-volt, 40-mile transmission system now being built by the Ventura County Power Company, west from Castaic to Saticoy, where a branch is taken off to Oxnard, while the main line continues

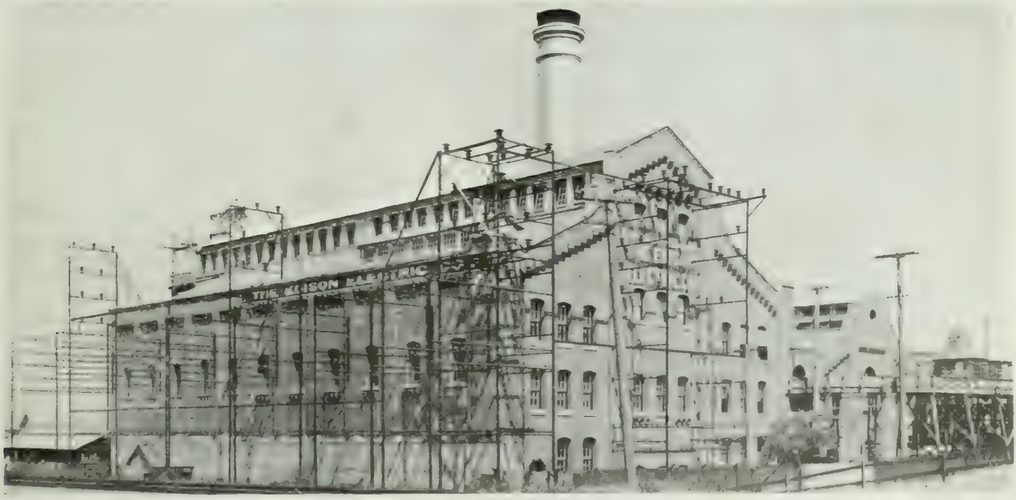


FIG. 38.—LOS ANGELES NO. 3 RECEIVING STATION, SHOWING 60,000-VOLT, 30,000-VOLT AND 15,000-VOLT CIRCUITS.

to Ventura. This branch will eventually be continued to Santa Barbara, 30 miles farther, where the Edison Electric Company has extensivev power and railway holdings.

At San Fernando there will be installed a 1200-kw bank, which will supply power at 2300 volts to lamps and motors.

[illegible]

The Kern River No. 1 transmission line terminates in Los Angeles, 117 miles from the power plant, at the steam and transformer station known as Los Angeles No. 3. This station, which was partially described in the ELECTRICAL WORLD AND ENGINEER of March 11, 1905, is constructed to receive, transform and distribute to the local sub-stations power transmitted from the company's water-power plants on Santa Ana River, Mill Creek, Lytle Creek and Kern River, and also contains a large steam auxiliary plant to supplement the water-generated power. It receives power at 60,000 and 30,000 volts and generates and distributes at 16,000 and 2300 volts.

Both of the Kern River circuits enter the station through the east gable, as shown in Fig. 40. After passing through choke coils the lines enter oil switches which connect them to their respective bus-bars. There is also an oil tie switch between the two buses. Each transformer has an oil switch which can be connected by means of a double-throw knife-blade switch to the bus-bars belonging to the west or to the middle circuit. When the east circuit comes in it will have a pair of oil switches so that it can be run on either of the bus-bars.

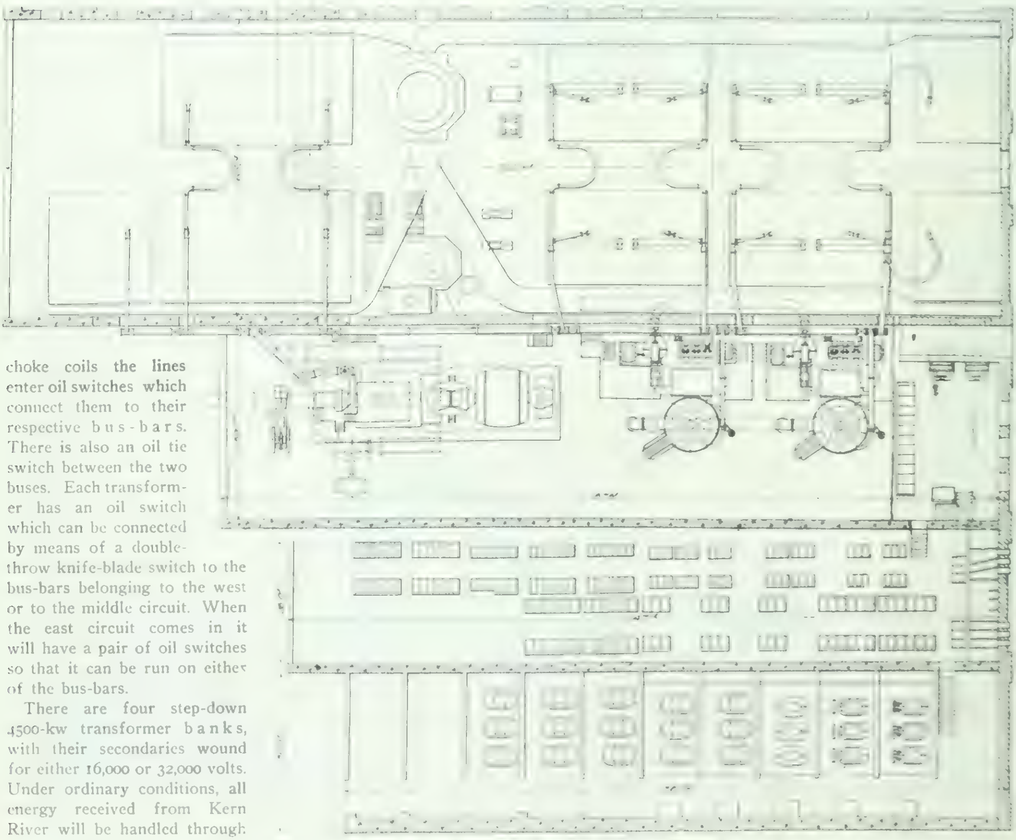


FIG. [illegible].—PLAN OF LOS ANGELES NO. 3 RECEIVING STATION.

There are four step-down 4500-kw transformer banks, with their secondaries wound for either 16,000 or 32,000 volts. Under ordinary conditions, all energy received from Kern River will be handled through the double 15,000-volt bus. The transformers are cooled by forced-oil circulation. The oil, after leaving the transformer, is handled in the same manner as at Kern River. It enters a receiver, is forced by variable-speed centrifugal pumps into boiler-tube cooling coils outside the building and passes back into the pressure line which fills the transformers. There being no extensive supply of cold water available, the cooling water is circulated continuously from the oil cooler basin into elevated troughs from which it drops over a series of screens, where it is cooled immediately before falling on the section containing the hot oil.

This building also contains provision for switching the old 30,000-volt, 80-mile transmission line, fed by the Santa Ana and Mill Creek plants, with its various branches and all the 15,000-volt distribution around Los Angeles. The arrangement of the various circuit bus-bars, oil switches and the transformers is shown in the accompanying diagrams. All switches and circuits are controlled from a 12-panel switchboard on the gallery of the turbine room, which is equipped with the necessary control switches and instruments for the 60,000, 30,000, 15,000 and 2300-volt buses.

All bus-bar wiring connections to the transformers and the outgoing circuits are carried in ducts. In the new portion of the station these are filled with 15,000-volt leaded paper cables of 211,000 cm cross-section, with the exception of those for the Westinghouse turbo-generator, which has 400,000 cm cables.

There were installed in the steam end of this plant during 1903 two 2000-kw, 2300-volt Curtis turbo-alternators, with 4000 horse-power of Stirling boilers, in 500-hp units. When it became necessary to order an extension for the plant, in 1905, larger size apparatus was determined upon throughout. An additional 5250 horse-power in 750-hp units was installed in the boiler room.

The turbine installation in the new plant consists of a single 6000-kw Westinghouse-Parsons turbo-alternator, with

Worthington condensing equipment. The steam end is of the Westinghouse standard construction, receiving steam through an intermittent valve. This steam, before reaching the machine, passes through a separator, an automatic butterfly valve, and a hand-operated throttle valve. This unit is four-stage, single-flow, and is operated at from 27½-in. to 28-in. vacuum. Thus far loads up to 10,000 kilowatts have been carried on the machine without any indication of its maximum load being approached. The by-pass throttle does not open until a load of 9000 kilowatts is reached under normal steam and vacuum conditions.

The generator is wound for 16,500 volts, star connected, and is run with grounded neutral on the 50-cycle distribution of the company. The generator operates perfectly and runs in multiple with the main system without causing any disturbance whatever. Between the neutral of the machine and the station ground wire, a potential difference of several hundred volts exists under operating conditions, with the machine in connection with star-to-delta-connected transformer banks. This voltage and the resultant flow where the neutral switches close vary with the number of transformers and the load on them, but does not apear to vary from other causes. An observation of the wave shape across the neutral connection showed a somewhat peaked potential wave at three times the frequency of the main circuit. For the present the exchange current is limited by the insertion of the choke coil in the neutral connection. At a later date a resistance will be substituted for the coil. This phenomenon in one shape or another is observable on all Y-connected four-wire generator installations.

Steam from the exhaust end of the turbine passes to the atmosphere during warming up through an automatic release valve. After the machine is up to speed, 750 r. p. m., the steam is condensed into a 24,000-sq. ft. condenser, and the water of condensation returned to the hot-well by a two-stage motor-driven centrifugal pump. The vacuum space is cleared of entrained air by means of a steam-driven dry-vacuum pump. Forty-nine cu. ft. of condensing water are forced per second through the condenser by means of a 30-in. Volute centrifugal pump, direct-connected to a 450-hp induction motor, receiving power from the 2300-volt station mains.

A transformer bank stepping from 15,000 to 2200 volts is to be connected to the machine leads so that the auxiliaries can be transferred to the generator leads after the unit is in full operation.

Circulating water leaving the condenser passes beneath the boiler room in a steel lined, concrete duct to the edge of the cooling tower, where it rises through a steel pipe to the top of the tower. The new portion of the tower installed for the Westinghouse unit is 73 ft. x 150 ft. in floor plan and the water has a clear fall of 27 ft. This gives a tower area of 6100 sq. ft. per cubic foot of water per second and with a humidity of 58 per cent and a wind velocity of six miles per hour, the water temperature is reduced from 102 degs. F. to 85 degs. F. The tower framing consists of 4-in. x 4-in. posts, 2-in. x 4-in. intermediates, 1-in. x 2-in. horizontals, and 1-in. x 3-in. bracings. The main flume is placed on 6-in. x 6-in. posts and is itself built of 1½-in. redwood. The distribution troughs are built of galvanized iron, having rectangular cross-sections with round holes punched in their bottoms. Their headers are also of galvanized iron, with wooden sliding gates. Strips 18 ins. wide of galvanized-iron mesh screen are placed at 3 ft. intervals throughout the depth of the tower. The trough spacings are 36 ins. x 36 ins. x 66 ins. throughout the tower.

The reservoir is of concrete 6 ft. deep, and 12 ft. wider than the tower. Water passes from it into the concrete suction pipe through close-set iron grizzlies. Its flow can be shut off when necessary by a 38-in. iron motor-driven gate placed in the engine-room basement.

The Westinghouse turbo-alternator unit was put in service in October, 1906, and has been run ever since without any shut-down due to the turbine, and without any serious shut-down whatever. The preliminary acceptance test gave results materially better than the manufacturer's guarantee.

PROJECTED KERN RIVER AND KINGS RIVER PLANTS.

In addition to the Kern River No. 1 plant, the Edison Electric Company has four plants located on Kern River. These plants are further up the river than the plant just completed, and cover the entire 160 miles length of the river from the mouth of the cañon to the headworks, with the exception of the plant of the Power, Transit & Light Company at the mouth and the Kern River Company's plant about 30 miles above. These four additional plants will have a total output of 46,600 kw and will be developed as the demand for the power arises. The next plant to be constructed will be Kern River No. 2, the power house for which will be located immediately above the intake of the No. 1 plant. Its diversion works will be 15 miles above, just below the Kern River Company's station. With the 317 feet net head which will be available, this plant will develop a total of 11,600 hp with 400 cu. ft. of water per second. Some work has already been done on this plant and before long the construction will be prosecuted more actively.

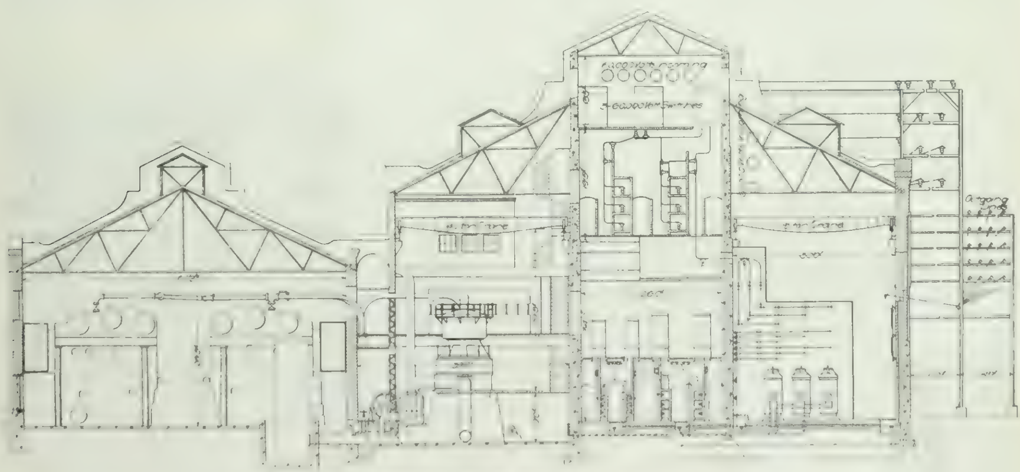


FIG. 40—VERTICAL SECTION OF LOS ANGELES NO. 3 RECEIVING STATION.

In addition to the Kern River power location which the

Edison [illegible] a two-thirds interest in five excellent power sites on the Kings River where 95,000 kw can be developed.

As mentioned in the articles appearing in the ELECTRICAL WORLD AND ENGINEER two years ago, the earlier water-power plants of the Edison Electric Company consist, in the order of their construction, of Mill Creek No. 1 (original Redlands); Santa Ana No. 1, Mill Creek No. 2, Mill Creek No. 3, Santa Ana No. 2, and Lytle Creek. These plants, which have a total output of 8700 kw are located in San Bernardino county, and in addition to supplying local power demands in the vicinity transmit power at 30,000 volts by means of an 80-mile transmission line to Los Angeles.

In addition to the water-power plan[illegible]

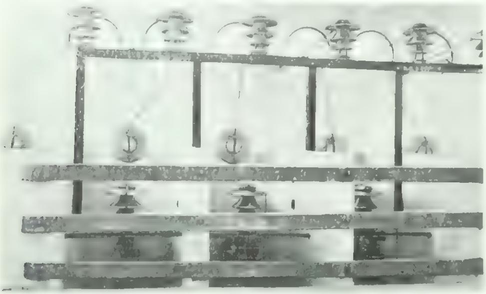


FIG. 41.—HIGH-TENSION LINES ENTERING LOS ANGELES NO. 3 [illegible] STATION.

steam generating rating of 14,075 kw. It is expected that the Kern River plant will be able to deliver in Los Angeles a maximum of 23,000 kw. This with the other water-power plants will give a normal hydro-electric generating rating of about 30,000 kw delivered in Los Angeles. Thus far the company's maximum peak load has been about 20,000 kw. However this by no means indicates the demand made on the company for power, and it is the company's expectations, judging by past exerience, that all of its power will be contracted for as fast as it is available. The Edison Company is the only power corporation in Southern California that aims to keep ahead of the demand for power by the construction of new plants, and this policy has proved an excellent one as compared with some of the other power interests who have at times been badly crippled by an insufficient supply, and have had to call on the Edison Company for power.

The cities in Southern California supplied with electric power for lamps and motors by the Edison Electric Company comprise a population of 418,500 and include Los Angeles, Pasadena, Pomona, Santa Ana, Redlands, Santa Barbara, Santa Monica, Ocean Park, Venice, Long Beach, Monrovia, Whittier, Riverside, Colton, San Pedro and Redondo. The transmission lines traverse Los Angeles, Orange, Riverside, San Bernardino, Kern and Ventura Counties.

Gas plants are operated in each of the cities named with the exception of Los Angeles, Pasadena and Redondo, the Santa Monica plant supplying Ocean Park and Venice. The gas plants have a generating capacity on a 12-hour run of 1,798,000 cu. ft. and double that for 24 hours. A storage capacity of 500,000 cu. ft. is provided. Crude oil is used for fuel.

As indicative of the conservative and efficient management of the properties under the company's control, it is interesting to note that in the four years, 1903 to 1906 inclusive, the proportion of operating expenses to gross earnings has been reduced from 52 per cent to 41 per cent. The following table covering the field of activities of the company as of record on January 1, of each of the years, 1905, 1906 and 1907, shows the excellent growth made during those years, and also incidentally illustrates the effectiveness of the selling and publicity campaigns carried out by the company.

[illegible]

	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Several interesting conclusions can be drawn from a study of these figures. For example, in the two years, 1905 and 1906, the company's incandescent lamp service increased 67 per cent with an increase of 66 per cent in the number of meters. Gas meters increased 227 per cent, and a corresponding increase of 247 per cent in the number of gas stoves installed indicates a remarkably efficient sales staff in the gas department. The figures also indicate that there is practically no gas illumination in the territory served by the Edison Company. The number of electric motors installed increased 197 per cent with an increase of 152 per cent in their horse-power. The average horse-power per motor decreased from 10.82 to 9.18, indicating an increasing use of small motors, presumably in small manufacturing lines.

The Edison Electric Company is incorporated under the laws of Wyoming and has issued $11,200,000 of its capital stock, consisting of $4,000,000 preferred and $7,200,000 common. The company has outstanding $10,895,000 in bonds and debentures.

The following-named gentlemen are officers of the company: President, John B. Miller, Pasadena; vice-presidents, Henry Fisher, Redlands; Wm. R. Staats, Los Angeles; H. H. Sinclair, Pasadena; John W. Edminson, Los Angeles; secretary, R. H. Ballard, Los Angeles; treasurer, W. L. Percey, Pasadena; general manager, A. L. Selig, Los Angeles.

The construction of the Kern River No. 1 power plant was prosecuted under the general supervision of H. H. Sinclair, vice-president of the company, who originally located the power sites on the Kern River and on most of the other streams whose power supplies are controlled by the Edison Company. The hydraulic features of the Kern River work, including the dam, gravity tunnels, pressure tunnel and many of the details

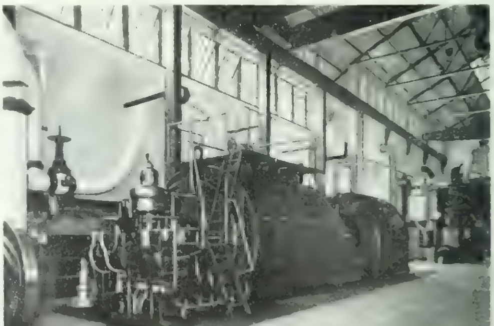


FIG. 42.—[illegible]

of the water-wheel equipment were designed under the supervision of F. C. Finkle, chief hydraulic engineer, and now consulting engineer for the company. F. E. Miller, as superin[illegible] direct supervision over, the construction work. The electrical details were looked after by Ralph Bennett and R. J. C. Wood, [illegible] the machinery. John Taylor, formerly chief operator at the [illegible] operation of the Kern River No. 1 plant. To these gentlemen [illegible] ing of the drawings and much of the data which have made [illegible]

Cos Cob Power Station of the New York, New Haven & Hartford Railroad Co.

In connection with the descriptions of the catenary line construction and the electric locomotives used by the New York, New Haven & Hartford Railroad, which appeared in our issues for Aug. 17 and 24, it is appropriate to add a description of the generating station from which electrical energy is obtained for train propulsion. This station is interesting, both on account of what it contains and by reason of what it does not contain. Thus the interest is not distinguished by the fact that a considerable portion of the equipment is of the standard type. However, the changes that have been introduced in order to render the standard equipment suitable for the special duties imposed upon it are of exceptional interest at this time.

The power house is located adjacent to the main line of the railroad and on the bank of the Mianus River at a point on the river about one mile from Long Island Sound. The location is such that coal can be delivered either by water or rail, and an unlimited amount of salt water for condensing purposes is available from the Mianus River. By the erection of a dam in this river at a point about a mile up-stream from the power house an abundant supply of exceptionally pure boiler feed water is also readily obtained.

The general style of architecture of the power house building is Spanish mission; the walls being constructed of plain-faced concrete blocks, the color of which forms a pleasing contrast with the red Spanish tile roof. The building walls, below the water-table, and the machinery foundations are monolithic concrete. The water-table and the walls above it, including the window arches and coping, are of concrete blocks. The basement floor is of concrete, laid upon the foundation rock. All other floors in the building are of reinforced concrete; and the roof, which has a pitch of 4½ ins. per foot, is of reinforced cinder concrete finished on the exterior with Ludowici tile.

A self-supporting steel stack 13 ft. 6 ins. in diameter, extending to a height of 100 ft. from the [illegible] floor, is carried by the steel columns which support the [illegible] floor, leaving the space below, on the boiler room floor, entirely clear.

The turbine room is 60 ft. wide by 119 ft. long, and the switchboard occupies a space over the [illegible] room which is 25 ft. wide by 110 ft. long. The boiler room is [illegible] ft. long and 110 ft. wide. The [illegible]

turbine equipment is shown by the fact that the distance from the floor to the top of the crane runway rail is but 27 ft. 2 ins., and the height from the turbine room floor to the bottom of the roof trusses is but 39 ft. 2 ins. The interior walls of the engine room are finished with a wainscoting of Faience tile 6 ft. in height.

TURBO-GENERATORS.

The initial generating equipment of the power house consists of three multiple-expansion, parallel-flow Parsons steam tur-

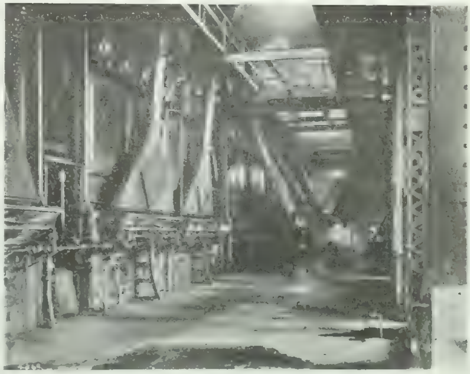


FIG. 2.—POWER ROOM OF COS COB POWER STATION.

bines direct-connected to single-phase Westinghouse generators. Provision has been made for the installation of a fourth unit, of corresponding size. The turbines are rated at 4500 bhp each, and the generators at 3000 kw each, at 80 per cent power factor.

The turbines are operated at 1500 r. p. m. by steam at 200 lbs. pressure and 100 degs. superheat. The continuous overload

FIG. 1.—EXTERIOR VIEW OF COS COB POWER STATION, SHOWING COAL HANDLING EQUIPMENT.

capacity of the [illegible] when operating condensing. The turbines are equipped with the latest accessories in the way of automatic safety stops, water-packed glands for the turbine shaft, and adjustable water-cooled bearings equipped with a continuous circulation oiling system.

[illegible]

current for delivery to the New York Central system as well as single-phase current for the operation of the electric locomotives over the New Haven Railroad, the generators are wound for three-phase current, but arranged for the delivery of both three-phase and single-phase current.

The generators are entirely enclosed by a casing, into which air is drawn through suitable ducts from a fresh air chamber under the switchboard gallery, and from which the air is discharged through other ducts into the basement. This system of generator ventilation renders the operation of the generators practically noiseless.

The excitation of the generator fields is provided for by two 125-kw, direct-current generators, direct-connected to Westinghouse engines; and one motor-driven exciter.

STEAM AUXILIARIES.

A separate condensing outfit is provided for each turbine, consisting of an Alberger three-phase counter-current surface condenser, a two-stage dry-air pump, a centrifugal circulating pump direct connected to a Westinghouse engine, and a Monitor hot well pump, the speed of which is automatically controlled by a float.

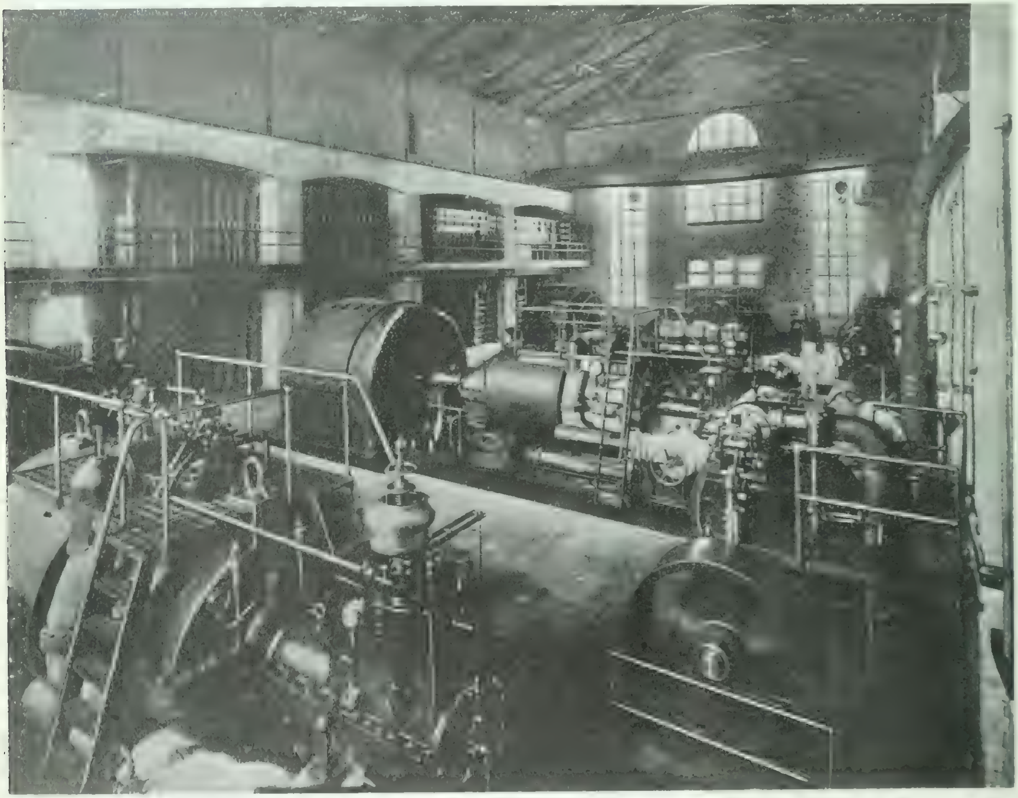


FIG. 3.—INTERIOR VIEW OF COS COB POWER STATION SHOWING GENERATORS, EXCITERS AND SWITCHBOARD.

Condensing water for all the condensers is furnished by a single flume, which is constructed of timber having a lining of creosoted lumber from the intake at the face of the dock to the shore line, and of concrete for the remainder of its length to and under the generator room. To prevent the rapid deterioration of the brass condenser tubes by the galvanic action which usually occurs where salt water is employed for condensing purposes and which is often aggravated by stray currents passing through the water pipes into the station, and from thence to the condensers and out through the pipes leading into the intake and discharge flumes, a motor generator set has been installed and provided with suitable controlling apparatus for maintaining in each condenser a counter electromotive force slightly in excess of the electromotive force due to the galvanic action and the stray currents.

The initial installation consists of twelve 525-hp Babcock & Wilcox water-tube boilers set in batteries of two boilers each, and arranged with eight boilers on one side and four boilers on the other side of the boiler room, separated by a 21-ft. firing floor. Provision is made for four additional boilers to take care of the fourth turbo-generator unit when it is installed. These boilers are equipped with Roney mechanical stokers and Babcock & Wilcox superheaters and deliver steam at 200 lbs. gage pressure and 125 degs. superheat.

Under ordinary conditions the boiler feed-water is delivered from the pump house at Mianus through a 10-in. main to a concrete reservoir of 600,000 gals. capacity situated just outside the power house. From this reservoir the make-up water flows by gravity to two 13,000 gal. feed-water tanks located in the boiler room basement. These tanks also receive the discharge from the hot-well pumps. The water is then drawn from these tanks by the feed pumps and delivered through the feed-water heaters and economizers into the boilers. An auxiliary source of feed-water supply is provided for by a connection to the mains of the Greenwich Water Company.

The feed pumps, which are three in number, are of the compound, direct connected, duplex, outside-packed plunger type. The pumping equipment at Mianus comprises two single-acting vertical triplex plunger pumps, geared to Westinghouse three-phase motors. One of these is of sufficient capacity to meet the requirements of the plant running non-condensing, and the

other to supply all the fresh water needed when running condensing. These pumps are operated by current obtained from the power house.

Three Green fuel economizers are provided.

After leaving the economizers the flue gases pass through sheet-iron flues to the fan chamber over the center of the boiler room. Here four 14-ft. fans, direct connected to horizontal high-speed engines, deliver the flue gases to the stack, which is only of sufficient height to carry the gases away from the building.

COAL HANDLING INSTALLATION

All coal received by water is unloaded from the barges by a steel derrick operating a clam-shell bucket and delivered into a hopper of 15 tons capacity at a height of 55 ft. above the dock. This bucket is operated by an engine on the dock, supplied with steam from the power house. From this hopper the coal is fed by gravity into a coal crusher, and from the crusher it drops into steel cars where it is weighed. The cars are then drawn by cable up an inclined single-track railway of 13 per cent grade and into the boiler room through an opening near the roof. This track is supported upon structural steel towers and is designed so that two cars can be operated upon it, passing each other through an automatic turn-out at the center. The cars discharge the coal into a hopper, from which it is delivered into two flight conveyors extending the length of the boiler room. Openings in the bottom of the flight conveyors discharge the coal into spouts leading to the stoker hoppers of the boilers. The capacity of the flight conveyors is in excess of the amount of coal required to operate the boilers, and the surplus coal is discharged at the further end of the boiler room into a concrete storage bin below the boiler room floor.

Coal received by rail is dumped from the car directly into a chute leading to this same storage bin. When the boilers are to be supplied from this source, the coal is discharged from the bin by gravity into a coal crusher and from thence into a bucket conveyor located in a tunnel underneath the bin, by which it is delivered to the flight conveyors above the boilers and thence through the chutes to the stoker hoppers.

The cable railway and the flight and bucket conveyor are operated by three-phase induction motors taking energy from the "station service" line.

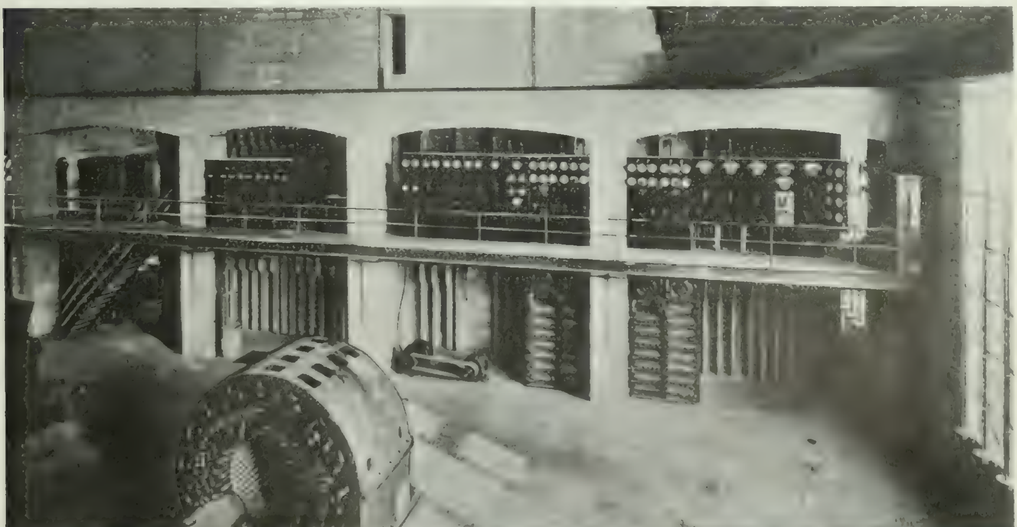


FIG. 4.—MAIN SWITCHBOARD GALLERY IN COS COB POWER STATION.

For cleaning the generators, switches, etc., compressed air is furnished throughout the engine room and switchboard gallery by means of a locomotive type of air compressor, supplying air at 100 lbs. pressure.

A continuous circulating oiling system for the turbine and generator bearings is installed. The oil is elevated by a small steam pump into a tank situated in the fan room and flows from this tank by gravity to the various bearings. After passing through the bearings it is discharged into a filter, and from the filter the oil passes to a receiving tank in the engine room basement to which the suction of the oil pump is connected. Taps are placed in this line at convenient points for filling the oil cups on the auxiliary engines and pumps.

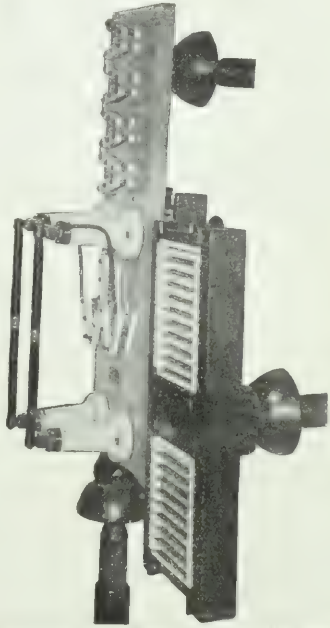
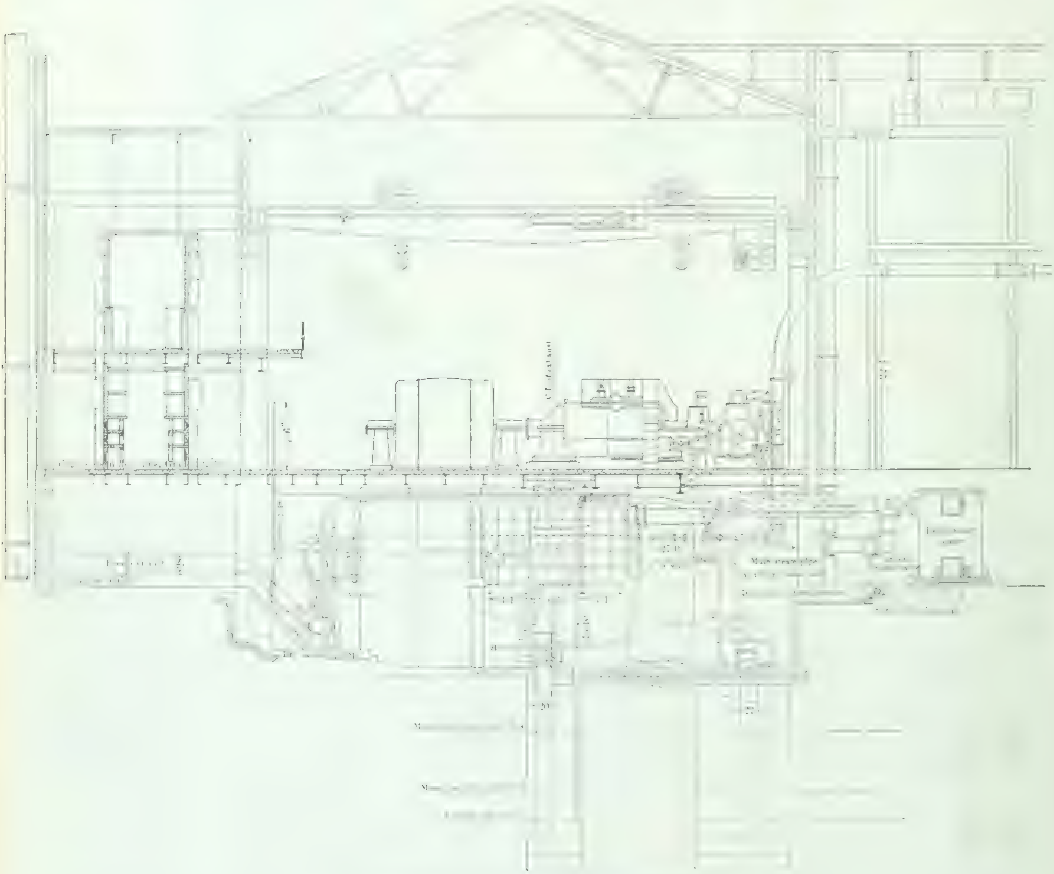


FIG. 5.—SPECIAL LOW EQUIVALENT LIGHTNING ARRESTER

[illegible]
o the high-tension buses under the switchboard gallery. These ircuit-breakers are electrically interlocked so that the buses [illegible]

The two high tension buses, with their accompanying switching equipment are interchangeable and are arranged so that each an be used separately; one supplying three-phase current to he Port Morris feeders, and the other supplying single-phase urrent for the locomotives. Each bus is further divided by knife switches into three sections; each end section containing generator leads and propulsion feeders, and the center section



[illegible]

[illegible] a still further subdivision can be effected.

[illegible] single-phase propulsion current, one leg is grounded directly to the track rails of the right of way through suitable switches; another leg supplies the outgoing feeders, which are run in duplicate, connecting directly to the trolley and which form the complete single-phase circuit; the third leg of this bus is also connected to a feeder which is carried along the right of way for the purpose of supplying energy for local purposes and completing the three-phase circuit along the line.

[illegible] single-phase machine without excessive loss in output, it may be mentioned that if in a star-connected three-phase generator the e. m. f. is E volts per phase and the current is I amperes per lead the total output is $3IE$; when the same machine is [illegible] current I amperes, so that the output is 1.732 IE, or 57.7 per cent of its former value. When the machine is given a combined three-phase and single-phase load, its output increases gradually to 100 per cent, as the three-phase load becomes more and more predominating.

For normal operation of this station one set of buses will supply the three-phase feeders leading to Port Morris, and the other set the single-phase propulsion feeders and the local three-phase circuits.

Each leg of the high-tension bus, consisting of two 3-in. x ¼-in. copper bars, is enclosed in a separate masonry compartment composed of pressed brick and soapstone, and is supported [illegible] of the compartment, the bushings providing for cable connections to the bus. Removable glass doors are provided in the bus compartments at small openings opposite all connections and supports. The connections between the bus-bars and [illegible] up in separate brick septums on the back of the bus-bar and oil circuit-breaker structure. Each oil circuit-breaker can be disconnected from the bus and circuit by hook type knife switches located on the rear of the structure.

The feeder cables pass along the top of the circuit-breaker

structure, thence to choke coils in the arrester gallery and through special windows to the line.

The arresters used in the generating station are of the multigap, non-arcing, low-equivalent type, in which respect they do not differ essentially from standard arrester equipments. An unusual feature resides in the use of a double auxiliary series of non-arcing gaps which are connected to the ground through enclosed fuses, as illustrated in Fig. 5. Considering the arrester in detail, it is to be noted that the main series of gaps is connected between the line wire and the ground with a resistance in series on the ground side; an additional resistance is placed in shunt to certain of the main gaps. The two series of auxiliary gaps with their separate fuses are joined in series with the main gaps on the ground side, and hence are in parallel with the resistance which is in series with the main gaps. It will be observed that if only one of the fuses blows, the other continues to be in operative condition; while if both fuses blow, the arrester is merely converted into a protective device of the low equivalent type. It is expected that minor discharges will pass across the arrester without damaging the fuses, and that the fuses will blow only in the case of excessive discharges which, with the more usual arrester arrangement, would probably cause the station to be thrown out of commission due to the opening of circuit-breakers.

The voltage of each high-tension bus is maintained constant by a Tirrill regulator controlling the exciter field circuits.

SWITCHBOARD.

The main switchboard is made up of marble slabs carrying Westinghouse instruments and switching apparatus. It contains four panels for the operation of the generators, three panels for the control of the exciters, two panels for the Tirrill regulators, one load panel, one inclined station panel for the synchroscope and alternating-current voltmeters, and five panels for the apparatus controlling the outgoing feeder system and the local high-tension circuits.

Each generator panel is equipped with instruments indicating the current per phase, the power factor, the watts, and the field current. Receptacles are also provided on each generator panel for making connections with the synchroscope and the voltmeters on the inclined panel. This panel contains the main

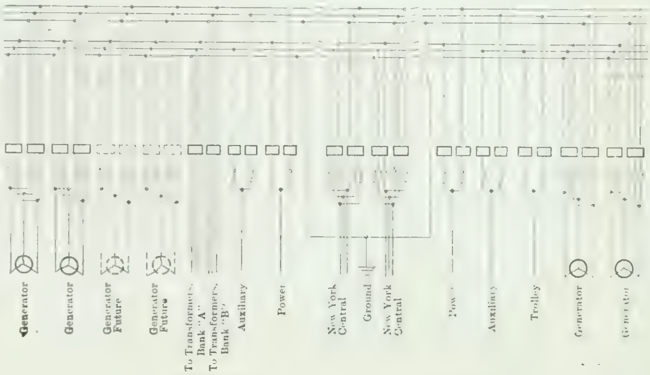


FIG. 8.—DIAGRAM OF HIGH TENSION CONNECTIONS.

field switch and rheostat hand wheel, together with an electric governor controller for changing the speed of the generators from the switchboard gallery for the purpose of synchronizing when it is desired to throw two or more generators in parallel. The oil circuit-breakers between the generator and the buses are also electrically controlled from these panels. Watt-hour meters are placed in the bus sections in such a way as to register the total output of the generators or of any group of feeders.

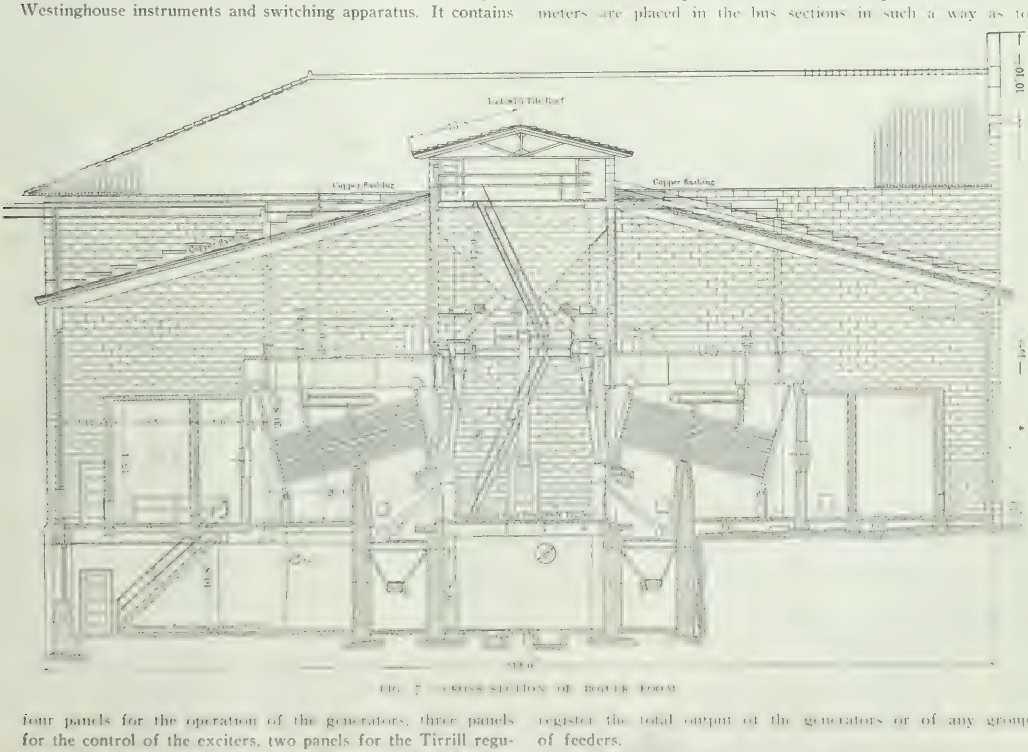


FIG. 7.—CROSS-SECTION OF BOILER ROOM.

Each feeder is equipped with an ammeter, overload relay and

[illegible] lamps on the [illegible] breakers.

[illegible] equipment for the feeders is found in the time-limit feature of the overload relay. Each overload relay is shunted by a fuse, which must blow before the fuse can act. The impedance of the fuse is so small compared to that of the relay that most of the current passes through the fuse. It will be seen, therefore, that the relay mechanism as a whole possesses a "time limit" exactly equivalent to a fuse. If for any reason it is desirable to operate without a "time limit," the fuse can be omitted. Moreover, the relay can be reset at any time without inserting a fuse, and yet the apparatus will be adequately protected.

For supplying power to the various motors throughout the station, duplicate sets of two transformers each are used. They are T-connected and supply three-phase current at 440 volts.

For the control of the station circuits a local service switchboard is installed containing apparatus for controlling the motor of a motor-driven exciter, the station lamp circuit, the motor circuit and the storage battery circuit. The storage battery, which is located in the basement below the switchboard gallery, consists of 55 cells of the Westinghouse Machine Company's type of 10 amps., rating for 8 hours, and is used for operating the control circuits of the circuit-breakers and the switchboard signal lamps. The battery is charged through a Cooper-Hewitt mercury converter, taking current from the alternating-current lighting circuit.

Cooper-Hewitt mercury arc lamps are used for general illumination and incandescent lamps for restricted locations. Alternating current for these lamps is supplied by duplicate single-phase 75-kw transformers delivering current at 115 volts.

The turbo generators and the exciters were assembled in place by the Westinghouse Electric & Manufacturing Company.

The power plant was designed and constructed under the administration of Vice-President McHenry. The regular engineering facilities of the road were supplemented by the services of Westinghouse, Church, Kerr & Company, who were associated in the design of the plant, and who, in behalf of the road, erected the building, and, except as before stated, installed the equipment.

Luminous Arc Lamps from the Standpoint of Central Station Operation.

A paper presented by Mr. Howard Grabhill at the recent Toledo convention of the Ohio Electric Light Association gave some interesting data concerning the commercial operation of luminous-arc lamps at Ashland, Ohio, during the past two years.

In comparison with the open arc lamps, which were used formerly, the luminous-arc lamp gives a better distribution of light, a better quality of light and experiences fewer "outages." Moreover, it is more economical in electricity consumption, permits of greater ease of adjustment and of trimming, and entails a lower cost for maintenance, repairs and renewals.

With the magnetite lamp the light distribution is more uniform than with the open-carbon arc lamp. A globe with a frosted or sand-blasted bottom is used, and there is almost no shadow beneath the lamp. Two things make possible the better light distribution of the magnetite lamp. First, the positive electrode does not form a crater as does the positive carbon of an open-arc lamp, resulting in the axis of maximum distribution being at an angle of about 45 per cent. And, second, the arc in the magnetite or luminous-arc lamp always has the same relative position, so that it is possible to use a reflector. This reflector is placed in a horizontal position just above the arc, but being of enameled iron it is unaffected by the heat and hence is not a part that would need to be renewed during the life of the lamp. The result is that the axis of maximum distribution of this lamp is at an angle of about 90 per cent, or almost horizontal. As the streets of Ashland are quite irregular and there [illegible] many shade [illegible] the better light distribution of the magnetite lamp is quite noticeable, and it is appreciated by at least a part of the citizens. Moreover, the quality of the light is excellent, being whiter than alternating-current lamps and steadier than open-carbon lamps.

Another advantage which this lamp has is that of fewer outages. When a lamp is found not to be burning it can usually be started by jerking the rope by which it is raised and lowered. The stoppage is caused by a small particle of the burnt electrode getting between them and acting as an insulator. It has been found necessary to replace broken globes at once, as this lamp will not burn unprotected from the air. This is not a serious defect, as the long burning feature of the lamp makes frequent trimming or handling unnecessary; hence the chances for broken globes are reduced. Moreover, it is believed that a city has a right to expect the lighting company to keep its globes in repair, whether the lamps used be open carbon, alternating current or magnetite lamps. The ratio of outages as compared with the carbon lamp has been one to three in favor of the magnetite lamp.

The low wattage of the magnetite lamp is one of its most distinguishing characteristics. It is designed to operate on direct-current series circuits with from 70 to 80 volts at the lamp terminals or by mercury arc rectifiers connected to alternating-current circuits. In Ashland the direct-current system is used, energy being furnished by a Brush arc machine. The replacing of a 480-watt lamp with one consuming 320 watts has been found to be a great benefit to the company.

Because of the long burning feature of this lamp, the maintenance cost, as compared with open-carbon lamps, is very low. The upper or positive electrode, a heavy piece of copper, is reversible and has a life of about 4000 hours. The lower electrode, an iron tube, ⅝ in. in diameter and 8 ins. long, and filled with black magnetic oxide of iron, has a life of 175 hours. It is thus necessary to trim the lamps only nine times a year. The cost of maintaining these electrodes on the midnight schedule is about 60 cents per lamp per year.

The two adjustments, the length of the arc and the feed contact magnet, are easily made. The length of the arc is controlled by an adjustable stop which is fastened by a set screw to the left hand guide rod. To increase the arc voltage, raise this stop; to decrease the voltage, lower it. After an adjustment has been made the lower electrode rod should be tripped and then pushed up as in trimming. The feed contact magnet is adjusted by lowering or raising the armature disk and check-nut placed just below it. If the lamp feeds too often, the disk should be turned to the left. If not often enough, it should be turned to the right. This magnet is in shunt with the arc and should close the contacts, causing the lamp to feed, when the arc voltage rises to about 110 volts.

In trimming the lamp, the first thing to do, after the globe has been unlatched and swung over to the side, is to clean the center tube, which serves as a chimney through which the fumes of the arc pass out of the lamp; unless the tube is kept clean there is danger of the reddish-brown fumes accumulating in it and clogging it up and settling on the inside of the globe and shutting off the light. A small brush run through this tube a few times readily cleans it. Next the globe should be cleaned. The accumulation of the reddish-brown dust on the globes, from one trimming to the next, while slight, is sufficient to cut off considerable light. It is, however, easily removed with a cloth dampened with coal oil. To replace the burned-out electrode, the tripping rod should be pushed up until the clutch in the lamp is disengaged. The lower electrode holder will then drop into a position where the change is quickly made. To those who have had the experience of trimming the open-carbon lamps, the ease with which the magnetite lamp is trimmed is at once apparent.

Repairs and renewals cost last year 54 cents per lamp. With the latest type of lamp it is believed that this item will not be so large, because it has a heavier globe and does away with a large copper ash pan, and these were the only two parts requiring replacement during the year. [illegible]

however, this item will be larger on account of changing to the new type of lamp.

As a whole, the system comes fully up to the lighting company's expectations and is regarded as the best in operation at the present day.

What Is the Best Form of Power for Stations of Five Hundred Kilowatts or Less?

In a paper presented at the recent Toledo convention of the Ohio Electric Light Association, Prof. F. C. Caldwell stated that for small stations there are now available the following types of apparatus: Direct-current, two-wire, 220-volt and three-wire, 110-volt; also, alternating-current, single-phase or polyphase. The choice between these will depend, first, on the character of the load to be supplied; second, upon the size of the plant, and, third, upon the conditions under which it will be operated. A few years ago the two-wire, 220-volt, direct-current system seemed likely to take an important position for the smaller central station supply. Two factors, however, have recently been introduced into the problem, both of which are unfavorable to its growth. The first of these is the development of metallic filament incandescent lamps. The low resistivity of metals, as compared with carbons, makes the extension of these to voltages as high as 220 seem improbable, while the great saving in energy, resulting from their use, dare not be overlooked. The other factor is the placing on the market of successful three-wire generators at a cost not greatly in excess of the standard type. The 220-volt system has never been much used in this country outside of the smallest plants, though its simplicity and comparative economy in distribution were strong arguments in its favor. It will doubtless continue to be employed in cases where transmission for power purposes is the main business; but where lighting is an important element, it is probable that it has passed its period of greatest usefulness. The problem may, therefore, be narrowed down to a question of three-wire direct current versus alternating current, single-phase or polyphase.

As between the direct and alternating current, this question of distribution of load is the most important factor. Wherever more than one town is to be supplied with energy from the same plant, or where the character of the farming population is such as to make the sale of energy for lamps and motors among them a matter of importance, the decision must be in favor of alternating current. On the other hand, where the conditions seem to set definite and comparatively narrow limits to the area over which the plant will supply energy, the greater simplicity, higher economy in distribution and superior regulation usually obtained from direct current plants, may determine in favor of this form of supply. The amount and character of the motor load must be given careful consideration. If this is large in the immediate vicinity of the power plant and especially if variable speed is important, the direct current will have the preference. If, on the other hand, the demand is more widely scattered, or is of such a nature that the simplicity and brushless character of the induction motor recommend themselves, the decision may be favorable to alternating current. The use of the storage battery in connection with the direct-current system gives it an advantage. In some cases, for instance, it may be possible to supply direct current for 24 hours with the use of only one 10 or 12-hour shift, at the same time obtaining the great advantages in the matter of regulation and storage against an emergency shut-down which are provided by the battery. Such a use of the battery, however, would only be possible in cases where the motor load is negligible, a condition which is in itself unfortunate. In general also the small plant is unable to supply the same quality of expert attention for the battery as is possible in larger stations, and this would often make its use questionable. In the case of [illegible] being installed to a considerable extent in the villages of the country, the use of an alternating-current system with a frequency of 25 cycles should receive careful consideration. This would often be advantageous on account of the possibility, actual or prospective, of joining up such a plant with the 25-cycle distribution system of some interurban electric railway. Ample experience has demonstrated the satisfactory operation of incandescent lamps with 25-cycle current, and in almost every case it would be more economical to purchase energy from railway systems during a considerable part of the 24 hours rather than to keep the generating plant operating continuously. In many cases the whole output of the station could be most advantageously obtained in this manner. This suggests the supplying of energy from one plant to a number of small towns throughout a given district, a field which deserves more energetic cultivation than it has yet received.

The question of the use of single or polyphase alternating current is also an interesting one. Single-phase motors are obtainable in small sizes running up to about 30 horse-power, so that where the supply of power in large units is not to be anticipated, as, for instance, in the case of a strictly farming community, much is to be said in favor of the greater simplicity of the single-phase. Especially is this true in the case of the smaller plants where it is not practicable to employ a superintendent who has had much training or experience. In the case, however, of the larger plants within the range under consideration, especially if connection with an electric railway supply circuit is considered, the polyphase system should probably be used. With a little more care in distribution, just as good results can be obtained as with the single-phase, and the possibility of the use of larger motors is always present.

With reference to prime movers, Prof. Caldwell made the following classifications: I. Water power; II. gas power—natural gas, producer gas; III. steam power—reciprocating engines, turbines.

With regard to water power, nothing need be said, further than to predict that before many years energy will be developed in Ohio by water power at a greater rate than is now done. It is a very interesting problem, but, of course, peculiar to special localities only.

Where natural gas is available, there is hardly room for any further discussion of this subject, so far is the gas engine thus operated superior to all other forms of heat engines. With a thermal efficiency approximately double that of reciprocating steam engines, with the entire absence of loss when the engine is not running and with the great rapidity with which it can be brought into operation, no form of steam engine is to be compared with it for small plants. The complication and liability to accident and shut-down which have been in the past attributed, with more or less justice, to the gas engine, have of late been rapidly losing weight by virtue of improvements in design and greater familiarity on the part of engineers. In the case of small plants for lighting or power purposes, the defect of the gas engine in not having a considerable overload capacity is not so serious as in other lines, although it must be taken into account in the design of the plant.

In the absence of either water or natural gas, the producer and gas engine plant is in free competition with the various forms of steam engine, with a strong indication that the odds are coming to be more and more favorable to the former. Here success depends entirely upon the producer, which seems satisfactory in the case of the harder coals. In Ohio, however, the producer must demonstrate its ability to handle the bituminous coals of the state before it can be generally accepted as a substitute for the steam boiler. Its friends already claim the victory and when account is taken of the relative time that has been spent in the development of the producer and the boiler, those who have been devoting themselves to the former certainly deserve congratulation. With a producer working successfully with soft coal, the steam engine will, indeed, have to look to its laurels, for the possibility of getting nearly twice as much energy from a ton of coal, together with the small standby losses and the quick service, give the gas engine enor- [illegible]

[illegible]

the turbine has induced in the case of the larger stations, has not been much felt by the smaller. Although at present turbines in a variety of smaller sizes are available, their use does not show as great an advantage over the reciprocating engine as in the large sizes; generally speaking, also, in the case of the small station, economy of space is not so vital a matter as with the large city plant. On the other hand, the simplicity of the turbine should be a matter of even greater consequence, so that the question of relative first cost would probably be a determining factor in most cases. Of course, wherever condensing water is available in ample quantity, anything but the very smallest plant should be operated with compound condensing machines. The availability of condensing water would also be important in determining the use of turbines. The question concerning the use of artificial means for the cooling of condensing water is a financial one, and depends largely upon the price of coal, the cheapness of which in Ohio would seldom permit of the use of this system. Another factor which should always receive consideration and which may at times determine the character of the steam plant, is the sale of exhaust steam for heating purposes. The jacket cooling water in a gas-engine plant may be similarly used.

In the case of small lighting and power plants, their combination with some other form of industrial activity should be given consideration. In many cases, a power plant may be made to pay if during the daytime the energy of the plant can be consumed in the operation of some productive industry. This works out especially well where the industry is of such character that a part at least of its machinery can be closed down an hour or two earlier during the winter months without seriously interfering with its success. A combined electric and pumping plant is a similar case. This is an especially desirable arrangement, if water storage is available, so that the pumps can be entirely shut down during the period of peak load. In this connection the electrically-driven centrifugal pump which has recently come before the public ought to prove useful.

New Telephone Patents.

[illegible] SWITCHBOARD SYSTEMS.

In all common battery systems the function of the battery in absorbing the irregularities of the charging machine current is well understood, and to obtain the full advantage of this it is customary to connect all leads so that the battery is actually between the generators and switchboard. An entirely opposite arrangement is now proposed by E. E. Clement, of Washington, D. C. He connects the battery to all line circuits permanently through individual retardation coils, while the machine is connected to all cord circuits. It will be understood, then, that whenever a cord is plugged to a line, the generator supplies current to the line and also through the coils to the battery. This will keep the battery charged and the inventor claims will provide for an absorption of the generator noises. This latter claim, however, seems to have little foundation, if we are to judge from usual experience, as retardation coils of sufficient size to prevent a shunting of the talking currents by the battery must certainly back up into the line a large part of the noise.

Relays connected in a talking circuit have for a long time been provided with a comparatively high-resistance, non-inductive shunt to prevent undue attenuation. Now C. S. Winston, of Chicago, has introduced the same arrangement on relays whose circuits are abruptly opened to absorb the coil discharge, and thus prevent this from causing undesired operation of the apparatus connected in its circuit. For example, where a locking relay is in the circuit, the unabsorbed kick of a relay in a branch of the circuit may overcome the locking coil current. Mr. Winston [illegible] of this sort to the Kellogg Switchboard & Supply Company.

H. P. Claussen has patented two circuit inventions, which are assigned to the American Electric Telephone Company. One of these relates to the busy test of a two-wire system, and provides a retardation coil in the test circuit. This coil holds back the current of the test so as to prevent any annoying clicks upon the lines tested. It has the further function of preventing any leakage of the talking currents of busy lines to the test circuit. The other patent describes a system where both magneto and central signalling lines are used. A repeating coil may be cut in or out of circuit according to whether the lines connected are similar or dissimilar.

PARTY-LINE SYSTEMS.

A. J. Fanner, of Detroit, Mich., has invented apparatus for party stations working upon the group system. The lines from the various stations are brought to a control point, where the group switching apparatus is placed. From this point the main line extends back to the central office. The operator can control the distant switching apparatus to connect up the various stations as desired. This is accomplished by a step-by-step action which rotates an arm over a contact dial. The stepping action takes place automatically in response to a steady pressure upon a special key. Each step is indicated by a signal lamp before the operator. After a conversation, the pressing of another key advances the switch to the zero position.

A lock-out system forms the subject of a patent granted to D. W. Kneisly, of Dayton, Ohio. The lock acts upon the hook switch lever at each station, the lock lever at each station being released by a certain number of steps forward of the controlling bar. Normally the locks clear the hooks, but the first step of the bar locks up the line, the desired station then being released by further motion of the moving bars.

[illegible]

A pole cable terminal has been patented by E. C. Flory, of Santa Barbara, Cal. This provides a sealed compartment, two of whose faces are of insulating material upon which binding posts are mounted. A smaller internal compartment having a perforation serves as a cable entrance, and after the cable is in position, may be filled with sealing compound. The terminal is arranged on a circular base and is provided with a cylindrical sheet-iron cover.

In order to close the opening of a transmitter to shut out all sound at will, H. Gross, of New York City, has mounted his transmitter mouthpiece upon a slide. This slide moves across the transmitter face so as to close the opening, or to maintain the mouthpiece in front of it as desired.

LETTERS TO THE EDITORS.

Telephones for the Partially Deaf.

To the Editors of Electrical World:

SIRS:—In your issue of Aug. 10, you refer to a miniature telephone receiver, recently produced and now being experimented with in Stockholm, Sweden. The statement made as to its adaptability as an aid to the deaf prompts me to make several statements of fact, in that connection, that may prove of interest and perhaps of some value, in view of my work in the production of instruments for the deaf, now in common use, and to which I devoted seven years of effort.

Owing to the supersensitiveness of the deaf, a device to meet with their approval must necessarily be inconspicuous. Unfortunately there is an element which enters here that places a limit on the diminutiveness of the ear piece or receiver, and that element is the surgeon's knife.

Several years ago I constructed a diminutive receiver, only one-quarter of an inch in diameter, and five-sixteenths of an inch long. When introduced into the external meatus, the diaphragm being one-quarter of an inch from the tympanic membrane or drum of the ear, the results were astonishing. The flesh-colored flexible cord leading out and connected to a

transmitter and a small dry battery concealed on the person, completed the outfit. The deaf man on whom I was experimenting was happy, but he did not remain so very long. He went to the hospital and came out minus a part of his skull, from a mastoid operation

Other efforts toward concealing the receiver within the ear, and even with models constructed with front conical projections barely entering the meatus, caused a recurrence of the same symptoms that existed prior to the operation on the other subject above referred to.

Many materials were tried, with a view toward arriving at a combination such as would not cause irritation. My efforts were of no avail, and I eventually adopted the watch-case receiver type, necessitating its being held against the concha of the ear by the hand or small head band.

There is an old medical axiom for which I have a great deal of respect—"Nothing smaller than one's elbow should be introduced into the ear." There are many so-called "ear drums" advertised, intended for insertion into the ear. They cost a very small amount to purchase and for insertion, but on the other hand, the revenue of aurists is greatly enhanced by *removing them,* and many times in a big hurry.

The ear resents the presence of foreign material very much as does the eye, although in a slower and more dangerous manner. The brain and ear are not far removed from each other. Inflammation of the ear is quickly communicated to that of the mastoid portion immediately behind the ear. Once this becomes affected, it is very apt to mean a serious operation to prevent death. I therefore feel that any experiments along this line should be entered into with a full knowledge of the conditions obtaining.

As to the value of the device described, to a telephone operator in a central station, I am of the opinion that, aside from the inflammatory effect above referred to, there will be found another element which enters here. In such a receiver, there is a closed air column between the diaphragm of the receiver and the drum of the ear. We have all experienced the painful "clicks" to which we are sometimes subjected in the use of the ordinary telephone, often necessitating instant removal of the ear piece from the ear. The ordinary watch-case receiver diaphragm is removed considerably from the tympanum and this effect is considerably less than would obtain if a receiver is inserted into the ear.

It will be found by our friends across the sea that the receiver is the simplest part of an instrument for the deaf. It is the transmitter that is the key to the situation. One to be of value to the deaf must amplify in inverse ratio. The faint articulate sound of words must be amplified much more than the vowel sounds, which latter the partially deaf person already hears. An instrument which will amplify in direct ratio will so overload the ear with sound as to render appreciation of the articulation impossible. For instance, the proper transmitter when *whispered* into, should operate at its maximum, and when *shouted* into, not operate at all. As the speaker recedes from the transmitter, this ratio is not so great, but with the result that spoken words at a distance are distinctly heard by the deaf person.

There are many other elements which enter into the design of an aid for the deaf, such as sluggishness of the small bones that transmit the sound from the ear drum to the oval window, all of which would render this letter too voluminous; but I shall be glad at some future date to contribute an article bearing on this subject.

My efforts in this direction were interrupted before I had arrived at what I considered a perfect machine, so there is room for improvement. Experimenters entering this field should, however, remember that a fairly good knowledge of medicine is necessary to produce the best results, and that no one device or one adjustment of instrument can be expected to meet with universal success. Such devices should be fitted to the ear as are eye glasses to the eye, and not until this is done intelligently *and by experts,* can the deaf expect to receive benefit from a panacea for their affliction.

New York. MILLER REESE HUTCHISON.

Instruction in Illumination for Architects.

To the Editors of Electrical World:

SIRS:—In view of a statement in an editorial of your issue of July 27, namely, "We are not aware of a single course in illumination given to students of architecture anywhere in the world," I trust that the accompanying marked copy of the current catalogue of the University of Illinois will be of interest. As you will see from it, a short course for all students in architecture and in architectural engineering is given at the University of Illinois, described in the catalogue as follows: "Lighting—For architects. Electric lamps and other illuminants, and their effective use. Interior wiring. Methods of electrical distribution." This course has been given regularly for the past five years, and covers illumination for utility, for decorative effect and for advertising. It also includes a discussion of prismatic glass and the relation of the location of day to evening light sources. The students are urged to introduce raceways for wires in any building they may design, and are required to report on some actual installations, noting any infraction of the Underwriters' Rules. Demonstration of lighting by different types of lamps is given in the "Illumination Room" of the electrical department, where the proper lighting of pictures is also discussed. The course should occupy more of the architectural students' time, and will probably be strengthened now that interest is growing in all matters relating to illumination.

UNIVERSITY OF ILLINOIS. MORGAN BROOKS,
Professor of Electrical Engineering.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors, and Transformers.

Alternating-Current Motors.—H. GÖRGES.—The conclusion of his paper read before the German Association of Electrical Engineers on the theory of all alternating-current motors discussed from a common point of view. The explanation of the action of single-phase and polyphase alternating-current motors is based on a resolution of the induced magnetic flux in the rotor into two components in electrical space quadrature to each other, of equal frequency, but differing in amplitude and phase. If the winding of the rotor is also imagined to be resolved into two windings the axes of which are in the direction of the above components, two e. m. f.'s occur in each of these windings, their amplitude and phase being determined by the components of the magnetic flux. The currents are divided into free, unfree and forced ones, and are determined from Ohm's law. By combining the currents with the magnetic fluxes, two torques of double frequency are obtained which always produces in single-phase motors a pulsating total torque. This theory is applied to the four main types: induction motors, series motors, series short-circuited motors and repulsion motors. The direction of rotation is found from the torque at rest, and the behavior of the motor while running is then discussed. Finally some notes are given on general problems concerning voltage, size and weight, capability of regulation, commutation and frequency. In the same issue an account is given of the extended discussion which followed this paper, and also of the discussion of some other papers on single-phase motors (the other papers themselves being not yet published). In this discussion, in which Eichberg, Heyland, Richter, Schueler, Breslauer and Sahulka participated, the

relative advantages and disadvantages of the different new types of single-phase commutator motors were discussed. Goerges thinks that each type will find its own field of application.—*Elek. Zeit.*, Aug. 1.

Single-Phase Motors.—W. CRAMP.—An account of the result of tests of his single-phase motor, which is diagrammatically shown in Fig. 1, where A and B are the two limbs

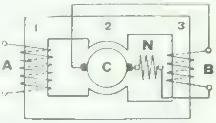
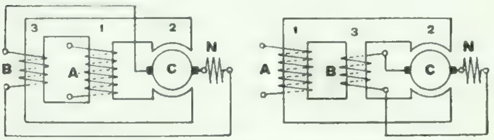


FIG. 1.—DIAGRAM OF SINGLE-PHASE MOTORS.

of the motor, C the armature. On the limb A is wound a coil connected to the supply mains. By transformer action the coil on the limb B supplies current to the armature C, which may or may not have a neutralizing coil N in series with it. The results of the tests, which are given in diagrams, show that such a motor has characteristics of speed, torque, current, voltage, very similar to those of a series motor, and that with constant terminal voltage, the primary current may be expressed by a circle diagram very similar to that of the induction motor. Besides the form shown in Fig. 1, two other forms are possible, which are shown in Figs. 2 and 3. Of



FIGS. 2 AND 3.—OTHER FORMS OF SINGLE-PHASE MOTORS.

these three forms the author thinks Fig. 2 to be the best one, its advantage over Fig. 1 being that the iron between limbs 1 and 2 does not have to carry the flux due to limb 3, so that this form may be constructed lighter and more compact than that of Fig. 1. The differences between such a machine and a series motor are mainly, first, in the armature turns required for a given terminal potential difference and, second, in the section of yoke ring required. With respect to the first point the comparison is to the disadvantage of the series motor; with respect to the second point it is to its advantage.—Lond. *Elec. Rev.*, Aug. 9.

Lamps and Lighting.

Flame-Arc Lamps.—A. BLONDEL.—The conclusion of his serial on recent progress in flame-arc lamps. The author first gives some notes on the obnoxious fumes (nitrogen, oxides, etc.) developed in the lamp and on the methods of avoiding them, also on the reduction of the potential drop in the electrodes and on the quality of the light of flame arcs. Tables are given summing up the principal properties of different direct-current and alternating-current arc lamps made in Europe, especially current, volts, watts, candle-power, specific power consumption in watts per candle-power, and consumption of the electrodes. From these tables it appears that the chief merit of the impregnated carbons is the realization of small candle-power lamps with a good efficiency. It is possible to go down to 3 amperes and 55 volts, although the light then becomes somewhat unsteady and more red in color. Lamps consuming a greater amount of power have a more steady and whiter light; lamps of 250 or 300 watts for direct current or 350 or 400 watts for alternating current are specially recommended for public lighting. Some tests are quoted which have been made in a French laboratory. For impregnated carbon arcs, supplied with direct current between 6 and 8 amperes and between 27 and 33 volts the luminous flux in lumens is given as function of the current i in amperes and the voltage V by the following empirical formula: lumens $= (34.3\ i + 610)\ V + 1550\ i - 25{,}146$. For example, with 7 amperes and 33 volts, corresponding to about 230 watts, the luminous flux is 13,750 lumens, the mean spherical candle-power being 10,900. For alternating currents between 12.5 and 16.5 amperes and between 28 and 36 volts, the corresponding formula is: lumens [illegible] 222.5 [illegible] — 1573.5 [illegible] — 4100 [illegible] For example, with 14 amperes and 30 volts, corresponding to about 400 watts, the flux is 20,000 lumens, the mean spherical candle-power being 15,900. The latter lamps are used very satisfactorily for lighting a Paris street. The flame-arc with carbons impregnated with calcium salts, consumes between 0.1 and 0.25 watts per hefner candle; that is, about one-fifth or one-fourth as much as arcs with pure carbon and one-third or one-half as much as mercury-vapor arcs. While with the ordinary arc the source of light is an incandescent disk (crater), partially obscured by the negative carbon, the source of light in the flame arc with impregnated carbons is a vertical luminous cylinder below a diffusing disk. The flame arc is far more favorable for lighting of large spaces. By giving the reflector a special form the distribution of the light may be modified. The author thinks that the flame arcs with impregnated carbons will replace the open arcs in Europe, while the titanium arc will replace the enclosed arcs in the United States.—*L'Eclairage Elec.*, July 13.

Influence of the Surrounding Temperature on the Candle-Power of Incandescent Lamp.—F. [illegible] AND R. [illegible].—An account of laboratory experiments in which the authors investigated whether the temperature of the surrounding air has a measurable effect on the candle-power of an incandescent electric lamp. An incandescent lamp consuming about four watts per candle was fixed in a stove with a transparent side. A photometer was placed at a certain distance from the stove, and equal ilumination was obtained on its screen by moving the standard lamp. Great precautions were taken to maintain the voltage across the lamp terminals constant, a potentiometer being used for this purpose. In order that the variation of temperature should have no influence on the resistance of the contacts, both the main and voltmeter wires were soldered direct to the lamp terminals. The candle-power of, and the current through, the lamp were measured under the following conditions: (1) With the stove cold, at a temperature of about 15 degs. C.; (2) during the heating of the stove; (3) with the stove at a constant temperature of 115 degs. C.; (4) during the cooling of the stove; (5) with the stove completely recooled at a temperature of about 15 degs. C. The candle-powers measured were found to be practically constant, the greatest variation between the extreme readings not exceeding 1 per cent. From the Stefan-Boltzmann law it is deduced theoretically that the candle-power would increase 0.4 per cent per 100 degs. of temperature variation, which would not have been observable with the experimental conditions of the investigation of the authors.—Lond. *Elec.*, Aug. 9.

Traction.

Electric Railway in Spain.—The Company of Railways in southern Spain intends to operate electrically, as a trial, a branch line 22 km. in length, of the railroad between Linares and Almeria. This branch line, which has an almost constant grade of 2.75 per cent, is single-track and with steam traction the disadvantage is now experienced that the trains running down hill can run only at low speed. When the freight traffic increases on this line, improvements are expected from electrical operation. To recuperate energy when running down hill, three-phase currents will be used, and a double trolley line is provided for this purpose, the voltage being 5500. Electric locomotives will haul trains of 150 to 300 tons at a speed of 25 km per hour. For the trial, electricity will be obtained from a steam-generating station, but if the experiment is successful, the whole line will be equipped electrically and water powers along the line will be developed.—From [illegible] Vol. [illegible] abstracted in *Elek. Zeit.*, Aug. 1.

Storage Battery Traction.—E. C. ZEHME.—On specially selected lines of the Palatian railways, storage battery cars have proven quite satisfactory since 1895; they are now used

there on lines having a total length of 135 km. The success is due primarily to a careful selection of the lines on which this system is used. The equipment of these storage battery cars is described and illustrated. They are used only in such districts where the railways have their own generating plants, so that cheap energy is available for charging the batteries. The Prussian-Hessian railways are also now installing storage-battery cars for suburban traffic near Mainz. Each of the smaller cars will contain 180 cells of 10 tons total weight while each of the larger cars will contain 180 cells of 15 tons weight. The axles will be driven by means of two series motors in the usual way. The following estimate of cost is given. For the generation of 200,000 kw-hours with Diesel engines the cost per kw-hour including interest and amortization is 1.25 cent. No special attendance is assumed, since the motorman will attend to the charging of the batteries at the station. The consumption of 200,000 kw-hours per year relates to a distance of 180,000 km covered per year by the five cars, so that each car is assumed to travel 36,000 km per year. The cost of maintenance of the storage batteries is assumed as 2 cents per car-km. The total cost of operation is 8.75 cents per car-km, including interest and amortization. With the new cars which contain 100 or 110 passengers the total cost is estimated as 12½ cents per car-km. so that if the tickets are sold at one-half cent per km, the income will cover the expense even if only one-fourth of the seats are filled. The life of the positive plates is assumed as 120,000 km, that of the negative plates 80,000 km.—*Elek. Zeit.*, Aug. 8.

Surface Contact System.—The report and accounts for the Lincoln municipal tramways, which is the only line now working on the "G. B." surface contact system (to be used on a trial line in London), show working expenses of 13.396 cents per car-mile, not including capital charges, a figure which is brought up to 22.224 cents per car-mile by the inclusion of all capital costs. The line is less than two miles in length, and the car mileage is smaller than for any other municipal tramway system.—Lond. *Elec. Eng'ing*, Aug. 1.

Current Collecting Device.—An illustrated description of a new form of current collecting device for overhead electric railways of the British Thomson-Houston Company. Contact is made with the trolley wire by a number of bars, and a means of adjustment is provided at right angles to the trolley wires, so that as the grooves are worn into the bars they can be shifted lengthwise, and the wear can thus be distributed over the whole surface.—Lond. *Elec Eng'ing*, Aug. 1.

Electric Traction on Railways.—P. DAWSON.—The third article of his paper on electric traction on railways. In the present instalment he gives remarks on choice of acceleration and motors.—Lond. *Elec.*, Aug. 9.

Rail Corrugation.—W. W. BEAUMONT.—A paper read before the British Association for the Advancement of Science on the origin and reduction of the corrugation of tramway rails.—Lond. *Elec. Eng'ing*, Aug. 8.

Wires, Wiring and Conduits.

Submarine Cables for Electric Transmission.—An account of a case of the transmission of electrical energy at high pressure through submarine cables. The cables in question form part of the line connecting Venice with Lido. This line is partly overhead and is supported on insulators fastened on iron trellis-poles which are fixed in cement foundations; but as it has to pass across several navigable canals, it is necessary that a part should be submarine. The longest submarine section is somewhat over half a mile, and is laid at a depth of about 3½ fathoms. Energy is transmitted by three-phase currents at 6200 volts and a frequency of 42. Three single cables are used to allow of greater flexibility. A fourth cable is laid which provides against possible damage due to blows from anchors, etc. The cables used are constructed with a new type of insulating material, having gutta-percha as a base. Over the core, which is 25 sq. mm. in section, are wound two layers of insulating material of different compositions. These are protected against damp by a lead sheath, which is covered with tarred jute and with an armoring of phosphor-bronze wire. This system was chosen in order to diminish the loss of energy due to eddy currents and hysteresis.—From *Ellettricista;* abstracted in Lond. *Elec.*, Aug. 2.

Electrophysics and Magnetism.

Constitution of Atom.—E. RUTHERFORD.—A paper read before the British Association for the Advancement of Science. The author reviewed the development of the conceptions of ions and electrons. While the electron is the unit of negative electricity, there is much speculation as to the nature of positive electricity; some regard a positive charge as a sort of cement to hold electrons together in the atom. As the smallest negative charge that can exist is that of the electron, so it is probable that the smallest positive charge corresponds to that of the whole hydrogen atom. It is doubtful whether the whole mass of the atom can be explained electrically. The author does not think that much help will be derived in the future from spectrum analysis in the elucidation of these problems, since it is probable that the bright lines in the spectrum are largely due to electrons superficially attached to the atom, and not to the actual electrons forming its internal structure. The real spectrum from these probably lay far away in the ultra violet direction. In the discussion which followed Sir Oliver Lodge spoke as one of the champions of the electrical theory of matter. Mass and inertia can probably be explained by consideration of the magnetic field set up by the motion of the charge. Radiation can be accounted for by the fact that a charge, when accelerated, must radiate energy and throw the ether into waves, and for this it is not necessary to assume a compressible ether. Sir William Ramsay said that what interests chemists more than the internal construction of the atom is the detachable electrons upon which the valancies probably depend. F. Soddy took a contrary view to Sir Oliver Lodge, and said that he had difficulty in making all the work of the theorists agree with recent experimental results and could not bring himself to regard matter as purely electrical. Prof. Schott, in the course of his remarks, spoke of difficulties in reconciling the large number of lines in metallic spectra with the small number of superficially attached electrons postulated by some authorities. Lord Kelvin spoke at some length, and again referred to his abandonment of the theory that elasticity could be explained by motion alone. He did not agree with the view that the internal energy of the atom was entirely kinetic, and considered it was more of a potential or static nature.—Lond. *Elec. Eng'ing*, Aug. 8.

Short Sound Waves Produced by Spark Discharges.—W. ALTBERG.—The shortest sound waves hitherto produced by acoustic means were those produced by Koenig with tuning forks, and by Edelmann with a Galton whistle. The wave length of the former was 3.8 mm. and of the latter 2 mm. Lodge, on the other hand, produced audible notes by means of condenser discharges through large inductances. The present author used this method for obtaining the shortest possible sound waves, and measured their lengths by means of diffraction gratings. The shortest wave-length which the author succeeded in measuring was 1 mm. which is an octave higher than Edelmann's shortest.—*Ann. d. Phys.*, No. 7, 1907; abstracted in Lond. *Elec.*, Aug. 9.

Helium in Common Ores.—R. J. STRUTT.—An abstract of a paper read before the British Association for the Advancement of Science. It is now recognized that the origin of the presence of helium in many minerals is due to radioactive changes and the author has investigated whether helium can be found in certain common minerals which are not known to contain even traces of radioactivity. He has been able to find traces of helium in almost all metalliferous ores and strong minerals. Concurrently with the helium determination, the quantity of radium was also determined by well-known methods, and it was found that the quantity of radium present is in almost all cases sufficient to explain the helium without postulating its production with the small radioactivity which there has been

Eng'ing, Aug. 8.

Resonance Transformers.—A. BLONDEL.—An English transla- [illegible] charged by transformers and on the regulation of resonance transformers. The author investigates the conditions determining the nature of the secondary discharges.—Lond. *Elec.*, Aug. 2.

Photoelectricity.—W. F. HOLMAN.—An account of an experimental investigation of fatigue and recovery of the photoelectric current.—*Physical Review*, August.

[illegible] can Physical Society paper on the bolometric measurements of [illegible] *Review*, August.

Electrochemistry and Batteries.

Electrolytic Rectifier.—G. SCHULZE.—An account of an investigation in which he found that for an electrolytic rectifier tantalum is even superior to aluminum as a material for the electrodes. There is no electrolyte in which tantalum fails to show a valve effect. The voltage which the non-conducting layer deposited on the anode is capable of resisting is also much higher, being over 650 in carbonate of soda, 600 in various fluorides, and 70 in concentrated caustic potash. It is best to have the tantalum electrode entirely immersed, as otherwise sparks may pass from the surface of the liquid to the emergent portion. Such sparks show the tantalum spectrum, whereas sparks through the liquid show nothing but the spectrum of the electrolyte. The anode skin is easily formed in the course of a few minutes, and is not much affected by heat. Herein it has a great advantage over aluminum. This advantage is, however, to some extent balanced by the instability of the skin on tantalum electrodes, which is greatly reduced in effectiveness in the course of a few minutes' break of the current. Niobium and vanadium also show a valve effect in all electrolytes, though it does not approach 1000 volts, as in tantalum. Other metals, like Cu in copper sulphate, show a slight action of this kind, but it is not of any practical utility.—From *Ann. d. Phys.*, No. 7, abstracted in Lond. *Elec. Eng'ing*, July 18.

Units, Measurements and Instruments.

Manganin Resistances.—W. JAEGER AND S. LINDECK.—Rosa and Babcock have found at the National Bureau of Standards in Washington that their higher manganin resistors show a yearly cyclic change in resistance in the climate of Washington corresponding to the variations of the relative humidity at different times of the year. The amplitude of these variations is about 0.01 to 0.02 per cent, an increase in humidity causing an increase in resistance. According to their own explanation, this phenomenon has nothing to do with the manganin resistor material, but is traced to the swelling of the shellac used for insulating purposes and to the resulting elastic deformation of the resistor wire. The present authors have studied the same matter at the German Reichsanstalt and found that the variations of the resistance due to the shellac if existing at all in the climate of Berlin remain very small. "That resistances wound on lacquered wooden spools are unsuitable for precision work in consequence of the swelling of the wood, has been known for a long time at the Reichsanstalt. For this reason resistors of this type are not given certificates as precision resistors by the Reichsanstalt." The proposals of Rosa and Babcock to overcome the faults noticed in Washington by making the resistance independent of the variations in humidity by coating the resistors with paraffin or by enclosing them in a glass tube are considered undesirable by the present authors. "The formerly much-used paraffin insulation (*e. g.*, the older resistance boxes of Messrs. Siemens & Halske) has been abandoned by the Reichsanstalt in order to allow the coils to be placed in petroleum (in which paraffin is soluble), thus permitting a more accurate determination of their temperature and avoiding thermoelectric effects. For not only standard resistors, which are also designed for measurements of current strengths and which may be heavily loaded under these circumstances, but even resistance box coils and potentiometers are sometimes used to advantage in petroleum. If the use of petroleum is given up, an essential advantage which has been striven for in construction of the Reichsanstalt coils is lost."—Lond. *Elec.*, Aug. 8.

[illegible] ciation for the Advancement of Science by the committee on electrical standards. The main work during the year has been the completion of the work with the ampere-balance. It appears that the result is probably accurate to 1 in 50,000. Expressed in terms of the international ohm, as realized at the (British) National Physical Laboratory, and of the ampere as given by the new current weigher, it is found that the value of $C \times R$ for the normal Weston cadmium cell is 1.01830 at 17 degs. C. This assumes that the value of g at Teddington is 981.19, a number probably correct to within 3 parts in 100,000. An uncertainty in this amount in g introduces a possible error of 1½ parts in 100,000 in the value of the ampere, and, as all other probable errors are smaller in magnitude, it is important that a more accurate determination of g be made. At present, the uncertainty in the absolute value of the international ohm approximates to 4 in 10,000. An account is also given of the present condition of the work on electric units at the (British) National Physical Laboratory.—Lond. *Elec. Eng'ing*, Aug. 8.

Spherical Photometer.—R. ULBRICHT.—An article giving some supplementary notes on the use of his spherical photometer for determining the mean spherical candle-power or the hemispherical candle-power by a single measurement. The author first discusses how it is possible to avoid the errors due to the presence of foreign bodies within the sphere. In Fig. 4 M is the opening in the sphere through which the measurement is made, L is the lamp to be tested, and L_1 is the calibrated

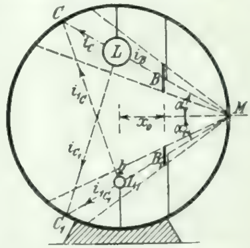


FIG. 4.—SPHERICAL PHOTOMETER.

standard lamp, while B and B_1 are the screens which prevent any direct light passing from the lamps to the observation window M. The constant of the sphere is determined by means of the standard lamp L_1, while the lamp L to be tested afterwards is already at its place, but, of course, not yet lighted. Afterwards during the test of L the standard lamp L_1 also remains at its place, but is, of course, not lighted. The size of the screen B should not be more than one-twentieth of the cross-sectional area of the sphere. ($R^2\pi$, where R the radius.) If the lamp L is tested without globe, the screen B when viewed from the observation window M must cover the source of light and the reflector. When the lamp is tested with a frosted globe, the screen must cover the whole globe. When the lamp is tested with a plain, clear glass globe, the screen must cover the source of light, the reflector and the mirror image of the source of light. The screens must in any case be large enough to prevent any direct light from reaching to the rims of the observation window. If F is the area of the screen B and F_1 the area of the screen B_1, then the error of measurement due to the presence of screens in the sphere is, in per cents, approximately $(80F - 100F_1) \div R^2\pi$ for spherical candle-power determinations and $(300F - 100F_1) \div R^2\pi$ for hemispherical candle-power determinations. If these formulas give values which cannot be neglected, the correction may be easily made by adding the above percentages. Finally, rules are given concerning the points where the lamps L and L_1 are to be placed. —*Elek. Zeit.*, Aug. 8.

Effect of Frequency on the Capacity of Condensers.—CURTIS [illegible]

—It is proposed to construct an absolute air condenser of two circular plates of optically plane glass. Such plates cannot be easily made much larger than 10 cm in diameter, and hence they must be placed very near to each other in order to obtain a sufficiently large capacity. In order to render the two opposing faces of the plates conducting, they are half silvered so that light may be seen by transmission through them. They then form practically a Perot and Fabry interferometer and the beautifully sharp fringes seen by transmitted light enable their parallelism and distance apart to be observed with the utmost accuracy at any instance. Knowing the geometrical dimensions of the systems, its absolute electrostatic capacity can be calculated. The half-silvered conducting surface of the condensers, however, have a very high resistance and a doubt arises as to whether this condenser is completely charged and discharged when a rapidly varying e. m. f. is impressed upon it. The calculations made by the author to investigate this, show that when the surface resistance is high, the capacity falls off to an enormous extent for comparatively low frequencies. The capacity of a condenser diminishes with increasing frequency as well as the self-inductance of a coil; so that their effects are additive and in all work in which high-frequency currents are employed the experimenter must assure himself that certain corrections are negligible or must apply them.—*Physical Review,* August.

Three-Phase Induction Meter.—An illustrated announcement of the Reichsanstalt concerning the admission for calibration of an induction meter of the Siemens-Schuckert Company. The meter consists essentially of two induction motors, the armatures of which are coupled by an axle, and a magnetic brake for each armature and a common counting device. The construction and the operation of the motor are described in detail.—*Elek. Zeit.*, July 18.

Meter.—E. Wagmuller.—The author recommends the charging of a certain flat rate for all energy consumed up to a certain value; the energy consumed above this value to be measured and paid for extra. A meter which enables the measurement of the excess energy is described.—*Elek. Zeit.* Aug. 8.

Calorimeter.—W. P. White.—An abstract of an American Physical Society paper on an accurate calorimeter which is used in connection with an electric resistance furnace.—*Physical Review,* August.

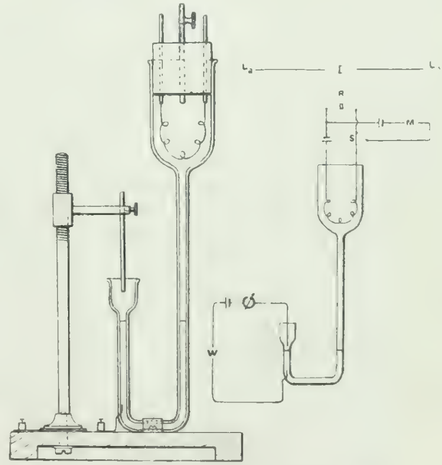
Ballistic Galvanometer.—F. Wenner.—An abstract of an American Physical Society paper in which the effect of the time of passage of a quantity of electricity on the throw of a ballistic galvanometer is studied.—*Physical Review,* August.

Telegraphy, Telephony and Signals.

Loaded Telephone Line.—W. Preece.—A paper read before the British Association for the Advancement of Science, giving an historical account of the efforts which have been made to improve telephone transmission by increasing the inductance of the line. He more particularly discusses the Pupin method of using a line with induction coils in series and gives theoretical reasons for its success, together with an account of the work done by the New York Telephone Company under the direction of J. J. Carty. Tapering—or the gradual reduction of the inductance of the loading coils as the terminal stations are approached is beneficial according to Hayes. The size of coils and the distance apart are said to be chiefly a question of experiment. The author seems to be in doubt whether coils with or without iron cores give better results.—Lond. *Elec.*, Aug. 9.

Loaded Telephone Lines.—E. S. [illegible] remarks on the paper of Preece (see preceding abstract). As far as the writer's experience goes there appears no possible doubt as to the superiority of the iron-core coil over coil without iron from both the technical and financial points of view. The wave length in telephone lines varies from a maximum of about [illegible] miles for a very heavy aerial line down to a minimum of about nine miles for a highly loaded cable. The spacing of the coils which has been adopted by the National Telephone Company in Great Britain is in general the same as that used in America and varies with the type of line to be loaded. [illegible] is found to meet all conditions. In practice about [illegible] standard spacings are employed.—Lond. *Elec.*, Aug. 9.

Hot-Wire Relay for Selective Signalling.—R. Heilbrun.—Telegraphic circuits containing a number of stations of small traffic are frequently used in continental Europe, and it is of practical value, *e. g.*, for railway telegraphy, to devise means for selective signalling, or, at least, for enabling the stations to correspond with each other without disturbing one of them, the principal office, and for calling this principal office selectively. This is effected by means of a retardation relay placed at the principal office. The relay is traversed by the telegraphic currents common to all the stations in the circuit, but it works too slowly to be actuated by them. The essential part of an instrument of this type, developed by the author, is simply a hot wire and the principle is shown in Fig. 5. A relay of any usual type has its coil included in the telegraphic circuit, and when actuated causes currents to be sent through the hot wire. The wire can be seen with its loops inside the glass vessel of the illustration. But the ordinary signalling currents are of too short a duration appreciably to expand the air contained in the glass vessel, and in consequence the liquid rises only very little in the left limb. The quantity of the air is too large to be appreciably heated by the short currents, and the apparatus cools off too quickly to render possible the adding up of the numerous small effects to a large one. The air in the bulb



Figs. 5 and 6.—Diagram of Hot-Wire Relay.

expands sufficiently to make the relay respond only in case the Morse key is uninterruptedly depressed for several seconds. The responding is effected by the liquid making a contact when rising in the left limb. The selective quality of this hot wire arrangement was demonstrated by experiments in which a Morse key was impressed and currents varying between 43.5 and 7.1 milli-amperes were sent through the hot wire. The displacement of the liquid was observed first when the Morse sign of the letter V (. . . —) was slowly repeated three times and, secondly, when the current traversed the wire uninterruptedly for three seconds. The height to which the liquid rose in the left limb was in general one-third as large in the first case as in the second case. Fig. 6 shows the diagram of connections at the principal station, the key and battery being left out. L_a and L_b is the line, R the ordinary relay, I denoting its primary contacts, II the secondary ones. The latter lead to the hot-wire relay. As a rule, the signalling in the circuit will not affect the hot-wire relay at the principal station. But when any of the stations depresses its key uninterruptedly for a few seconds, the hot-wire relay responds and causes the bell, w, to ring. By means of the switch, s, the relay is then switched off, and the Morse instrument, M, cut into the circuit. At the end of the conversation with the principal station the switch is again placed in its former position.—Lond. *Elec.*, Aug. [illegible]

Wireless Telegraphy.—A number of papers read before the British Association for the Advancement of Science. W. Duddell discussed the use of the arc method and of the spark method for generating electric waves. The arc methods seem eminently suitable for very high speeds of working, and render wireless telephony possible. Sir Oliver Lodge read a paper on modern developments and experiences in tuning as practiced in the Lodge-Muirhead wireless telegraphy system. J. T. Morris gave an account of an oscillographic study of low-frequency oscillating arcs. The chief object was to study the effect of a change in the medium in which the arc is burning and also to examine the effect, if any, produced on the arc by the application of a transverse magnetic field. The arc was studied in air, coal gas and in amyl acetate.—Lond. *Elec. Eng'ing*, Aug. 8.

Miscellaneous.

British Association for Advancement of Science.—An account of the 77th meeting of the British Association for the Advancement of Science, which was recently held in Leicester. The presidential address by Sir David Gill dealt mainly with problems of astronomy. The engineering section held meetings under the presidency of S. P. Thompson, whose address dealt with the question of pure and applied science. He maintained, first of all, that the pursuit of scientific research for its own sake or as an adjunct to industrial advancement depends entirely on the persons concerned. Some people cannot carry out an investigation unless they have the application of the investigation as a goal, while with other people the commercial application of a discovery is a matter of small importance, and they cannot take it into account during the progress of their work. He also instanced cases of industrial applications which actually compelled further scientific research.—Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, Aug. 2 and 9, and Lond. *Elec. Eng'ing*, Aug. 8.

Electroculture.—B. H. Thwaite.—A paper read before the (British) Royal Botanic Society describing the new experimental installation for the Royal Botanic Gardens in London. The author divides the early workers on this subject into those who utilized the effects of the arc light on the leaves of plants, and those who applied electrostatic stimuli to the plant and to the roots and stalks, in association with solar light. The author thinks that if we want to imitate all the natural forces which are effective on plant growth we have to supply, first, ample violet or chemically active rays from powerful arc lamps; second, the supply of electrostatic current from atmospheric root electrification; third, an atmosphere containing moisture and CO_2 in the proportions common to the most fertile countries at a temperature between 70 and 80 degs. Fahr.; fourth, an ideal fertilizing agent, and, fifth, an ample supply of water for the roots. In the installation described the necessary heat and actinic light, as well as the carbon dioxide moisture and nitrogen fertilizer, in the form of ammonia sulphate, are to be derived from coal with the aid of a suction gas producer and gas engine, whereby perfect combustion is obtained with the development of electrical energy. The arc lamps are equipped with special reflector hoods confining the beam of light within narrow limits of concentration.—Lond. *Elec. Rev.*, Aug. 2.

Laboratory.—E. C. Coker.—A paper read before the British Association for the Advancement of Science describing the new engineering laboratory at the City and Guilds of London Institute, Finsbury.—Lond. *Elec. Eng'ing*, Aug. 8.

BOOK REVIEW.

Electrons, or the Nature and Properties of Negative Electricity. By Sir Oliver Lodge. London: George Bell & Sons. 230 pages, 25 illustrations. Price 6s.

The nature of matter has been a fascinating subject for the philosopher and physicist, the thinker and the worker from the days of Democritus and Lucretius down to the present hour. And, indeed, it may safely be said that at no time in the history of scientific discovery was greater activity displayed in the study of problems relating to the constitution of the ultimate forms of matter than in recent years. Were proof needed, it would be afforded by every one of the 230 pages of this present well-printed and well-illustrated octavo.

This volume by Prof. Lodge, like his *Modern Views of Electricity* and numerous contributions to the *Philosophical Magazine*, shows a clearness of exposition which leaves no lingering doubt in the mind of the reader. The style is always simple and lucid, occasionally incisive, rarely sarcastic.

The author has done pioneering work in the electronic field and has discussed proposed solutions of outstanding difficulties with the leaders of scientific thought at home and abroad, so that this latest work of his is sure to command at once the confidence of the reader, even when dealing with the more speculative parts of the subject.

That the "electron" has opened up not only a new chapter, but also a vast domain in general physics will be evident from a glance at some of the titles of the successive chapters: Nature of chemical and molecular forces; increase of inertia due to rapid motion; the electron theory of conduction and radiation, etc.

Though several good works on that smallest of entities, the electron, have recently appeared, no student of physical theory can afford to be without this last volume from the pen of Prof. Lodge. It is a *résumé* written by the hand of a master of contemporary speculation.

Electric Dynamometers for Testing Gasoline Engines.

One of the easiest, most accurate and efficient means of obtaining instantaneous values of the brake horse-power of an engine is the electric dynamometer, and owing to the simplicity of the apparatus and calculations a test can be made by comparatively inexperienced attendants. In fact most of the automobile manufacturers employ this method in testing their gasoline engines. The Sprague Electric Company of New York City has brought out a line of electric dynamometers which has been essentially designed for absorbing and measuring the power developed by gasoline engines in factory tests. This dynamometer differs from the well-known Prony brake in

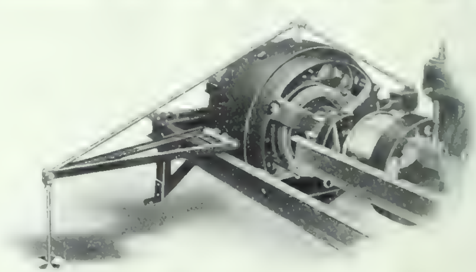


Fig. 1.—Electric Dynamometer.

that the reaction of friction is replaced by an electro-magnetic reaction, an advantage of great importance as is shown later.

The general arrangement of the electric dynamometer, shown in the accompanying illustrations, consists of a specially constructed direct-current generator with compensating poles. The generator field frame consists of a cylindrical magnet yoke to the inner side of which the poles are bolted, each pole supporting a field coil. Brackets which contain the bearings are bolted to the end of the yoke, the front bracket carrying the rocker arm. Special bosses are cast on the end brackets for receiving ball bearings which support the entire generator in such a manner as to permit the field frame to oscillate concentricly with the armature.

The movement of the field frame is limited by means of a

stud on the outside of the yoke. Two arms extend horizontally from opposite sides of the field frame. The short arm carries a metal box to receive the necessary amount of lead to counterbalance the field frame on its ball bearings. The long arm is provided with a hanger, on which slotted weights may be placed. The engine to be tested is set in position and bolted to the supporting frame in alignment with the dynamometer. The two shafts are then connected together with a flexible coupling and the engine started. The torque exerted by the armature is transmitted to the field and tends to rotate the field frame in the same direction as that in which the armature is turning. By placing weights on the hanger attached to the long arm previously mentioned, the torque is readily measured.

The horse-power HP developed by the engine may then be found by using the following formula. In this formula $W =$ the weight in pounds on the hanger, $D =$ the distance in feet from the center of the armature to the weight, and $S =$ the speed of the engine in revolutions per minute.

$$HP = W \times 2D \times 3.1416 \times S \div 33{,}000.$$

It will be noted in this formula that the only variables with a given dynamometer are the weight W and the speed S. If a curve be drawn or a tabulation made showing the horse-power developed at different speeds, an ordinary mechanic can perform the tests without making any calculations. The voltage and current produced by the dynamometer do not enter into the calculations. In some cases it is possible to utilize the electricity generated by the dynamometer by connecting direct

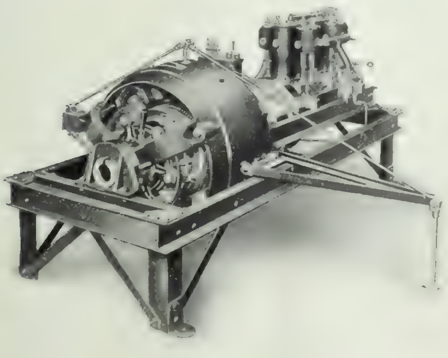


FIG. 2.—ELECTRIC DYNAMOMETER.

to the shop wires and operating the dynamometer in parallel with the generators already in service. Under these conditions variations in the engine speed can be obtained very easily by adjustment of the rheostat in the field circuit of the dynamometer. If it is not convenient to utilize in this way the electricity generated by the dynamometer, it can readily be absorbed in a water rheostat.

It is also possible to use the dynamometer as a motor to start the engine, taking energy from the shop mains or an outside supply circuit, thus saving the labor of "cranking."

This use of the dynamometer also affords an accurate means of determining the torque necessary for starting the engine and for testing the engine frictional losses under various conditions. The dynamometers are manufactured in sizes from 10 to 100 horse-power, and any one of these sizes is capable of operation over a wide range of speeds and loads. A structural steel frame for supporting the dynamometer and gasoline engines of various sizes is also provided.

Exhibits at Ohio and Michigan Conventions.

The conventions of the Ohio Electric Light Association and the Michigan Electric Association, at Toledo, Ohio, and at Battle Creek, Mich., last week, brought out a number of exhibits, some of which contained new and interesting features for central-station men.

The Oneida galvanized chain for arc lamp suspension was exhibited at Toledo.

The Holophane Company had a demonstration and exhibit of reflectors and globes at Michigan.

Turbine Construction.—The Allis-Chalmers Company had on exhibition the turbine blades of its steam turbine, together with some of its electrical machinery, in the shape of motors.

Mr. J. B. Coale, of the Columbia Lamp Company, also had secured for exhibition some of the new German incandescent lamps made from rare metals.

The Fort Wayne Electric Works exhibited meters, arc lamps, small motors, etc. The W. G. Nagel Electric Company, of Toledo, made a parlor exhibit of some of the supplies it handles.

The Fostoria Incandescent Lamp Company had in the hotel lobby at Battle Creek the new Gem meridian type of lamp and the 80-watt tantalum in addition to the tipless and common standard types.

The Nernst Lamp Company lighted the hotel convention hall at Toledo with its new direct-current glowers. The new glowers are 37 per cent more efficient than the old, and are made for both direct and alternating currents.

Miscellaneous Electrical Supplies.—The Western Electric Company made an exhibit at both conventions, in which prominent features were high-tension line material, arc lamps and regulators. Direct-current and three-phase induction motors were also shown.

Electric Heating Appliances.—The W. J. Barr Electric Manufacturing Company, of Cleveland, made a large and admirable exhibit, introducing some of its excellent new electric heating appliances, which it has recently perfected; in addition to its flatirons, whch are already well known. This included two-quart water boilers, curling irons, chafing dishes, percolators, etc.

Lightning Arresters.—The Gifford non-arcing lightning arrester was exhibited for the first time at the Michigan convention. This is made by Campbell Brothers, of Traverse City, Mich. It consists of a number of carbon high-resistance rods in multiple, each rod being connected in series with a small spark gap. Static discharges pass through these high-resistance rods and spark gaps in multiple to the ground, the resistance being too high for the line current to follow.

Lamps.—The General Electric Company exhibited a number of 100-volt, 105-watt tungsten lamps. Apparently, the breakage on their exhibit shipments was not as large as at previous exhibitions, encouraging the belief that the question of such loss in shipment will ultimately be solved. The tungsten 25-watt, 28-volt lamp for operating in clusters, four in series, was exhibited, and at the Michigan convention, experiences were given as to its use at Sault Ste. Marie. This lamp has a left-handed thread, so that it cannot be destroyed by being accidentally put into common multiple sockets. The round-bulb meridian tantalum lamp was also one of the new-comers shown.

Single-Phase Motors.—The most prominent exhibit at Toledo was that of single-phase motors made by the Wagner Electric & Manufacturing Company, and located in the hotel lobby. Messrs. Thomas T. Richardson, Nat Emerson and Harrison Wright were in charge. The new feature was a Wagner variable-speed ventilating fan motor of 2 horse-power, with a 30-in. fan. This is of the variable-speed type with auto-transformer control and can be operated continuously at any one of several speeds. The same motor is adapted to variable speeds running with printing presses and other work where variable torque is not required. Besides this single phase motor, one of the company's polyphase motors and its lamp-testing wattmeter were shown.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—[illegible] made all over the country that the outlook for fall trade is excellent. Buyers in many lines are replenishing stocks and preparations in general indicate confidence as to large and sustained consumption in all staple goods; while the heavy import trade would incline one to suspect that luxuries are not being forgotten. Yet there is no evidence of a tendency to over-trading, the attitude of merchants being, if anything, reserved and cautious. Weak points in the structure of industrial credit have apparently been easy to locate and remedy, because of their scarcity. *Dun's Review* says: "Jobbing markets are well attended by interior buyers and country merchants, who operate with great freedom, considering the financial stringency which has compelled the postponement of much contemplated structural work. Yet many Western and Southern cities report building operations far in excess of last year's, and as the harvests progress there is more disposition to increase preparations for future needs. Retail stocks have been depleted by the customary bargain sales, and preparations for fall and winter trade indicate confidence in continued activity. At most domestic points there is no complaint regarding collections, but reports from Canada indicate many requests for renewals. Leading industrial plants are well occupied, many mills having output sold far into 1908, and there is little serious interruption by strikes. A sharp rise in grain was the feature of the commodity markets, but best prices were not maintained." As to copper, the tendency seems still to be downward; at least, prices look that way, Lake reaching 18.50 cents bid and electrolytic 17.50. There is said to be a small, but steady accumulation of supply going on even at these figures, which, after the high range of a few months ago would seem calculated to bring into the market heavy consumers known to have been holding off. The crop reports, while not particularly optimistic, would indicate that on the whole the agriculturist will have another good year and average up as well as he did in 1906.

THE COPPER MARKET.—With regard to conditions, the National Conduit & Cable Company says in its "Copper Gossip": "All developments in the copper market recently have certainly been in the consumer's favor and no important sales are being made. The irregularity in quotations is a most unfortunate thing for producer and consumer alike, and market stability is impossible so long as sellers continue this irregularity in an absolutely dull situation. Such a proceeding can only work confusion in the trade and is exceedingly detrimental to manufacturers conducting a legitimate business. There is an unfortunate condition which would seem to be created more or less by speculators and those who are known as manipulators, which lend credence to the theory that quotations are often made with a view to their influence on Wall Street and the hope of securing financial gains by conspiring to create an unhealthy condition either by over-inflation or undue depreciation of values, as the case may be, but the general result upon business interests is very bad. When the demand was unusually good, copper was rushed up to 26½ cents per pound, when the wiser policy would have been never to have allowed it to go above 20 cents. The precipitate haste in advancing prices met with some efforts to counteract this action, but more short-sighted interests were unable to resist the temptation to exact the big premiums obtainable from the needy consumer, and even at top prices it was hard to obtain a full supply except for distant future. After the tension of last year has become a thing of the past the trade conditions are coming down to a normal and more healthy basis. The whole situation is perplexed by the action of an erratic copper market, and consumers for their own safety are compelled to adopt a waiting policy. What the manufacturer and buyer needs is the assurance that they can safely buy copper for two or three months' deliveries and not be left in the lurch before 30 days have passed by a radical decline in the market value of their raw [illegible] [illegible] ing lines are fairly active, and such as to warrant the maintenance of a reasonably firm copper market, provided the unnatural means for depressing it cease. The present rate of consumption is less than that of last year, but the pace 10 or 12 months ago was very much too fast to continue, and the country was attempting more than it could reasonably finance. Now current business is sufficiently good to keep up a steady demand upon the mills of the country at a fairly encouraging level, and with the proper readjustment of the copper market to existing conditions trade should open up hopefully in the fall. The larger American producers have been quite inactive of late, but they have not made any formal announcement of a change in price of electrolytic since the 22-cent level was established. Quotations by irresponsible parties are very misleading, and to the consumer really mean nothing, as not a pound of copper is bought or sold at the alleged low prices. The proceeding is kept up by regularly quoting copper, presumably for the sentimental effect it has in all business circles in this country and Europe. Conservatism should be the watchword of the consumer, and a "hand to mouth" policy followed until our unfortunate financial problems are solved, and the market for raw copper is on a stable and solid basis."

ELECTRICAL MANUFACTURING.—An interesting special dispatch from Boston says: "The business of four large electrical companies for the first half of the year contains no justification for the somewhat disturbing reports of a dropping off in business and a wholesale reduction of working forces. The General Electric Company booked over $35,000,000 of orders in the first half of the present fiscal year, compared with about $29,000,000 in the same period of 1906. Western Electric gross for the first six months of the current fiscal year was about $30,000,000, or $1,000,000 less than for the same half of last year. Westinghouse officials estimate shipments for the current year, based on the results of the first five months, at over $42,000,000. The Allis-Chalmers closed its year June 30, and gross receipts are understood to have been approximately $20,000,000. It is, of course, probable that in the event of any general let-up in business, new orders for electrical apparatus will drop off in the last six or seven months of the current fiscal year. At the same time the General Electric, Westinghouse and Allis-Chalmers each has orders booked ahead sufficient to keep the shops in full operation for five or six months. Based on actual results for the first five or six months of the present fiscal year, and assuming that in the current year Allis-Chalmers does no greater business than during the 12 months just ended, the gross earnings of the four companies would work out at the following rate:

	Present [illegible] Year	Previous [illegible] Year
General Electric	$70,000,000	$60,071,883
Westinghouse [illegible]	[illegible]	[illegible]
Western Electric [illegible]	[illegible]	[illegible]
Allis-Chalmers	20,000,000	20,000,000
Total	$[illegible]	[illegible]

The gross receipts of the four companies show an increase of nearly $10,000,000, or over 5 per cent over the previous year."

THE CHICAGO SUBWAY.—According to advices from Chicago, President McRoberts, of the Illinois Tunnel Company, says that connections with 23 railroads having freight terminals will be completed Nov. 1. It is officially estimated that by Jan. 1 the daily movements in the tunnel will be 10,000 loads, or between 20,000 and 30,000 tons of freight daily. The daily mail transferred aggregates 32,000 to 35,000 pouches. The subway consists of 51 miles of bore under the loop, duplicating 18 streets east and west, and 12 streets north and south, with 325 street intersections, at an average depth of 42 ft. except at the river approaches. There will be 3000 cars and 130 electric locomotives instead of 1200 and 80, respectively, at present. The average speed of a tunnel train is 8 [illegible] miles an hour, including stops, with a possible maximum of 15 miles. General Manager Kenyon has arranged a duplicate loop system of operation whereby 30,000 cars a day, with 90,000 [illegible] tons of freight might be moved every 24 hours in three shifts of employees. Block signals and [illegible]

switches will be introduced. All tunnel track is laid with 56-lb. rails, with a gauge of 2 ft. At each street intersection there are four three-way switches.

EFFECT OF WIRE STRIKE.—It is stated from Baltimore, Md., that the telegraphers' strike is helping the Rowland Telegraphic Company of that city. The company has had its factory running overtime since the strike broke out, filling orders for machines. The Postal Telegraph Company for more than a year has had the machines in operation between Boston and New York, and this week placed them in service between Chicago and St. Louis, and between New York and Philadelphia. The company will use them also between New York and Chicago, and probably in a number of other cities.

Financial Intelligence.

THE WEEK IN WALL STREET was a notable one in the general wiping out of values that it witnessed. As a matter of fact, the past month has seen a depreciation in active securities of over $900,000,000, and the total depreciation is put at about $3,000,000,000. Bonds have also declined heavily. If anybody thinks this loss has fallen merely on "malefactors of great wealth," or that the malefactors conspired to do this on themselves, the day of belief in miracles is not past. It is generally understood, however, as incidental to this situation that Standard Oil interests have withdrawn support in various ways from the market, and have given orders of curtailment in whatever industries their capital may be engaged in. There are, however, enough unsettling causes without looking for an explanation of all the troubles to a conspiracy which if it could be proved would blast and exile in ruin every man even remotely engaged in it. Meantime things would seem to have brightened a bit, and would possibly be much better but for the disastrous situation in the Interborough-Metropolitan traction

NEW YORK.

	Aug. 20	Aug. 27		Aug. 20	Aug. 27
Allis-Chalmers Co.	6½	5½	General Electric	24	[illegible]
Allis-Chalmers Co. pfd	20	17	Hudson River Tel. ..		
Am. Dist. Tel	—	—	Interborough Met. com	8	[illegible]
American Locomotive..	52	50½	Interborough Met. pfd	23	[illegible]
Amer. Locomotive pfd	101	99	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable.	75	70	Mackay Cos. pfd	[illegible]	[illegible]
American Tel. & Tel..	105	104	Marconi Tel.	—	—
Brooklyn Rapid Transit.	43	41½	Metropolitan St. Ry.	[illegible]	[illegible]
Electric Boat	33	33	N. Y. & N. J. Tel		
Electric Boat pfd...	80	80	Western Union Tel		[illegible]
Electric Vehicle	—	—	Westinghouse com	[illegible]	34
Electric Vehicle pfd.	—	—	Westinghouse pfd		

BOSTON.

	Aug. 20	Aug. 27		Aug. 20	Aug. 27
American Tel. & Tel..	-	[illegible]	Mass. Elec. Ry. pfd.	[illegible]	[illegible]
Cumberland Telephone.	--		Mexican Telephone		[illegible]
Edison Elec. Illum...	[illegible]	[illegible]	New England Telep	[illegible]	[illegible]
General Electric	124½	—	Western Tel. & Tel...	-	[illegible]
Mass. Elec. Ry..	—	13	West. Tel. & Tel. pfd..	-	[illegible]

PHILADELPHIA

	Aug. 20	Aug. 27		Aug. 20	Aug. 27
American Railways	-	[illegible]	Phila. Electric ...	[illegible]	[illegible]
Elec. Co. of America...	-	[illegible]	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery..	[illegible]	[illegible]	Phila. Traction ..		[illegible]
Elec. Stor. Battery pfd.	-				

CHICAGO.

	Aug. 20	Aug. 27		Aug. 20	Aug. 27
Chicago City Ry..	—	[illegible]	National Carbon		[illegible]
Chicago Edison ..		136	National Carbon pfd		[illegible]
Chicago Subway		[illegible]	Union Traction		
Chicago Tel. Co..		[illegible]	Union Traction pfd..		
Metropolitan Elec. com	—	—			

* Asked.

securities of New York, where the merger has been attended with most adverse developments and where dividends on the tremendous overcapitalization are at the vanishing point. But there are brighter aspects. Secretary Cortelyou has taken steps to ease the money market by placing deposits during the next five weeks of deposit at banks in different localities. The reports of 30,000 correspondents of the Commercial National Bank of Chicago are conservatively favorable without an exception, and exhibit no misgiving as to the future. The steel outlook is excellent, and railway earnings in the first half of August were 7.5 per cent larger than last year's figures. Official returns of foreign commerce in July far surpassed the same month in any previous year, the gain over 1906 amounting to $22,000,000 in imports and $17,000,000 in exports. The [illegible] Time money grew firmer, which did not encourage speculative purchases. Bank exchanges at New York [illegible] per cent less than in the same week last year, when speculation was active, but at other leading [illegible]

of 7.6 per cent. With regard to failures, *Bradstreet's* reports 153 failures in the United States during the week, against 142 for the previous week, and 155, 176, 185 and 142 for the corresponding weeks of 1906 to 1903. Canada had 19, against 30 for the preceding week. About 83 per cent of the total number of concerns failing had capital of $5,000 or less, and 11 per cent had from $5,000 to $20,000 capital. The quotations of stocks for Aug. 27 are given herewith.

NEWBURGH LIGHTING STOCK.—The New York Public Service Commission in the Second District has announced that it has denied the application of the Newburgh Light, Heat & Power Company for leave to increase its capital stock from $500,000 to $750,000. The application, the commission says, was really for permission to issue $250,000 8 per cent cumulative preferred stock. The decision, prepared by Commissioner Decker, says that if the proposed increase was approved it "would create a permanent annual charge of $20,000 upon the property, and in our judgment allowance of a permanent fixed charge of this character to meet temporary exigencies of the money market is not justified. Favorable action upon this petition would constitute a precedent which, if followed in other cases, might operate disastrously to minority stockholders, and also work hardships upon affected communities through the continuous necessity for service rates or charges sufficiently high to meet such permanent obligations."

CHICAGO TELEPHONE.—Advices of Aug. 22 from Chicago says: "All but $200,000 of the $4,000,000 of new capital stock of the Chicago Telephone has been subscribed for. The balance will be disposed of if it does not go to the stockholders who are entitled to it, but who are out of the United States and probably did not receive their notice. It appears that the trading in the subscription rights on the local Stock Exchange created a bad tangle in the work of allotting the new stock. The privileges were greatly overtraded in, and it has been with difficulty that the company was able to determine who among the outside buyers were entitled to the new shares at par."

BALTIMORE ELECTRIC EARNINGS.—The earnings of the Baltimore Electric Company for six months, Jan. 1 to June 30, are as follows:

	1907.	1906.	Changes.
Gross	[illegible]	$315,860	Inc. [illegible]
Op. exp. and taxes	[illegible]	[illegible]	Inc. [illegible]
Net	[illegible]	[illegible]	Inc. [illegible]
Interest on bonds.	113,000	112,596	Inc. 404
Surplus	[illegible]	[illegible]	Inc. $30,644

WESTINGHOUSE ELECTRIC.—The Westinghouse Electric & Manufacturing Company reports for July and four months ended July 31, 1907, as follows:

	July.	4 Months.
Manufacturing profits............	$428,422	$2,134,247
Miscellaneous income............	106,064	343,335
Total income	[illegible]	[illegible]
Interest, depreciation, etc.	[illegible]	[illegible]
Net surplus	[illegible]	[illegible]

ALLIS-CHALMERS BONDS.—Allis-Chalmers Company will soon issue a call for the tenth and last payment of 10 per cent on the bond issue of $13,000,000 created last year. Of that amount approximately $10,500,000 was subscribed for, the syndicate taking about $9,500,000. This will give the company about $1,000,000 additional cash. It is interesting to note that not a single member of the bond syndicate has failed to make his regular payments when called upon to do so.

THE STANLEY WORKS COMPANY, of New Britain, Conn., has received authority to double its capitalization of $1,500,000. This company has also received legislative permission to transmit electricity for power from its plant, on the banks of the Housatonic River, near Kent, by high-tension cables to its plant in New Britain.

DIVIDENDS.—Directors of the Twin City Rapid Transit Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Oct. 1. Union Gas & Electric Company has declared its regular quarterly dividend of 1½ per cent on preferred, payable Oct. 1.

CANADIAN GENERAL ELECTRIC.—The stockholders of the Canadian General Electric Company have ratified the proposal to increase the stock from [illegible] to $8,000,000, [illegible] of the new stock to be [illegible] per cent cumulative preferred.

CALIFORNIA GAS & ELECTRIC.—The directors of the California Gas & Electric Corporation at a recent meeting in San Francisco decided to increase the capital stock of the company from $15,000,000 to $35,000,000 at a meeting of the stockholders to be held in October. President John A. Britton states that after this increase the corporation will be in a position to redeem the outstanding bonds of its various subsidiary companies throughout the state as they fall due. Mr. Britton says: "It will also enable us to sell new bonds in a blanket issue to provide for improvements made by subordinate concerns. It is a simple and convenient plan of corporation finance. The value of the properties held by the California concern is about $55,000,000, on which the capitalization has been comparatively small—only $15,000,000. The directors have decided to increase the capitalization by an additional $20,000,000, to comply with the law relative to the necessary proportion between capital stock and bonds issued. We will then be able to sell new bonds and make one issue take care of the indebtedness and improvements needed by the subsidiary companies. The bonded debts of these concerns will be refunded by means of the single blanket issue, which will be a more satisfactory plan of finance." The California Gas & Electric Corporation, together with the San Francisco Gas & Electric Company, constitutes the Pacific Gas & Electric Company. These comprise some 15 smaller gas and electric companies doing business in quite a number of counties and interior towns as well as in San Francisco. It controls among other properties the Bay Counties Power and Standard Electric companies. This financial scheme is supplemental to the action of the Pacific Gas & Electric Company recently in deciding to raise $3,000,000 by assessing its stockholders $10 a share on their aggregate holdings of 300,000 shares of stock.

WESTERN ELECTRIC OUTPUT.—Advices from Boston state that the gross business of the Western Electric Company for the present fiscal year will be affected to some extent by the undoubted overstocking in telephone apparatus in which the majority of the Bell associate companies indulged last year. Reliable estimates show that at the opening of 1907 the subsidiary companies had on hand over $10,000,000 of telephone supplies, which were being carried in stock. For the six months ended June 30 last the gross receipts of the Western Electric were but $1,000,000 less than for the same period a year ago. In 1906 the Western Electric booked total orders for over $69,000,000 of apparatus. Business was a little larger in the last six months than in the first half of the year, but it is safe to place the aggregate gross business for the first six months of 1906 at fully $30,000,000. On this basis the Western Electric is now doing a business at the rate of $60,000,000 per year. About $25,000,000 of the total $69,000,000 gross receipts in 1906 were for other lines of electrical apparatus than telephone supplies. The volume of this "outside" business is constantly increasing, and forms one of the most profitable departments of the Western Electric's production. There has been no recent reduction in the number of men employed by the Western Electric Company. In March the company reduced its working force by from 2500 to 3000 men, but there have been no further reductions since that date. The company had the maximum number of employees on its books in August, 1906, during the heaviest rush of telephone orders, when a total of 30,000 were employed. By Dec. 31 this number had declined to 27,000, and is probably now about 24,000.

KANSAS CITY NOTE ISSUE.—The stockholders of the Kansas City Railway & Light Company at a special meeting have voted to issue $5,500,000 five-year 6 per cent notes and authorized the creation of a mortgage covering the same. Subscriptions for $4,125,000 of the issue have been asked of stockholders at 95, in the ratio of 22 per cent of the par value of shares in the company now held. The notes will bear interest from Sept. 1, 1907, and will mature Sept. 1, 1912. Of the issue $4,125,000 are to be known as series A, and $1,355,000 as series B. Each of the former $1,000 notes is to be converted at the option of the holder, on and after Sept. 1, 1908, into 6½ shares of the common capital stock and seven shares of the preferred capital stock of the company. The security authorized by the stockholders for the notes includes a pledge of at least $5,500,000 par value of notes of the Metropolitan Street Railway, of Kansas City, at least $1,000,000 par value notes of the Kansas City Electric Light Company, $2,695,000 par value of common capital, and $2,977,000 par value of preferred capital stock of the Kansas City Railway & Light Company. The stockholders authorized the directors to issue series B in amount of $1,375,000 at their discretion in the future, to sell them, and use the proceeds in the interest of the company.

NEW YORK TRACTIONS.—It is stated that the dividends on the preferred stock of the Interborough-Metropolitan Company, as well as the guaranteed dividend on the old Metropolitan Street Railway stock, which has met with such violent declines in the markets in the last few days, will be passed at the next meeting of the directors. In spite of the denials of several men who are in close touch with the affairs of the two companies, that there was any basis for the rumors of a reorganization of the traction situation in this city which would account for the violent declines in the stocks of the merger and its constituents, Wall Street is ready to believe that the last dividend has been paid as the stocks stand now. One of the voting trustees of the merger and a long time director of the Metropolitan system said: "There is absolutely no truth in the reports that a receivership is in prospect for the Interborough-Metropolitan Company. There is no ground for such a report whatever, nor is there any more reason for the other rumors concerning reorganization or readjustment of the company's affairs or finances."

KNOXVILLE RAILWAY & LIGHT.—The report of the Knoxville Railway & Light Company of Tennessee for the year ended June 30, 1907, and for the six months to June 30, for the years 1907 and 1906, follows:

	Year End. June 30, '07	Six Months Ended June 30. 1907	1906	Increase
Gross	$559,685	[illegible]	[illegible]	[illegible]
Exp. and tax	298,360	[illegible]	[illegible]	[illegible]
Net earn	261,329	[illegible]	[illegible]	[illegible]
Int. charges	119,034	[illegible]	[illegible]	[illegible]
Surplus	142,295	[illegible]	[illegible]	[illegible]
Set aside for res. and dep.	30,000	15,000	15,000	......
Net surp.	$112,295	[illegible]	[illegible]	[illegible]

The deduction for reserve and depreciation was not made monthly in the year 1906, but a single deduction of $30,000 was made in December, half of which is here considered as applying to the first half of the year 1906. The company has paid regular dividends of 6 per cent upon the preferred stock since issuance, and is now paying dividends at the rate of 4 per cent per annum upon its common stock.

PITTSBURG LIGHTING LOAN.—The Duquesne Heat & Light Company, of Pittsburg, of which Robert C. Hall is president, has arranged for a loan of $10,000,000 from the Fidelity Title & Trust Company. With the money the company proposes to build a rival heat and light plant to that operated by the Philadelphia Company, which has a monopoly on the business in Allegheny County. Recently the Philadelphia Company advanced the price of gas by 30 cents per 1000 cu. ft., and the state authorities have been asked to bring quo warranto proceedings against the concern to annul its charter. The Duquesne Company proposes to issue bonds for the amount of the loan and has issued an appeal to the public for support. The company proposes to erect an electrical plant to cost $1,500,000.

SPRINGFIELD UNITED EARNINGS.—The report of the United Electric Light Company of Springfield, Mass., for the year ended June 30, 1907, compares as follows:

	1907.	1906.	Increase.
Gross earnings	[illegible]	[illegible]	$66,8[illegible]
Expenses	[illegible]	[illegible]	[illegible]
Net earnings	[illegible]	[illegible]	[illegible]
Dividends (8 per cent)	[illegible]	[illegible]	[illegible]
Surplus	[illegible]	[illegible]	[illegible]

NEW YORK CITY BONDS are unsalable these days and are being handed out to pay bills and then sold at a discount. Mr. August Belmont has announced that the Interborough Rapid Transit Company would take bonds for what the city owes the company. There is due to the company on the Brooklyn subway extension and for terminals and extra work about $1,500,000.

U. S. TELEPHONE.—The United States Telephone Company reports June gross earnings of $35,491; six months gross, $234,038; a net for the six months of [illegible]; and a net over all charges of [illegible], all items being [illegible] over the corresponding period.

AUBURN & SYRACUSE.—The Auburn & Syracuse Electric Company's June quarter report shows a gross of $80,454, a gain of about [illegible] over 1906. The surplus over all charges was $16,80[illegible].

GENERAL NEWS

Construction News.

ANNISTON, ALA.—The work of securing the right of way for electric lines from Jackson Shoales, near Tallegago, to Anniston is about to be started and material has already been ordered for building the line. It is understood that these steps are being taken by the Electric Share & Bond Company which owns the Jackson power rights in addition to owning the Anniston Electric & Gas Company and other electric light and power franchises. The company proposes to sell electrical energy in Anniston for less than it can be produced by manufacturers in that town.

DECATUR, ALA.—Manager H. B. Johnson, of the Decatur Light, Power & Fuel Company, states that his company expects to spend the sum of $70,000 on the improvements of its plant in New Decatur, which supplies both Decatur and New Decatur with electricity. The plant also furnishes power for the North Alabama Traction Company of the Decaturs. The company has already spent $5,000 on the improvement of the plant.

DOWNIEVILLE, CAL.—The promoters of the big power plant at Denton on the Feather River announce that before the project reaches its consummation a new railroad connecting Marysville and Oakland may result. A 10-ft. dam is to be constructed at the mouth of Gold Lake and the water piped down Gray Eagle Creek to the power plant. It is claimed that 20,000 hp can be generated in this manner.

ETNA MILLS, CAL.—It is stated that the proposition is being agitated to bond the town for the purpose of buying the water works, installing a sewer system and acquiring a source of electricity for light and power purposes.

PASADENA, CAL.—The Electric Light & Supplies Commission of the City Council is stated to have decided to enlarge the municipal electric lighting plant by adding 150 lamps, 50 to be arcs and 100 incandescents of 32 cp. C. C. Glass, manager.

REDONDO, CAL.—The War Department is reported to have granted to the Los Angeles Wave Power & Electric Company (Fred. Starr, president), of Los Angeles, all necessary rights and privileges for the establishment of a plant here.

SACRAMENTO, CAL.—The Great Western Power Company has secured rights of way from Antioch to Richmond by way of Concord for its high-tension wires. At Antioch the high-tension wires will cross the river on two high steel towers and continue on over right of way more than 100 feet wide.

SAN FRANCISCO, CAL.—At a recent meeting of the Artificial Lights Committee of the Board of Supervisors, John A. Britton, president of the San Francisco Gas & Electric Company, submitted a chart showing the locations of the lamps to be restored in the burned district. The company will install 1300 gas lamps and 63 arc lights and Chinatown will be lighted at once. He also submitted a statement showing that of the appropriation of $275,000 for public lighting, the sum of $215,641 would be required to pay for the lighting of 4210 gas lamps and 1616 arc lights in use on July 31, leaving a balance of $25,309 to be devoted to the rehabilitation of lamps in the burned district and the erection of new lamps in the suburbs.

CANON CITY, COL.—The Beaver Creek Power Development Company has filed in the county clerk's office a map and plan of the company's development. The purpose of the company is to develop electric power in connection with the Beaver Land & Water Company improvements. The pipe lines have their head gates on East and West Beaver Creek. The East Beaver line will be nearly ten miles long and will be constructed of 24-inch pipe having a capacity of 15 cu. ft. of water per second with a fall of 1800 ft. The West Creek line will be a little over 4½ miles long, will be constructed of 30-inch pipe and have a capacity of 18 cu. ft. of water per second with a fall of 1200 ft. The power station will be erected below the junction of the creeks and the approximate cost of the undertaking will be $750,000.

AVON, CONN.—Work on the new electric light line from Unionville to the town has begun.

MERIDEN, CONN.—Plans are under way for lighting the dome of the new town hall with electricity in a fashion similar to that of the dome of the State capitol at Hartford.

NEW BRITAIN, CONN.—The Connecticut Railway & Lighting Company has made a reduction in the price for electricity in this city and vicinity. The new schedule provides for a decrease of 10 per cent on all bills from $1 to $25 a month, 20 per cent on bills between $25 and $50, and 37 per cent on bills over that amount. The minimum monthly bills will be $1 and there will be no discount for cash payment within ten days.

NEW LONDON, CONN.—On account of an accident to the big turbine in the Water Street plant of the New London Gas & Electric Company electric service was interrupted for a time. Before night, however, the circuits were again in operation.

WATERBURY, CONN.—The Connecticut Railway & Lighting Company has reduced the rate for electric energy over its entire system as follows: There will be a 10 per cent decrease on all bills from $1 to $25 per month, a 20 per cent decrease on all bills between $25 and $50, and about 37 per cent decrease on all bills over $50. The minimum monthly bill will be one dollar and the usual discount for cash in 10 days is revoked.

WASHINGTON, D. C.—The Potomac Electric Power Company has petitioned for a hearing before the Board of Assessors in order that the question of the taxation of service conduits and meters may be thoroughly discussed.

WASHINGTON, D. C.—Bids will be received until Sept. 18 by the General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for furnishing, as per circular No. 387, the following: Steam riveting machine, pneumatic tools and hoist, electric drills, repair parts for steam shovels, testing apparatus for power plant, vacuum pump, electric motor, steel, iron, rivets, cotters, boiler and condenser tubes, etc.

MACON, GA.—Next week the new electric and power company, chartered as the Americus Railway & Light Company, will take over, by purchase, the electric and gas plant here.

MILLEN, GA.—It is stated that bids will be received about Sept. 12 by H. Q. Bell, Mayor, for an electric light and water plant for this place. Probable cost, $30,000. J. B. McCrary & Company, engineers, Atlanta.

BOISE, IDAHO.—The Twin Falls, Northside Land & Water Company will award a contract early next month for the next section of canals and possibly three reservoirs covering 150,000 acres. The Shoshone Falls power plant, built by the Shoshone & Twin Falls Water Power Company, was completed two weeks ago. The wires are all in and Twin Falls was supplied with electricity last week.

ELGIN, ILL.—The Aurora, Elgin & Chicago Electric Company has completed the work of burying its wires and conduits in the business section of Elgin. About 100 poles have been taken down from the streets since the work was started, and within a short while the company expects to erect a new sub-station.

JOLIET, ILL.—The Lamont light plant has been purchased by the Economy Light & Power Company.

MANITO, ILL.—This city is to have electric lights in the near future. Carl Miller, who is a practical electrician, has moved here from Bloomington and will proceed to install the plant as soon as possible.

SHAWNEETOWN, ILL.—A. L. Swanson, of Evansville, Ind., has been awarded the contract for a complete electric light plant for this city.

URBANA, ILL.—The work of rebuilding the light, heat and power plant in this city is progressing.

BLOOMINGTON, IND.—Negotiations have been completed at Columbus, Ind., for the sale of the Columbus Street Railway & Light Company's property to the Central Indiana Light & Power Company.

CLAY CITY, IND.—J. H. Bence, town clerk, writes that the town would grant a franchise for an electric lighting plant to responsible parties.

MICHIGAN CITY, IND.—Work upon the Michigan City Gas & Electric Company's power house has been resumed.

MUNCIE, IND.—The Muncie Electric Light Company is preparing to install some large machinery in the new addition being made to its plant. When finished the plant will be one of the most modern and extensive of the kind in the State.

DAVENPORT, IOWA.—The new power station of the Independent Power & Light Company in this city will be constructed of concrete blocks in two pieces, the contract having been let to the Tri-City Cement Products Company.

BANGOR, ME.—The [illegible] Power Supply Company has petitioned for the right to erect and maintain a pole line from Ellsworth to Bangor. Public notice was ordered in accordance with the statutes and a hearing under the petition will be given Sept. 5.

TURNER, ME.—The water wheel for the new electric light power house is being put in place, and the owners expect to have the dynamo in running order in a short while.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has been sued by the city for the expenses incurred in removing poles and stumps of the United Electric Light & Power Company in the burned district after the great fire in 1904. The claim of the city is for $632.40, with interest. An itemized statement attached to the bill of complaint shows that about [illegible] poles and stumps were removed.

[illegible]

LEE, MASS.—The Lee Electric Company has practically completed the improvements to its station, which meant almost the rebuilding of it. A new addition was built to accommodate the switchboard and a new en- [illegible]

[illegible]

night last week, during which time the town was in darkness.

[illegible] of Hopedale can provide lights for South Milford.

DETROIT, MICH.—Robert Oakman, who represented the interests of the Detroit United Railway, has obtained an option on the Pontiac, Oxford & Northern Railroad, running between Pontiac and Caseville, on Saginaw Bay. It has been understood the road would be extended to Bay City. The report now comes that the new management will experiment with the third rail between Detroit and Pontiac, twelve miles, and if it is successful the entire line will be thus equipped. Mr. Oakman stated when he obtained the option the road would soon be operated with electricity.

TRENTON, MICH. [illegible] of the citizens. The company is to furnish electricity at a cost of $65 per year for each arc lamp to burn all night. The company is also to buy the present plant for $8,000.

MINNEAPOLIS, MINN.—The City Council has passed an ordinance providing that the city estimates for next year include an item of $500,000 [illegible]

ALAMOGORDO, N. M. [illegible] tions for the installation of a power plant on the Fresnal, near the route [illegible]

ALBANY, N. Y. [illegible] vestigation the commission is about to start in order to devise plans for the progressive development of the water powers of the state for public use under state ownership and control. Thirty-five thousand dollars was [illegible]

ALBANY, N. Y.—Anticipating a favorable decision from the Public Service Commission on its application for permission to issue bonds amounting to $3,332,000 to finance the project, the Hudson River Power [illegible] Lake George in size and electrical energy to the extent of about 200,000 hp will be available. This will make the Hudson River and its tributaries the most prolific source of water power in the country, with the exception of Niagara Falls. The lake will be about forty miles long and from two to three miles wide and the dam will be of solid masonry. The greater portion of the energy developed will be sent westward to Amsterdam and Utica.

BUFFALO, N. Y. [illegible] Lockport & Ontario Power Company hopes by this means to prevent delays which have been caused by thunder storms in the past. The two lines are from five to fifteen miles apart and are connected at the Solvay [illegible]

[illegible] the McCaffery Water, Motor & Power Company, of Troy, is stated to have secured water privileges along the Caroga and Peck creeks from Caroga Lake to the Mohawk River, and from Peck's Pond to its junction [illegible] Fulton and Herkimer counties.

[illegible] plied by the Niagara, Lockport & Ontario Power Co. for lighting Depew, Lancaster and Sloan.

[illegible] district has denied the application of the Newburgh Light, Heat & Power Company for permission to increase its capital stock from $500,000 to $750,000.

ROCHESTER, N. Y. [illegible] & Light Company $1,363.29 for outages of arc lamps for the first six months of the year. Beginning with July 1 a new system for charging for outages was adopted in accordance with the lighting contract, which went into effect between the city and the Rochester Railway & Light Company at that time. Under this system a charge of 15⅞ cents per lamp per hour will be deducted, and if the same lamp is out a second night in succession the time is multiplied by five, and for the third and following nights again multiplied by five. The cost of city lighting under the new contract is about $5,000 a month less than under the old contract.

SARANAC LAKE, N. Y.—The power house of the Saranac Lake Light, Heat & Power Company was badly damaged by the bursting of a ten-ton fly wheel. The plant was, however, kept in operation, a reserve water wheel being placed in use.

SCHENECTADY, N. Y. [illegible] a great scarcity of water in the streams of this vicinity. The Hudson River Electric Power Company, which operates large plants at Spier Falls and Mechanicsville, is feeling the effects of the scarcity of water keenly. At the former plant the amount of water is not sufficient to run all of the big generators, and at the latter place the plant is almost shut down. The Eastern New York Railroad Company was requested to start its own power plant, and Schenectady is being supplied with electricity from the plant at the General Electric Company's works.

SYRACUSE, N. Y. [illegible] Commission have expressed the opinion that municipal subways, such as are used in Baltimore, Md., would offer advantages in many ways for Syracuse over those of private corporations. Several of the committee who went to Baltimore were favorably impressed with the conduit system in that city, and the final report of the commission is expected to be [illegible]

HICKORY, N. C.—M. E. Thornton, of Hickory, writes that the contract for constructing a concrete rock reinforced dam with power house across the Catawba River, at Hickory, and installing 3,000-hp turbine water wheels and electrical apparatus and transmission lines for lighting and power purposes, has been awarded to [illegible] Hickory.

FARGO, N. D.—Manager Clark has completed his plans for enlarging the power plant of the Union Light, Heat & Power Company. The company will expend about $30,000 in improvements.

COLUMBUS, OHIO.—Bids will be received until Sept. 17 by the Board of Trustees of the Columbus State Hospital (Geo. Stockton, M. D., secretary), for furnishing and installing complete at the power house at the said hospital an engine, dynamo and switchboard. Frank L. Packard, architect, Columbus.

SPRINGFIELD, OHIO.—The stockholders of the new North Side Lighting & Heating Company are reported to have on Aug. 13 decided to incorporate with a capital of $50,000. The name of the company is not yet decided upon. The site for the plant has been purchased and contract will soon be let for the erection and equipment. A. J. Eisenmayer is acting chairman of the company.

NORTH BEND, ORE.—The City Council has granted a franchise to Seymour H. Bell for the construction of gas and electric plants in this city, the gas and electricity to be used for all purposes.

PORTLAND, ORE.—Water power plants on the Upper Sandy River, [illegible] Eastern capitalists to finance the work.

ELIZABETHTOWN, PA. [illegible] bethtown & Marietta Electric Light Company in order that it may compete with the Nanheim Electric Company.

HALLSTEAD, PA. [illegible] pipes in order that it may be used for generating electricity. It is estimated that in flowing from Windsor to Landon the river has a fall [illegible]

PITTSBURG, PA. [illegible] sation for the franchise.

GARY, S. D.—Oscar Claussen, of St. Paul, Minn., is reported to be preparing plans for the proposed [illegible] light plant. [illegible] town clerk.

GEDES, S. D.—Work is under way for the construction of an electric light plant.

COLUMBUS, TENN.—The City Council is reported to be considering the question of improving the electric light plant.

KNOXVILLE, TENN.—At a cost of approximately $100,000 the Southern Railway is installing an electric lighting plant at Coster. When the plaut will have been completed the Southern Railway will do its own lighting for all the yards in and around the city for the different depots and other buildings occupied by the company in Knoxville and at Coster. The determination to furnish its own light was reached some time ago and was followed up promptly by the work of installing the plant. The electrical equipment for the plant is already on the way, the building at Coster is being provided and poles are already being erected in the yards and adjoining the different buildings and depots used by the company.

TULLAHOMA, TENN.—The new power house, together with the electric generating equipment and water works plant, was turned over to the city last week. The new power station cost about $10,000.

GALVESTON, TEXAS.—Improvements to the amount of $120,000 are being made at the plant of the Brush Electric Light & Power Company.

GOLIAD, TEXAS.—The commissioners' court in session granted Dr. I. W. Chilton the privilege of erecting poles, etc., for an electric light plant in this city.

ABERDEEN, WASH.—The Gray's Harbor Electric Light & Power Company has a big crew at work on its power buildings being erected between here and Hoquiam.

TACOMA, WASH.—The Council, on Aug. 13, is stated to have decided to accept conditionally on election to be held Sept. 10, the bid of Geo. Milton Savage Company, at $1,750,000, for installing on the upper Nisqually River a municipal hydraulic power plant of 10,000 hp.

EAU CLAIRE, WIS.—The Chippewa Valley Light & Power Company is reported to have filed a mortgage for $1,000,000, and proposes using some of the funds for improvements and extensions.

KENOSHA, WIS.—The people of Kenosha are preparing for another fight over the question of municipal ownership of an electric light plant. So much opposition has been developed that it is certain that the Chicago & Milwaukee Railway Company, now building a power house at North Chicago, will seek to secure a contract for lighting Kenosha.

LACROSSE, WIS.—The Lacrosse Gas & Electric Company has applied to the State Railroad Commission for authority to increase its rates for electrical energy.

BATTLEFORD, SASK.—The contract for the installation of an electric power plant has been awarded to the James Stuart Electric Company, Winnipeg, selling agent for the Canadian Westinghouse Company.

DELHI, ONT.—The electric light plant of the Delhi Light & Power Company was put out of commission Aug. 11 owing to a break in the new cement dam. It will take from six weeks to two months to repair the dam, the cost being from $2,000 to $3,000.

EDMONTON, ALB.—The City Council has passed a by-law reducing the electric light rates by 10 per cent. This is the second reduction in two years, making the price 30 per cent below that charged when the plant was put in operation.

LLOYDMINSTER, ALB.—Morison Brothers will erect a power house and have received a grant from the town for this purpose.

NEW WESTMINSTER, B. C.—The British Columbia Electric Street Railroad is preparing to let a contract for the construction of a railway between here and Chilliwac. Address R. H. Sperling, general superintendent, Vancouver, B. C.

OTTAWA, QUEBEC.—The difficulty over the power supply for the municipal electric plant has been definitely settled. The Hydro-Electric Commission has executed the contracts with the Ottawa & Hull Power [illegible]

[illegible] Mayor, until 6 p. m., Sept. 6, for all labor and materials required for additional equipment and rearrangement of the civic hydro-electric plant, comprising a 500-hp producer gas plant and engines, generators [illegible] and general conditions may be seen at the office of H. Floyd, city clerk.

[illegible]

New Industrial Companies.

[illegible] constructing and equipping central station, water, heat, light and power plants. Charles A. Gilham, Byron T. Gifford and David T. Wallace are directors.

THE CRESCENT ELECTRIC COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $25,000 by Henry W. Jachems, Henry M. Dickinson and Alfred W. Rake. The company will deal in electrical appliances, etc.

INTERNATIONAL ENGINEERING & CONSTRUCTION COMPANY, of Newcastle, Pa., has been incorporated with a capital stock of $25,000. The company proposes to build telegraph and telephone lines.

Company Elections.

REDLANDS, CAL.—At a meeting of the board of directors of the Home Gas & Electric Company, Delmont Locke was elected a director to fill the place of W. N. Campbell.

SALEM, N. H.—At the annual meeting of the Salem Light, Heat & Power Company held recently the following officers were elected: W. Du Bois Pulver, president; Levi Taylor, vice-president; William Lancaster, secretary, and Wallace Cole, treasurer.

STRATFORD, ONT.—At a meeting of the Stratford Gas & Electric Company held Aug. 14, the following officers were elected: W. C. Kennedy, president; J. P. King, secretary and treasurer; J. C. Baxter, managing director, and J. O'Loane and C. S. King, directors.

New Incorporations.

LESLIE, ARK.—The Leslie Telephone Company has been incorporated with a capital stock of [illegible] W. R. [illegible] is president.

LITTLE ROCK, ARK.—The Ozark Mountain Traction, Light & Power Company has been chartered with a capital stock of $200,000. The company proposes to construct an interurban railway between Russellville and nearby towns. The officers are: Adam J. Robinson, president; J. C. Wilson, vice-president; James Gould, secretary, and W. N. Langford, treasurer.

RUSSELLVILLE, ARK.—The Russellville & Ozark Mountain Traction, Light & Power Company has been incorporated with a capital stock of [illegible] Adam J. Robinson, J. C. Wilson and James Gould and others, to build an electric railway from Russellville to adjoining towns, and to furnish electricity in the towns through which the electric railway runs. The first road will be built to Dover. It is reported that plans have been completed for a masonry and concrete dam to be constructed across the Illinois Bayou, near Russellville.

FRESNO, CAL.—The Fresno Home Light & Power Company has filed an article of incorporation with the county clerk. The company has a capital stock of $250,000 and will erect a $280,000 plant. The circuits will be all underground and the company proposes to connect seven or nine of its ornamental electric lamps in each block of the downtown business district.

LOS ANGELES, CAL.—The Santa Monica Gas & Electric Company has been incorporated with a capital stock of $250,000 by F. A. Crowe, [illegible] Los Angeles.

ATLANTA, GA.—Articles of incorporation will soon be filed for an electric railway from Greenville, S. C., to Spartanburg, a distance of about 31 miles. The incorporators are A. A. Gates, C. C. Good, H. H. Prince and O. K. Maulden.

BOISE, IDAHO.—Articles of incorporation have been filed for the [illegible] and Milton H. Cohn.

CHICAGO, ILL.—The Elizabeth Light, Heating & Power Company has been incorporated with a capital stock of $25,000 by Harry R. Murray, Frank M. Marvin and others.

FULTON, ILL.—The Fulton County Telephone & Telegraph Company [illegible] and others.

MARSHALL, ILL.—[illegible] 000, has been organized in New York to construct telephone and telegraph [illegible]

[illegible]

SOMERSET, KY.—Articles of incorporation have been filed with the [illegible]

[illegible]

[illegible] Rust, president; M. B. Haines, vice-president and treasurer; E. H. Guie, of Seattle, is secretary, and H. K. Owens is engineer. The principal office will be at Seattle.

OAKLAND, MD.—The Youghiogheny Light & Power Company, of Garrett County, has been incorporated at Oakland. The company proposes to erect a power plant below Deep Creek Falls, seven miles north of Oakland, at which point the water power of the Swallow Falls in Yough River, the Deep Creek Falls and the Muddy Creek Falls nearby, will be concentrated and utilized for the purpose of generating electricity. It is proposed to furnish electricity in Oakland, Mountain Lake, Deer Park, Grantsville, Accident, Friendsville and other towns in Garrett County, Kingwood and other towns in West Virginia and towns on the southern border of Pennsylvania, and also to supply electricity for the electric railways, one of which is to run from Frostburg to Uniontown, over a section of the old National Pike.

MEDFORD, MINN.—The Straight River Rural Telephone Company has been incorporated with a capital stock of $10,000 by G. O. Lee, W. H. Boynton, W. F. Eaton and W. A. Bailey.

PARK RAPIDS, MINN.—The Park Rapids & Lake George Telephone Company has been formed with a capital stock of $[illegible].

SPRINGFIELD, MO.—At a meeting of the promoters and stockholders of the new North Side Lighting & Heating Company, which was recently granted a franchise by the municipality, it was decided to incorporate with a capital stock of $50,000.

SILVER CITY, N. M.—The Silver City, El Paso & Southwest Telephone Company has been organized by Clyde Smith, of Silver City; W. D. Murphy, of Central, and C. S. Bosworth, of Deming.

NEW YORK, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Magnet Light Company. The company is capitalized at $10,000, and the directors are Nathan Greenburg, Samuel Eisenburg and Joseph Miller, of New York.

Legal.

RIGHT TO CONDEMN LAND.—In an action brought by the Indianapolis & Cincinnati Traction Company to condemn land for a proposed electrical transmission line, consisting of poles and wires, for the transmission of electricity from its power house to a station in Shelbyville, Ind., where the electricity was to be reduced in voltage and used for lighting and motive power in operating an interurban railroad, a number of objections were set up to the right of the company to acquire the land. Among other things, it was objected that the company had no power or right to exercise the privilege of eminent domain and appropriate the lands in question; and that the line, if erected, would constitute a nuisance. It was held that under the statutes of the state of Indiana, the company was empowered to condemn the land, and that the transmission of electricity over such a line would not be, per se, a nuisance. The law authorizes the construction and maintenance of lines for the transmission of electricity and the conduct of a lawful business is never a nuisance per se. Mull vs. Indianapolis & Cincinnati Traction Company, Supreme Court of Indiana, 81 N. E. Rep. 657.

RESPONSIBILITY FOR ACCIDENT.—The Privy Council of Canada has just rendered a decision on appeal in favor of the Montreal Light, Heat & Power Company in regard to an accident suit, in which the jury had returned a verdict against the company. It appears that the company had a 4000-volt transmission line on a public street. A contractor in erecting a fire station for the city of Montreal put up a derrick on the sidewalk in such a position that when the boom was swung out into the street to pick up stones, steel beams, etc., the steel hoist cable would come in contact with the bare conductors. Before the contractor had time to use the derrick the company warned the men in charge and also notified the contractor, in writing, receiving a receipt for the notification. After this had occurred the employees of the contractor fastened a rope to the boom of the derrick so that it could swing out a certain definite distance, but not far enough to come in contact with the wires. A week or two later a large stone out in the middle of the street was wanted, and in order to get it lifted by the derrick, the safety rope was untied to ensure wider range of action. When the steel cable became taut in the effort to raise the stone, it came in contact with the circuits, and the man at the crank handle was killed instantly by shock. A passerby who attempted to assist was also killed. As noted, the jury found against the company and exonerated the contractor, but when the case on appeal reached the King's Bench the adverse decision was reversed, and the Privy Council has now sustained the decision for the company.

[illegible] OF PLANT.—An electrical company entered into a contract to furnish and install an electric light plant in the basement of the Hollenbeck Hotel, in the city of Los Angelos, the plant to consist of a dynamo of specified description, and a "Shepard cross-compound, vertical non-condensing engine." The electrical company, in order to carry out its contract, entered into another contract with an engineering company, under which the latter company agreed to furnish the engine and install both the engine and the dynamo. In this contract the engineering company guaranteed the engine from any defects or flaws for the period of one year, unless it could be shown that such flaws or defects resulted [illegible] the plant was [illegible] and [illegible] of the hotel people. [illegible] in an action by the engineering company to recover the balance due on the purchase price of the engine the electrical company claimed not to be liable in that the engine was defective and, when operated, caused a loud and continuous knock or pound and also a constant flickering in the lamps. It could not be denied that the lamps fed from the plant flickered and that the engine, when operating the dynamo, produced the "knock" or "pound" as claimed. But the plaintiff argued that this was due, not to any defect in the engine, but rather to its unskilful management. One expert testified that there was no bump or knock discernible when the engine was first started, nor until after the hotel people had taken complete control of it, and that it was the quietest direct connection engine he had ever seen. Other experts testified in the same tenor. It was held that the engine was not defective, that neither the flicker nor the pound was due to any fault of the engine, and that the defendants were liable for the unpaid balance of the purchase price. Tracy vs. California Electrical Works, California Court of Appeals, 90 Pac. Rep. [illegible].

COMPANY NOT RESPONSIBLE FOR DEATH.—[illegible] against a power company for damages, which was the subject of a recent decision of the Supreme Court of Wisconsin, brought forth the following facts: A fire occurred in Oshkosh, which was known as the "Plummer Fire." In the rear of the Plummer store, at the outer edge of the sidewalk, stood a telegraph pole on which were strung numerous telephone and other electric wires, among them being four wires belonging to the defendant power company, carrying about 2200 volts each. The pole was badly burned during the conflagration, and all of the wires attached to the pole, except those of the defendant company, were removed on the day of the fire. Three days after the fire one Zentner, who was the defendant's only lineman, was ordered by the defendant's general superintendent to replace the burned cross-arm. Zentner proceeded with his work and succeeded in replacing two of the cross-arms without mishap. Later in the day he was discovered leaning across the high-voltage wires, the insulation on which had been burned away by the fire, and when he was reached life was extinct. Two engineers in the employ of the defendant testified that for four years prior to the accident the current had never been turned off for the purpose of making outside repairs. If the company was liable it was upon the ground that it was guilty of negligence in not shutting off the power during the progress of the repairs and, the evidence to the effect that it was customary to allow the power to remain on while repairs on wires were being effected being uncontradicted, judgment was given for the defendant. Zetner had assumed the risk and his estate was not entitled to damages. Risks of employment are always assumed when the servant knows or ought to have known the dangers incident to the conditions under which he works, and all ordinary risks and hazards of the occupation in which he is engaged are assumed, whether the servant appreciates them or not. Zentner, by engaging in the work of a lineman for the defendant company, assumed the ordinary risks incident to such employment. It would be presumed that he was aware of the condition of the wires in question, and, having knowledge thereof, though presumptive merely, he accepted the risk, which precluded any recovery of damages against the company. Zentner vs. Oshkosh Gaslight Company, 112 N. W. Rep. 449.

DUTY TO INSULATE WIRES.—In the jurisdiction of Texas an action was brought against an electric company and a telephone company jointly for damages for the death of an inspector in the employ of the telephone company. The two companies maintained lines of poles along the same right of way and two of the electric company's wires, carrying deadly currents of electricity, passed in close proximity to one of the poles of the telephone company. The wires had burned out by coming in contact with the pole and a man was sent to make [illegible] repairs. He fixed them so that they would work that night and left an order for the lineman to repair them permanently. One of the linemen testified that he found the wires in bad condition and that he fastened them to the telephone pole, intending later to solder and fix the joints, but that he "just neglected it, that is all." While ascending the pole to attend to the telephone wires, the inspector, without any knowledge of the danger thus created, came in contact with the unrepaired wires and met instant death. It seems that there was in force in the city an ordinance regulating and governing the construction and maintainance of wires for conducting electricity, which stated, in substance, that live wires must have an approved weather or rubber insulating covering, and be so spliced or joined as to be both mechanically and electrically secure without solder, and that the joints must then be soldered to insure preservation, and covered with an insulation equal to that of the conductors. The electric company sought to shift the responsibility on to the telephone company by pleading that the latter company allowed its pole to lean to one side, and that the accident would not have occurred had the pole been perpendicular. The blame, however, was allowed to remain with the electric company [illegible] the deliberations of the jury. The failure of the company to keep its wires insulated was, by reason of the ordinance, negligence in itself. The duty of the proper maintenance of the wires was expressly imposed upon the company, and it was held that the fact that the dangerous condition of the wires was due to the company's employes failing to finish their work, and leaving it in a half-completed condition, did not detract from its character as an act or omission on the part of the company it[illegible]. San Antonio Gas & Electric Company vs. [illegible], Court of Civil Appeals of Texas, [illegible] S. W. Rep. [illegible].

SUPERIOR, WIS.—Articles of incorporation have been filed with the Secretary of State for the Interstate Transfer Railway Company. The company is capitalized at $600,000, and the incorporators are: S. L. Perrin, W. W. Savage, of Superior; Joseph B. Cotton, George L. Reis, and William A. McConagle, of Duluth, Minn. The company proposes to build a railway connecting Superior and Duluth, a distance of 20 miles.

Personal.

MR. C. McK. PARR has established headquarters at Greensboro, N. C., for the Electrical Material Company of Baltimore, Md.

MR. D. H. FOOTE has been elected secretary of the Pacific Gas & Electric Company and of the California Gas & Electric Corporation, succeeding C. W. Conlisk.

MR. W. G. MIDDLETON, of the Tri-State Telephone Company, St. Paul, Minn., has been appointed assistant provincial telephone expert for Manitoba to assist Orrin F. French.

MR. C. M. BUNNELL, formerly assistant manager of the Birmingham, Ala., office of the Southern States Electric Company of Atlanta, has joined the sales organization of the Westinghouse Electric & Manufacturing Company, being attached to the Atlanta headquarters of that corporation.

MR. HUGH J. McGOWAN, president of the syndicate traction lines in Indiana, who, with his family has been traveling in France, Switzerland and Ireland, returned on Aug. 28. Mr. McGowan found several knotty interurban questions to deal with upon his arrival.

MR. A. A. TIRRILL and family were passengers on the steamship *Finland*, which arrived in New York, Tuesday, Aug. 20. Mr. Tirrill, who is the inventor of the Tirrill regulator, has been in Europe for the past four months in the interest of the General Electric Company, which is now manufacturing this regulator.

MR. J. B. KENNEDY has resigned as the New York representative of the Wirt Electric Company, Inc., of Philadelphia, now owned by the Cutler-Hammer interests. He is now engaged in the chief engineer's office of the Department of Water Supply, Gas and Electricity.

MR. CHARLES C. MORDOCK, formerly manager of the Terre Haute Traction & Light Company, of Terre Haute, Ind., has been appointed a permanent member of the board of expert engineers of the Stone & Webster Engineering Corporation, Boston, Mass. Mr. Mordock will make his headquarters in Boston.

MR. PUTNAM A. BATES is building a home for himself at Madison, N. J., which is intended to be a model of electrical installation and use of domestic devices for cleanliness, convenience and economy in operation. He is also engaged on equipments for Mr. C. W. Harkness, of Madison, and Mr. Clyde Fitch, at Katonah, N. H. He is to lecture this winter before the Franklin Institute on the equipment of country houses and farms with electricity.

MR. M. A. VIVIEN, of the Marconi Wireless Telegraph Company, arrived here this week on *La Touraine* to inspect the Marconi system in this country. He is enthusiastic over the great progress the wireless is making on both sides of the Atlantic. The Marconi Company, he predicted, will, within a few months, be able to compete with the cable companies. "Marconi," he said, " is now at the high power station at Cape Breton perfecting the apparatus there, and at the same time the work of perfection is under way in England, so that within a month it is expected the company will be in direct wireless communication from the continent to England, and we will be able to send and receive messages, thus entering into competition with the cable companies." Mr. Vivien will remain on *La Touraine* for a few days perfecting the wireless outfit on the liner. The French line, he announced, will equip its steamships with powerful instruments, so that it will be enabled to keep up communication with Europe and America all the way across. Mr. Vivien will go from here to inspect the station at Cape Cod.

Trade Publications.

THE GENERAL ELECTRIC COMPANY has issued Bulletin No. 4521 for July devoted to its floor outlet boxes, which are adjustable and watertight. They are described and illustrated in detail.

THE SPRAGUE ELECTRIC COMPANY has issued a second edition of Price List No. 423, which includes several new types of fittings for use in connection with Greenfield flexible steel conduit and flexible steel-armored conductors. The publication of this edition has been necessitated through the addition of new types of boxes and box fittings and by the reduction in price of several types of boxes. Owing to these changes, new discounts on all conduit materials listed in Price List No. 423 have also been sent to the trade.

Business Notes.

THE HOLOPHANE GLASS COMPANY has just established an office and stockroom, with demonstration room, at 298 Wabash Avenue, Chicago, telephone, Harrison 329, in charge of Mr. C. A. Howe, who will be manager of the Western department. A stock of globes and reflectors will be kept for quick delivery in and near Chicago, which will doubtless prove a great convenience to customers who have heretofore secured their orders through the New York headquarters.

DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburg, Pa., announces that its Charlotte (N. C.) warehouse is now open and ready to take care of the requisitions for the Southern trade. The stock is large and comprehensive, covering the best lines of material, such as "O. K." weatherproof wire and "Parac" rubber covered wire, Bryant, Perkins and Paiste materials, Emerson alternating-current desk and ceiling fans, "Peerless" lamps, Hubbell specialties, etc. From this stock the demand of the lighting stations, electrical contractors, street railway companies and telephone companies can be promptly supplied.

THE CONTINENTAL FIBRE COMPANY, of Newark, Del., incorporated last year, reports such a demand for its product that it has already been necessary to double the capacity of its plant. These improvements are now about completed, and the usually active fall trade will find it equipped to make immediate deliveries in practically unlimited quantities. The success of this firm may be attributed to its long and intimate connection with the vulcanized fibre business, each of the incorporators having been connected with the industry since its infancy, together with sufficient capital and a thorough organization, offices being maintained throughout this country and Europe.

HARTFORD MACHINE COMPANY.—At Hartford, Conn., on Aug. 21, the new four-story addition to the plant of the Hartford Machine Screw Company was the scene of much good fellowship, when the dedication of the building took place with about 1000 persons present, including officers of the company, employees and friends. Mayor William F. Henney, in behalf of the employees of the company, presented to Philip B. Gale, vice-president and general manager of the company, a silver loving cup of rich and handsome design. Mr. Gale was wholly unprepared for this part of the programme, but as soon as Mayor Henney had completed his remarks, the former was ready with a response that clearly showed his appreciation of the friendly attitude in which he is viewed by those who are under him in the factory. Mr. S. E. Doane, superintendent of the factory and chairman of the committee having the dedication of the new addition in charge, spared no pains in making the event pass off smoothly. The entertainment was on a large scale, and in many ways was unusual. Both of the rooms which were dedicated were as clean as the model housewife's kitchen, and were it not for a small part of the shafting that had been placed one would hardly realize that he was in a large factory. The new addition to the factory plant consists of the third and fourth stories in the building known as No. 9. The machinery will all be installed by this week and the wheels will be in motion. The building is of brick, 275 feet long by 60 feet wide. The work on the addition was begun about three months ago.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. [illegible], 1907.

[illegible]

[illegible]. ELECTRICAL SIGNALING FROM MOVING TRAINS; [illegible] D. Jones, [illegible]. App. filed [illegible]. An apparatus actuated by [illegible] for completing an electrical [illegible] means, as the train [illegible].

863,613. MEANS FOR OPERATING THE CONTROLLING SWITCHES OF ELECTRIC VEHICLES; [illegible], France. App. filed [illegible] automobiles and has a switch arranged co-axially within the column and operated by a handle projecting axially therethrough in the manner of an ordinary train controller.

[illegible]. COMBINED TELEPHONE RECEIVER AND TRANSMITTER; R. F. Ludlow, Philadelphia, Pa. App. filed April 6, 1904. In a telephone, [illegible] variable resistance conductor in the other compartment, but in series with the windings of the magnet, a single diaphragm, and means extending through the first-mentioned compartment directly connecting the diaphragm [illegible].

863,629. COMBINED DROP AND JACK; [illegible] M. Overshiner, Chicago, Ill. App. filed May 3, [illegible]. A combined drop and jack comprising a shutter, and a movable device adapted to be engaged by a non-entering portion of a switch plug, when the plug is within the jack, and adapted also to engage and move relatively to the said shutter, whereby the said shutter is automatically restored by the endwise movement of the plug in the jack.

863,643. GRINDING MACHINE; George P. Ransom, Oshkosh, Wis. App. filed May 20, 1907. Construction of motor-driven grinding machine having a grinding wheel and means acting on the periphery of [illegible] predetermined speed for a given wheel will not be exceeded.

863,656. SAFETY FUSE; Joseph Sachs and Frank D. Reynolds, Hartford, Conn. App. filed March 22, 1906. The usual fiber tube of a fuse has a U-shaped slot on one side through which an indicating fuse extends so as to form an indication when the main fuse is blown.

863,667. RELAY; Jacob Struble, Wilkinsburg, Pa. App. filed Feb. 18, 1907. Construction of relays for use in railway signaling in which sectional track rails charged by an alternating current and connected by inductive bonds are used.

[illegible]. JOINT FOR CARBON ELECTRODES; Frank [illegible], Niagara Falls, N. Y. App. filed Sept. 25, 1906. A joint for carbon electrodes

[illegible] ng oppositely disposed parallel [illegible] guides, the brush having taper [illegible] th which they are engaged.

[illegible] E. Belcher, Los Angeles, Cal. [illegible] by which the trolley wheel may be expeditiously re-engaged whe[illegible] it has left the wire by means of pneumatic pistons connected to impart [illegible] vertical movement to the pole.

863,602. SYSTEM OF ELECTRICAL DISTRIBUTION; William L. Bliss, New York, N. Y. App. filed July 20, 1904. System in which a motor is driven from the wheel axles of a train and including a storage battery and regulator by which the current is maintained constant regardless of changes of speed or direction of the train.

[illegible] kee, Wis. App. filed March 19, 1906. Drop signal and key for party line system.

[illegible] William Kaisling, Chicago, Ill. [illegible]zed call bell or ringer comprising [illegible] having cores provided with pro[illegible] [illegible]pporting yoke extending between [illegible] each of said threaded ends [illegible]al groo[illegible] into which the adjacent [illegible] of the yoke project.

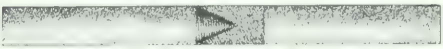
863,755. CONTROLLING APPARATUS FOR RAILROAD SIGNALING; Petrus J. Portman, Amsterdam, Netherlands. App. filed June 8, 1906. System operated by magnetic induction by which an engineer is kept notified of the condition of the trolley conductor both ahead [illegible]

863,773. LIGHTNING ARRESTER; Ernst J. Berg, Schenectady, N. Y. App. filed Jan. 8, 1907. A lightning arrester comprising a reactance, condensers in parallel therewith, a ground connection for said condenser, and a separate discharge path to ground through a spark gap.

863,774. PARALLEL CONNECTED GENERATORS; Ernst J. Berg, Schenectady, N. Y. App. filed Jan. 17, 1907. A direct-current generator comprising a series field winding opposing the main field magnetization, and a reactive coil shunting said field.

863,791. PROTECTIVE DEVICE; Loren Emery, Schenectady, N. Y. App. filed Jan. 10, 1907. A protective device adapted to open the circuit [illegible] arranged with a time limit device operative on normal overload but inoperative on an excessive overload or a reversal of energy. Apparatus may be used on direct or alternating current circuits.

863,799. ELECTRIC METER; Charles E. Holmes, Lynn, Mass. App. filed Nov. 23, 1904. Construction of electric motor having a casing [illegible] supporting the [illegible] removing the [illegible] from the casing.



[illegible]

863,807. SNAP SWITCH; Frank W. Sanford, Schenectady, N. Y. App. filed Feb. 1, 1905. A two-button snap switch having a switch blade spring impelled into either one of two limiting positions, and a spring follower motion controlled by a detent for impelling the switch arm at the limits of movement of the operating buttons.

863,808. DIAL PLATE FOR SWITCHES; Howard R. Sargent, Schenectady, N. Y. App. filed Aug. 24, 1905. A rotary switch having a rotatable spindle and a switch contact having upwardly extending portions and a dial plate supported on said portions.

863,810. TELEGRAPH KEY; Henry Smith, Raleigh N. C. App. filed July 17, 1906. Telegraph transmitter of the type having one button for sending dots and another for sending dashes. Has a sectionally arranged vibratory spring engaging a plurality of contacts different ones of which are effective upon depression of different keys.

863,814. DYNAMO ELECTRIC MACHINE; Louis E. Underwood, Lynn, Mass. App. filed April 9, 1904. In a dynamo-electric machine, a frame, polar projections extending therefrom, and sheet metal tanks or receptacles located in the spaces between adjacent polar projections.

863,818. RAIL BOND; Ben Willard, New Orleans, La. App. filed March 31, 1899. In order to obtain better contact of the bond with the rail, patentee has a single strand conductor provided at its ends with a plurality of contacts fixibly connected to one another.

863,847. ELECTRICAL SOCKET SEAL; Llewellyn T. Hatfield, Sacramento, Cal. App. filed Aug. 3, 1906. The lamp socket has a cavity which receives a plug engaging the base of the lamp to prevent its removal. This plug is sealed in place by a wax or lead seal.

863,852. TRANSMISSION OF INTELLIGENCE BY ELECTRIC MEANS; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 5, 1904. Circuits for telephone system. Electric transmission line having two local circuits more or less remote from one another and joined by a transmission line, each of the local circuits having a value at least equal to the value of the line.

863,853. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed April 24, 1907. Duplex telegraph system having two sources of current in opposition to one another and means for grounding sectional windings of an electromagnetic device at each station.

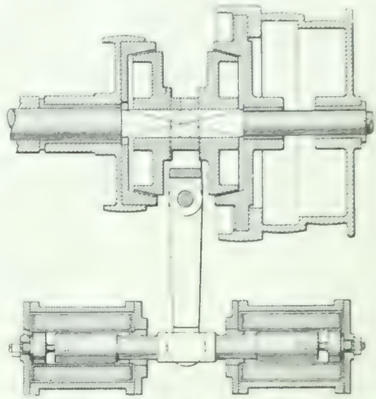
863,875. SYSTEM OF SELECTIVE ELECTRIC SIGNALING; S. A. Reed, New York, N. Y. App. filed Aug. 4, 1906. In a selective system, a circuit containing condensers and oppositely biased ringers respectively in series, a source of current and a resistance, in combination with a periodic switching device for charging said condensers alternately with charges of opposite polarity and adapted to interpose said resistance into the condenser circuit during the change from maximum positive charge to maximum negative charge or vice versa.

863,913. BLOCK SIGNALING APPARATUS; Walter E. Foster, Chicago, Ill. App. filed April 25, 1907. Has a signal locking device arranged to be operated by a reversal of the line polarity, and means whereby the passage of a train into and out of a block automatically reverses the line polarity and thereby operates such lock.

[illegible] But[illegible] [illegible]mbinati[illegible] [illegible]e of signaling [illegible] [illegible]

[illegible] ical device for controlling an electric circuit on electric locks or levers [illegible] only be turned in one direction to operate the switches.

863,955. INTERRUPTER APPARATUS; Reinhold H. Wappler, New [illegible] circuit of an induction coil for a wireless apparatus having a vibrator which is mechanically operated by a cam shaft.



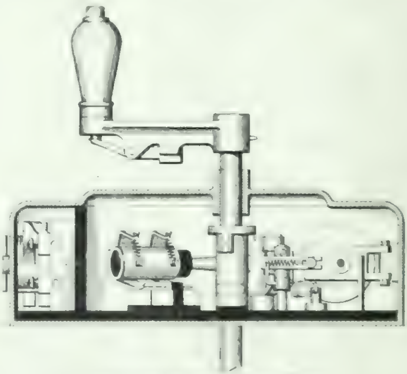
[illegible] Motion of Machine Tools.

863,966. ELECTROMAGNETICALLY-OPERATED MECHANISM FOR REVERSING THE MOTION OF MACHINE TOOLS; Julius Billeter, Aschersleben, Germany. App. filed Oct. 25, 1906. A pair of friction cones moving in opposite directions may be selectively engaged by a central cone or clutch moved by solenoid magnets.

863,969. TELEGRAPH AND TELEPHONE CABLE CORE; William Dieselhorst, Old Charlton, and Arthur W. Martin, London, England. App. filed March 29, 1904. A method of making telephone cables which consists in twisting together pairs of individual conductors with a constant length of lay from end to end of each twisted pair, and again twisting the twin conductors in pairs, but with a different length of lay.

863,984. TROLLEY; Nelson J. Greenison, New York, N. Y. App. filed Jan. 28, 1907. The trolley wheel is swiveled on a vertical axis on the end of the trolley pole and is constrained to move within a limited arc of angular movement by gears or lugs thereon.

863,985. MEDICINE CABINET; John Haller, Chillicothe, Ohio. App filed Jan. 6, 1906. A medical cabinet having alarm devices and bells so that the various compartments are illuminated when the doors thereof are opened, and inscriptions displayed to guard against poison.



[illegible]

[illegible] plate.

[illegible] tomatic circuit closer applied directly to the controller shaft in connection with a circuit breaker, all the parts being enclosed in the same casing.

[illegible] ING SYSTEM; Willard H. Gil[illegible] upon each movement of the arm [illegible] contact devices.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

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NEW YORK, SATURDAY, SEPTEMBER 7, 1907.

CONTENTS.

OUR NEW HOME.

On and after this date the ELECTRICAL WORLD will have its offices in the large new building which has been erected as the home of the McGraw Publishing Company, at 229 West Thirty-Ninth Street. All editorial and other communications should therefore be sent to the new address. The facilities and location are all that could possibly be desired, and we hope to make the ELECTRICAL WORLD more useful and efficient than ever under the new auspices. The building is understood to be the largest of its kind in New York City, the construction being solid reinforced concrete. It has a frontage of 126 ft., is 11 stories in height, and contains every modern office and printing house appliance. The location of the building is particularly convenient for visitors to New York. It is within three blocks of the subway station at Times Square and of easy access to the Grand Central Station, as well as to the Forty-Second Street station of the Sixth Avenue elevated line, and to the Broadway surface cars. The building is readily reached, also, from the leading hotels and clubs, and is only a few hundred feet from the new building of the United Engineering Societies. The new Pennsylvania Railroad terminal, when completed, will be distant but three minutes' walk.

INCANDESCENT LAMP SPECIFICATIONS AND TESTS.

The incandescent lamp specifications adopted by the United States Government electrical engineers, the substance of which was published in the ELECTRICAL WORLD of Aug. 3, offer an excellent and well-considered set of rules covering the purchase and test of incandescent lamps. That the United States Government engineers have felt it necessary to adopt such specifications should bring forcibly to central stations and isolated plants the desirability of more scientific and business-like methods in the purchase of incandescent lamps than have been common in the past. American central-station men and lamp manufacturers have pointed with pride to the general superiority and higher efficiency of incandescent lamps commonly used in America as compared with those in Great Britain. To what has this American superiority been due? Very largely to the method of purchasing lamps for supplying free lamp renewals by the large central-station companies of the United States. These companies for years have made it a practice to have life, candle-power and efficiency tests made on samples taken from the entire product purchased, following the same general line of procedure as that described in the recent government specifications. Outside of the group of large central stations which buy and pay for lamps according to their tested performance, the number of central stations and large isolated plants which make a regular practice of testing lamps purchased is deplorably small. To be sure, there are a few which keep excellent records. It goes without saying that the best lamp product in the country goes to companies which test what they purchase. What becomes of the rest can easily

[illegible] what he is really purchasing. To paraphrase a pointed remark [illegible] last spring, it takes more than a good talk from a lamp salesman to secure a uniform grade of lamps which give a certain standard life at a given efficiency. The greater the percentage of the incandescent lamp product of this country, which is bought according to actual life, candle-power and efficiency tests, the better it will be for all concerned.

Details of Electric Cooking Outfits.

The report on "Electric Heating Devices" made to the Ohio Electric Light Association by Mr. M. E. Turner and printed in abstract elsewhere in this issue, indicates that there is considerable room for difference of opinion as to the best arrangements of details of complete electric cooking outfits. We have already expressed the opinion that the central-station man for the immediate present should concern himself more with light electric cooking on the dining-room table, where electricity has no competitor, rather than to spend too much time and money trying to introduce complete electric cooking kitchen outfits. While many complete electric kitchens are now in use and are proving entirely practical and exceedingly convenient, there are, as Mr. Turner indicates, many details which really ought to be worked out better than they are at the present time. To begin with, there is the question of whether cooking utensils shall be separable from the heating elements. If the heating element is in the utensil, there immediately comes up the question of how to arrange the cord connection. One style of electric range has the cords coming out over the table where they are more or less in the way of the cooking utensils on the table. As this arrangement is objected to by some users, the plan of having the cords come from under the front edge of the table has been adopted in some cases. Mr. Turner advocates the plan of having the cord connections detatchable both from the heating device and from the switchboard; or, in other words, having a plug connection at both ends. Such an added expense and complication may be desirable for some reasons, but with a convenient arrangement of switches and cords where they can be kept out of the way, it is a question whether it is necessary. There is still a great dearth of good plugs and receptacles for the use of such heavy currents as are required in electric cooking. Considering the propensity of the average small boy for prying open the doors of the present common types of flush receptacle and the chances that he will short circuit them with nails and hairpins, it is no wonder that some electrical men insist that whatever receptacles are used in a house must be of the concealed contact type which is difficult for a child to short-circuit. Some feasible method of heating water is essential to the development of the exclusive use of electricity for cooking. The heating of water for washing, however, is really the most difficult problem in the whole range of household applications, because of the large amount of energy it requires. Even meters operated with cheap gas are likely to astonish users in the quantity of gas consumed; and when the central-station man recommends the heating of large quantities of water electrically, he is simply inviting trouble if the customer cares anything about the expense. With the small quantities of hot water which are needed in small families, it may be feasible.

September Fan Business.

In former years the central-station solicitor and electrical dealer in the Northern states would rightly consider that the electric fan season ended with August. This should not be the case this year. There are usually some hot days during the first half of September and people may still be induced to invest in fans for use now with the prospect that they can be put to good use helping out the hot-air or steam heating system next winter. The electric fan may be made a great aid in warming cold rooms in either steam or hot-air heated houses. In the steam-heated room it is simply a question of setting the fan so as to force air against the radiator surface. In the hot-air heated house the fan can either draw air out of any particular register or can be made to force air through the whole heating system by being placed in the air intake pipe of the furnace. In the meantime there seems likely to be plenty of use for the electric fan as a cooling agent in September, so backward has been this year's summer season. The Commonwealth Electric Company in Chicago has been calling its customers' attention to the fact that there is a "lake breeze" lurking in "every room of the house" which needs only an electric fan to start it up.

Recent Developments in Wireless Telegraphy and Telephony.

The lecture recently given by Prof. Fleming at the Royal Institution, on "Recent Contributions to Electric Wave Telegraphy," is a notable addition to the recent literature of the subject. The title of the lecture was somewhat unfortunate because it suggests that only wireless telegraphy employs electric waves; whereas both wire and wireless telegraphy employ electric waves. However, the title was probably directed to the appreciation of a popular audience. A large part of the lecture appears to have been devoted to undamped oscillations. At the present time, spark-telegraphy, or wireless telegraphy with a large logarithmic decrement in the oscillations, is by far the more extensively employed. In the future, however, we may look for simplified and intensified methods of developing arc-telegraphy, or wireless telegraphy, with little or no logarithmic decrement in the oscillations. In the end, the spark method can have no chance against the arc method, for power and range in signalling. The arc method should, of course, include any system of maintaining undamped oscillations. It was pointed out that some steam-turbines are made to run at a speed of 500 revolutions per second, and that inductor-alternators coupled to such prime-movers permit of generated frequencies of 50,000 or 100,000 cycles per second. The synchronous impedance of such high-frequency alternators is, however, very high, and their regulation of pressure under load is relatively poor. It is still a matter of difficulty to produce undamped oscillations under practical conditions.

Wireless telephony was also described and the experimental results between Berlin and Nauen were alluded to. The result reported was satisfactory transmission of speech over a distance of 12 miles, using copper-carbon arcs at the transmitting station. It seems certain that any method which greatly extends the range of wireless telephony must likewise be capable of extending the range of wire telephony. The limitations of overhead wire telephony are determined at the present

time by the magnitude of the impressed e. m. f. at the sending end of the line, generated by the speaker's voice. If the speaker's voice could be made to generate an impressed e. m. f. of, say, 100 volts, instead of two or three volts, and this powerful voltage could be maintained under current delivery to the lines, we might expect to carry wire telephony enormous distances, although the difficulties from cross-talk would be magnified in like proportion. This is just the problem in wireless telephony, namely, how to produce a relatively powerful e. m. f. and current in conformity with vocal vibrations, so as to deliver plenty of power to the sending antenna, for radiation into space. The problem, although difficult, does not seem insuperable. Given vocal vibrations, electric power, and suitable apparatus, e. m. f. and current waves should be capable of being generated in conformity with the vocal waves, to any desired amplitude.

The Permanent and Variable Magnetism of Steel Vessels.

One advantage that the old wooden vessels of a hundred years ago possessed over our modern steel vessels lay in the fact that they were non-magnetic. The navigators of those days had to deal with the variations of the compass needle due to the varying divergence between the geographical and magnetic meridians from place to place, but there was no deviation of the compass needle to be taken into account due to the local influence of iron in the ship's hull. Nowadays, however, the ship's deviating influence is sometimes so large as to overpower the earth's magnetic action on the compass needle. In such cases the compass may have to be moved to some more magnetically sheltered situation, even if it has to be supported at some elevation above the decks. It is not only the permanent influence of the modern ship's steel hull, acting as an independent permanent magnet, which calls for the navigator's attention, but also the daily or weekly change which may take place in that influence. For example, if a ship has been built in a yard running north and south, the hull is likely to receive during construction an appreciable permanent fore and aft magnetization. After having been launched, however, and especially after taking a long voyage, this original magnetization is likely to be materially modified, both in intensity and in direction, with respect to the ship's fore-and-aft line. Moreover, to complicate the matter still further, the ordinary steel hull of a ship assumes induced magnetization as a soft iron bar in addition to its permanent or semi-permanent magnetism as a hard steel magnet. The induced magnetization varies with the direction of the ship with respect to the magnetic meridian, and also to some extent with the ship's position on the ocean, since the earth's induced magnetism varies from place to place.

While, therefore, it is both possible and customary to compensate for the ship's local magnetic influence on the compass needle, by fastening opposing permanent magnets and soft iron masses in the vicinity of the binnacle, no compensation is possible for the [illegible] ship's [illegible] effect as she alters her magnetic state with time or with place. It is, therefore, necessary for the navigator to check the compass error by compass [illegible] of the bearing of the heavenly bodies at frequent intervals, and daily, if possible. In [illegible] weather, this operation presents no difficulty, but in continued cloudy weather it is, of course, impossible. An experienced navigator, familiar with the magnetic history of his vessel, has usually no difficulty in determining the deviation for any given course, even in cloudy weather, but without a record of past observations to guide him, he might be in considerable uncertainty. Non-magnetic steel can be produced by an alloy of 20 per cent or so of nickel. Such an alloy is, however, both expensive and hard to work. It has, however, been recently attempted to reduce the ship's magnetic deviation on the standard compass needle by replacing all of the steel within a few feet of the compass with non-magnetic steel alloy. The success of this attempt has not yet been made known.

Comparison of Illuminants.

There is probably no question connected with electric lighting that comes up more frequently for earnest consideration than that of the comparison of various electric illuminants. It is a subject upon which information is constantly being sought, and on which, unfortunately, a wealth of misinformation exists. We have many times commented on the impossibility of comparing illuminants on the basis of rated candle-power, and on the very erroneous conclusions that comparisons made on such a basis must lead to. It is now very well agreed among those who have studied the subject that the true initial rating of any illuminant should be according to its mean spherical candle-power. This rating will give each illuminant full credit for all the light that it emits without regard to the direction in which the principal flux or flow of light is sent out. The comparison on the basis of mean spherical candle-power per watt is entirely fair, as far as it goes; but one must go farther than this initial comparison in figuring on the use of lamps for certain specific installations, and consider the comparative amount of light emitted in useful directions by the different sources of light when equipped with the reflectors and glassware best adapted to the specific case in hand. For example, in most in-door installations we are concerned mainly with the amount of light delivered below the horizontal, that is, the mean lower hemispherical candle-power; or, to use the latest terminology, the lumens delivered below 90 deg. from the vertical. In fact, some illuminating engineers narrow it down even more than this and figure as useful light that given out in a zone extending 70 deg. from the vertical on the assumption that the light given out above 70 deg. usually has to be reflected back and forth so many times from side walls before it reaches the useful plane that it can largely be left out of account. If, therefore, several different illuminants are being considered for the general lighting of a large interior, the fair comparison should be made by calculating the lumens per watt or the mean zonular candle-power per watt falling on the area within which the light is wanted. Such comparisons take into account all the losses in reflectors and glassware. They must, of course, be based on tests made with the lamps equipped with the reflectors and glassware to be used in practice. These figures are easily obtained once a Rousseau curve of the lamps and reflector is plotted. Of course, where some light is wanted above the horizontal, this must be taken into consideration; but with all the commercial reflectors except those which have an entirely opaque top, more than enough usually escapes upward. If, as in street lighting, the chief concern is with the light emitted in another zone, the lamp best equipped to deliver light to that zone should be considered. Recent [illegible]

show that even such a fair and useful basis of rating as mean spherical candle-power can be misused by unscrupulous or unthinking persons.

Renting and Trial Installations of Motors.

It is of so much importance to the central-station industry that we cannot refrain from again calling attention to the plans adopted by some companies of installing motors for prospective customers on trial and thus building up a profitable motor load much more rapidly than could be done by persuading each customer to make the investment in a motor without knowing how much electric energy is to cost. To be sure, it would be unwise for a central-station company to go into this kind of thing blindly, but if the company is convinced that it can render service in a way which will be satisfactory to the customer, there is no reason why it should not prove this faith by offering to put in a motor on trial. Some time ago we commented on the practice at Alliance, Ohio, where it was very difficult for the company to get prospective customers in the notion of buying motors until the company went ahead and put in some trial installations. In Detroit, the central-station company also makes it a practice to loan motors subject to 30 days' trial, the customer paying for the wiring. The company will also rent motors at 25 per cent of their cost per year and local supply houses also do this. The faster the motor load of a central station can be made to grow, the better will be the company's financial condition, because it is the long-hour and non-peak business that increases the net receipts per dollar invested.

Central-Station Rate Reductions.

The general downward tendency of central-station companies' rates has probably been even more marked during the past year than in previous years, in spite of the fact that the general trend of prices on commodities, labor and coal is upward. These reductions have in some cases been the result of adverse public sentiment, but in many others the improvements in production or the use of more economical generating machinery and the supplying of a larger and more diversified load have made possible the realization of the central-station company's desire to make rate reductions in order to attract to it still larger and more diversified business. The question of diversity of load—that is, supplying of energy to one kind of customer at one time of day and to another at another hour of the day—has very important bearing on all central-station rates. The fixed readiness-to-serve charges, which on most central-station business are more to be considered than the operating charges, thus become divided up among several customers on diversified load and so make it possible to lower the rate to customers as a whole. The general desire and tendency among central-station companies themselves is not to lower the maximum rate or the rate which takes care of fixed readiness-to-serve charges, but to lower the rate which covers operating expenses. For example, the last rate reduction in Chicago, which was made Aug. 1, applies to such energy as is used over and above 30 hours' use of the maximum demand. In every case where the rates of a company have been under arbitration or review by a board of experts or by any disinterested parties who have gone into the matter thoroughly, the principle of charging a customer in some manner for the station and distribution system investment which must be kept ready to serve him, has been upheld. It is notable that in the recent expert arbitration on the cost of street lighting in Boston, summarized in our issue of July 20, the arbitrators unanimously agreed that the maximum-demand method of charging used by the company in its commercial rates would be more fair and equitable under present conditions than the pro-rating of the business among all classes of customers at so much per kw-hour. Every one who has investigated the subject of central-station rates knows that the average cost per kw-hour is far from being the proper rate for different classes of customers, being too high for some customers and too low for others. It is gratifying that as the central-station business grows, more and more prominent precedents are being established for charging for energy according to what it costs the company to serve different classes of customers, rather than according to average figures. There is justice in such methods, and justice will win out in the long run, in spite of the howls of politicians and of a few misinformed customers.

Factory Lighting.

The question of factory lighting came in for lively discussion at the Michigan Electric Association convention as a result of the reading of a paper wherein Mr. A. P. Biggs described the Detriot central station policy of advocating the use of incandescent lamps for the individual lighting of machines and so-called "gas arcs" for the general lighting of a factory. The idea upon which this policy is based is, of course, that a factory running only day shift uses energy for general lighting so few hours per year that this lighting cannot be made to pay interest on the central-station investment necessary to supply it. Even at the highest rate that a company charges any of its customers, this factory lighting, it is argued, must be unprofitable; and it is furthermore likely to be productive of complaint from the customer on account of high electric bills. Therefore, in order to retain the customer in a satisfied frame of mind for the profitable long-hour motor business the use of "gas arcs" is recommended for the general lighting of the factory. As can well be imagined, the proposition of advocating gas lighting was not unanimously agreed to in an electric light convention. There is room for doubt if the lighting in the ordinary factory which does not run night shifts is profitable to the central-station company, even at the very highest rates the company charges any of its customers. It is held that to argue that the company may have this extra generating capacity at the time the contract is taken, is aside from the question, because if the company is growing as it should, it will soon have need of this capacity for profitable customers, and will then have to make additional investment on account of having taken on its unprofitable factory lighting.

The main question then is, whether it is desirable for an electric light company to take on such factory lighting, even though it be unprofitable, for the sake of motor business which may be obtained along with it, or for the sake of advertising, or while awaiting the advent of a cheaper source of electric light which will hold its own with gas, or because of the chances that the factory will subsequently run night shifts and change from an unprofitable to a profitable lighting customer. In many cases the company must rely on making up the deficit on lamp business by profit on the motor business.

In other words, the factory lamp and motor load must be considered in a lump sum. The Detroit practice also gives the gas company good talking points to combat electric lighting in general. If this is a losing class of business, it certainly is very much to the central-station company's interest when it has this business to seek in every way to increase the illuminating efficiency of a customer's factory so that the maximum demand he makes on the central-station during the peak load period may be kept down. Many a factory is lighted with bare 16-cp incandescent lamps hanging directly in front of each workman's nose. Eight-cp lamps covered with a metal reflector will give much better illumination on the work and save the eyes of every workman in the factory. This at once means a reduction of 50 per cent in the maximum demand for the lighting of individual machines and benches. One method of solving the whole problem, which was only touched upon in the paper, but which in some cases is feasible, is to persuade the customer to change his hours of work so as to keep off the evening peak with both lamps and motors, thus making a great change in the cost of serving him.

THE GROUNDING OF SECONDARY CIRCUITS.

Elsewhere in this issue we print a letter from Mr. C. M. Goddard, secretary of the Underwriters' National Electric Association, commenting on an opinion recently expressed in these columns to the effect that the grounding of alternating current secondary circuits should have been made compulsory long ago. In making this statement, we were moved not so much by a desire to criticize the Electrical Committee of the Underwriters' Association as to call forcible attention to the matter in a way which would cause electrical interests in general to demand that grounding be required in the National Electrical Code. From the underwriters' standpoint it is doubtless entirely logical, but not in consonance with the past attitude of the association, to argue that safety to property rather than safety to life is the only thing the fire underwriters can concern themselves with. We do not infer from Mr. Goddard's letter that the underwriters' committee is inclined to take so narrow a view of the situation. It is true that the National Electrical Code can only be enforced by the underwriters, and that enforcement must be in the last resort by an increase in insurance rates where faulty construction causes extra fire hazard. The underwriters have fortunately thus far been very broad in their policy, and have called into conference committees from all the national associations representing electrical interests, in framing the National Code. It is therefore evident that the code which the association undertakes to enforce represents something more than purely an underwriters' production, although it is primarily based on the necessity of reducing the electrical fire hazard.

Coming now to the technical points involved, it may properly be argued (as was stated by a speaker at the last National Electric Light Convention at Washington) that the underwriters must recognize anything which causes danger to life in a building as equivalent to an increase in fire hazard. If a non-grounded secondary circuit gets crossed with a high-potential circuit and a watchman or other occupant of the building is killed by contact with a secondary circuit, there will be no one at hand to extinguish any incipient fire that may be caused by this defective condition of the building. Indeed, a fire starting from any cause might, by death of an occupant, be allowed to gain headway. It cannot, therefore, be claimed that danger to life does not cause any additional fire risk. As to the fire risk with a properly grounded as compared with a non-grounded secondary circuit, what are the conditions which may exist in the two cases? With a grounded circuit the potential that may exist between secondary wires and ground is much less than that which may exist if the secondary is not grounded. The very existence of this high potential on secondary wires is likely to cause the breakdown of the insulation at some point where it will cause a fire and is obviously an extra hazard. With a non-grounded secondary a dangerous arc is more likely to be maintained for some time between a wire and some grounded pipe in a building than if there is a dead ground on the secondary. We are aware that some electric light companies have objected to grounding secondary circuits, some doubtless because of ignorance or carelessness as to the possible results if circuits are not grounded, or what is worse, from sheer parsimony. Others have feared the effect on transformers, believing that lightning would more readily puncture the insulation between primary and secondary if the secondary were grounded. We can only say that if the insulation between primary and secondary is so weak as to be punctured by the grounding of the secondary, it is high time that the defective condition of the transformer be found out. The admission that the insulation of the secondary circuit is needed to keep the transformer from being punctured is at once an admission that the transformer insulation is so weak that a dangerous potential is likely to exist almost any time on the secondary circuit. Now that grounding has been so thoroughly tried, one can learn from the answers given in the National Electric Light Association question box and other sources of information that any company which has tried grounding has experienced no unusual troubles from burning out of transformers during thunderstorms; and in fact, some companies even go so far as to say that there is less trouble from this source since grounding than before. If the latter is true, it would certainly indicate a reduced fire hazard. The presence of a grounded wire among the electric light and power conductors led into a building should certainly tend to reduce any hazard due to lightning on these conductors.

The National Code already contains some provisions which are not even primarily concerned with the fire risk. For example, Rule 1 (c), relating to generators, requires that those which cannot have their frames insulated, shall be permanently and effectively grounded and surrounded with an insulated platform so arranged that a man must always stand upon it in order to touch any part of the machine. Here is a rule which obviously is not dependent on fire hazard for its insertion in the code, except insofar as the fire hazard is increased by the death or injury of the dynamo attendant. Do the underwriters regard this rule as a bluff, or do they propose to enforce it? If the latter, they have even better reason to enforce a grounding rule. We are glad that Mr. Goddard has brought up this matter, as we have sought every opportunity for some years to give publicity to this question of grounding and to point out to central-station companies that safety to life of customers and freedom from costly damage suits abundantly justify and peremptorily demand proper grounding of secondaries.

Programme of the Edison Convention.

[illegible] programme of the annual convention of the Association of Edison Illuminating Companies, to be held at Hot Springs, Va., Sept 10, 11 and 12. It is evident that the meeting will compare in interest with any of its predecessors. There will be six reports from special committees, as follows: Electric Heating, Mr. J. F. Gilchrist; Incandescent Lamps, Mr. J. W. Lieb, Jr.; Meters, Mr. J. W. Cowles; National Code, Mr. W. C. L. Eglin; Steam Turbines, Mr. C. H. Parker; Storage Batteries, Mr. L. A. Ferguson.

In connection with two of these reports it is expected that there will be special discussions; the committee on incandescent lamps being desirous of obtaining expression of opinion of membership as to the best policy in governing repairs of metallic filament lamps; and the committee on steam turbines having arranged for some statements of recent experience with steam turbine installation.

Two subjects for special discussion are: "Sales of Industrial Power," introduction by Mr. Louis A. Ferguson; "Periodic Inspection and Testing of High-Tension Apparatus and Lines," introduction by Mr. P. Junkersfield. Papers will be read as follows: 'Experimental Data on Illuminating Values," Dr. C. H. Sharp and Mr. P. S. Miller; "Smokeless Furnaces for Power Plants," Mr. W. L. Abbott; "Steam Heating from Central Stations," Mr. Bingley R. Fales; "The Boston Edison System in 1907," Mr. L. L. Elden; "The Status of the Wholesale Customer," Mr. James V. Oxtoby; "The Raising of Power Factors and the Regulation of Potential by the Use of Rotary Condensers," Mr. C. V. Stone; "Organization of an Electric Supply Company with Particular Reference to Its Dealings with Customers," Mr. R. S. Hale; "The Status of Municipally Owned and Operated Lighting Plants in Massachusetts," Mr. L. R. Wallis; "The Work of the Electrical Testing Laboratories," Mr. Wilson S. Howell; "A Proposed Electric Mutual Insurance Company—a Report," Mr. S. C. Mumford.

Dr. Charles P. Steinmetz has promised to talk on the subject of "High Potential Disturbances in Electric Circuits." By request he will touch on phenomena recently observed on underground systems of large capacity.

With regard to the important subject of large gas engines, President Dow reports that he has been unable to obtain a suitable treatment. The papers at present obtainable are either speculative or of the nature of advance advertisement. He submits, as a fair indication of the present status of large gas engines the following extract from a paper presented by Mr. Dugald Clerk at the annual meeting of the British Association for the Advancement of Science held in Leicester, England, July-August, 1907: "The large gas engine really presents two distinct problems. The first is to build engines of large power which will continue to run effectively and economically for long periods without breaking down, and the second is to build such engines at costs sufficiently moderate to enable the engines to compete effectively with the large steam engines in the matter of first cost. British engineers have recognized for some time that the first part of the problem has been solved to some extent on the Continent, but many of them have felt that this solution has involved weights of material and costs of construction which are almost prohibitive, considering the moderate powers obtained. In fact, English engineers consider the large gas engine as it at present exists both too heavy and too costly for its power. Personally, I do not believe that sound and continued commercial success can be looked for with really large gas engines until some better solution be found for their present constructive difficulties.

"Apart from the questions of the engines themselves, there are other difficulties which prevent the equal competition of gas engines with steam engines for powers, say, greater than 400 or 500 hp. Coal gas is too expensive a fuel for large engines. Producer gas, evolved by the suction producer from anthracite, air and steam, effectively meets the wants of medium sized engines up to 500 horse-power, but the cost of anthracite handicaps engines of larger size, and equal competition will not be possible until better bituminous fuel producers are designed than those which at present exist. The work on the Continent has not aided the solution of the bituminous fuel producer problem. Practically all the large Continental gas engines are operated with blast-furnace gas. Some success has been attained in Britain as the result of strenuous and praiseworthy efforts of Mr. Mond, Messrs. Crossley and others; but it cannot yet be said that an entirely satisfactory bituminous producer has appeared. In my view, no bituminous fuel producer can be considered really satisfactory until it attains simplicity, lightness and the fewness of parts of the anthracite suction producer which now forms so large a British industry."

Thefts of Electrical Energy.

By some very clever and patient detective work, the New York Edison Company has succeeded in running to earth and capturing a dangerous criminal, who for some time past had been selling and installing on its circuits an ingenious device for checking or reversing the meter, under the pretence that it was a regulator. Some 30 or 40 ways of "beating the meter" are known and have been detected, but this is admitted to be easily one of the best—or worst. The electrician in this case is a young man named Herman Barth, who seems to be following other nefarious lines also, as when caught he had a bottle of "knockout drops," the mere possession of which is a serious offence, involving a severe term of imprisonment.

The "regulator" is essentially a big horseshoe magnet which fits down over the top of the electric meter, one leg coming in front and one in the back of the meter, so that the positive pole of the magnet inside the meter is next to the negative pole of the "regulator's" magnet, and vice versa. The "regulator" is then connected with the service wires, and since its magnet is more powerful than the one inside the meter it makes the hands turn backward. One of the company's counsel in the case says:

"These devices have been used chiefly in saloons They are warranted to reduce the light bill more than half. They are usually put over the meter late Saturday night, and by running a certain number of hours they reduce the meter marking for the previous six days just about 60 per cent. There is no danger of an inspector getting into the basement of a saloon Sunday morning.

"By chance some user of the 'regulator' left it on his meter, and it was found by one of the company's inspectors. This saloon keeper bought freedom from prosecution by telling the name of the 'regulator's' maker. We then set in to try to catch the man in the act of tampering with a meter, for a conviction can't be obtained for simply stealing electricity. There is a special section of the Penal Code, however, making it a misdemeanor for a person to interfere with a gas or electric meter, and so our best chance was to actually catch the maker of the 'regulator' installing one of the devices.

"We heard that a concern in Clinton Street had agreed to buy a 'regulator.' There is a legitimate device that is used to regulate the pressure of gas, preventing it from blowing out more than is actually needed to supply a particular jet. Some people have been fooled into thinking that electricity blows the same way, and they have been induced to by 'regulators' to 'save electricity.'

"We told them that about the thing they were buying, and they agreed to let two detectives and one of our men be present in the basement when the 'regulator' was installed. Barth, they say, came, cut in on the meter, explained the use of the device, and then was arrested. He wanted $200 for the machine."

Another recent case is that reported from Vancouver, B. C., the details of which are furnished us by Mr. E. Rummel, of the Columbia Electric Railway Company, Limited. In this instance, Mr. William Davis, the proprietor of a Turkish bath, tapped the circuit in such a manner that his meters registered

only once in a while or else registered on that which carried with it a lower rate. One meter was for lighting and the other for a sign and an electric bath. Mr. Rummel had noted that the bills had fallen off from $5 a month to 92 cents, and this led to an examination, when the tampering with the wires and meters was discovered. The magistrate before whom the case was brought sentenced the defendant to six months hard labor, and said: "This is a most contemptible charge to have brought against a man. It involves sneaking methods because the crime or misdemeanor is so hard to detect. I have no doubt about your guilt after having gone into the evidence thoroughly." In addition to this penalty Davis was fined $75 for a breach of the inland revenue act in tampering with a meter, and is also liable to punishment for a breach of the city ordinances and by-laws in installing electric wires without a permit.

High-Voltage Direct-Current Railways.

In a paper read before the Chicago Section of the A. I. E. E., Mr. W. J. Davis, Jr., stated that 1200-volt direct-driven railway equipments had been sold during the past year for a total of 129 miles of railway, the total rating of the motors being 11,700. Each of the car equipments includes four 75-hp commutating-pole motors. The roads are the following: Central California Traction Company, 69 miles, 6 cars; Pittsburg, Harmony, New Castle & Butler, 63 miles, 12 cars; Indianapolis & Louisville, 41 miles, 10 cars; Indianapolis, Columbus & Southern, 3 cars; San José & Santa Clara, 9 miles, 8 cars.

The roads that are now being equipped may be divided into three classes: 1. Those which are required to operate on 600-volt direct current at full maximum speed as on the 1200-volt sections; 2. those which are required to operate on 600-volt direct current, but at approximately half maximum speed; and, 3, those which operate only on 1200 volts.

The first class requires motors wound for 600 volts, but designed to withstand 1200 volts without danger or flashings or injury to the insulation. The motors are connected in four-multiple when run on 600 volts and in two parallel groups of two motors in series when run on the 1200-volt sections.

In the second and third classes the motors may be wound for either 600 or 1200 volts, preference being given to the latter on account of the improvement in the tractive power at the slipping point of the wheels. In order to obtain satisfactory commutation qualities and to prevent tendency to flashing at the commutator at the high voltages encountered, all motors for the 1200-volt system are provided with series-wound auxiliary poles located midway between the magnetizing poles, and so proportioned as to neutralize the armature reaction locally under all loads. The additional insulation required causes the motors to weigh from 15 per cent to 20 per cent more for a given output than 600-volt motors. This additional weight is not due to the inter-pole construction, as on the basis of equal voltages the inter-pole motor will weigh about the same or a little less than the standard railway motor.

The control system is substantially the same as that used on the 600-volt system, with the exception of some slight changes in the insulation of the primary circuits. The secondary circuits are all energized at 600 volts, as are also the car heaters and lamps, and for this purpose a small motor-generator is furnished for use when run on 1200 volts, the function being to change the voltage to 600. The capacity of this motor-generator as furnished with quadruple 75-hp equipment is 38 amperes, which can provide for the lighting, heating and air-pump circuits for one car, and the secondary control-circuit for a train of six cars.

Programme of the Canadian Electrical Association.

Details have already been given in these columns of the electrical exhibition at Montreal, in connection with which the Canadian Electrical Association and kindred bodies will hold conventions. The programme of the association shows that an excellent meeting may be expected next week. The arrangements have been made by a local committee comprising Messrs. Henry D. Bayne, chairman; Ald. Sadler, J. W. Pilcher, L. J. Belnap, E. F. Sisė, Watson Jack and D. McDould. Registration headquarters will be at the secretary's office in the Canadian Society of Civil Engineers' Building, 413 Dorchester Street, West.

The programme is as follows: Wednesday, Sept. 11—9:30 a. m. Meeting of managing committee. 10:30 a. m. Opening session; minutes; president's address; reports and communications. 11 a. m. "Electric Heating and Cooking Devices," by Mr. A. B. Lambe. Afternoon session.—2 p. m. "Trials of the Operating Man," by Mr. M. A. Sammett; "Three-Wire Generators," by Mr. B. T. McCormick; question box. Evening—Visit to the electrical exhibition.

Thursday, Sept. 12.—Morning session.—9:30 a. m. "High Tension Insulators from an Engineering and Commercial Standpoint," by Mr. Clarence E. Delafield; "The Value of the Nernst Lamp to the Central Station," by Mr. A. E. Fleming; "Incandescent Lamps," by Mr. J. M. Robertson; question box. Afternoon session.—2 p. m. "Frazil and Anchor Ice: The Difficulties They Cause at Hydraulic Plants; Some Remedies," by Mr. John Murphy; "The Load Factor," by Mr. R. M. Wilson. In the afternoon a tea will be provided for the ladies at the Royal St. Lawrence Yacht Club. 4:30 p. m. Executive session. Evening. Theater party.

Friday, Sept. 13.—Morning session.—9:30 a. m. "Modern Lighting Transformers," by Mr. G. P. Cole; "The Responsibility of Electric Companies for Accidents," by Mr. George H. Montgomery; naming of standing committees; next place of meeting; unfinished business. Afternoon. Special cars will be provided to the race track. Particulars in programme of entertainment. Evening. Visit to Dominion Park.

Inspection of Meters.

At Albany on Aug. 29 the Public Service Commission, in the second district, conferred with representatives of electric lighting interests of New York state for the purpose of preparing plans for a system of inspection and marking of electric meters. A nominating committee was named to select a committee to prepare rules and regulations whereby the spirit of the law will be lived up to. It was agreed that these proposed rules and regulations should be formulated so as to afford ample protection to the customers and at the same time not work any undue hardships to the companies.

This committee was selected this afternoon by the nominating committee: T. R. Beal, Poughkeepsie; Arthur Williams, Yonkers; C. R. Huntly, Buffalo; Las Taber, Moravia; L. E. Imlay, Niagara Falls; G. W. Cunningham, Elmira; F. B. H. Paine, Buffalo; J. C. Langdell, Albany; R. M. Searle, Rochester; Prof. Robb, Troy; H. J. Blakeslee, Syracuse, and J. M. Sheehan, Newburgh.

The new committee, after it has prepared rules and regulations, will submit them to the commission for approval. The commission reserves the right to make whatever changes it deems necessary. In the conference Chairman Stevens, of the commission, read that section of the Public Service Commissions act which provides that all meters shall be inspected, approved and stamped or marked by an inspector of the commission before being used.

"I am compelled to say," said Chairman Stevens, "that this somewhat drastic provision of the statute we have up to this time found ourselves entirely unable to comply with. The difficulties in putting it in force need not be detailed at this time, but in attempting to put it in force we desire to follow precisely the same course that we are following with all other subjects which come before us for our action, and that is to confer with the persons interested, learn all of the practical difficulties, take advice and counsel and shape our rules and regulations so that they will make and create no hardship whatsoever and at the same time will insure, when the statute is finally put in opera-

tion, as near a perfect compliance with its spirit as it is possible to create."

The same important subject, as already noted, has been up for consideration in the first district—Greater New York—where there are probably 125,000 electric meters to be dealt with, on consumers' circuits, and in the inspection of which the companies already employ probably 200 men.

Progress in High-Efficiency Lighting Units in Ohio.

Messrs. C. C. Collins and A. N. Cope, of Columbus, Ohion, in a report made at the Ohio Electric Light Association convention, Aug. 21, gave the results of answers to a number of questions sent out to central-station companies in the state regarding the use of new high-efficiency electric lamps of various kinds. The compilation covers answers from 19 companies. The committee fears that in some cases high-efficiency units are condemned for high renewal cost, when the fault is entirely with the central-station company's poor voltage regulations; though the company be loath to admit it. Central stations using the 3.1-watt incandescent lamp report low maintenance cost, so that if maintenance costs are high it must be due to poor regulation, which makes it very expensive to operate any type of lamp. The flaming arc lamp is used by 15 of the 19 companies, but its use is very restricted, being equal to only 38 kw. The magnetite lamp is used by two companies for street lighting. Its adaptability is shown by the satisfaction which it is giving and by extremely low rates secured by cities using them. The Cooper-Hewitt lamp is used by five of the companies, its use being limited to photograph galleries, printing offices and machine shops. No Moore tubes are in use. Twelve companies are using the Gem lamp. This lamp seems to be in very general use. Two companies are using the tantalum lamp. One company is using the tungsten lamp. The Nernst lamp, like the Gem, is in very general use, 11 of the 19 companies using it. The average number of glowers per lamp is three. The replies indicate that we may expect a life from magnetite lamp electrodes of 180 hours; from the Gem lamp of 500 to 600 hours, and from the Nernst lamp 600 to 700 hours. Seven companies of the 19 are using a 3.5-watt carbon filament lamp, due in the majority of cases, to poor regulation of voltage. Every company replying states that an increase in revenue has been noticed after introducing high-efficiency units. It is very evident that business has been secured which could not have been gotten in any other way. The replies in regard to voltage regulation are very vague and indicate that sufficient attention is not being given this most important factor.

In the discussion President Engel said that it appeared from the report that the larger cities had taken up the high-efficiency units like the Gem and Nernst lamps very freely and with more or less success, but the smaller stations had not been heard from. One member cited a case in his city where a merchant substituted four tantalum lamps instead of ten common lamps for window lighting and is using them more hours per day, paying the central-station company more money and being better satisfied. Both the Gem and tantalum lamps are pleasing customers. The result of 400 installed by this station has been to broaden the peak.

Mr. F. W. Willcox, of the General Electric Company, said that the new incandescent lamps had the advantage that there is no antiquation or writing off of first cost each year because there is no depreciation besides the renewal cost. Future improved lamps will fit present sockets and reflectors. The Gem lamp costs so little more than the ordinary carbon lamp that the manager of a station can furnish it on the same basis of renewals as the ordinary lamp. He suggested that central stations furnishing free renewals of ordinary lamps could furnish customers using tantalum lamps entirely with free renewals at an additional cost of 0.5 to 1 cent per kw-hour. A similar course could be pursued with regard to the tungsten lamp, the renewal [illegible] still higher than the tantalum. Another plan would be to make a fixed maintenance charge per month to tantalum lamp users. Although there is at present no complete data as to the life service of the tantalum lamp, a maintenance charge of 5 cents per month would amply cover it. In some way or other the central station should maintain the control of the lamp, because the ordinary user does not know how and will not take proper care of the maintenance of his lamps. The service should be kept up to standard by intelligent care on the part of the station. The well-known delicacy of the tungsten lamp filament was simply a temporary trouble that will be overcome. The Welsbach mantle is fragile, but the difficulty has been practically met. The life of the Gem filament lamp has been materially improved the past year as the result of steady and careful work. If it is possible to produce a Gem filament of an efficiency of 2 watts per candle, it would be a lamp which by reason of its low cost, strength and flexibility of use would perhaps be a very serious competitor of the metal filament such as the tungsten and tantalum. How far the carbon filament of two watts per candle would lead the tungsten would depend upon the cost of the tungsten. With the tungsten lamp having an efficiency three times that of the ordinary carbon filament lamp, a tremendous advance is realized. Asked as to the life and depreciation in candle-power of the tungsten multiple lamp, Mr. Willcox said that it was too early to know what these lamps would do, as there have not been enough of them used. The life seemed to be in the neighborhood of 1000 hours with a candle-power maintained within 90 per cent of the original, but further experience might change these figures. The tungsten lamp had not yet been listed, but would unquestionably cost more than the tantalum. By using the lamp in the larger sizes, the cost would not be so great as in the smaller sizes, but it costs nearly as much to make a small lamp as a large one. It was unfair to compare the cost of a new device like the tungsten lamp with the cost of an ordinary carbon filament lamp, which is made more effectively and cheaply in small sizes.

Mr. Otto Foell, chief engineer of the Nernst Lamp Company, expressed the opinion that there was no immediate need for a higher-efficiency lamp than a multiple-glower Nernst, from the central-station manager's point of view. The central-station manager needs a lamp which he can maintain with advantage to himself. He then compared a 40-cp, 50-watt tungsten lamp obtainable in large quantities at $1.10, with an average life of 1000 hours, to one of the new 110-watt higher-efficiency Nernst lamps. The maintenance cost per kw-hour for the tantalum lamp would amount to 2.2 cents; that of the Nernst lamp 0.5 cent. He stated that two of the tungsten lamps were equivalent to one of the 110-watt Nernst lamps, but he gave no candle-power for the Nernst lamp. He did not believe that the tungsten lamp could be manufactured commercially in the near future; which was borne out by the fact that tungsten lamps are now on the market to operate four in series on 110 volts; a tacit admission that if there was a chance of the tungsten lamp being perfected for multiple operation, this would not have been done. There was no higher-efficiency lamp than the Nernst available which permitted of uniformity in design throughout an installation. Mr. Willcox replied that the Nernst lamp had the disadvantages of high initial investment cost and a maintenance more difficult than the incandescent lamp.

Mr. C. H. Davis, of the Nernst Lamp Company, claimed that on the basis of candle-power, the cost of one and two-glower lamps was about the same as that of the Gem lamps with their necessary equipments. Mr. Willcox promptly showed that this was not the case.

Points on Residence Wiring and New-Business Getting from the Ohio Convention.

The Ohio Electric Light Association, at its Toledo convention in August, devoted considerable time to a discussion of plans for securing the wiring of residences and to the question of allowing outside contractors to do the wiring, as compared

with wiring by central-station companies themselves. As to the best general policy for a company, the usual conflict of opinion occurred. Some thought that the wiring was best done by the central-station company; others thought it best to leave this to a local contractor when a reliable contractor can be induced to locate in the town. One member reported considerable profit on wiring business for the past few years, and thought the company might as well make this profit and do a contracting business as to let some outsider do it. Others did wiring simply because they could get no reliable contractor to locate in the town. Some amusing instances were given of unsatisfactory and even fraudulent work done by contractors. In one case wires had simply been stuck through the plaster at the outlets and there were no circuits. In order to determine the practice of the companies represented, a vote was taken, with the result that it appeared that 21 companies did wiring contracting and 12 did not do wiring. The following are among the special offers different companies are making to secure residence customers, taken from convention discussions and from conversation with different central-station men:

Massillon, Ohio.—Mr. W. E. Russell reported that at Massillon, a town of 15,000, there are no wiring contractors. The Massillon Light, Heat & Power Company does all the work in that line. It offers to wire a small house free, provided the house owner will pay a minimum bill of $1.50 a month for two years; figuring that it will cost $9 to wire the house. The ordinary minimum bill is $1; so this allows 50 cents monthly to pay for the wiring. If the customer does not want to pay $1.50 for two years, he can have the option of $1.25 for four years. In this way 120 new customers had been taken on in the last two months and a half.

Wilmington, Ohio.—Mr. J. C. Martin, of Wilmington, bought a municipal plant February, 1903, with 159 customers on the books and 15 or 20 not on the books, who had not been paying. There were no power customers. He has secured a 400-hp motor load and is driving the largest auger-bit factory in the United States and a number of other factories. One customer who raises poultry uses electric power for his grinding machines, wood saws, churns, etc., all from the same motor. The number of customers has increased from 159 to 700. There is one local contractor, but the company never bids against him. The customers' wiring applications consist of two schedules. Under Schedule A is included everything that is properly chargeable to the wiring, from the fuse plug to the point where the wires come through the ceiling. Under Schedule B are switches, chandeliers, drops or whatever lighting appliances the customer has. If the aggregate of A and B is $25, of which A is $15 and B $10, the customer pays $25 and the collector receipts for it. At the bottom of the schedule he certifies that the customer, having paid his bill, is entitled to a credit of $15 to apply against all future lighting bills. The meter is read monthly, but no bill presented until the customer has exhausted his credit memorandum under Schedule A. In the meantime the family has contracted the habit of using electricity. They are always urged to take irons and as many devices as possible that consume current. It would take two or three years to educate them up to these under a different introduction plan. When the credit memorandum is used up the customer is surprised, but has formed a habit that he will not get over.

Cleveland, Ohio.—Mr. J. Kermode gave an interesting account of recent developments in the movement to get old houses wired, which began in Cleveland some time ago and was reported upon at the 1906 Ohio convention. The company, last year, after extended investigation arrived at an average price per outlet for wiring the different rooms of houses of different kinds, and a schedule of these average prices was adopted for the taking of contracts. It is easy to get new houses, but difficult to get the old ones where the fixtures are already in for gas. A company can always get business by extending its lines, but it is hard to increase the business on old lines. For that reason a liberal policy is desirable in the wiring of old houses. The Cleveland Electric Illuminating Company formerly had solicitors working to secure the wiring of old residences exclusively. These solicitors took contracts for wiring at the rates prescribed by the printed schedule, this schedule being given in these columns in the issue of Sept. 15, 1906. The central-station company would then turn these contracts over to various electrical contractors in the city to carry out. As the payments were made on the installment plan, the central-station company had to pay the contractors a 15 per cent bonus for carrying the accounts for one or two years. This plan is now being changed. The company has withdrawn its solicitors and the electrical contractors are putting 20 men in the field soliciting on old houses. Instead of paying the contractors a bonus for carrying this account, the contractor must get his counteract bonus out of the price charged the customer. The company, to counteract this extra price, agrees to credit the customer on his monthly bills up to an amount equal to 15 per cent of the cost of his wiring if the wiring is taken at a price corresponding to the schedule. If the contractor takes the wiring at a lower price, the customer still gets the benefit of a credit of 15 per cent on the schedule price. The company helps the contractor by advertising, circular letters, etc. The result of experience so far is that solicitors will average about one customer per day. The cost of securing these customers, including soliciting, advertising and miscellaneous expenses, is about $4 each, though at the beginning of the campaign it was $6. About 600 houses have been wired on the installment plan in Cleveland during the past year, of which only two owners failed to pay. One of these was a real estate man, and in another case the house changed hands and the new owner refused to pay for the wiring ordered by the original owner.

Report on Electric Heating Devices.

A report was made by Mr. Mathias E. Turner, of Cleveland, to the Ohio Electric Light Association convention, Aug. 21, on "Electric Heating Devices," its scope being confined to electric heating appliances for household purposes. It is the custom generally for central-station companies to advertise and sell these appliances, but the time should not be far distant when electric heating devices will be so well advertised and their uses so well understood that they will be sold in large quantities as other household utensils are sold by department and other stores. It will, however, before that time be necessary for the manufacturers to build a much more durable and economically operated line of goods. Mr. Turner has thought best to refer to these defects in detail in the apparatus with which he has had experience during the present year.

The first general criticism is that most electric heating devices are too slow in heating. What is needed is higher temperatures during the first few minutes, and if necessary to get it, to use more current for a shorter space of time. The second general criticism is that the methods used for attaching the appliances to the electric circuit must be improved. It is desirable that the attachment be a flexible cord, removable both from the heating appliance and the circuit, with a simple, durable plug for making the connection and disconnection to the heating appliance, which does not necessitate the burning of hands or the upsetting of the vessel's contents and will not continually open or short-circuit. In the laundry, immersion coils are practical for boiling clothes in the clothes boiler, the chief objection to their use being the danger of severe shocks where the laundry floor is wet. Laundry irons of 6-lb. weight and single heat are, perhaps, best adapted to general household use. A switch located on the iron is a simple and effective improvement over the former method of heat regulation for ironing different materials.

Criticizing electric cooking outfits, he limits himself to his own experience in catering to the wants of a number of purchasers of complete cooking sets. In these cases the type of outfit advised was an oak table with a slate switchboard at the back and an oak raised shelf at the side for the oven. The table legs were equipped with well adjusted castors. On the back of the switchboard was an asbestos-lined cabinet containing

[illegible] single-heat appliances and four three-point plug attachments, were set in flush with the slate. Above these connecting points were placed three snap switches indicating "off" and "on," and four three-heat snap switches indicating "off," "low," "medium," "high." Flexible cords 18 ins. long were provided, having at the circuit-connecting end Hubbell plugs for single-heat cords and three-pronged plugs with handles for three-heat cords.

Manufacturers are developing two distinct types of cooking outfits: One in which the portable appliances are connected to a table similar to that described; and one in which stationary heating disks are designed much like the ordinary gas range, the difference only being that disks are used in place of flame burners. It may be that neither of these types is best. Possibly sectional shelves mounted with switches, connectors and disks, and capable of easy connection end to end or above and below each other, may offer a much more flexible method, adaptable to extension from a very small cooking outfit, as the need for a larger outfit increases in many families.

The electric oven with heaters top and bottom, is a superior baker, but decidedly wasteful of heat. A chef proficient in electric cooking stated that it was the best baker he had ever used. But this one piece of apparatus wastes so much heat that through it electric cooking development is somewhat retarded. The oven should be very much better heat insulated; it should be deeper; its door should be at the narrower end and fitted practically air tight when closed; it should be easy to clean; it should heat to a sufficiently high temprature in about 10 minutes and maintain a temperature suitable for most baking purposes for several hours, consuming not more than 250 watts—which it will do if properly constructed.

In a particularly well equipped kitchen, an electric cooking outfit replaced a gas range, excepting only a vertical gas broiler; later a vertical electric broiler (so-called restaurant size) was tried. A voluntary testimonial, given below, indicates the success:

"This is the first time I have found to write and tell you about the electric broiler. I have tried fish, chops and steaks, and in each experience success was the word. No smoke, no smell, no flame. I think it quite the best of all the electrical utensils that I have tried for you. I intend to keep it, and would ask you to get me one extra wire broiler, as in steady cooking two are needed."

This particular type of vertical broiler is one of the best designed cooking appliances of any kind that has come to the notice of your reporter.

Hot water always available is requisite in all households. Until recently it has only been possible to obtain a sufficient quantity of hot water for washing purposes by means of immersion coils or similar devices which are bothersome to use, and this has made it necessary for would-be exclusive users of electricity to obtain hot water by other means. Lately there has been put on the market an instantaneous electric water heater. This device, together with all the other electrical heating appliances—more or less perfected—now enables us to specify in the house building plans (where we are permitted by prospective customers) special heating circuits and single-pipe water systems, for the exclusive use of electricity in all the duties usually performed by other illuminants and fuels, excepting winter interior heating, which we must still allow the furnace to do.

It is pertinent for your reporter to say, that in so far as his experience goes, it is at present inadvisable for central stations to accept manufacturers' "Complete Cooking and Heating Outfits," but rather to build up their own sets, each piece being selected from the manufacturer who may be making the best article for the particular work it will be called upon to perform.

It is very necessary to the rapid development of electric cooking and heating, that these pioneer electric outfits give as little trouble as possible to the users of them.

It was not possible to obtain from all the users of electrical cooking [illegible] in each household, etc., by reason of many families using these outfits being away from the city on a vacation. Reliable data were, however, collected from 11 homes using complete cooking outfits, as given in the accompanying table:

[illegible]	Months of Use.	[illegible]	[illegible]	[illegible]	All or Part. [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	all
[illegible]	6	3	[illegible]	[illegible]	all
[illegible]	5	[illegible]	[illegible]	[illegible]	all
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	all
[illegible]	[illegible]	[illegible]	34	[illegible]	partly
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	partly
[illegible]	2	[illegible]	[illegible]	[illegible]	partly
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	partly
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	partly
[illegible]	[illegible]	[illegible]	360	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	partly
[illegible]		[illegible]	555	[illegible]	all
		[illegible]	[illegible]	[illegible]	partly
		[illegible]	[illegible]	[illegible]	[illegible]

[illegible]
†Includes laundry ironing.

The above number of families using electric cooking outfits exclusively is too small to draw any definite conclusions, yet it would indicate that we might expect with the growth of this branch of the business an increased energy consumption of from 100 to 200 kw-hours per residence per month.

In Cleveland a two-rate method is used for billing residences. The result is that electric heating generally receives the benefit of the secondary or lower rate. In fact, the cooking in all the 11 residences cited was done at a 5-cent rate. The expense under these conditions compares favorably with artificial gas.

To illustrate how popular electrical energy consuming devices are becoming in the home, there were sold in Cleveland by the Illuminating Company during the 12 months preceding last June, over 1100 electrical heating devices. This was done through the efforts of one salesman, and newspaper advertising. There are now being sold over 100 such devices a month without the aid of any direct solicitation. In addition to this, supply dealers have been selling their quota in the city.

DISCUSSION.

Prof. F. C. Caldwell, of Ohio State University, thought that the cost of cooking and heating devices for the kitchen must be reduced, as there is no place where there is a greater desire to economize than in kitchen appliances. Lagging, or heat insulation, is one of the things that ought to be improved. Here the amount of heat necessary to heat up the lagging is a serious matter. Where a heating device, like an oven, is started in the morning and kept at the same temperature for a length of time, that does not cut so much figure. He suggested that good results might be obtained by double-jacketing the oven and establishing a vacuum between the jackets, to be secured by a small air pump attached, upon which a few strokes could be taken daily, sufficient to maintain the vacuum.

Mr. J. Kermode, of Cleveland, said the only trouble experienced with electric irons had been on a lot of 98 220-volt irons in a clothing factory where the irons kept burning out, and it was finally discovered that the pressers in dampening cloth were putting too much water on it and the large amount of steam ruined the insulation where the cord and connecting post came together behind the handle.

Mr. Martin reported 100 irons in use in a town of 700 customers. Only eight or ten of these had been returned for repairs, some of which were damaged by bad usage by being waxed and the wax afterward being scraped off with a knife-blade. He estimated that for a family of six the iron is worth $1 a month to the central station. It is one of the best energy consumers the station has.

Mr. Plaice, of New Bremen, said that he started in 1905 with 12 irons on a flat rate of 75 cents per month for a family of five and 5 cents for each additional member. He lost 10 out of these 12 the first year and concluded it was bad business. The second year he put everything on a meter basis and put out 50 irons last year, losing but three out of that number. This year he had 80 connected, and so far had not lost one. [illegible] He thought the manufacturer should provide a better cord, thus obviating pres- [illegible]

In connecting-up irons he did not allow the customer to put them on a general lighting circuit. He put in a special drop.

President Engel said that many customers want to use the iron in other rooms than the kitchen. His company requires that the customer put in a knife switch with a receptacle on the wall close to the switch for attaching the plug from the iron.

Mr. Grabhill said that his company had installed a number of irons to be used by two or three families in one flat, using one laundry in common. Circuits were run so that this iron could be used on the individual meter of the customers, the switch for each customer being locked in some manner.

Mr. Rust, of Greenville, said it was his company's practice to use a pendant switch with the iron and instruct customers never to turn the iron off at the socket, but to use the pendant switch. He encouraged customers to use the iron in any room in the house.

CURRENT NEWS AND NOTES.

DARING WIRE THEFT.—At 4 a. m. the lamps were lighted on the circuits at Norwood, Mass., recently. No sooner had the current been shut off than thieves climbed the poles and got away with half a mile of copper wire. Old linemen are suspected, as the job was a clean one, but the police have been unable to find any traces.

CRIME AND LIGHT.—Chief Shippy, of the Chicago police force, is quoted as saying that lamps at all alley entrances in the more populous parts of the city would make it possible for the police to make Chicago "as peaceful as a country village." The Chicago *Record-Herald,* commenting on this, says that the city's official poverty has done it as much harm in preventing the complete lighting of the streets as in any other way.

THE TELEGRAPH STRIKE seems to be slowly petering out. The latest news is that in Texas the Postal employees have hoisted the white flag, and are trying to get back their old positions in large numbers. President Roosevelt has denied emphatically the rumors as to his intention to intervene. Meantime the operators have raised their demand for an increase of wages to 25 per cent. The Long Island Railroad has granted its operators an advance of about $5 a month, applicable to both station operators and tower signal men, taking effect Oct. 1. Cases of violence on the part of strikers are reported from one or two points, but at the main offices in the great cities quietude prevails, and there is no outward sign of any trouble.

LIGHTING OF GROSSE POINT FARMS.—The aristocratic suburb of Grosse Point Farms, near Detroit, has a street about 11,200 ft. long, facing the lake, with houses on one side only. This street is about to be lighted with 5.5-ampere series 50-cp Gem lamps, two of which will be placed on each pole. There will be 41 poles of ornamental iron construction in the 11,200 ft. The spacing will be irregular in order to conform to the frontage of the different estates along the street; the location of poles being agreed upon by the commissioner of public works and the property owners immediately interested. The wires will be underground in a bituminized fiber conduit. Later on tungsten series lamps of the same current and candle-power, but of lower voltage, will probably be substituted.

HEATING PAPER DRYERS.—Attempts are being made in France to use electricity in the heating of paper dryers, and to dispense with steam in the cylinders. As the cylinders, with electricity, have no pressure of steam to bear and no steam pipes they can be made lighter. The present style of cylinder can, it is said, be [illegible] of heating by simply placing a fixed electrical resistance in the center, at the point formerly occupied by the direct fire in primitive systems. The extremities of the cylinder are closed to prevent loss of heat. If there is room it is considered preferable to place the resistances against the internal metal walls of the cylinder. One notable advantage of this new system is said to be the ease with which the temperature of the cylinder can be regulated while in operation. Taking, for instance, the case of a machine producing 60 kilos. (132 pounds) of paper per hour, and supposing that the paper reaches the dryers with 50 per cent of water to be vaporated, the electric system is thus seen to be capable of evaporating 30 kilos. (66 pounds) of water per hour. So as not to injure the paper progressive drying is recommended, three cylinders being used of the respective temperatures of 70 deg., 100 deg. and 130 deg., C. (158 deg, 212 deg. and 266 deg., F.). The total power needed is 35 horse-power, supposing the cylinders to be of equal diameter and to need respctively 9, 12 and 14 horse-power. It is remarked that this seems rather a large consumption of electrical power, but as paper mills have often a large amount of hydraulic power at their disposal this fact is not regarded as being of much practical importance.

LIGHT A LUXURY.—One of the fundamental reasons given for subjecting public service corporations to regulation of price is that light is a necessity that everybody must have; and hence sumptuary legislation. But the New York *Tribune* points out that this is not true, because there are enough hours of daylight to leave the hours of darkness free from occupation and artificial illumination. "There are, no doubt, many things which must be done at night. That is to say, there are special operations which must be performed at night, such as the printing of morning newspapers, and there are others which must be kept going all through the 24 hours, in darkness as well as light. But the great mass of human activities could be done exclusively during hours of daylight. The common theory is that eight hours constitute a full day's work. Well, in our latitude, there is no time of year when there are not more than eight hours of actual sunlight. On the shortest day of the year there are nearly nine hours between sunrise and sunset, and on the longest day there are more than fifteen and a half hours. Yet at all times a considerable amount of work which could just as well be done by daylight is done by lamplight, and enormous sums are spent for artificial light in the evenings to make up for the loss of wasted daylight in the mornings. In a readjustment of activities so as to utilize more daylight and avoid the need of so much lamplight, there would, of course, be no diminution of the hours of sleep, but merely some shifting of their place in the circuit of the day."

TELEPHONE SERVICE.—In 1897, on the first of July, there were 18,943 telephone stations in the book of the New York Telephone Company in Manhattan and the Bronx. Ten years later there were 234,185 stations, a tremendous gain in the ten years of 215,242 stations, or 1136 per cent. July 1, 1897, the minimum rate for 600 calls on a direct line was $90 per annum. Ten years later, on July 1, 1907, the minimum rate for the same service was only $48 per annum. This is a reduction of $42, or 46 per cent in the ten years. The rates for extra calls have suffered a big reduction in the ten-year period above mentioned. Extra calls in 1897 were ten cents, whereas the charge for extra calls is now only five cents. This is a reduction of 50 per cent. A material item in the cost of furnishing telephone service, is the compiling and furnishing of a telephone directory to each of the subscribers three times a year. Ten years ago this was not a very serious matter, as only 19,000 copies had to be prepared, but the directory, with its present list of about 235,000 names in Manhattan and the Bronx alone, has become such a ponderous volume that its preparation and distribution engages the entire time of a large force of employees. If the books which were distributed in May, this year, were placed one on top of the other, laid flat, they would make a pile about seven and one-quarter miles high. In fact if they get much larger some change will have to be made, as the type is even now too small to be read with ease by the average citizen.

LIVE WIRES.—It is generally supposed that all the methods of getting in contact with a live wire have been found out. But there is a new one, in ballooning. At Nutley, N. J., last week, the parachute of a balloonist caught in the wires, which the performer seized, but the shock caused him to let go of his hold and fall to the ground, a distance of 20 ft. He appears to have escaped with his life.

ABSORPTION OF CAPITAL.—The London *Statist* publishes figures showing that in the seven years from 1897 to 1904, the British municipalities were the great absorbers of new capital. Railway debt rose from 923 millions sterling to 1054 millions. Government debt rose from 645 millions to 794. These increases were, respectively, 131 and 149 millions. But municipal debt rose from 303 millions to 469, being an increase of no less than 166 millions.

A DENVER ORGANIZATION.—The members of the School of Gas and Electric Practice, conducted by the Denver Gas & Electric Company, Mr. Henry L. Doherty, president, have recently organized a social and athletic club to promote good fellowship among the college men engaged in engineering work in Denver. The society is known as the "El Diablo Club," and is composed of about 30 members, representing the following colleges and schools: Dublin, Clarkson, Queen's, Cornell, Columbia, Lehigh, Lafayette, Georgia Tech., Purdue, Rose, Michigan, Illinois, Wisconsin, Missouri, Colorado, Ohio State, Washington State, California and Armour.

THREE-PHASE ARC LAMP.—Among recent patents on arc lamps is one to Mr. Guido Semenza, of Milan, Italy, on an arc lamp for three-phase currents, which rests upon the employment of a carbon of special shape. The specification states that when three cylindrical and parallel carbons are employed in a three-phase lamp, the arc formed at the lower extremity changes position continually by rising and falling in the space located between the carbons, thus giving very unsatisfactory results. The carbons described in the patent have about a third part of the cylindrical surface replaced by a flat surface. In the lamp, the flat surfaces face each other, and with this arrangement it is stated that an arc is obtained which satisfactorily remains at the base of the carbons, and their use allows a construction of a commercial three-phase arc lamp capable of working even on frequencies as low as 25 and 15.

ANTI-SPARKING DYNAMO WINDINGS.—A recent patent granted to Mr. Walter J. Richards, of Norwood, Ohio, describes an improvement in connection with auxiliary or commutating or interpole windings of dynamos. These windings have usually been connected at series with the armature, the current variation in them and in the armature thus being proportional. It is, however, sometimes desirable that the current in the commutating winding shall vary at a different ratio than the armature current, particularly when the machine is operated near its maximum load, in which case the magnetic saturation curve rises much more slowly than the current. In order to control the ratio between armature and commutating current, resistances are placed both in series and in shunt with the commutating winding and arranged so as to be varied with the variation of the main current to cause the commutating winding to rise and fall proportionately more rapidly than the current in the armature winding.

A CHINESE MUSEUM.—U. S. Consul W. T. Gracey, of Tsingtau, calls attention to the commercial museum at Tsinanfu, recently visited by him, and states that American business men might possibly find it to be of value in advertising and exploiting their goods in China, as is now done to a large extent by the English and Germans. The museum contains mainly maps, globes, diagrams illustrating physiography, geology, astronomy, natural history, models of buildings, specimens of manufactures, natural history specimens, models of engines, electrical apparatus, etc. One of the most effective exhibits is a working model of an electric railway, beside which stands a model dredge, also worked by electricity. Models of a circular saw, pump, etc., are worked by the same battery. A German firm has supplied the museum with a complete electrical plant for 200 lamps at cost price in order to bring its manufactures to the knowledge of the Chinese. Another firm has supplied a complete acetylene gas plant, with which the buildings are partially lighted.

COOLING DYNAMOS AND MOTORS.—Recently a number of patents have appeared describing means for cooling motors and dynamos in order to increase their capacity. Since the rating of a dynamo or motor depends upon its rise in temperature in operation, practicable cooling means whereby the heat may be carried off which otherwise would increase temperature will enable a machine to be operated successfully at loads even greatly in excess of the normal load. The patents thus far issued have been related more particularly to motors for electric railway service, but on Aug. 20 a patent was issued to Mr. L. E. Underwood on means for cooling dynamos, and particularly those in which the moving parts are enclosed more or less completely to protect them from dust and moisture. The means employed consists of sheet metal tanks located in the space between adjacent polar projections, the tanks being connected with a reservoir of water without the machine. As the water in the interpolar tank becomes warm, a circulation is set up, and colder water replaces that which has been warmed.

ARC-LAMP ELECTRODE.—A recent patent granted to Samuel P. Wilbur, of Wilkinsburg, Pa., describes a composite electrode for arc lamps which is stated to overcome the difficulty encountered from the slag forming during the operation of the lamp, preventing an arc from being re-established should it be extinguished. This difficulty has been due to the fact that when the arc is extinguished the slag hardens into an electrical non-conductive substance forming projections which prevent electrical contact of the electrodes when the latter are swung together. The means adopted to avoid this difficulty consists in coating the facing sides of the electrodes with a ridge or a series of projections consisting of a conductive material suitable to the establishment of a stable arc, and so arranged as at all times to over-reach the slag formation on the electrode proper; consequently, when the electrodes are swung together contact is first made between the ridges or projections, thereby permitting the establishment of the arc. On separation, the arc travels to its normal position along the lower ends of the electrodes. The type of lamp to which these electrodes are applicable is that in which either parallel or converging electrodes are employed.

OWNERSHIP AT MONROE, LA.—The reports from Monroe, La., show that the municipal ownership craze in that town has worn itself out, leaving behind a burden of debt and bad investment. A special correspondent at New Orleans says: "The little city of Monroe, La., has at last awakened from a dream to the discovery that municipal ownership is a far more serious problem than it thought when it accidentally stumbled into it a few years ago. At first 'everything was lovely.' The praise and advertising Monroe got were pleasant and it was very proud of its municipal street railway, light and water works and its other municipally owned plants, and of the great distinction of being the first city in Louisiana to lead the way on the new politico-economic path. All these improvements were applauded to the skies, and the most brilliant stories of their success were sent broadcast over the country. The machinery has been long enough in operation, two to four years, to test it. It is now frankly admitted that it is not working as well or as smoothly as it did originally, and the taxpayers and public generally are complaining of the increased taxation, the heavy and greatly increased city debt, the poor municipal service rendered, the excessive cost for such service, which have come with municipal ownership." The Monroe *Star* is hot in its denunciation of the state of affairs.

The 50,000-Volt Line of the Taylor's Falls-Minneapolis Power Transmission.

IN the first issue of the ELECTRICAL WORLD for July was an article descriptive of the power plant at Taylor's Falls, on the St. Croix River, which was recently erected to supply the Minneapolis General Electric Company with power. The present article takes up the 50,000-volt transmission line which connects this power plant with Minneapolis. This line is 40.6 miles long and is designed to carry the total present capacity of the Taylor's Falls plant—namely, 10,000 kilowatts—with a line loss of 6 per cent and a voltage drop of 10 per cent. It is built in almost an air line from the west side of the St. Croix River and Taylor's Falls to a sub-station at the city limits of Minneapolis. At the Minneapolis sub-station are step-down transformers for reducing from 47,500 to 13,800 volts. From this sub-station the transmission is at 13,800 volts to the various stations and sub-stations of the Minneapolis General Electric Company. The Minneapolis distributing system and the work of preparing to receive and distribute Taylor's Falls power in Minneapolis will be the subject of a later article.

FIG. 1.—STRAIGHT LINE CONSTRUCTION AND TELEPHONE BOOTH.

FIG. 2.—LINE CONSTRUCTION AT GUYED POLE.

FIG. 3.—LINE CROSSING RAILROAD CUT.

FIG. 4.—TRANSPOSITION POLE.

POLE LINE.

A right of way 60 ft. wide was purchased for the entire line. The right of way, however, is not fenced in, and farmers are allowed the use of the land just as before the purchase. The general direction of the line is northeast and southwest, so that it cuts diagonally across all fields. As the highways follow the section and half-section lines, the nearest highway zigzags across the line from one end to the other. As the country is dotted with small lakes, a number of these had to be crossed, and for such crossings steel towers were employed.

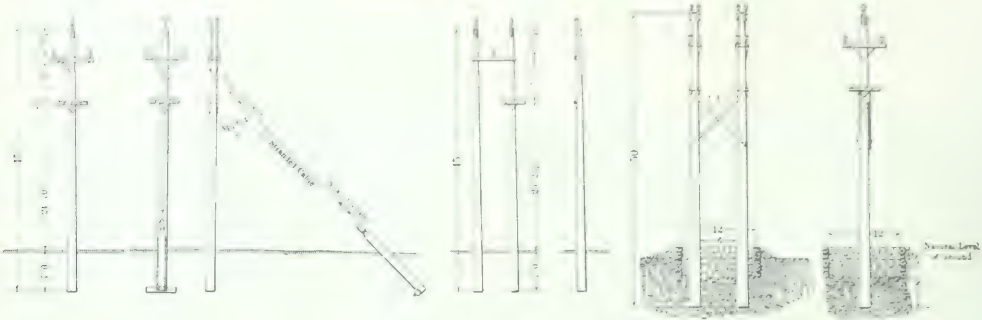
Fig. 1 is from a photograph of the typical straight-line construction. This shows also one of the telephone booths. Fig. 5 is a drawing showing the dimensions on a standard straight-line pole. The separation between wires is 6 ft. The conductors are No. 4-0 stranded, semi-hard-drawn copper. A four-pin telephone cross-arm is placed 7 ft. below the transmission line. The poles are set from 100 ft. to 120 ft. apart and vary in length according to the local conditions and contour of the country from 40 ft. to 60 ft., the object of this being, of course, to avoid too sudden changes in the level of the conductors. The following pole dimensions were specified:

For a length of 40 ft.	Tops 8 ins., butts 15 ins.
For a length of 50 ft.	Tops 9 ins., butts 16 ins.
For a length of 60 ft.	Tops 10 ins., butts 18 ins.

[illegible] ft. 7⅝ ins. long.

The main transmission cross-arms are 7 ft. 4 ins. long and 5 ins. x 7 ins. in section. There are in all 12 telephone booths [illegible]

construction used at a railroad crossing at a cut. Fig. 8 is a drawing of the same construction giving dimensions and foundation details for use when crossing a narrow stream. Fig. 4 shows the arrangement at the transposition of the transmission conductors. A transposition of one-third turn occurs every



FIGS. 5, 6, 7 AND 8.—VARIOUS TYPES OF POLES.

halfway point, the other patrolmen living at Taylor's Falls and Minneapolis. For crossing lakes four sizes of steel towers are used—40 ft., 45 ft., 50 ft. and 60 ft. in height. These were made by the Aermotor Company, of Chicago, and are shown in some of the accompanying illustrations. Conductors are spaced 7 ft. apart on towers. There are 27 steel towers on the line on account of the large number of bogs and lakes to be crossed. The telephone wire is No. 10 semi-hard-drawn copper. Double cross-arms are used at all curves and pronounced changes in the profile.

FIG. 9.—STEEL TOWERS IN LEEDHOLM LAKE.

3½ miles. A double pole is used for this purpose. The telephone line is transposed every tenth pole. Fig. 9 shows a pair of steel towers at the crossing of Leedholm Lake. The process of raising a 60-ft. steel tower is shown in Fig. 10.

INSULATORS AND PINS.

The transmission line insulator used is known as S. & W. No. 1, made by Locke. A cross-section of this insulator is shown in Fig. 11. It consists of four parts held together with neat cement. These insulators are shipped in crates assembled, but without pins. The crates were provided with holes just the right size to take in the pin. The cementing in of pins was done before the insulators were uncrated, the crate thus serving the purpose of a template to hold the pins in position while the cement dried. The insulator, as seen by the drawing, is 12¼ ins. high by 14 ins. in diameter over all. The four parts were tested before assembling with a 60-cycle, 200 kilovolt-ampere testing set. The top-piece withstood a test pressure of 60,000 volts; the second shell, 40,000 volts; the third shell, 50,000 volts, and the fourth inner shell or center, 50,000 volts. The assembled insulator without cement was tested at 120,000 volts.

The strain insulators, as shown in the guy-wire in the illustrations, consist of pieces of oak 2½ ins. x 2½ ins. and 30 ins. long, boiled in linseed oil. [illegible]

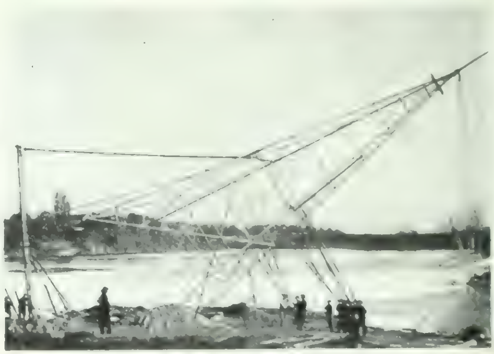


FIG. 10.—RAISING A STEEL TOWER.

Fig. 2 is from a photograph of the line construction at a guyed pole at which the cross-arms and pins are double. Fig. [illegible] the make-up of the guy in detail. Fig. 3 shows the double pole

is used for fastening the No. 4-0 stranded conductor on the 50,000-volt insulators.

[illegible]

white-pine cross-arm. The cross-arms of the transmission line are of fir, unpainted.

The pins for the transmission insulators are made from 2-in. extra heavy steel pipe, with ends swedged down for cementing into the insulators. Fig. 12 shows the pin used on the cross-arms. This pin is held by a bolt passing at right angles through the cross-arm. The pins used on the pole tops have their lower ends flattened so as to bolt against the pole. Fig. 13 shows the pole-top pin. Two pins out of every 100 are tested and must stand a lateral strain of 2000 lbs. applied at a point 1 in. above the top without yielding.

LIGHTNING PROTECTION.

Few transmission lines have had so much attention given them as regards lightning protection. Minnesota thunderstorms are very severe, and it was felt that with a line of so

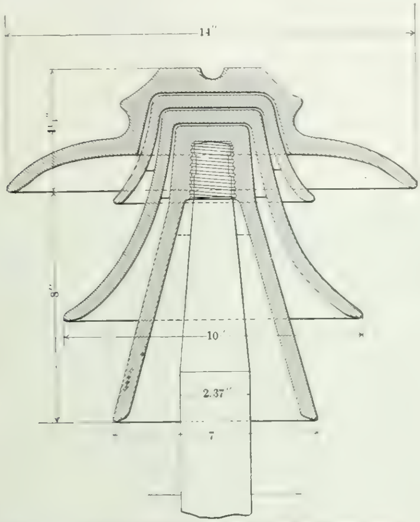


FIG. 11.—CROSS-SECTIONAL ELEVATION OF INSULATOR.

much importance, upon which the electric light and power service of a great city might be dependent, there was every reason for obtaining the best in lightning protection. Of the lightning protection appliances about to be described, many are of a partially experimental nature and have been set up with a view to determining points about which there is at present considerable uncertainty. Owing to freshets which caused unexpected delays in the completion of the power house, the transmission line was finished some time in advance of the

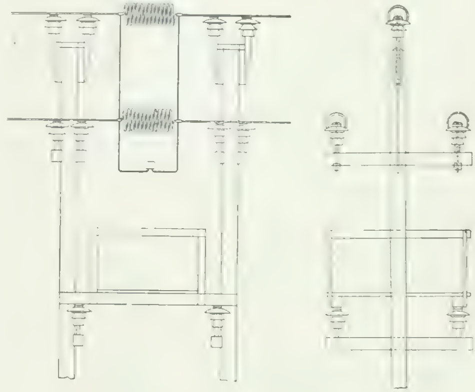


FIG. 14.—CHOKE COILS.

other work, and this gave opportunities for some experiments with lightning protection apparatus during the summer of 1906. Mr. N. J. Neall, of Boston, the specialist in lightning

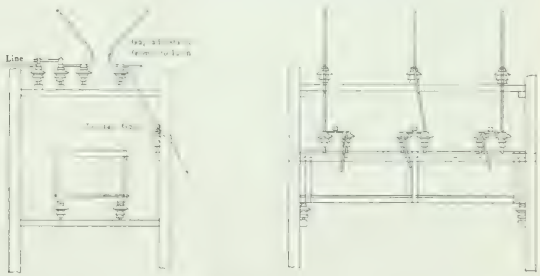


FIG. 15.—HORN TYPE LIGHTNING ARRESTER.

protection, has been acting as consulting engineer of this part of the work.

FIG. 12.—CROSS-ARM INSULATOR PIN.

FIG. 13.—POLE-TOP [illegible] PIN.

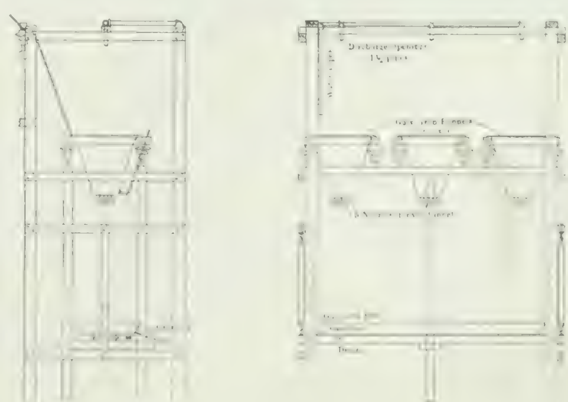


FIG. 16.—[illegible]

At each end of the line and at the middle, horn-type lightning arresters have been installed in accordance with Fig. 15. A rectangular cross-arm frame is built between four poles and the necessary insulators mounted on these [illegible]

The horn spark-gap is adjustable from 0 in. to 12 ins. Underneath the arrester is a platform, also mounted on transmission insulators.

A water-column resistance can be inserted in the series with a ground wire from this arrester, this water column resistance being described later. The choke coil used in connection with lightning arresters is shown in Fig. 14. There is also a platform under these choke coils, so that the paper in the tell-tale spark-gaps, which are placed in shunt around choke coils, can be renewed. A tell-tale spark-gap which has been used in large numbers in getting records of static discharges on this line is shown in Fig. 18. Fig. 17 shows the framing used in connection with the adjustable spark-gaps, telltale spark-gaps and fuses installed for obtaining records on discharges.

The water-column resistance before referred to, which can be used in series with the ground wire of the horn arrester, is shown in Fig. 16. It consists of three galvanized iron tanks or funnels, one for each leg of the circuit. These are mounted

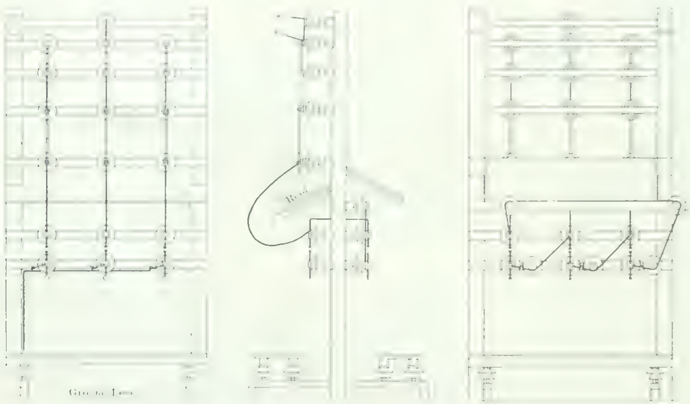


FIG. 17.—SPARK-GAP FRAMING.

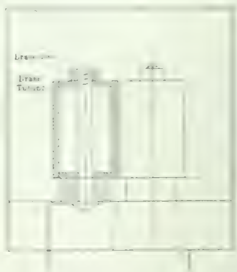


FIG. 18.—TELL-TALE GAP.

on transmission insulators and each is connected to the ground wire from a horn arrester. In the bottom of these tanks are four nozzles, one or all of which can be turned on according to the amount of water-column resistance it is desired to insert.

Water from these nozzles falls into a grounded iron pan. This iron pan can be adjusted in height, as shown by the drawings, being suspended on pulley blocks. The water supply is piped to the arrester tanks by pipes discharging several feet above the tank. For purposes of obtaining records, every pin on every third pole of the transmission line has been grounded through a tell-tale spark-gap. Several experimental schemes of overhead grounds have also been installed on different portions of the line to determine the best construction. One form of overhead ground is to place a grounded wire at the center of the transmission wire triangle. Another plan has been to place grounded wires directly above the two lower wires of the triangle. Still another plan has been to place a lightning rod on each pole with its point above the top wire of the transmission triangle. This lightning rod is fastened to the pole, and is bent out around the top transmission wire to keep it a safe distance away. Another lightning rod scheme installed is that of placing lightning rods on separate poles set alongside the transmission line, the rods extending about 25 ft. above the level of the top transmission wire. Tell-tale spark-gap boxes are inserted in all ground wires. The line is looked after by four patrolmen.

Stone & Webster, of Boston, are general managers of the property and did the engineering and constructing, both on the power plant and the transmission system.

Oil-Engine Driven Power Plant of the Pittsfield Electric Company.

The Pittsfield, Mass., Electric Company recently placed in regular service in that city an interesting oil-engine driven electric plant. The station is located on the north shore of Silver Lake and almost one-half mile from the business center. The plant supplements the equipment of the company's older steam station on Renne Avenue in the heart of the city, and the possibilities are that the electrical output of the old plant will be more and more superseded by that of the new station if the machinery in the latter installation continues its present excellent record. The company does a large exhaust steam heating business in the cold season, so that it is unlikely that the Renne Avenue station will be entirely given up, even though the new plant may be expanded far beyond its present limits.

The new station building is 73 ft. 6 in. long and 60 ft. wide inside; the walls are of concrete blocks built up in two tiers, the total thickness of the walls being 2 ft. The foundations consist in the main of a bed of concrete 3 ft. thick extending beneath the entire building. Concrete blocks were used on account of their being cheaper than brick; they were made on the site of the building by a Pettijohn machine. The building is trimmed with terra cotta, the lower section of the outside walls being rough finished. Construction was begun on June 11, 1906, and the station was placed in partial service on the night of Oct. 5, 1906. As yet only one generating unit has been installed, but space is available for a second without enlargement of the building. The plans call for future enlargement of the building to 140 ft. x 73 ft. 6½ ins.

A side track of the Boston & Albany Railroad extends parallel to the north wall of the station, and all the fuel oil is handled upon this spur. A concrete retaining wall was built behind the station building to hold the side track in place, the track being considerably above the level of the ground upon which the station stands. Fuel oil is stored outside the plant in three 6000-gal. tanks. These tanks are filled by gravity from the oil cars run upon the siding, and from the tanks the oil is piped into the basement of the power house through a conduit. Cooling water for the jackets and bearings of the machinery in the station is drawn from Silver Lake through an 18-in. pipe which terminates in a wall about 60 ft. inland from the shore. From the wall a triplex pump in the basement draws and delivers the water as needed in the plant.

The present generating unit is a 350-kw, 60-cycle, 2300-volt, two-phase Stanley revolving-field alternator mounted on a shaft midway between two 16 in. x 24 in. 3-cylinder Diesel engines, built by the American Diesel Engine Company, of New York. The nor-

mal speed of this unit is 164 r. p. m. It is governed by by-passing the oil supply back into the suction side of the oil pump. The operating principle of the Diesel engine is so well known that only a brief reference to it need be made at this time. In general design and appearance the engine follows the lines of a vertical enclosed type of steam engine. The action is on the four-stroke, or Otto, cycle, but the engine differs from all previous internal-combustion engines in compressing a full charge of air to a point above the igniting point of the fuel, whether liquid or gaseous, and then injecting this fuel for a certain period, variable according to the load, into this red-hot air, where it burns under controlled limits of temperature and pressure. The cylinder operation is, therefore, rather one of combustion than explosion. The fuel used is the common crude oil of Pennsylvania, Texas or California. A Begtrup governor is used in this installation. Each engine is rated at 225 horsepower, weighs 80,000 lbs., and has the following over-all dimensions: Floor space, 9 ft. 6 ins. x 16 ft. 6 ins.; height, 12 ft.; foundation dimensions, width of top, 10 ft.; bottom, 12 ft.; length, 20 ft.; height, 7 ft. 1 in. The latter dimensions include the space required by a direct-connected engine-type generator.

The engine cylinders are cooled by water. Fuel is delivered into them in the form of a spray by an air compressor outfit located in the basement, air being stored under pressure in several steel bottles for starting the engines. The air for fuel injection is carried to mingling chambers located on the sides of the engine cylinders, to which chambers the fuel oil is also led previous to injection. This plant is now showing a fuel consumption in regular service of 7.5 gals. of oil per 100-hp hours.

There are two air compressors for fuel injection located in the basement, each compressor being capable of supplying air to two engines. Pressures approximating 1000 lbs. per square inch being used, and special steel piping is installed for the air. The compressors are of the three-stage type; they were built by the Norwalk Iron Works, of Norwalk, Conn. Each compressor is belt-driven by a 220-volt, 25-hp, two-phase Stanley induction motor located above the compressor plant, on the engine room floor. Six air bottles are provided for each engine. Normally two of these bottles are kept connected with the air pipes to absorb fluctuations in the air pressure. The plant can be started up from rest in from 5 to 10 minutes. Mechanical couplings are used on the engine and generator shaft, so that either engine may be disconnected when desired. Magnetic couplings were used during the first week of the plant's operation, but these did not prove satisfactory.

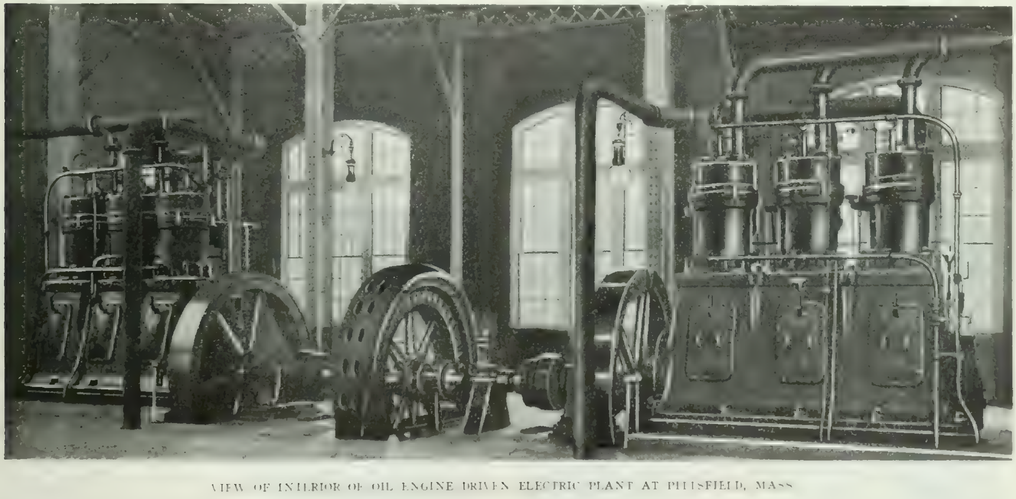
The cooling water pump in the basement is a Goulds vertical triplex 6½ in. x 18 in. machine of the single-action type and runs at 25 lbs. pressure. The pressure can be varied at will by means of a valve located in a by-pass line connecting the suction and the discharge pipes. The pump is located on a common base with its driving motor, which is a belted 5-hp, 220-volt, two-phase induction machine. If desired, the hot water from the engine jackets can be passed through coils in the oil tanks outside the plant, but no trouble was experienced from the oil becoming thick during the cold weather of last winter.

Only two switchboard panels are at present in use in the plant. These are located on the engine room floor near the generator, but it is planned when the station equipment is increased, to install the switchboard on a gallery overlooking the entire floor. The engine room is equipped with a 20-ton hand-operated crane, built by the Cleveland Crane & Car Company. One switchboard panel is a generator panel, and the other an exciter-controlling panel. All 2300-volt wiring and switch connections are carried well out of the way on the basement ceiling. As far as possible the wiring is laid in a continuous line from the generator to the outgoing tile thimbles which bush the wall opposite the pole line leading to the Renne Avenue station.

A single motor-driven exciter is installed in the engine room. It consists of a 15-kw, 120-volt generator, driven at 900 r. p. m., by a 35-hp, two-phase, 220-volt induction motor. This motor is started initially by energy from the Renne Avenue station, but in the future it is expected that a direct-connected exciter will be installed on the engine shaft, thereby making the plant self-starting. The various motors used in the plant are supplied with energy through two 40-kw Stanley 2300-to-220-volt transformers. The station at present obtains energy for lighting from the Renne Avenue plant. Each generator, feeder circuit and motor is provided with a hand-operated non-automatic oil switch; an automatic switch will, however, soon be installed in the outgoing feeder circuit. These switches with the current and potential transformers, are of Westinghouse manufacture. Watt-hour meters are located in two of the phase leads of the generator circuit and in the station lamp and motor circuits.

The triplex pump forces water through the jackets of the air compressors, and also supplies water to the engines. Two oil tanks are located in the engine room, and once an hour the attendant in charge of the plant pumps oil into these by means of a hand-operated Bowser self-registering pump. The air supply for the engine cylinders is drawn from ducts located beneath the basement stairway, and is piped separately to each cylinder by suitable branch lines.

Four 10-in. discharge pipes are installed to carry the engine



VIEW OF INTERIOR OF OIL ENGINE DRIVEN ELECTRIC PLANT AT PITTSFIELD, MASS.

[illegible] only two of these are at present in service, one pair being sufficient for two engines. These discharge pipes are placed beneath the basement floor in a 30-in. Akron conduit running at right angles to them and parallel to the station wall nearest the lake. From this conduit, in which there is always about 8 ins. of water, a 6-in. Akron pipe leads to a brook which discharges into the lake. A small dam across the brook channel holds the water at the proper level in the conduit, and thus a noiseless exhaust is secured.

At present two eight-hour shifts, each of one man, are adequate for the station service, which extends from 8 a. m. to 12:30 p. m. At night the plant operates the street lighting circuits of Pittsfield and the street and commercial lighting circuits of Dalton. In the daytime it operates a synchronous motor for 500-volt direct-current transformation in the Pittsfield business district, with some day lighting service also. The four feeders leading away from the station are given the proper direction by a triangular arrangement of cross-arms on the poles.

The architects of the station were Harding & Seaver, of Pittsfield. The superintendent of construction was Mr. J. I. Shepardson, of the Pittsfield Electric Company, and the operating chief engineer, Mr. Fred Treat. The electrical engineer was the company's superintendent, Mr. W. A. Whittlesey, to whom we are indebted for courtesies extended in the preparation of these notes.

Electric Illumination of the Falls at Niagara.

Various schemes have been proposed to illuminate Niagara Falls, but none of these has ever been carried out. The latest proposition for illuminating the great water falls is quite in keeping with their natural grandeur and beauty and illustrates one of the most interesting developments in illuminating engineering.

The city of Niagara Falls has contracted with the General Electric Company for the necessary apparatus to illuminate the cataract and the work of installation is expected to be completed early in September, when the falls will be artificially lighted for the first time. Two batteries of searchlights of the naval type will be used. One battery of not less than five 60-in. projectors will be mounted on the highest available point on the Canadian side and so placed as to catch the crest of the falls and plunge the light into the broken water as it rushes down between the bridge and the brink on the American side. The color attachments will be used so as to tinge the water various shades of carmine, crimson, orange, yellow, green, violet and purple. These various colors will be combined in different ways so as to introduce innumerable pleasing tints and shades in various combinations.

The second battery will consist of not less than 25 30-in

FIG. 1. BATTERY OF SEARCHLIGHTS AND SCINTILLATOR APPARATUS.

FIG. 2.—REAR VIEW OF SEARCHLIGHT BATTERY.

FIG. 3.—TEST OF SCINTILLATOR.

FIG. 4.—TEST OF SEARCHLIGHTS AND SCINTILLATOR.

projectors mounted in the form of a crescent at the base of the gorge on the Canadian side. These will also be provided with color attachments, and the projectors will be so placed that they can be concentrated on either the American or Canadian falls, or sub-divided so as to cover the Canadian or American falls, as well as the "Bridal Veil" falls. Along the edge of the water opposite the battery the scintillator-head, which discharges clouds of steam to augment the mists in producing cloud effects, will also be placed.

The two batteries of searchlights are powerful enough to bathe the falling water in a flood of dazzling light and with the color scintillators the effects will be beautiful. All the projectors will be controlled from a single vantage point by one operator manipulating a keyboard. In this way it will be possible to obtain a thoroughly artistic interpretation of the color scheme.

The scintillating apparatus consists of three parts, namely, the scintillator-head, the color disks and the boiler. The scintillator-head consists of the steam pipes, nozzles and valves by which the various cloud effects are produced. The color disks are carried in a frame in front of the projectors. The construction of these color screens is such that sheets of various colored gelatine can be attached therein. Upon revolving these screens colors can be brought in front of the arc with the result that a beautiful color is imparted to the beam.

The scintillator-head will be located close to the water and at intervals masses of steam will be emitted from the nozzles. Upon this bank of rising steam the searchlights will play their colored beams, producing a sunset effect of startling beauty. Steam will be supplied from a concealed boiler. Other novelties will be bombs filled with black powder, which will be thrown above the falls to burst with heavy clouds of smoke or a shower of confetti.

The apparatus with which the falls will be lighted has been thoroughly tested at Nahant, Mass. Several of the searchlights to be used will be the largest and most powerful types made.

The illumination of the mighty torrent by night will be an added attraction to the sight-seeing tourists who annually visit Niagara. The apparatus permits of so much originality that the programme will be changed every night and in the early winter the color effects upon the snow, the ice and the frost-coated trees will be of a spectacular beauty unsurpassed by anything other than the great northern lights.

The accompanying illustrations show the apparatus under test at Nahant, Mass. The color scintillator is the invention of Mr. W. D'A. Ryan, and was designed as a part of the illuminating plan for the Jamestown Exposition, but for various reasons was not used. The original apparatus consisted of three parts, the scintillator head, the boilers and the projectors. This apparatus, on a larger scale, will be used at Niagara, but the falling water, flying mist and the rapids will be used to a large extent in place of the steam clouds. The scintillator head consists of steam pipes, nozzles and valves by means of which numerous cloud effects were obtained at Nahant. These pipes, as may be seen from the engravings, extend in a vertical direction and are held by a wooden staging, which may be covered with canvas or other material as desired. On the ends of these pipes were placed nozzles of various shapes through which the steam was emitted. The Niagara nozzle consists of a long, horizontal pipe with short vertical pipes at comparatively close intervals, the escaping steam forming a white vertical sheet, making a perfect screen on which the projectors play their colored lights. With the plume nozzle the steam escapes in distinct and individual plumes upon which the light is trained. The snake nozzle consists of two or more vertical pipes connected to a riser and carrying on the upper end two pieces of common garden hose. When steam is turned on, the hose wriggles in a grotesque manner. Other nozzles tried gave pinwheel, sunburst, column, etc., effects. In addition to this a beautiful effect was obtained by forcing clouds of small paper into the air by means of a motor-driven blower.

The Engineering of Show-Window Illumination.

BY J. R. CRAVATH AND V. R. LANSINGH.

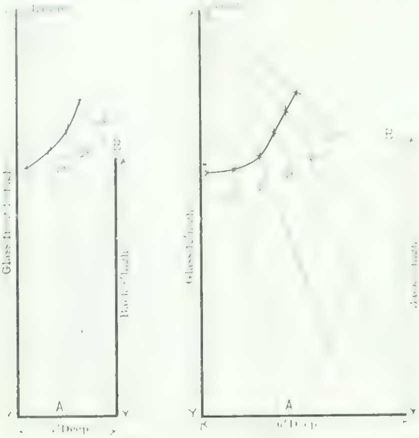
The central-station contract agent or solicitor should be in a position to give customers sound advice on the lighting of their show windows, as this is now a most desirable class of business. It is the purpose of this article to take up only show windows which are to be lighted for the purpose of displaying the goods in them to the best advantage. Decorative lighting has its place in certain kinds of show windows, especially those in which the display of the goods is of secondary importance. Light is of itself attractive both to moths and men, and a window in which there are a lot of exposed lamps may attract attention and invite people to pass along the street where it is located rather than along a darker street. It does not, however, show up the goods to the best advantage, and that is the main object of a strictly "show" window. The merchant is not advertising the electric light company; he is trying to show his goods in such a striking and pleasing manner by night as to be able to sell them. In such windows the display of goods is the first consideration. A display of light, if brought into too great prominence, may even go so far as to detract from the display of the goods and give them a place of secondary importance, either by blinding the observer so that he cannot see the goods, or by making the decorative lighting features so prominent that the goods are forgotten.

It is now too generally established to permit of controversy that for the best illumination of goods in a show window, most of the sources of light must be concealed. Whatever light is exposed should be for secondary decorative purposes. When dealing with the illumination of goods from concealed lamps, we have a purely engineering problem rather than one of decorative or artistic effect.

The position of the lamps in the window is the first thing to consider. The common form of show window necessitates placing the lamps at the front and top of the window. This accomplishes the double object of making it easy to conceal the lamps from the casual observer and of throwing light on those portions of the goods which are seen from the street. The plan of studding a lot of lamps over the ceiling of the show window is not to be recommended except for decorative purposes, as the lamps in the back of the window cast so much of their light behind the goods in the front part of the window instead of illuminating the portions of the goods facing the street. It is, however, important to have all sides of the goods which can be seen from the street well illuminated; that is, there should be no dark shadows at the sides of the goods. If the window is wide, that is, has a wide pane, and there is a row of lamps at the top next to the glass, this matter of lighting the sides of the goods takes care of itself. If the window has a very narrow pane and is very deep, that is, if it extends far back from the street, it may be necessary to provide for more lamps than those along the front window pane. Lighting from above has sometimes been supplemented by concealed lighting from below. At present writing, such lighting from below has hardly passed the experimental stage, and therefore cannot be taken up here. If lighting from below is used at all, the lamps must be well concealed from passers, and the great preponderance of light must still be from above in order to prevent unnatural shadows.

Taking, therefore, the top of the window next to the glass as the proper location for the lamps, the next step is the selection of the proper lamps and reflectors to produce the best results in the different sizes of windows. Right here it may be said that while the average run of window lighting of to-day is very much in advance of that of ten years ago from an illuminating engineering standpoint, there is room for an equally great improvement in the next ten years. To-day we see concealed lamps in most show windows instead of the exposed lamps of ten years ago, and we see the lamps equipped with reflectors where reflectors were not used formerly; but

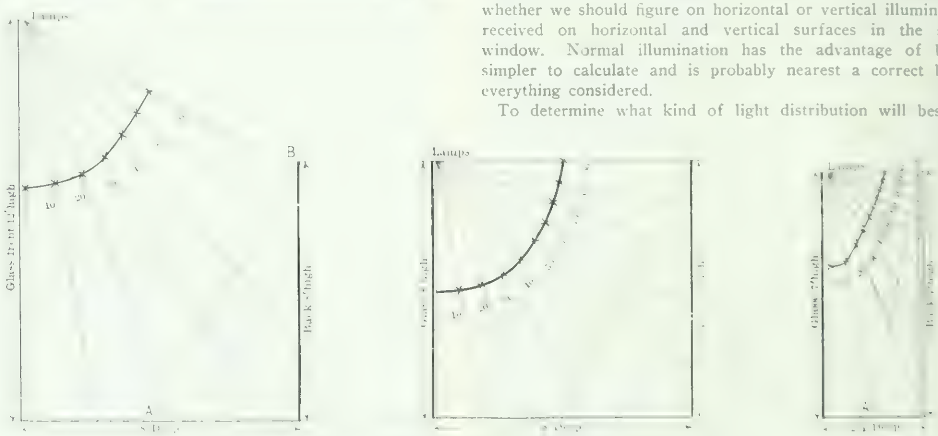
the selection of the reflectors in most cases has been made without any regard to the shape of the window to be lighted. As a result, we see high, narrow windows which call for reflectors which concentrate the light over a small area, equipped with reflectors with a wide distribution adapted to low, deep windows, thus sending much light where it is not needed entirely



FIGS. 1 AND 2—SHOW WINDOW ILLUMINATION.

outside the window area. On the other hand, we see low, deep windows in which very concentrating reflectors are used.

In many windows the reflectors are so pointed as to deliver a large percentage of their light on the sidewalk rather than in the show window. There are some who maintain that ample illumination of the sidewalk in front of the store is a part of the game of attracting people to the place at night. With the numerous electric signs and ample street lighting on most down-town streets, however, such lighting of the sidewalk is not necessary, and in fact detracts from showing up goods



FIGS. 3, 4 AND 5—DISTRIBUTION OF LIGHT IN SHOW WINDOWS.

to the best advantage. If a show window is thoroughly lighted there will be enough reflected light from the back of the window and the goods for all practical purposes of sidewalk illumination. Taken altogether, the business streets of our cities are full of absurdities in show window lighting.

The question of the proper selection and installation of lamps and reflectors for show window lighting depends mainly on the shape of the window to be lighted. As show windows are made in such a great variety of relative dimensions, it is difficult [illegible] approximate the numerous problems that come up in practice. The problem will be solved for a number of the more common proportions of show windows and the same methods can be followed with other dimensions than those given.

The two principal things to be accomplished by the reflector that we use for a given window are first, the confinement of most of the light flux or rays to the space within the window, so that there will be as little as possible going in useless directions; and second, the even or uniform illumination of the goods so that there will not be too much of a contrast between the lighting of different parts of the window.

In selecting reflectors, we must, of course, have before us information on the light distribution of the reflectors that are likely to be useful. Photometric tests showing the light distribution given by various common reflectors are now easily available. With such information before us to work with the first thing is to find out what shape of photometric curve, or in other words, what kind of light distribution is the ideal one for the window under consideration.

We will take up first a very high, shallow window, such as shown in cross section in Fig. 1. In this the lamps are 13 ft. above the bottom of the window, the window is 3 ft. deep and has a back 8 ft. high. In case the window has no back, as frequently is the case in small stores, the method of treatment will be similar. The first step in the problem is to draw a cross section of the window to scale, as in Fig. 1. We wish now to learn the most desirable distribution of light from the lamps in order to illuminate equally the show window in all parts where goods are displayed. As the contents of show windows change from week to week, one cannot always predict exactly what distribution of light is desirable. One way is to figure on securing an equal illumination at the points most remote from the lamps, namely, along the floor and back of the window. If the goods stand some height in the window, they will, of course, receive greater illumination than the bottom and back, so that usually a point less distant than the bottom and back of the window must be figured on. There is undoubtedly also some room for argument as to whether we should figure on normal illumination (that is, the illumination on goods placed at right angles to the rays from the lamps) or whether we should figure on horizontal or vertical illumination received on horizontal and vertical surfaces in the show window. Normal illumination has the advantage of being simpler to calculate and is probably nearest a correct basis, everything considered.

To determine what kind of light distribution will best illuminate our window, or, in other words, to find out the form of the photometric curve which we should seek, a perpendicular line from the lamps to the bottom of the window should be drawn. Then, with the lamps as a center, draw radial lines every 10 degs. to the bottom and back of the window, as in Fig. 1. It is now evident that we want a reflector that gives most of its light within an angle of 30 degs. We must next learn what distribution is best within that limit. We will now assume that the position of the goods in this window will

usually be about that of the dotted reference line *AB*, which is drawn from the top of the back to the middle of the bottom of the window. If the goods are all to be in the bottom of the window, our reference line *AB* should be the bottom of the window. Measure the distance on each radial 10-deg. line from the lamps to the reference line *AB*. Extract the square root of the number (best done with a slide rule) and then measure and mark with a cross on the radial line a point

Candle power.

FIG. 6.—LIGHT ABOUT A CONCENTRATING PRISMATIC REFLECTOR.

Candle Power

FIG. 7.—DISTRIBUTION OF LIGHT ABOUT A CONE-PARABOLIC REFLECTOR.

corresponding to the square root so obtained. Repeat this operation for each radial line. Draw a curve through the points thus obtained and this curve is the ideal distribution curve for that window. We now have to select from the reflectors commercially available the ones coming nearest to these conditions. None conform to them exactly. The authors have selected from the reflector tests they have at hand the reflectors which seem to be best suited to the various windows considered. Some of these tests have already appeared in the book entitled "Practical Illumination" by the authors, but they are reproduced here for convenience in studying the problems brought up by this article.

To meet the conditions in such a window as shown in Fig. 1, the authors have selected several reflectors, the light distribution of which is shown in Figs. 6 to 11. Fig. 6 is that of a holophane concentrating prismatic reflector, with a 32-cp lamp. This reflector delivers a large percentage of its light within an angle of 30 degs. or 15 degs. each way from the vertical. If used in such a window as Fig. 1, the lamp axis should be tipped so as to come between 10 and 20-deg. lines in Fig. 1, preferably a little to the right of the 10-deg. line.

In Fig. 7 is shown the light distribution of a concentrating D'Olier aluminum reflector, with a 16-cp lamp. The lower part of this reflector is conical in form, curving off to a parabola near the neck. This reflector, if used in such a window as Fig. 1, should be pointed between the 10 and 20-deg. lines. Fig. 8 shows the light distribution about an "X-Ray" deep conical mirror reflector with a 16-cp lamp. This should also be pointed slightly in toward the back of the window. Fig. 9 shows the light distribution about a common form of conical reflector consisting of sections of mirror mounted in a metal cone case.

The reflector has an opening of about 90 degs. and is 10 ins. in diameter. Fig. 9 shows the distribution with a 16-cp lamp and Fig. 10 with a 32-cp lamp. It is seen that it is extremely concentrating with both the lamps, giving most of its light within the confines of such a window as Fig. 1. Another reflector suited to this kind of window is one recently brought out under the name of the "X-Ray Helmet." This is designed for 125-watt Gem lamps or 105-watt tungsten lamps. It is not symmetrical, but has a flat side which is intended to be placed toward the window pane to catch and reflect light which would otherwise be wasted outside the window. The distribution of light from it is therefore not symmetrical. Fig. 10 shows the distribution of light in a plane at right angles to the flat side of the reflector. If hung as in Fig. 10, the window pane would be at the right and the goods at the left. Fig. 11 shows the distribution of light from this reflector in a plane parallel with the flat side of the reflector; that is, the distribution as it would be sideways in the window.

As to the number of lamps and reflectors that must be installed to satisfactorily light a window, or in other words, the distance apart of the lamps, local conditions must always be considered. In cities where very high window illumination is necessary in order that the show windows may not seem dark by contrast with those of other merchants, the lamps should by placed close together; while in country towns and on suburban streets, fewer lamps will answer the purpose. The position of the lamps, the angle at which they are placed and the reflector should, however, be the same for all windows of the same dimensions, the only variation being in the number per yard of window front.

We will next take up the window indicated in Fig. 2, where the lamps are placed 12 ft. above the floor; the window is 6 ft. deep and the back 8 ft. high. Here we evidently need a reflector which will cover 50 degs. and give a curve like that plotted in Fig. 2. For such a window the reflector mentioned in Fig. 11 would evidently give good results, as would also that in Fig. 8 if it were inclined at an angle of about 25 degs. from the vertical The regular concentrating prismatic reflector used on 125-watt Gem lamps, the distribution of which is shown in Fig. 12,

Candle power

FIG. 8.—LIGHT ABOUT A [illegible] MIRROR REFLECTOR.

FIG. 9.—LIGHT ABOUT A [illegible] MIRROR REFLECTOR.

would also be fairly good for this purpose, although evidently allowing much more light to escape above in the window and into the street than would be consistent with the maximum economy.

In Fig. 3 we have a window with lamps placed 12 ft. high, with a window 8 ft. deep and 8 ft. high at the back. Here an angle of 60 degs. must be covered. For such a window the distribution of light shown by Fig. 16, which is that of an "X-Ray" [illegible]

Fig. 12, as well as that used in Fig. 11, could also be used in this window if properly pointed at an angle to cover enough area. If the reflector shown in Fig. 11 were used at an angle, it would be advisable to place a supporting strip along the top of the window against which the flat side of the reflector could rest, so as to take the strain of the very heavy reflector from the shade holders and lamp sockets. In fact, such a supporting strip is advisable with all concealed window reflectors when placed at an angle, although it is more necessary with the extremely heavy reflectors. Such a support can easily be installed by putting a piece of wood or pipe across the window at the proper place.

In Fig. 4 is shown the proportions of an extremely deep, low window where the lamps are only 8 ft. above the window floor and the window is 8 ft. deep and 8 ft. high at the back. In such a window it is usually desirable to light it well clear to the top of the back, as well as in the extreme front, which means that the reflector must cover an angle of 90 degs. Usually with such low windows, there is not much room for the lamps; hence it is sometimes impracticable to put a lot of conical reflectors along the top of the window because of their size.

Were it not for this, the reflector which gave the light distribution shown in Fig. 16 would be good for this window

A reflector specially adapted to this work is the "Poke Bonnet," the light distribution of which is shown in Fig. 14. This reflector gives nearly the same amount of light high in the window as straight down, which, in the case of a window of this kind, is exactly the thing desirable. Another reflector which could be used in such a window is the common parabolic aluminum half reflector which gives a distribution of light like that shown in Fig. 14, with a 16-cp lamp.

A peculiar form of window which is found frequently in stores which are slightly below street level is that shown in section in Fig. 5. The window is only 2½ ft. deep and 7 ft. high both at front and back. There is usually but little available space for the lamps because they come such a short distance above the heads of passers. In such windows goods are frequently placed in the extreme top. In fact, the best part of the display is usually in the top because the window is very small and goods in the bottom do not receive as close inspection from passers as those in the top. For such windows the common form of window trough with sectional plate mirrors is well adapted in its light distribution. The distribution of light from such a trough with two 16-cp lamps is shown in Fig. 15. The light distribution shown in Fig. 14 could also be used in such a window and would produce higher illumination of the top of the window than the common window trough, though there would be more contrast between the top and

FIG. 10.—LIGHT ABOUT A CONICAL MIRROR REFLECTOR.

FIG. 11.—DISTRIBUTION OF LIGHT IN TWO PLANES ABOUT AN X-RAY HELMET REFLECTOR.

FIG. 12.—LIGHT ABOUT ... AND CONCENTRATING REFLECTOR.

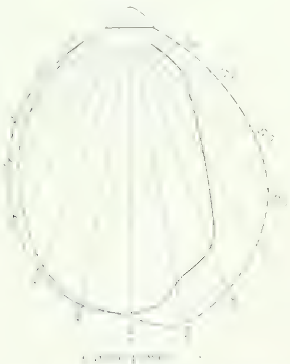


FIG. 13.—LIGHT ABOUT A PARABOLIC ALUMINUM REFLECTOR.

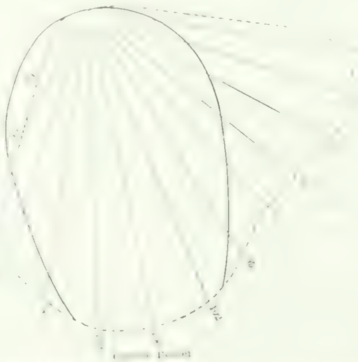


FIG. 14.—LIGHT ABOUT AN X-RAY POKE-BONNET IN TWO PLANES.

FIG. 15.—LIGHT ABOUT COMMON WINDOW TROUGH.

bottom of the window if a reflector like that shown in Fig. 14 were used.

The reflectors have so far been considered mainly on their reflecting qualities when new, without regard to their probable depreciation or their relative first cost. The first cost is such a small item on any reflector that is used every night in a show window, that it need hardly be considered. The probable depreciation is a serious question, however, because it may result in a great loss of light. As to depreciation, the common plate mirror type is the worst offender. It starts in with an efficiency which is very high, but under the heat that is developed by the large number of lamps in the top of the show window, it may easily be depreciated in a few years so as to be passed by some of its less pretentious rivals. Some specially patented processes of silvering give better results in durability than common plate mirrors. Prismatic reflectors, of course, consisting as they do of nothing but glass, need simply be taken down and washed to make them as good as new. All reflectors suffer equally from dust on the inside and on the lamps. None of those considered in this article is affected by dust on the outside. All of those considered are subject to more or less breakage, except the aluminum. While the plate

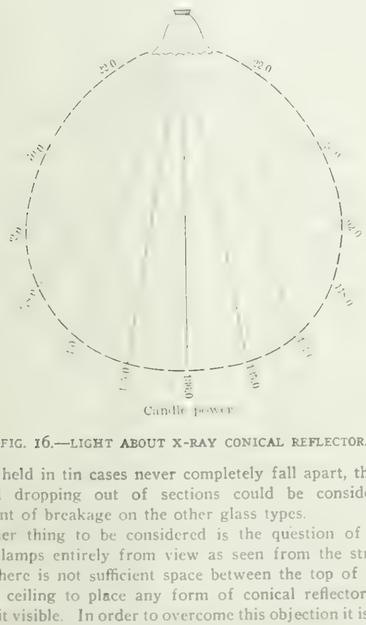


FIG. 16.—LIGHT ABOUT X-RAY CONICAL REFLECTOR.

mirrors held in tin cases never completely fall apart, the breaking and dropping out of sections could be considered the equivalent of breakage on the other glass types.

Another thing to be considered is the question of concealing the lamps entirely from view as seen from the street. As a rule there is not sufficient space between the top of the glass and the ceiling to place any form of conical reflector without making it visible. In order to overcome this objection it is customary either to use a shade which, when the lamps are lighted, is lowered to conceal them, or to paint a black, red or other colored strip across the top of the window. This strip can also be used to good advantage for advertising purposes to display the company's name or goods sold by making the letters transparent, or, in other words, leave the letters clear, painting in the balance of the strip. This, of course, requires the window to be lighted by reflectors which will allow some light to fall on the strip. In this case prismatic reflectors, such as that shown in Fig. 6, are best adapted, although such a reflector as that shown in Fig. 13, if placed near the top of the band, will often admirably answer the purpose. In the case of trough reflectors of either the standard or "poke bonnet" type, it is often unnecessary to paint such a strip in the window on account of their relative shallowness, as the lamps are generally placed horizontally. Whether a window should be lighted so as to take advantage of the illuminating [illegible] at the top of the window or not must be left to each individual case.

The Economy of the Tungsten Lamp.

By Alfred A. Wohlauer

It is undoubtedly important for the illuminating engineer and central station man to have a clear conception of the conditions under which the use of the tungsten lamp is more favorable than that of other illuminants. Its long life and its high efficiency—three times that of the old carbon lamp—advocate its use; on the other hand, it is fragile and its initial cost is great at present. A critical discussion, therefore, of the relations between the initial cost of the lamp, its life and its efficiency, price of energy, etc., will probably be interesting and useful for the illuminating engineer, central-station man and lamp manufacturer.

A formula may be employed to calculate the effective or total cost of light production, C_e, per lamp-hour. This must take into account the initial or renewal cost, C_i, of the lamp per hour, as well as the cost, C_c, of the energy consumed in the lamp per hour. It is obvious, therefore, that

$$C_e = C_i + C_c$$

It further does not require any proof, that

$$C_i = \frac{P}{L}$$

where P represents the actual price of the lamp and L the average life of the lamp.

Now, if $n =$ the number of candles per lamp, $W =$ the specific consumption in watts per candle, M the cost of energy per kw-hour, then

$$C_c = \frac{n \cdot W \cdot M}{1000}$$

and

$$C_e = \frac{P}{L} + \frac{n \cdot W \cdot M}{1000} \qquad (1)$$

is the formula for the total cost of light production per lamp-hour.

Another formula, derived herefrom, gives the total cost of light production, C_h, per candle-hour.

It is evident, that

$$C_h = \frac{C_e}{n} = \frac{C_i}{n \cdot L} \times \frac{W \cdot M}{1000} \qquad (2)$$

This term, the candle-power, appears to be of considerable importance for the central-station man. As has been pointed out several times of late, most recently by Hale in his paper before the convention of the Illuminating Engineering Society, the tendency in the policy of our central stations is to furnish light rather than electricity to their customers, and to this end, they install lamps without cost. It is quite natural, therefore, that the charge should also be made for light and not for its equivalent in energy. If this were effected and if, for instance, the candle-hour or the kilo-candle-hour were adopted as unit, there can be no doubt that the lighting companies far from fearing would even welcome the advent of lamps of the highest possible efficiency.

Returning to the formulæ (1) and (2), I shall use them at first to calculate the cost of lamp-hour and of candle-hour for different rates of energy and different candle-powers. For this purpose we must agree upon the price of the lamp.

Now, it is an established fact that low candle-power incandescent lamps of full voltage are more difficult to produce than lamps of higher candle-power. Not counting the price of the bulb, a 20-cp lamp, for instance, is more expensive than a 100 cp lamp. As, however, the public is not so easily persuaded to pay a higher price for a lamp of lower candle-power, it seems to be a good scheme to adopt the same price for all tungsten lamps ranging from 20 up to 100 candle-power.

From the best information I could obtain this policy very likely will be adopted and a price of $P = \$1.50$ can be used in

[illegible]

The life of the tungsten lamp may for the present be valued [illegible] power.

These last two values are not absolutely established as yet; they are, however, so near to the truth that they can be safely introduced in the formulæ.

With these three constant quantities, price, life and consumption of the tungsten lamp, we are in the position to calculate the total cost of light production per lamp-hour and per candle-hour. The results are given in Tables I and II.

For comparison, the total cost of light production may be calculated also for the old carbon lamp of 16 candle-power and for the graphitized filament or Gem lamp of 20 candle-power.

FIG. 1.—LIGHT ABOUT 4-LAMP CLUSTER WITH [illegible] OPAL REFLECTORS.

The price of the carbon lamp is given as 16 cents; its consumption, $H_c = 3.1$ at a life of $L_c = 450$ hours. The price of the graphitized filament lamp is 20 cents, and its consumption is $H_m = 2.5$ at a life of $L_m = 450$ hours.

It is evident that, in the tables, the low energy rates refer to the cost of generating electricity, whereas the high rates refer to the selling price. In this regard the results of the calculations as reproduced in the different tables reveal that the candle-hour of the tungsten lamp is cheaper than the candle-hour of the old carbon lamp and of the metalized filament lamp for energy rates ranging down to 4 cents per kw-hour.

For this reason it would be of economical interest to the general public, as well as to a number of isolated plants, to substitute, at their own expense, for each carbon lamp a tungsten lamp of equal candle-power. As an example, at the usual rate of 10 cents per kw-hour, the saving per lamp would amount to about 40 per cent. A still greater saving could be effected by substituting for a number of carbon lamps one tungsten lamp equalling in candle-power the total candle-power of the carbon lamps.

As an illustration, the economy in using one 50-cp tungsten lamp in connection with a Holophane hemisphere and reflector, instead of a cluster with four 16-cp carbon lamps with an opal reflector, would be about 70 per cent. Regardless of the economical considerations, the tungsten lamp as used above would also present a more artistic appearance. The photometric curves published in Cravath and Lansingh's book on "Practical Illumination" (Fig. 151 and Fig. 170), and reproduced in Fig. 1 and Fig. 2, show that the light distribution is practically of an equal efficiency. It is assumed that the light distribution will not be noticeably affected by the substitution of a 50-cp tungsten lamp for a 50-cp carbon lamp in Fig. 2.

In cases such as the above illustration, even the central sta-

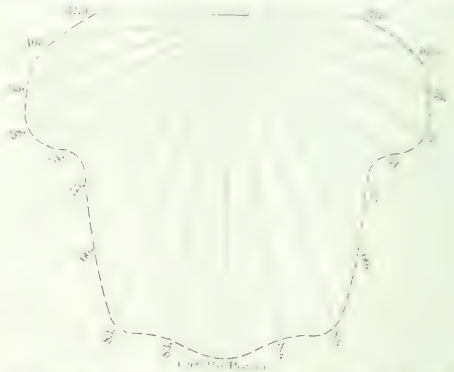


FIG. 2.—LIGHT ABOUT HOLOPHANE [illegible] REFLECTOR.

tions, generating the electricity at a cost of 1 cent per kw-hour, would be able to produce a cheaper candle-hour for their own use with the tungsten lamp than with the carbon lamp.

Due to such economical features as the above, and also due to the fact that the price of the tungsten lamp will probably not be reduced in the immediate future, it would be advisable for the lamp manufacturer to consider only the introduction of high candle-power tungsten lamps of about 32 to 40 candle-power. This would also entail the advantage for the central station that whereas the use of 16-cp tungsten lamps instead of 16-cp carbon lamps would involve a loss of 67 per cent due to decrease of the energy consumed, the use of 32-cp tungsten lamps instead of 16-cp carbon lamps would [illegible] only 30 per cent.

As to the public, the lamp-hour of a 32-cp tungsten lamp would cost not more than the lamp-hour of the 16-cp carbon lamp or the lamp-hour of the graphitized filament lamp, as indicated in Tables I and III. It would, therefore, not involve higher expense for the general public, if it would replace one 16-cp carbon lamp by a 32-cp tungsten lamp, even if the 16-cp lamp would give sufficient illumination for the special purpose.

In such cases, however, where the cost of the kw-hour is less than 4 cents, it would not be advantageous to substitute a 32-cp tungsten lamp for a 16-cp carbon lamp on account of the high

TABLE I.—EFFECTIVE OR TOTAL COST OF LIGHT PRODUCTION PER LAMP-HOUR INCLUDING COST OF [illegible] AND OF LAMP RENEWALS FOR TUNGSTEN LAMPS OF DIFFERENT CANDLE-POWER AT [illegible] ENERGY RATES.

	Rate per kw.-hour in cents														
C. P.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10	.16	.17	.18	.19	.20	21	.22	.23	.24	.25	.26	.27	28	.29	.3
16	.166	182	198	214	.23	.246	.262	278	.294	.31	.326	342	358	.374	.39
20	[illegible]	19	.21	23	25	.27	29	.31	.33	.35	[illegible]	.39	.41	43	45
25	175	[illegible]	225	25	.275	.3	.325	.35	375	4	.425	.45	.475	.5	.525
32	182	214	.246	278	.31	.342	374	.406	438	.47	.502	534	566	.598	63
40	19	23	[illegible]	31	35	39	.43	.47	.51	.55	.59	.63	.67	.71	.75
50	2	.25	3	35	.4	45	.5	55	.6	.65	.7	.75	.8	85	.9
80	.23	.31	39	.47	55	63	.71	.79	.87	.95	1.03	1 11	1 19	1.27	[illegible]
100	25	.35	45	55	65	[illegible]	85	95	1.05	1.15	[illegible]	[illegible]	1.45	1 55	1.65

price of the lamp, as given above, whereas a 32-cp tungsten lamp may very well be used in place of two 16-cp or one 32-cp carbon lamp with the same economy as heretofore cited.

It would be, however, of interest to consider how much the tungsten lamp ought to be reduced in price to make it desirable to consumers who pay less than 4 cents per kw-hour for their energy. This price X, can be derived by employing formula 1 in connection with the following considerations: In order to know the highest price of the tungsten lamp to be granted, the cost per lamp-hour of a 32-cp tungsten lamp, for instance, should be equal or less than the cost of the 16-cp carbon lamp at a certain rate of energy.

Employing, then, formula 1 and using the values decided on above for life, consumption, etc., we can solve the above expression for X, assuming for instance, a rate of 2 cents per kw-hour. This results in

$$\frac{16}{450} \quad \frac{50 \times 2}{1000} > \frac{X}{1000} \quad \frac{32 \times 2}{1000}$$

and
$$<$$
$$X = 72 \text{ cents.}$$

This, therefore, is the price that the tungsten lamp most likely will have to be reduced to in order to meet all the demands.

All these calculations hold good assuming that the power stations follow the policy of furnishing electricity and do not supply the lamps to their customers, and that these lamps be paid for by the consumers, in spite of which fact it has been shown that the general public will derive great benefit from the tungsten lamp.

The position of the central stations toward the tungsten lamp cannot be such a favorable one, as far as the use of the lamps for themselves and the sale of electricity is concerned. Although it is beyond doubt that an improvement such as the tungsten lamp will increase the number of customers for the central stations and finally raise their total output tremendously, [illegible] load of the individual customer may decrease.

However this may develop, I believe that the adoption of the candle-hour will do away with all these fears and the general public as well as the central station would share the benefit of the new lamp.

Though the introduction of the candle-hour rate would offer great advantage over the kw-hour rate, several difficulties may present themselves in its adoption and execution. One of the problems, however, the measuring of the candle-hour, which appears to be one of the most difficult ones, could be solved in a rather simple manner. Taking for granted that in the tungsten lamp, one watt produces one candle, then one watt-hour would equal one candle-hour, and one kw-hour one kilocandle-hour. Therefore, by changing the "watts" into "candles" on the meters, the measurements could be effected without any change in the construction of the meters.

In view of the price of the kilocandle-hour this could be determined by starting from the following points: It has been calculated that the lamp-hour of the 16-cp carbon lamp costs about as much as the 32-cp tungsten lamp, including charge for renewals. As shown by the tables, the carbon lamp-hour costs about 0.5 cent at a rate of 10 cents per kw-hour, while the tungsten lamp-hour of 32 candle-power costs a little less at the same rate.

This price of about ½ cent per lamp-hour could be adopted as a basis for a new light rate, the central stations renewing the tungsten lamps free of charge in pursuance of the policy to furnish light and not power and supplying their customers exclusively with 32-cp tungsten lamps for reasons discussed above.

To calculate the new light rate, the following formula can be used:

$$C_l = \frac{[illegible]}{1000} \tag{3}$$

[illegible]

C_l represents cost of lamp-hour.
n candle-power of supplied lamps.
r rate on price per kilocandle-hour.

Basing upon the above assumptions the central stations will feel justified in making a charge of

$r = 16$ cents per kilocandle-hour.

TABLE II.—EFFECTIVE COST OF LIGHT PRODUCTION PER CANDLE-HOUR, INCLUDING COST OF POWER AND OF LAMP RENEWALS FOR TUNGSTEN LAMPS OF DIFFERENT CANDLE POWER AT VARIOUS ENERGY RATES.

C. P.	Rate per kw.-hour in cents														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10	.016	.017	.018	.019	.02	.021	.022	.023	.024	.025	.026	.027	.028	.029	.03
16	.0104	.0114	.0124	.0134	.0144	.0154	.0164	.0174	0184	.0194	.0204	.0214	.0224	.0234	.0244
20	.0085	.0095	.0105	.0115	.0125	.0135	.0145	0155	.0165	.0175	.0185	.0195	.0205	.0215	.0225
25	.0070	.0008	.009	.01011	.011	.012	.013	.014	.015	.016	.017	.018	.019	.02	.021
32	.0057	.0067	.0077	.0087	.0097	.0107	.0117	0127	.0127	.0147	.0159	.0167	.0177	.0187	.0197
40	.00475	.00575	.00675	.00775	.00875	.00975	.01075	.01115	.01275	.01375	.01475	.01515	.01675	.01775	.01875
50	.004	.005	.006	.007	.008	009	.01	.011	.012	.013	.014	.015	.016	.017	.018
80	.00287	.50039	.0049	.0059	.0069	.0079	.0089	.0099	.0109	.0119	.0129	.0139	.0149	.0159	.0169
100	0025	.0035	.0045	.0055	.0065	.0075	.0085	.0095	.0105	.0115	.0125	.0135	.0145	.0155	.0165

TABLE III.—TOTAL COST OF LIGHT PRODUCTION PER LAMP-HOUR OF CARBON AND GEM LAMPS AT DIFFERENT RATES OF ENERGY.

LAMP	Rate per kw.-hour in cents														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Carbon	086	.136	.186	.236	.286	.336	.386	.436	.486	.536	.586	.636	.686	.736	.786
Gem	096	.146	.196	.246	.296	.346	.396	.446	.496	.546	.596	.646	.696	.746	.796

TABLE IV.—TOTAL COST OF LIGHT PRODUCTION PER CANDLE-HOUR FOR CARBON AND GEM LAMPS AT DIFFERENT ENERGY RATES.

LAMP	Rate per kw.-hour in cents														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Carbon	0054	0086	.0116	.0147	.0178	021	.024	.0272	.0305	.0335	.0365	0395	.0425	0455	.0485
Gem	0046	0072	0097	0123	0148	[illegible]	.0198	.0223	.0247	.0273	.0298	.0322	.0348	[illegible]	.0398

The consumer who is not inclined to pay high prices for light bills will find at the end of the month that his light bill is not larger and that under the new rate he is receiving more light for the same or for a lower amount. Thus, while the consumer profits by the use of the candle-hour system, the central stations do not lose by it. They get 6 cents more for the kilocandle-hour than they received for the kw-hour at the old rate. That means 6 times 32 or $1.96 for each lamp. While the central stations furnishing the lamps free of charge still make an additional profit of at least 46 cents on each lamp, the consumer pays now 16 cents per kilocandle-hour instead of about 30 cents as heretofore.

Two things, however, have to be carefully considered in connection with the new light rate; these are the fragility and the life of the tungsten lamp as made at present.

Due to the fact that the tungsten lamp is more fragile than the carbon lamp, it is absolutely necessary that the same be handled with considerable care and that the central station insure themselves against unreasonable claims by establishing rules, for instance, to prevent the use of drop lights with key sockets, etc.; although, according to my experience, the tungsten lamp can very well be used with drop light with key socket for more than 1000 hours, if reasonable care is observed.

As to its life, it has been pointed out that so far as determined the average life of the tungsten lamp is about 1000 hours, although this fact has not been exhaustively investigated; but the work that has been done along that line reveals that one watt per candle-power or even somewhat less would guarantee the above life as the most economical of the tungsten lamp.

Small overloads due to overvoltage do not affect the life of the tungsten lamp as much as the carbon lamps due to the positive temperature coefficient of the metal. While this is another advantage of the tungsten lamp, it has been my experience that in spite of the positive temperature coefficient, low periodical fluctuations of the voltage are more noticeable in the tungsten lamp than in the carbon lamp, very likely due to the higher intensity of light or intrinsic brilliancy per unit of the light-giving body.

Dangers in Sub-Stations.

In the annual report of the Chief Inspector of Factories and Workshops in England some dangers in sub-stations are pointed out. Many cases were found where safety had been insufficiently provided for, and some where the means intended to procure safety added considerably to the dangers. In some sub-stations, where it was important that the supply should be available continuously, the high-pressure switchboards were arranged so that it would be impossible without great danger to carry out any repair or adjustment unless by completely shutting down the supply. In two cases sub-stations were supplied at 10,000 volts pressure, three-phase. The 10,000-volt conductors were of bare copper. The transformers and high-pressure switchgear were on one side of the room and the consumers' switchboard on the other, with only a few feet of space between them. The arrangement of exposed high-tension conductors was dangerous in any case, and particularly so in view of the consumers' employees having access.

In some less recent transforming sub-stations a form of protection was provided for the high-pressure switchgear, which distinctly added to the danger. The switches and bus-bars were of bare metal exposed, but the whole switchboard was surrounded by an iron cage with a door. When any switching or replacing of fuses became necessary, the attendant would, therefore, have to go into the cage, which was so confined that he would inevitably be in contact with its iron bars, thereby being in contact with earth, and would besides have insufficient room to work in. In some other underground chambers, far too small, the inspector found some survivals of a bygone age in the form of protection of the high-pressure terminals of the cables by metal covers or bells. The terminals were bare, and in order to get at them for any purpose, the bell, which was heavy, had to be lifted vertically with a very steady hand, or it would touch the terminals. An earth wire was attached to the bell, but in one case this wire proved to be very much alive.

In motor-generator sub-stations the inspector found numerous cases of the high or extra-high pressure coils of the motors being insufficiently protected. Accidents have occurred through men putting out their hands to steady themselves and touching the high-pressure stator coils when examining the lubrication of the bearings. In some continuous-current sub-stations the motor-converters are placed with a passage-way between them of less than 20 ins., and having their exposed high-pressure terminals sticking out into the passage-way on each side.

Some Fundamental Principles Underlying the Sale of Electrical Energy.*

By [illegible]

The methods of charging for electrical energy vary so widely in different localities, and as they should combine in general the same elements in all cases, evidently a good many of them are, at best, rather haphazard in character. It is the purpose of the present article to briefly discuss some of the salient features upon which a logical system of rates should be based, supplemented with a numerical example.

With a given number of kw-hours sold, the supply company will expect a certain definite income, and if each consumer does not bear his proper share of the cost of supplying him it is evident that some may be undercharged while others may be overcharged, if a detailed study of each consumer's load has not been made. Before going into the consideration of the cost of furnishing electrical energy proper it is important first to consider briefly the nature of the supply of electrical energy, as having a bearing on its cost of production.

While electrical energy may be generally regarded as a manufactured product in the ordinary sense of the term, yet a little reflection will prove this to be hardly in accordance with facts. Electrical energy stands unique, in that it differs from the ordinary manufactured goods of commerce because: First, it is an intangible product of manufacture and must therefore be classed as a service; and second, electrical energy can be stored only to a very limited extent, and in this way also differs from ordinary manufactured products, which can be made at a constant rate, stored and disposed of as demand dictates.

From the two above facts, it is evident that the supply of electrical energy is a service which must be rendered simultaneous with the demand, and since no virtual storage is possible, it means that the generating, distributing and measuring equipments must be of ample capacity to handle the maximum demand that may be made upon them. Evidently then, the instantaneous maximum demand of each consumer fixes the investment for the service of that consumer, and therefore fixes all of those charges which are dependent upon the investment.

The charges which are dependent upon the investment are insurance, taxes, interest or profit, a certain portion of the maintenance of the plant which is not dependent upon the use of the apparatus, and also a large proportion of the depreciation due to age, in addition to the remaining indeterminate portion of the depreciation charge which is due to what is known in engineering language as "changes in the art" and which is brought about by new and better apparatus invented from time to time. Also in the case of hydro-electric development there is usually a certain water rental which may be regarded as a fixed charge and which is based upon the capacity of the apparatus installed in the generating station.

All of the above charges are directly proportional to the investment made for the service of every different consumer

and they increase as his instantaneous maximum demand for service increases and are not reduced in any manner by a reduction in his consumption of energy.

This clearly points out that no matter whether a consumer uses electrical energy or not, if he be connected to the system of supply that system must hold itself in readiness to supply him, and by so doing incurs the major portion (as explained below) of the cost of reaching him which is constant and dependent not upon the continued use of his apparatus at maximum load but solely upon his liability to demand maximum load, even if only for a short period. (It might here be added that in quite a large number of steam-electric plants the annual fixed charges form about 75 per cent of the total cost of operation and that for hydro-electric plants the annual fixed charges run about 90 per cent of the total expense of operation.)

After the investment has been made for the consumer it costs a certain amount to keep the apparatus in operation. That amount for steam-electric plants includes management, fuel, water, waste, oil, lamp renewals (if a lighting company), the value of the lost energy (whether due to actual loss, meter slip or theft), a certain amount of labor and repair expenses which are a direct result of the use of the apparatus. For a hydro-electric system about the only items that vary with the output are the cost of repairs, the value of the lost energy and a certain proportion of the labor expense.

These running expenses for electrical systems are proportional to the number of hours' use of the apparatus and are in no way dependent on the first cost of the same. This is equivalent to saying that there is a certain lesser portion of the cost of supplying a consumer with electrical energy which continues or discontinues accordingly as his consumption is discontinued or interrupted.

It has now been shown that in general the cost of supplying electrical energy to any consumer is made up of two unequal portions, namely:

a. The greater portion consists of a fixed charge, which depends solely upon the consumer's instantaneous maximum demand and which is independent of the duration of that demand.

b. The lesser portion consists of a running charge which depends upon the energy consumed.

The above elements at once suggest a method of charging for electrical energy which will bear a proper relation to the cost of furnishing it and must evidently consist of the fixed charge based upon the consumer's maximum demand in combination with the charge which is dependent upon energy consumption.

Each of the component parts of the above system are in use in various localities, under the names respectively of "flat rates" and "meter rates," and the principal disadvantages of each of these alone are as follows:

Flat Rate.

Assuming the use of a fixed charge alone, or what would be known as a flat rate, it is apparent that there is nothing in this method of charging which causes the consumer to use his electricity economically. Knowing that he has got to pay for his energy whether he uses it one hour or 24 hours, he carelessly lets a certain portion or perhaps all of his load remain on the system the full 24 hours.

The flat rate at first thought would seem to be almost ideal for the sale of hydro-electric energy, where the cost of the same is for the most part fixed and independent of the output, as already pointed out, and might be used in the case of those developments where water is plentiful; but there are again many developments, which for their successful operation depend upon water storage and coupled always with the chance of reducing the station peak as well as minimizing the cost of repairs, are all arguments which favor the economical use of energy, which a flat rate will not insure.

With steam electric plants the objections to the use of flat rate are so obvious that they need not be commented on in this article.

Straight Meter Rate.

If the consumer is charged for all the energy he uses on a straight meter rate basis, this tends to discriminate against the long-hour user, who is the most desirable type of consumer the station supplies.

This defect with the straight meter rate arises largely from the fact that the unit used in the measurement of electrical energy, the kilowatt-hour, is made up of the average energy consumption in kilowatts multiplied by the time over which the energy is furnished. It is at once evident that an infinite number of time and energy values multiplied together will give the same result and from which it is apparent where the difficulty with the straight meter rate system lay, as will be seen from the following simple example:

Suppose consumer A uses 100 kw for 1 hour; then his consumption as shown by the watt-hour meter would be 100 kw-hours. Next suppose consumer B uses 10 kw for 10 hrs.; then his consumption as shown by the watt-hour meter would also be 100 kw-hours.

Now by the straight meter rate both these consumers would pay the same amount for their energy, and as it is necessary to have 100-kw capacity of plant to supply A, whereas it is only necessary to have 10-kw capacity of plant to supply B (neglecting losses in both cases) it is evident that this method of charging is anything but equitable.

Furthermore there may be a certain amount of load which, at some particular meter rate, would bear a definite relation to the cost of supply. Now assume the maximum demand of this load to remain the same with the average number of kw-hrs. increased by, say, 25 per cent. What happens, supposing, this load is supplied from a steam electric plant?

Since the maximum demand remains the same, only the running expenses will be increased twenty-five per cent, and as the running expenses for a steam electric plant form only about 25 per cent of the total cost of furnishing energy, the increased cost to the company of supplying this additional energy is only 6¼ per cent of the total operating cost, whereas the revenue to the company is increased in proportion to the additional consumption or by 25 per cent.

Similarly, if the maximum demand remain the same and the number of kw-hrs. be decreased by 25 per cent, the supply company sustains a reduction in total operating costs of only 6¼ per cent.

Hence it is seen in general that the most equitable method of charging for electrical energy involves the principle of a fixed charge which is independent of the output combined with the charge which is dependent upon the output. These two charges may be simply reduced to a kw-hour basis in the following manner:

As the running expenses are proportional to the output, in order to determine the running cost per unit or the cost per kw-hour, it is simply necessary to divide the total annual running expense by the total number of kw-hours sold during the year.

In order to ascertain the fixed annual charge upon a kw-hour basis, evidently the total annual fixed charges belonging to each class of service should be divided by the maximum number of kilowatts which may be demanded of the station, by the respective classes of service. This gives, for each class of service, the annual fixed charge per kilowatt of maximum demand.

Experience shows that the total number of kilowatts which may be demanded of a station depends upon the nature of the load as well as to some extent upon the magnitude of the individual consumer's maximum demand. With the lighting load the total number of kilowatts which may be demanded of a central station varies from 1.25 to 1.75 times the maximum load upon the station. With power service this ratio runs on an average from 1.5 to 3 times the maximum station load. This ratio of the aggregate of the several consumers' maximum demands to the maximum station load is termed "diversity factor" and arises from the fact that all consumers do not use their maximum load at the same time, there being some-

what greater diversity in the time of maximum demand in the case of motor load than with lamp load resulting in somewhat relatively reduced fixed charge for the former class of service as compared with the latter.

Having the annual fixed charge per kilowatt of maximum demand for each class of service, and dividing this quantity by the number of days in the year, evidently gives the daily fixed charge per kilowatt of maximum demand for the class of service considered.

The total cost per kw-hour for any consumer may now be obtained when the size and the length of time which he uses his installation are known. If a consumer only uses his installation an hour daily and it calls for 1 kilowatt capacity, he consumes daily 1 kw-hour. Therefore the total cost per kw-hour of serving this consumer is the daily constant or fixed charge plus the running cost of 1 kw-hour. If this same consumer increases the use of his installation so that his average daily use is 2 hours per day, the total daily fixed charge is consequently distributed over 2 hours' use and the total cost per kw-hour is now the sum of one-half of the daily fixed charge plus the running cost of 1 kw-hour.

No. of [illegible]	Annual [illegible] consumption.	[illegible] factor %	Fixed costs per Kw. hour — Cents. Power.	Private Lighting.	[illegible] lighting.	Running cost per Kw. hour. Cents.	Total costs per Kw. hour — Cents. Power X	Private lighting. Not including lamp renewals.	[illegible] renewals.	Street arc lighting.	[illegible] ing to column X, Dollars.
1	[illegible]	4.16	3.65	4.40	4.95	.092	3.742	[illegible]	4.812	5.042	$13.70
2	730	8.33	1.82	2.20	2.48	.092	1.912	[illegible]	3.240	2.572	[illegible]
[illegible]	1,095	12.5	1.22	1.46	1.65	.092	1.312	[illegible]	1.872	1.742	14.30
[illegible]	1,460	16.7	0.91	1.10	1.24	.092	[illegible]	1.192	1.512	1.332	14.60
[illegible]	1,825	20.8	[illegible]	0.88	0.99	.092	0.822	0.972	1.292	[illegible]	15.00
[illegible]	2,190	25.	0.61	0.735	0.825	.092	0.702	0.827	1.147	0.917	15.40
7	2,555	29.16	0.52	0.625	0.705	.092	0.612	0.717	[illegible]	0.797	15.70
[illegible]	2,990	33.3	0.455	0.550	0.620	.092	0.547	0.642	0.962	0.712	16.40
[illegible]	3,285	37.5	[illegible]	0.490	0.550	.092	0.497	0.582	[illegible]	0.642	[illegible]
10	3,650	41.7	0.365	0.440	0.495	.092	0.457	0.532	0.852	0.587	16.40
11	4,015	45.8	0.330	0.400	0.450	.092	0.422	0.492	0.812	0.542	[illegible]
12	4,380	50.	0.305	0.365	0.412	.092	0.397	0.457	0.777	[illegible]	17.40
13	4,745	54.16	0.280	0.340		.092	0.372	0.432	0.752		[illegible]
14	5,110	58.3	0.260	0.315		.092	0.352	0.407	0.722		[illegible]
15	5,475	62.5	0.243	0.293		.092	0.335	0.385	0.705		18.40
[illegible]	5,840	66.7	[illegible]	0.275		.092	0.322	0.367	0.687		[illegible]
17	6,205	71.	0.215	0.260		.092	0.307	0.352	0.672		19.00
18	6,570	75.	[illegible]	0.245		.092	0.295	0.337	0.657		[illegible]
19	[illegible]	79.5	0.192	0.232		.092	0.284	0.324	[illegible]		19.70
[illegible]	7,300	83.3	0.182	0.220		.092	0.274	0.312	0.632		[illegible]
[illegible]	7,665	[illegible]	0.174	0.210		[illegible]	0.266	0.302	0.622		[illegible]
22	8,030	92.	0.166	0.200		.092	0.258	0.292	0.612		20.70
23	8,395	96.	0.159	0.191		.092	0.251	0.283	0.603		[illegible]
[illegible]	8,760	100.	0.152	0.183		.092	0.244	0.275	[illegible]		21.40

Similarly, the cost of serving various hour users from 3 to 24 hours is determined by dividing the daily fixed charge by the number of hours' use and adding in each case the running cost per kw-hour.

This can perhaps be better understood by the application of the above principles to a concrete example, as follows:

Suppose a hydro-electric station situated in an industrial center, having a maximum station load 5000 kilowatts, divided as follows:

Private lighting .... 2,000 kw
Motor load .... 2,500 kw
Street arc lighting .... 500 kw

Total .... 5,000 kw

As previously explained, while the aggregate of the maximum demands of the several private lighting consumers may be from 1.25 to 1.75 times the maximum station load and with motor consumers this ratio or "diversity factor" may range from 1.5 to 3 times the maximum station load due to the fact that all maximum loads do not coincide in time, yet it will be evident that this does not apply to the case of street lighting load, which may be regarded as a single consumer, and therefore has a "diversity factor" of unity, and consequently deprives the station of the advantage of supplying a maximum demand greater than the maximum station load.

For private lighting service the "diversity factor" in the present case will be taken as averaging 1.25 for both commercial and residential lighting. (Strictly speaking residential lighting usually has a somewhat greater "diversity factor" than for commercial lighting, but for the sake of simplicity they will be averaged here.) For motor service the "diversity factor" will be assumed to be 1.5.

Based upon these assumptions the maximum load of 5000 kilowatts upon the system will correspond to the following maximum demands, viz.:

Class Service. Maximum Demand.
Private lighting, 2,000 kw x 1.25 .... 2,500 kw
Motor, 2,500 kw x 1.5 .... 3,750 kw
Street lighting, 500 kw x 1 .... 500 kw

The total annual fixed charges not including profit on the total system equipment for these three classes of service are assumed to be divided as follows:

Private lighting service $40.000.00
Motor service 50,000,000
Street lighting service 9,000.00

From which the annual fixed charges per kilowatt of maximum demand would be:

$$\text{Private lighting, } \frac{\$40{,}000}{2500 \text{ kw}} = \$16.00 \text{ per kw maximum demand.}$$

$$\text{Motor, } \frac{\$50{,}000}{3750 \text{ kw}} = \$13.30 \text{ per kw maximum demand.}$$

$$\text{Street lighting, } \frac{\$9{,}000}{500 \text{ kw}} = \$18.00 \text{ per kw maximum demand.}$$

Assuming all classes of service operative 365 days in the year, the daily fixed charge chargeable to each class of service is as follows:

$$\text{Private lighting, } \frac{\$16.00}{365} = 4.40 \text{ cents.}$$

$$\text{Motor, } \frac{\$13.30}{365} = 3.65 \text{ cents.}$$

$$\text{Street lighting, } \frac{\$18.00}{365} = 4.95 \text{ cents.}$$

If the station receives a total annual revenue on 12.000.000 kilowatt-hours, and if the running expenses or expenses which are proportional to the output and common to all classes of

service are \$11,000.00, then the running cost per kilowatt-hour would be:

$$\frac{\$11{,}000.00}{12{,}000{,}000} = .092 \text{ [illegible]}$$

It now remains to determine the total cost per kilowatt-hour of supplying energy for the three classes of service, from 1 to 24 hours per day.

Private Lighting Costs.

Taking up first the private lighting costs, it is evident from what has been said that if a consumer has a maximum demand of 1 kw and if he only uses his lighting service 1 hour per day, his charge would be made up of the total daily fixed charge for private lighting or 4.40 cents plus .092 cents, the running charge of a kw-hour, thus making a total energy cost of 4.492 cents. Similarly, if he uses his service 2 hours per day his fixed charge per kw-hour would be only one-half of the above or 2.20 cents, which, added to .092 cents, makes the total cost per kw-hour of 2.292 cents. By continuing this process the whole series of private lighting costs may be obtained, showing the variation in cost per kw-hour for different number of hours daily use. Such a series of calculations have been made for the case here assumed and are given in the accompanying table.

The cost of private lighting worked out as above described is that delivered at the premises of the consumer and does not include the cost of lamp renewals. If the company furnishes lamp renewals and uses 16-cp lamps having a consumption of 3.5 watts per cp and an average life of 950 hours to 80 per cent of normal candle-power (this is assumed to be the useful life of a lamp beyond which it does not pay to burn it) and if the lamps cost 17 cents each distributed, then the cost of lamp renewals per kilowatt-hour may be obtained as follows:

Total kilowatt-hours consumed in useful lamp life =

$$\frac{16 \times 3.5 \times 950}{1000} = 53.2 \text{ kw-hours.}$$

$$\text{Cost of lamp renewals per kw-hour} = \frac{17 \text{ cents}}{53.2 \text{ kw-hrs.}} = .32 \text{ cent.}$$

This cost per kilowatt-hour of .32 cent may be properly regarded as a running charge and would therefore be added to the running energy cost of .092 already obtained making a total .412 cent inclusive of lamp renewals. This charge combined with the fixed charges for various number of hours daily use gives the total cost to the company of supplying incandescent lighting under the conditions assumed in the present case, and are also included in the table given below.

Power Costs.

By making a similar set of calculations for motor service (excluding of course the question of lamp renewals) using the daily fixed charge for power or 3.65 cents and combining this, as modified for different number of hours' use, with the running cost of a kilowatt-hour gives the series of energy costs which will also be found tabulated below on the kw-year as well as the kw-hour basis.

Street Arc Lighting.

The energy costs for street arc lighting are obtained in a similar manner to those for private lighting and motor service, utilizing the proper fixed charge belonging to this class of service, in combination with the running charge used with the other two classes of service. These energy costs are figured out from 1 to 12 hours' daily use, 10 hours being assumed to be the average daily use the year round, the lamps being lighted this length of time every night in the year.

By reference to the table it will be seen that the total cost of energy delivered at the lamps is .587 cent per kilowatt-hour [illegible] a kilowatt-year as an arc lamp consumes on an average about one horse-power including all the losses, the total energy cost per lamp per year would be \$[illegible]. In addition to the above energy cost of arc lighting must be added the costs of carbons, trimming, [illegible] for an enclosed arc lamp operating 3650 hours a year would run about \$5.00 a lamp per year, giving the total cost of a lamp per year = \$16.00 + \$5.00 = \$21.00.

In conclusion is should be pointed out that the foregoing figures are not given as representing any existing installation, but are used solely to elucidate the principles involved.

The New York Edison Company's Scrap Heap.

Every electric light company accumulates more or less scrap material from time to time, owing to reconstruction work, repairs, etc., but few companies accumulate sufficient material to make the question of its final disposition an economic one. Such is not the case, however, with the New York Edison Company, the yearly value of whose scrap material approximates \$200,000, in lead, iron pipe and copper alone. The following table shows the amount of scrap material sold during the year 1906:

Scrap copper	631,788 lbs.
Pig lead	358,502 "
Mixed metal	71,335 "
Iron, approximately	500 tons

In addition to the above there were 18,460 ft. of iron pipe redeemed. This, for the most part, was 3-in. pipe heretofore used in the Edison tube system but reclaimed for use as conduit for cables. The iron pipe and a large majority of the copper is obtained from the old Edison tubes which are being rapidly displaced by vitrified conduit and cable.

Fig. 1 shows the reduction oven used in withdrawing the copper from the old Edison tubes. The furnace is fitted with

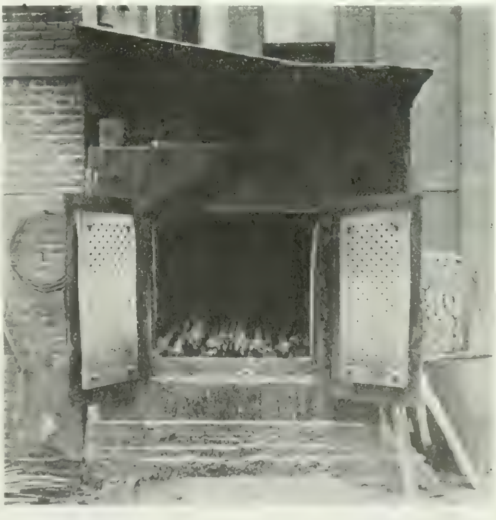


FIG. 1.—OLD [illegible] PREPARATORY TO BURNING.

bars at intervals, each bar being higher than the previous one, so that when the tubes are inserted the rear end is about 3 ft. higher than at the furnace doors. A fire is built under the tubes from the side of the furnace, and when this becomes sufficiently hot to melt the composition, the latter flows from the tubes by gravity and feeds the flame. After the composition has run out the copper is easily withdrawn as clean copper, and the tubes are either repainted or sold for scrap, depending upon their condition. If it is possible to use the iron pipe again this is re-threaded, painted and used, as previously stated, for cable work. About one-half of the pipe is fit for service again. The copper [illegible] up into small

pieces and put into hogsheads and sold. This furnace is used for Edison tubes exclusively, being unsuited in construction for any other form of scrap material.

Fig. 2 shows the furnace used for burning the composition out of old Edison junction, coupling and elbow boxes. The

FIG. 2.—FURNACE FOR SMALL [illegible]

compound is melted and burned out, and the iron is, for the most part, repainted and used, such material as cannot be thus treated being sold for scrap. This furnace is also used for burning up old boxes and other rubbish placed in an adjoining building.

In another furnace all the short pieces of braided and leaded cables, returned from jobs, and insulated wire of all kinds are thrown. The bed of this furnace is of concrete and is tapered toward the rear right-hand corner so that the molten lead will run out by gravity into a pot outside of the furnace. Here the dirt is skimmed off and the lead is taken up in ladles and cast into pigs, in which condition it is sold. On the bottom of each pig is molded the letters "N. Y. E. Co." The insulation having been entirely burned and the lead having run off, clean copper remains, and this is removed and packed into hogsheads for shipment.

Fig. 3 shows stacks of pig lead ready for shipment, and Fig. 4 shows stacks of iron pipe reclaimed from the old

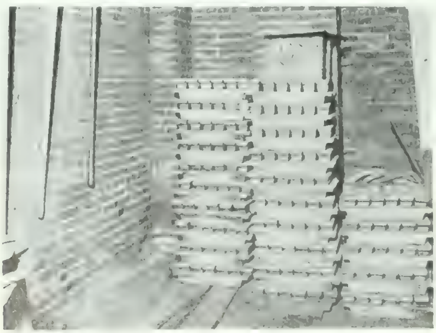


FIG. 3.—[illegible]

Edison tube system. The latter illustration shows the pipe being cleaned, threaded and repainted for use and also gives some idea of the large quantity of this material which is [illegible]

Outline of the Characteristics of Constant-Potential Transformers.

By [illegible]

In order to understand thoroughly the wiring and connection of constant-potential transformers, one should be somewhat familiar with the theory. This necessitates first of all, an understanding of the following terms: induced electromotive force, counter electromotive force, impedance, hysteresis, and eddy currents. These will be taken up in the above order and treated rather briefly.

INDUCED E. M. F.

Let N and S (Fig. 1) represent the north and south poles, respectively, of a permanent magnet, with the lines of force $f f$, passing from the north to the south pole. AB is a conductor to the ends of which are connected two flexible wires from the galvanometer G.

Now if the wire AB is moved through the field of the magnet, in the direction of the arrow, an e. m. f. will be "induced" or generated in the conductor AB, in the direction shown by the arrow-heads, and its presence may be detected by the deflection in the galvanometer G. The e. m. f. generated is proportional to the rate of cutting of the lines of force.

Another case of induced e. m. f. which would perhaps relate more closely to the principle involved in the transformer is

FIG. 4.—RECLAIMED TUBES BEING CLEANED AND PAINTED.

illustrated in Fig. 2. Let AB, as in the previous case, represent a conductor, the ends of which are connected to a circuit containing a battery E and key K. A second conductor, AB, is placed parallel to AB, having its ends connected to the galvanometer G. Now when the current exists in a conductor, a magnetic field is established around the conductor in the form of concentric circles, the planes of which are perpendicular to the axis of the wire in which the current exists as shown in the engraving.

Now assume the key, K, to be closed and electricity to flow from the battery E in the direction indicated by the arrow-heads; as stated above, lines of force will encircle the conductor AB. That is, the lines of force will diverge from the center of the wire and in spreading out will cut the conductor AB generating in it an e. m. f. which produces a current in the galvanometer G in the direction of the arrow-heads. It should be noted that the direction of the arrow-heads in the conductor AB are opposite to those in $A'B'$, showing that the induced e. m. f. is always in a direction opposite to that of the impressed e. m. f.

As it takes time for the current in the circuit to reach a maximum or a constant value, it always takes time for the field to reach a constant value, so that when the current becomes constant, the field is constant, or there is no change in the

lines of force, consequently the induced e. m. f. falls to zero—as is true in the case of dirrect currents.

COUNTER E. M. F. OR E. M. F. OF SELF-INDUCTION.

It was noted above that when a current exists in a conductor in Fig. 3, lines of force or of magnetic flux are set up around the conductor in a plane perpendicular to the conductor, in the form of concentric rings. (Fig. 3a.) Now suppose as is the case in Fig. 3, that the conductor AB is coiled into several turns. It is evident, from the construction of the coil, that the line of force from the coil 1 will cut the coil 2, and in the same manner the flux from coil 2 will cut coil 3, and so on throughout the series of convolutions. Thus the coil has

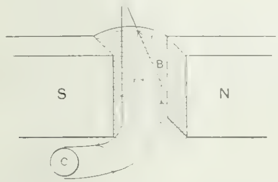


FIG. 1.—GENERATION OF E. M. F.

been cut by lines of force or flux and consequently an e. m. f. has been induced in it in a direction opposite to the impressed e. m. f.

A clearer understanding may be had if the arrow-heads a and b be allowed to represent the counter e. m. f. and the impressed e. m. f., respectively, both in direction and intensity. At the instant the key K is closed, the flux tends to become constant; when the flux changes less rapidly the counter e. m. f. a becomes smaller and smaller until it finally disappears, leaving the e. m. f. E, which is the impressed e. m. f. From the

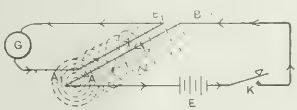


FIG. 2.—GENERATION OF E. M. F.

above, it is evident that when the flux is constant (as with direct currents) the counter e. m. f. is zero, but with alternating current, where the flux is continually changing, the counter e. m. f. becomes a prominent factor.

One effect of the counter e. m. f. is to retard the current in time-phase with respect to the impressed e. m. f. When a current is started in a wire it does not attain its maximum value, instantly, but a certain interval of time is required, just as when one attempts to rotate a heavy flywheel it cannot be made to reach its maximum speed instantly, but time is consumed in overcoming the effects of inertia. In fact, the characteristics of counter e. m. f. of self-induction is practically identical to those of inertia in connection with mechanism.

From the above, it may be seen that in addition to the ohmic

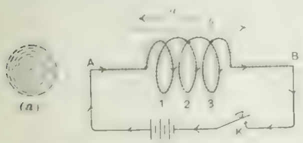


FIG. 3.—PRODUCTION OF COUNTER E. M. F.

resistance to oppose the current, there is a counter e. m. f. which, although acting in a different manner, attains the same end—that of decreasing the value of the current. The quotient of the counter e. m. f. divided by the current is sometimes called the "reactance." The combined effect of the reactance and the resistance is called "impedance."

EDDY CURRENTS.

When there is a change in the magnetic flux threading a coil, there is an e. m. f. set up in the coil. [illegible]

threads through a rod of iron, there will be an e. m. f. set up in the iron itself, as shown by the arrows in Fig. 4. The e. m. f. in the iron acts in a direction to oppose the change in flux producing it.

Now, if in the case of a solid iron core, as in Fig. 4, the resistance of the iron is very small, a comparatively small e. m. f. will produce a considerable value of current. The energy due to this current is dissipated in the form of heat; it can be greatly reduced by properly subdividing the cores, which construction will be discussed in a subsequent issue under the heading "Transformer Cores."

HYSTERESIS.

In a piece of iron or steel which is not magnetized, the molecules which constitute the iron lie in every direction with

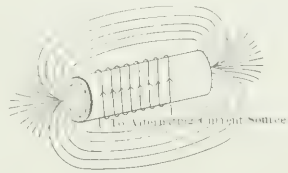


FIG. 4.—PRODUCTION OF EDDY CURRENTS.

respect to each other. For example, consider a keg of nails to represent the iron bar and let the molecules be represented by the individual nails. Now, as stated above, when the mass of iron is not magnetized the nails point in all conceivable directions, but if a number of turns of wire be placed around the mass of nails and current exists in the wire, the nails would have a tendency to lie parallel to each other and all of them would attempt to point in the same direction. That is, each nail would be a magnet in itself, all of the north poles of the magnets pointing in one direction and all of the south poles in the opposite direction. Each nail may be considered as having turned on its center, due to the mutual attraction between the magnetic poles of the adjacent nails or molecules, so to speak. Fig. 5 is a diagram showing the action of each molecule. Suppose that the nail in the position a' b' is acted upon by the magnetism set up by the surrounding coil and that its original position was that indicated by ab. Now, if the current is cut off from the coil, the nail will tend to assume its original position ab, but will not quite reach it; it will stop perhaps at the line xy.

Assume now that the current in the coil is reversed, then the north pole instead of being at a' will be at b'. It is evident that the nail has been turned from y to b' instead of from a to b as would have been the case had the nail not been magnetized. Thus it appears that the work required to turn the nail or molecule after it has been magnetized is greater than it would have been had the nail not been magnetized. This difference is represented by the arc ay, the work being dissipated in the form of heat. The loss of energy is attributed to "hysteresis." This is an exact analogy of what goes on in the molecules of the iron; that is, after the molecules have been

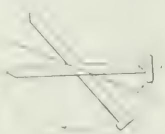


FIG. 5.—HYSTERESIS LOSS.

FIG. 6.—SINGLE-PHASE TRANSFORMER.

magnetized in one direction, and the current cut off from the coil, the whole amount of magnetism does not disappear from the iron, but a small portion remains. This remaining magnetism is called the "residual" magnetism, and in order that the magnetism of the mass of iron be reversed the residual magnetism must first be neutralized. The two losses due to eddy currents and hysteresis are generally combined as one, known as the "core loss" of the transformer.

Having outlined briefly the important factors in the action

of the transformer, it is well to consider next the action of [illegible]

Fig. 6 is a sketch of the simple form of a transformer, which consists of a closed magnetic circuit *a* of iron, on which are wound two coils called the primary and the secondary. It is evident from the sketch that there is no electrical connection whatever between these two coils. The primary coil is connected to a source of alternating current, and the secondary coil is connected to the external circuit, which generally comprises lamps or motors.

In order to make the action as clear as possible, consider that the two coils have zero resistance, and also that the reluctance (opposition to the flow of magnetism) of the core is negligible. Consider that an e. m. f. of 2000 volts alternating, is applied to the primary of the transformer, which consists of 2000 revolutions of wire. A negligible value of current in the primary will set up a flux in the iron which will cut the turns of the primary winding, thereby inducing in it a counter e. m. f. of 2000 volts. Assume that the secondary has the same number of turns as the primary and that there is no magnetic leakage, then the total flux set up by the magnetizing current in the primary cuts the 2000 turns of the secondary and evidently there will be 2000 volts generated in the secondary coil. If the secondary circuit be closed through a resistance of 400 ohms a current of five amperes will be produced therein, due to the *secondary* e. m. f. of 2000 volts. The five amperes of secondary current will tend to demagnetize the core, and an equal counter magnetizing current of five amperes will flow in the primary. Thus the input in watts in the primary will equal the output of the secondary; that is, the number of watts in the primary is 5 amperes × 2000 volts = 10,000 watts, which is the same as in the secondary. In the above case the number of turns in the primary and secondary were equal and the secondary voltage and current were equal to the primary voltage and current. Assume now that the secondary consists of 200 turns; in this case only one-fifth of the number of turns which constitute the primary is cut by the core flux; consequently, only one-fifth of the voltage will be induced, namely 200 volts between the secondary terminals, because the e. m. f. is directly proportional to the number of turns of wire—the flux being the same as formerly. If now the resistance of the secondary and circuit be reduced to four ohms, its secondary current will be 50 amperes (due to the secondary e. m. f. of 200 volts) and the secondary power will be 10,000 watts. Fifty secondary amperes in 200 turns will require five amperes of counter magnetizing current in the 2000 primary turns. Thus, although the e. m. f. was reduced from 2000 to 200 volts, at the same time the current has increased from 5 to 50 amperes; a reduction in the voltage of 10 to 1 and an increase in the current of 1 to 10; these factors are called the "ratio of transformation."

The ratio of the voltage in the primary and the secondary depends entirely upon the relative number of turns in the primary and the secondary coils, and by dividing the e. m. f. of the primary by that of the secondary, the ratio of transformation may be obtained.

In the above example we have a case where there was no eddy current or hysteresis in the core, no loss due to ohmic resistance of the copper, and no magnetic leakage reactance in the coils has been considered; these all play an important part in the commercial transformer. The efficiency is reduced from the ideal 100 per cent to from 96 to 98 per cent in transformers of from 50 to 75 kilowatts.

Economy in Conduit Work.

By T. W. Poppe.

In planning conduit circuits much labor and material may oftentimes be saved by a little forethought and an otherwise difficult situation simplified. It is not essential that a conduit line be installed for every pair of wires; as two or more circuits may be run in the same conduit if a conduit of sufficient size be run. As an example, the writer will cite a building where there is an office on the main floor consisting of one large room, in the center of which are placed the desks surrounded by a railing forming a square with high newels at each corner. On each wall is a bracket and on top of each newel an upright electrolier is placed. A necessary condition was that no conduit should be visible in the office, but in the room in the basement below the office, which was wired also, the conduit was run exposed. In the basement room an outlet was placed in the center of the ceiling.

Fig. 1 shows a plan of the office with the lamps indicated and Fig. 2 is a plant of the basement room. Fig. 3 shows diagrammatically the manner in which the conduit was installed. The squares on the diagram represent pull boxes, with the exception of box *C*, which is the center outlet for the basement room and is also used as a pull box. From box *A* to box *C*, and from box *C* to boxes *B* and *E*, ¾-in. conduits were installed. From boxes *A*, *X*, *C*, *E*, ½-in. conduits were run up through the flooring to the four brackets in the office. From boxes *B*, *C*, *D*, *E*, ½-in. conduits were run upward out of the bottom of the boxes through the flooring and the center of the newels to outlet boxes placed on top of each newel. From box *B* to box *X* a ¾-in. conduit was installed, and from box *X* to boxes *Y* and *Z* a ½-in. conduit was installed. From [illegible] the panel box to box *A*, a conduit line of like diameter was installed.

When the wire was drawn [illegible]

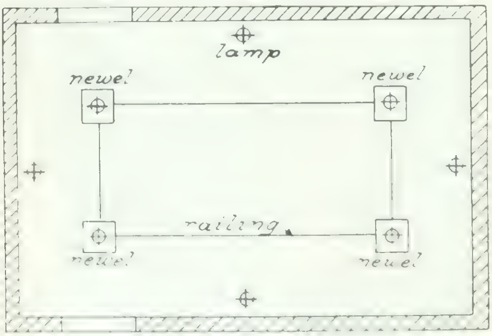


FIG. 1.—PLAN VIEW OF OFFICE ROOM.

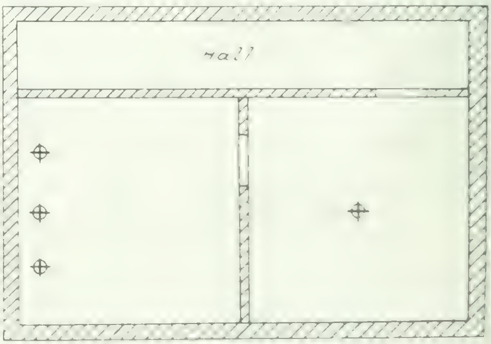


FIG. 2.—PLAN OF BASEMENT UNDER OFFICE ROOM.

duplex wires were drawn in between the panel box and box *A*. One duplex wire fed brackets No. 1 and 3 and one fed brackets No. 2 and 4. The third duplex wire fed the upright electroliers on the newel. From box *C* to box *B*, three No. 14 duplex wires were drawn into the ¾-in. conduit and two duplex wires

were drawn into the conduit from box B to box X. From box C to box E, two No. 14 duplex wires and one three-wire No. 14 cable were drawn into the conduit. From boxes A, X, C, E, one duplex wire was drawn connecting the boxes with the

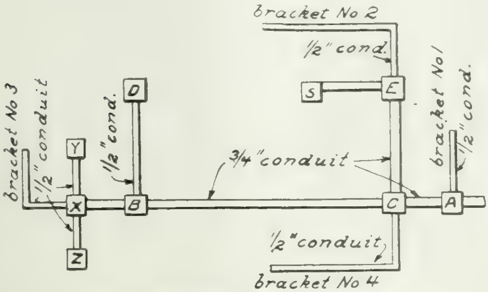


FIG. 3.—DIAGRAM OF CONDUIT LINES.

bracket outlets. From boxes C, B, D, E a duplex wire was drawn into each conduit to the newel outlets and from box E to switch box S, a three-wire cable was drawn.

The circuit connections were made as follows: At box A the duplex wire running to bracket No. 1 was connected to one duplex fed from the panel. This feed continued straight across through the ¾-in. conduit between boxes A, C, D to box S, where the duplex running to bracket No. 3 was connected to it. This completed one circuit. At box C the duplex running from bracket No. 2 through the ½-in. conduit to box E, through the ¾-in. conduit to box C, and through the ½-in. conduit to bracket No. 4 was connected to another feed from the panel, which continued from box A to box C. This completed the second circuit. The third feeder, which continued from box A to box C, was connected to the duplex wire running from the newels to box C, and was continued to boxes B, D and E, where the duplex wires running to the newels above were connected to it. This completed the third circuit. The remaining unconnected duplex wires were connected at box X to duplex wires running to Y and Z. The duplex was run through the ¾-in. conduits connecting boxes X, B and C. At box C it was connected to two wires of the three-wire cable which run into the ¾-in. conduit connecting boxes C, E and S. The object of placing the three-wire cable was to use two wires to feed the drop lamps at X, Y and Z, and to use the third wire as a sec-

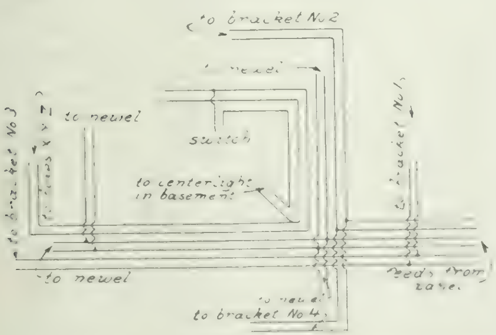


FIG. 4.—WIRING DIAGRAM.

tion wire between the switch [illegible] and box C, which is a center lamp outlet of the basement room. The switch S is single-pole, and serves to break the circuit through the section wire, the electrolier at the center and one of the two wires of the three-wire cable. The basement lamps were fed from a panel in the basement.

Fig. 4 is a diagram of wire connections, and a comparison of Fig. 3 and Fig. 4 will serve [illegible]

Were the circuits so installed that a separate conduit had to be used for each pair of wires, the conduit lines would be run as shown in Fig. 5. In the latter case not only would more labor be necessary, but also more conduits and the appearance of the ceiling in the basement would not be all that could be

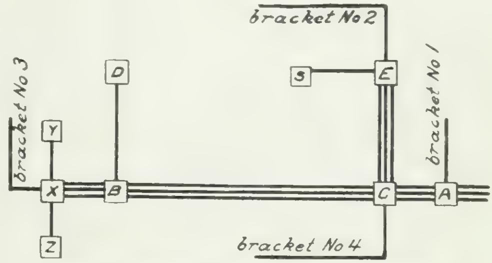


FIG. 5. INDIVIDUAL CONDUIT FOR EACH CIRCUIT.

desired. The boxes in Fig. 5 are set as in Fig. 3, the only difference being in the number of lines of conduit. It is obvious that the chief advantage of the arrangement shown in Fig. 3 over that shown in Fig. 5 is the saving of time and material, which in conduit work is quite an item.

Burning Cheap Grades of Fuel.

By Kingsley Williams.

In a station where the furnaces are equipped for hand firing a large reduction in fuel expense can be obtained by using anthracite dust and soft coal, fired in the following manner: First, the furnace or furnaces are cleaned of all ashes and clinker and an even bed of incandescent soft coal obtained over the grate-bar surface. This bed of coal should not be less than five inches thick. After obtaining this incandescent bed of fuel, an amount of hard coal dust equal to twice the weight of soft coal used is wet thoroughly. It will not do merely to sprinkle the dust; the dust must be made adhesive by means of water and no dry dust should be permitted to exist in the quantity. A fairly heavy layer of the wet dust is thrown evenly all over the fire and the furnace door shut. When the flame appears on the surface of the dust a light layer of soft coal is spread over the surface of the dust and the furnace door is again shut until the flame appears on the surface of the soft coal. When the flame appears on the second layer of soft coal, another heavy layer of wet dust is spread all over the surface of the soft coal and the flame permitted to appear through the dust. In this way the layers are alternated until the furnace is almost completely filled. The furnace door may now be shut and no more firing will be necessary for a run of six or eight hours, depending upon whether forced or natural draft is used. All the attention the fires will need will be to stop any air-holes that may appear in the bed of fuel.

Obviously the more dust used the greater will be the economy and in order to realize this economy the boilers should be large for the work required. In fact, within certain limits, the larger the boiler in comparison to the work required of it, the greater will be the economy realized from the use of this method of firing dust and soft coal. Firemen of average intelligence and experience in using this method can prevent almost completely the formation of smoke, and when proper attention is paid to this method of burning soft coal and dust there will be little clinkers or ashes to remove. In a trial run of twelve hours the following results were obtained: 1400 lbs. of soft coal and 3000 lbs. of hard coal dust, making a total of 4400 lbs. of fuel, were used in 12 hours. All firing ceased at 10 a. m. with the exception of an occasional shovelful of wet dust to stop air holes. The amount of water evaporated per pound of the mixture was equal to 7 lbs., and the total

lbs. Natural draft was used and the amount of ashes remaining after the run equaled 100 lbs. No clinkers were formed during the run.

The weight of ashes mentioned above should not be considered as composed entirely of ash, because at the end of the run whatever remained was pulled out of the furnace and weighed.

In the description given of the method of consuming soft coal and dust without the formation of great clouds of smoke, particular attention should be called to the fact that the soft coal and dust were not mixed. The different grades of coal were kept apart and not fired together as in the case of an actual mixture of the different grades of fuel used. In the results given for the 12-hour run it will be seen that the amount of dust is over two times as great as the amount of soft coal used. The soft coal cost $4 per ton and the dust cost $1 per ton; hence the fuel expense for the day was $4.30. Eighty horse-power was indicated on an automatic slide valve engine. The boilers were of the return tubular type, five feet in diameter and 14 feet in length. Two boilers were used in the trial run and half the amount of fuel was used under each boiler.

Besides supplying steam for the engine, the boilers supplied live steam for various purposes; but charging all the steam to the engine it will be seen that one horse-power per hour was obtained for less than one-half of one cent. Water expense, cost of oil and wages are not considered. It should be mentioned that the last layer of fuel to be supplied in the furnace is a heavy covering of wet dust. In all cases the dust must be used last, and no dust is used at the starting of the fire.

The Lining of Steam Boiler Furnaces.

By William Kavanagh.

The lining of the furnace walls of steam boilers is an expensive item. This is especially true with respect to large power houses generating electricity for railway and lighting purposes. The furnace of the horizontal tubular boiler need hardly be considered, since this type of boiler is almost entirely eliminated from large power stations. The furnace of the horizontal tubular boiler is, however, exceedingly simple in construction and easy of access, and less firebrick is required to line the furnace of this type of boiler than is the case with any other type of boiler generating the same quantity of steam. It is necessary to line the furnace of this type of boiler with firebrick from the grate bars up to the point where the lining touches the shell and from the front to or beyond the bridge wall. In some cases the back-connection is also lined with firebrick, but this is hardly necessary as a good quality of common red brick will maintain the walls sufficiently tight to prevent leakage. The fire door arches, jams and bridge-wall, however, will need to be built of firebrick; or, fireclay blocks properly shaped and baked may be substituted.

Since the water-tube type of boiler is now almost universally employed in power stations, the lining of this type will be considered more fully. Jams, door arches, bridge and side wall lining will be required, as in the case of the tubular boiler, and in addition the furnace of the water-tube boiler will need at least two deflecting arches; the bricks used for these arches being molded and baked to suit the requirements of the different water-tube boilers in use. One deflecting arch extends from the front to or over the bridge wall, and the other deflecting arch extends from the back towards the front and overlaps the front deflecting arch for some distance, compelling the flame or heated gases to traverse various surfaces of the tubes and drum and to form the letter X before entering the chimney.

In order to produce steam economically with the water-tube boiler these arches must be kept in good order, as well as the furnace lining, otherwise a large amount of heat will find its way to the uptake without coming in contact with any considerable area of the tubes or steam drum. Thus, a large portion of the heat is lost, involving a considerable expenditure of fuel uselessly.' When forced draft is employed, the pressure within the furnace lifts the deflecting arch bricks out of position unless they are sufficiently heavy to resist the pressure or are set in fireclay. Very good results are obtained when these bricks are set in fireclay, as this prevents leakage.

The correct method of using fireclay in a furnace is not properly understood by the average bricklayer because the bricklayer is dealing with an element and condition with which he is not thoroughly acquainted. In the first place, the strains caused by expansion and contraction of the firebrick are not met with under other conditions, and, in the second place, the method of laying brick in the furnace is not the same as ordinary methods of bricklaying. Bricklayers who make a specialty of furnace lining differ widely with respect to the laying of firebrick. Some of them advocate the use of cement in the fireclay; others want thick fireclay without cement, while still other bricklayers advocate merely the washing of the firebrick with a thin film of fireclay.

The bricklayer who uses the thick fireclay plasters the bricks with a heavy coating of it, which of necessity maintains the firebricks a considerable distance apart. The firebrick that is dipped or covered with a thin film of fireclay can be laid close together, thus diminishing the space between them and, therefore, the liability of leakage.

Bricklayers who are versed in the art of furnace lining will not fill in behind the firebrick with large quantities of mortar. Such men will endeavor to fill in with broken firebrick and use the least amount of mortar possible. The filling-in behind the firebrick lining properly is of more importance than at first appears. If the filling-in is done with large quantities of mortar bulged and cracked walls are sure to follow, because the mortar contains a large quantity of water, and, therefore, a long time will be required for the water to evaporate through the outer walls. Should a fire be started without permitting the filling to become thoroughly dry, steam will be formed which will either push the lining in towards the furnace center or blow out the fireclay joints, resulting in a cracked and leaky lining.

Cement should not be used with fireclay in the laying of furnace lining because the cement resists compression due to the expansion of the firebrick: hence the walls will crack or bulge. Firebrick should be laid as close together as possible with only a thin bond of fireclay between them. This partly eliminates the liability of leakage. The shape of the firebrick has much to do with the bulging of the furnace lining. When the ends of the firebrick are out of square and expansion begins, the bricks will hinge on the highest points and warp out of line, either towards or from the furnace center, depending on the high points.

The header-row of firebrick should be on a level with the grate-bar surface, and the rowlock course of firebrick should begin from this point. Then as the rowlock course is burned away it can readily be repaired without disturbing the header-course, which remains intact and capable of sustaining the weight of the different courses of brick placed on it. Three rows of headers should be used and placed as follows: The first row should be placed level with the grate-bar surface; then five rows above, another header-row is placed, and the third row is situated high enough to hold the lining close to the steam drum. The middle row assists materially in preventing the lining from bulging, while the lowest row admits of renewal of the firebrick that is subjected to the highest temperature and rough usage of the fire tools.

The use of water arches for furnace doors and bridge-walls lessens the expense for maintaining the furnace lining. The feed water in passing from the heater can be discharged through these arches raising its temperature considerably above the boiling point and thus in a measure lowering the fuel expense and adding to an appreciable extent to the economical operation of the plant.

LETTERS ON PRACTICAL SUBJECTS.

POWER FACTOR IN THREE-PHASE CIRCUITS

That the power in a three-phase circuit may be measured by two wattmeters is a fact very well known. The knowledge that the tangent of the angle of lag, and therefrom its cosine, or the power factor may be determined from the relation between the two readings of the wattmeters is fairly general. It is believed,

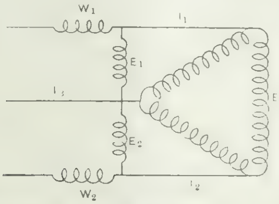


FIG. 1.—THREE-PHASE CIRCUIT DIAGRAM AND WATTMETER CONNECTIONS.

however, that the fact that the ratio of the readings of the two wattmeters when the load is balanced may be used at once for ascertaining the power factor is not so universal.

Referring now to Fig. 1, in which a delta-connected balanced three-phase load has been assumed, it will be noted that wattmeter W_1 reads $E_1 I_1 \cos(\Theta - 30)$ where Θ is the time-phase angle between the current I_1 and the mean voltage between E_1 and E_3. Likewise the reading of wattmeters W_2 is $E_2 I_2 \cos(\Theta + 30)$. Thus the ratio of the two readings is,

$$\frac{W_2}{W_1} = \frac{E_2 I_2 \cos(\Theta + 30)}{E_1 I_1 \cos(\Theta - 30)} \qquad (1)$$

Noting that for balanced loads $I_1 = I_2$, $E_1 = E_2$, and that $\cos(\Theta \pm 30) = \cos\Theta \cos 30 \mp \sin\Theta \sin 30$.

$$\frac{W_2}{W_1} = \frac{\cos\Theta \cos 30 - \sin\Theta \sin 30}{\cos\Theta \cos 30 + \sin\Theta \sin 30} \qquad (2)$$

$$\frac{W_2}{W_1} = \frac{\sqrt{3}\cos\Theta - \sin\Theta}{\sqrt{3}\cos\Theta + \sin\Theta} \qquad (3)$$

By assuming certain values for W_1 and W_2 and solving equation (3), corresponding values are obtained for $\cos\Theta$, and from such values the curve of Fig. 2 has been plotted. This curve allows the power factor to be ascertained at once from the ratio of the two wattmeter readings, provided the load is balanced.

ATLANTA, GA. [illegible]

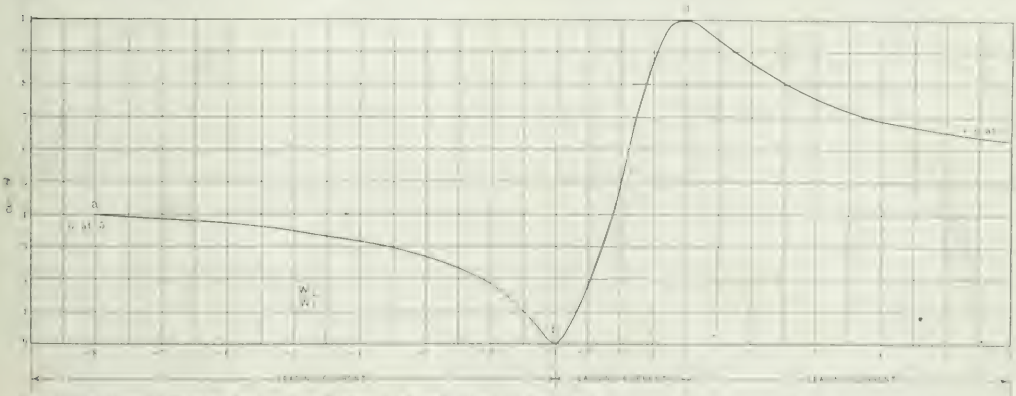


FIG. 2.—RELATION BETWEEN THE POWER FACTOR AND THE RATIO OF THE TWO READINGS OF WATTMETERS IN THREE-PHASE CIRCUITS.

THE QUESTION OF ENGINEERS' WAGES

It will readily be admitted that the stationary engineers, through their organizations, have shown the most friendly disposition toward employers, and have also shown exceptional broadmindedness and fairness, in dealing with the question of wages for engineers. The National Association of Stationary Engineers has the distinction of being the only organization of workers that positively declares against any methods akin to strikes, or agitation, or compulsion of any kind in an effort to raise wages. It declares in favor of increasing wages by increasing efficiency, and earning capacity.

I firmly believe in the wisdom of this policy. A proper adjustment of the matter of wages for engineers must be looked for through education of both employer and employee. This cannot be done in a day, but the effort should be made along broad and common-sense lines. It is a deplorable fact that in many cases good engineers are sadly underpaid, not because the employer is a selfish man or a bad one, but because he is ignorant of the value of a good engineer. He does not, and cannot see, with a non-practical eye the many leaks through which money can get away, in a steam plant, which will be kept closed by a good engineer, but through which an incompetent one will waste his wages easily.

Let us consider some of the possible savings that a good engineer will make over a poor or inferior one. I know an engineer who was called upon to take charge of a 215 kilowatt electric lighting and water works plant. An engineer had been in charge at this plant who received $65 per month. He neglected to keep the dynamos clean, paid no attention to the condition of the connections, the brushes, as well as the collector rings and commutators were allowed to get dirty. The steam pressure was allowed to vary without limit, causing variation of speed of the driving engines, and consequent variation of the voltage, and the condition of the light, causing patrons to complain, and loss of old business, as well as making it difficult to secure new business. The two generators were connected to the same main circuit, and were operated by convenient switches. The machines were allowed to get together at times and in this way the insulation was burned out of one machine, and the other was so badly broken down that a light load caused excessive heating.

This was in part the condition that the new man found on taking charge of the plant. The boiler settings were in bad condition, and there were so many openings in them that little draft could be had through the grates, and combustion as a consequence was poor, and fuel was being wasted in this way. The steam lines were laid out like a Chinese puzzle, and there were many unnecessary turns in them, and they were all entirely bare. The steam and exhaust valves of one of the Corliss engines were badly cut and leaking, causing heavy waste of steam and consequently of fuel also. From 6 p. m. until

[illegible] test was made and the run for the same hours and with ap- [illegible] fuel. No wonder that the treasurer of the company told him he was saving his wages in fuel alone! The pumps for the city water supply were of the plunger and ring type, and as the water was gritty, it was the last type that an intelligent engineer would have selected for the service under the conditions.

The grit caused the rings and plungers to wear rapidly and become leaky, and this reduced the efficiency of the pump greatly, so that the rings and plungers had to be renewed in each pump about once a year at a cost of $45 for each pump. Had a packed plunger or piston type of pump been selected, the cost for packing would have been about five or six dollars instead of the amounts stated. This is a typical case and shows how a good man at a fair salary is cheaper than a tow salaried man that does not understand his business, or neglects it. It also indicates what may be saved by having the advice of a good, practical man when selecting power plant equipment.

I call to mind another case, where a good engineer who had been for a long time in the service of a firm without any increase in pay to compensate for the increase of responsibility and work, asked for an increase of pay, and was promptly advised that others would be glad to take the job for less money than he was already receiving. He had other positions offered him and decided to give them a chance to get a cheap man. They did so, and trouble began. The machines were allowed to cover themselves up with dirt with the usual result. Inside of three months this plant had the armature of one of the dynamos burned out, causing an expense of several hundred dollars.

The new engineer had advised the help that it was not necessary to oil the valve gear of the Corliss engines more than once a day (24 hours), and that it was not necessary to oil the dies on the steam hooks or catch blocks at all. The result was that these dies soon had the edges worn so round that they would not hold. For a time they were made to work by placing heavy leather blocks under the steam-hook springs. This placed more work on the governor of the engine, and making the hook harder to disengage, caused undue wear on the knock-off cams. Finally, however, they absolutely refused to work at all, and the cheap man was up against it, as well as his employers. Strange to say he could not correct the trouble, though it was so simple that it would appear that any experienced oiler ought to have been able to do so without much thought.

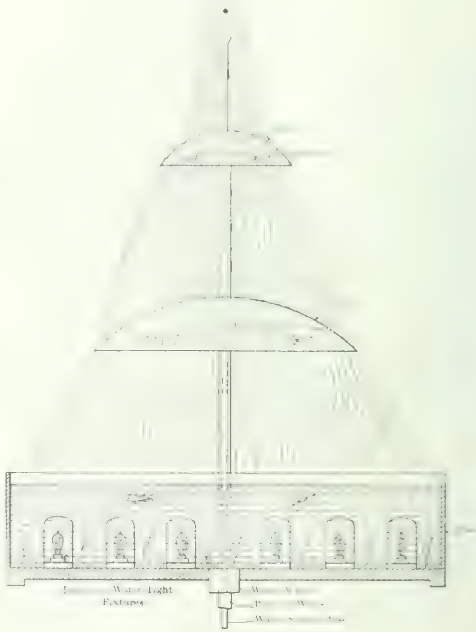
In conclusion, I wish to state it as a general rule, that a good thing will always bring its value. An article or commodity, no matter what it is, is worth in a commercial sense, just what it will bring. Now, we know that there are too few good men in the engineering line to fill the places where such men are needed, and there is hardly a large plant anywhere, that has not at one time or another had to accept the services of men they knew to be mediocre, simply because they could not find first-class men. These then, being the conditions in the engineering market, as we may call it, it is evident that a good man can command good wages, and that if he is wise he will endeavor to do so. Then it is inevitable, that if the employer wishes to retain a good man, he must pay a wage that will justify a good man in remaining in his service.

Many good engineers are poor financiers, and along with many employers have not learned the foregoing facts. They [illegible] learn their value. The mutual learning of these things by the engineer, as well as the employer, must result in a higher standard of wages, and the position taken by the N. A. S. E. warrants us in expecting higher standards of efficiency in engineers.

[illegible]

[illegible]

The average electric fountain used indoors on tables, etc., discloses to the observer the means by which the water is admitted and exhausted from the tank or reservoir which forms part of the fountain. The manner in which the various lamps are connected can also be detected so that it detracts from the novelty of the affair. The accompanying illustration shows a method of building an electric fountain, the water and electricity being supplied without the electric circuits or waste pipe lines being visible. The tank is made of glass with a wooden bottom and is rectangular in shape. Three pipes are shown entering the bottom. The largest is a waste-water pipe for carrying off the surplus water, the flow being regulated so as to equal the amount of water entering by means of the water pipe, which is the smallest of the three. This latter pipe passes through a second pipe used to hide the wires passing



ELECTRIC FOUNTAIN.

to the lamps under the glass domes. Lamps in water-tight fixtures are placed on the bottom of the tank and these are supplied with electricity through the bottom of the tank so that the wires do not come in contact with water. Under each dome is a small ring fastened to which are a number of miniature lamps connected in series. The domes may be made of colored glass and the lamps themselves may be of various hues so as to heighten the effect. Sea grass may be scattered on the bottom of the tank so as to hide the bottom of the lamp receptacles and live gold and silver fish may be permitted to swim in the water. If a greater effect is desired lead trees (made by precipitating lead on zinc when the latter metal is left in a solution of sugar of lead) may be placed in the water, or shells and various forms of marine growths. Fruit jars may be used in place of the water-tight receptacles and each jar may hold a number of vari-colored miniature lamps. The screw tops of the fruit jars have holes bored in them for the passage of the wires, the caps being fastened to the bottom of the tank. To insure against leakage into the jars the caps may in addition to the regular rubber washer used, be partly filled with melted rosin. A thermostat or rotary switch [illegible]

effect to the light, or the circuits may be divided so as to give various color effects by means of vari-colored lamps. Floating water lilies with tiny lamps may also be added; in fact, a person with proper ingenuity might vary the design and introduce all kinds of pleasing effects.

NEW YORK CITY. WILLIAM KAVANAGH.

CONNECTING FEED-WATER HEATERS.

The conventional method of connecting a feed-water heater is about as shown by Fig. 1, the exhaust steam all passing through the heater, whether the boiler feed pump is in operation or not. No matter how much exhaust steam there may be, it all must pass through the heater regardless of the amount of water to be heated. The latter comes out hot or cold, according to the amount of steam which chances to be passing through the exhaust apparatus at that time.

For small plants, where only one boiler and a single engine are employed, the conventional method illustrated may be employed to advantage, but it will be found that there is from two to three times as much exhaust steam passing from an ordinary simple engine as is necessary to heat the amount of feed-water required by the boiler supplying that engine. Such being the case, why the expense of a heater large enough to permit all the exhaust steam to pass through it, and why pass all the exhaust steam through a heater anyway, when only one-half the amount of heat is needed?

Exhaust steam delivered at one-quarter to one-half pound pressure above the atmosphere is worth much to anyone desirous of establishing almost any kind of refining or cooking process, and the struggling electric light station which is looking for some means of increasing its limited income will do well to consider the possibilities in offering inducements for some one to start a canning factory next door and utilize not only the idle power in the daytime, but also the waste heat at night.

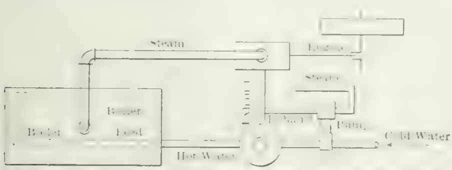


FIG. 1.—COMMON METHOD OF INSTALLING A FEED-WATER HEATER.

There would be enough of it to amply perform all the heating and cooking operations necessary in quite a large cannery, or in a salt works or in a dessicating factory. If located near a blast furnace, where slag is to be had for the taking, there are infinite possibilities for employing waste heat in reclaiming the many salts contained in the slag; and once the slag is freed from sulphur and other chemicals, the sand-lime brick maker is ready to take every bit of the purified slag he can get. Thus there are possibilities for the use of exhaust steam other than blowing it all into the atmosphere through a heater.

The heater shown in Fig. 1 is of the closed type, but it matters little which type is used; all the steam goes to waste through the large heater. To save some of the heat thus wasted, one should procure a type of heater which contains at least one-third of a square foot of heating surface to each horse-power rating of the boiler to be supplied with feed-water, and connect the heater as shown by Fig. 2. In this engraving, the heater is shown connected in parallel with the main exhaust pipe. The steam is supplied through a pipe large in diameter and covering the full opening to the heater. The upper connection, however, is throttled.

The object of throttling the outlet is to prevent the escape of steam from the heater. It is the intention that all the steam which goes into the heater shall be condensed there. It will be found necessary to provide a small outlet to the heater, otherwise it will become "air-bound" and cease to heat the feed-water to the degree required. The small opening shown at the top of the heater serves to carry away the troublesome gases.

It would probably be an improvement in this piping to place a valve above the heater in order that the size of the opening there might be adjustable. A valve in the horizontal pipe below the heater is also desirable, when cost of installation does not forbid, for, when thus connected, the heater can be cut out for repair or inspection at any time, without disturbing the operations depending upon the exhaust steam beyond the heater.

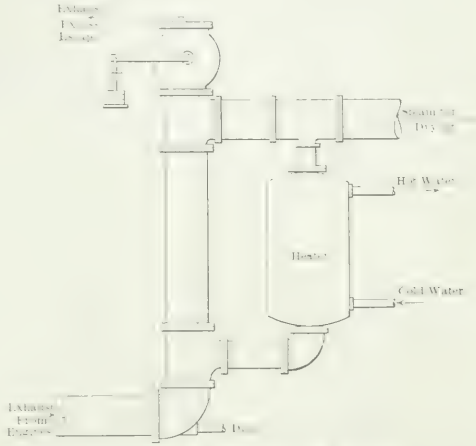


FIG. 2.—LOOP ARRANGEMENT OF HEATER.

In case it is desired to use the steam condensing, instead of using it for other purposes, this arrangement of heater is very desirable. It may be connected directly to the receiver, between the high and low-pressure cylinders and supplied with a throttled outlet as shown by Fig. 2. The throttled opening may be connected to the air-pump if desired, but this is rarely found necessary, as the method of connection shown by the engraving is usually found sufficient to give satisfaction.

All the exhaust steam may be passed through the heater, and the steam thus supplied may be more than necessary to heat the feed-water. In several cases of this kind, there was found to be a higher pressure in the heater than in the receiver, when the several outlets were closed, showing that the exhaust from the several pumps more than maintained the supply of steam necessary to heat the feed-water. In such cases, one of the valves in the connecting pipes may be closed, preferably the one at the top of the heater, in order that the water of condensation may readily escape through the other opening. This, however, depends upon the arrangement of the heater. However, one should see to it that there is at least one-third of a square foot of heating surface in the heater selected, to each nominal horse-power of boiler rating.

WILLOUGHBY, OHIO. JAMES F. HOBART.

A GRAPHICAL METHOD FOR DETERMINING THE POWER FACTOR OF AN ARC CIRCUIT.

The following is a simple graphical method for finding the power factor of an arc circuit, which involves the measurements of only the voltages, a fact that will recommend it for

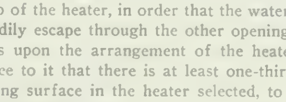


FIG. 1.—ARRANGEMENT OF CIRCUIT.

use in places where the requisite instruments are not available for determining the power factor in the usual manner.

Fig. 1 shows the arrangement of the circuit and indicates the voltages that were measured. V_t indicates the terminal voltage; V_r indicates the regular voltage, and V_a indicates the voltage of the circuit on the lamp side of the regulator.

To find the power factor of the circuit the readings V_a and

[illegible] shown in Fig. 2 was constructed in the following manner: AC was laid off in a hundred parts and AD and DC to the same scale, numerically equal respectively to V_r and V_a when expressed in per cent of V_t. Then AD was continued until it cut the semi-circle erected on AC. BC in hundredths of AC was the power factor sought.

This method is strictly correct only when the e. m. f. and current have true sine curves of time-values and under such condition that the drop in the regulator is wholly inductive, which latter of course is not strictly true, since any reactance must necessarily have some ohmic resistance. However, this IR drop in the case under consideration is usually so small in comparison with the total, or IZ, drop that it may be neglected. In the example noted below it was assumed that the current and voltage curves were sinusoidal time functions.

In those cases where the IR drop is a quantity comparable in magnitude with the total regulator drop, the latter may be taken into account as shown in Fig. 3. In this illustration, ED represents the ohmic drop. Here, as in Fig. 2, BC is the power factor sought.

The advantages of the method lie in the fact that only one kind of instrument is used, and it need not be in exact calibration since only the ratios are involved. The average central station is usually better equipped with voltmeters than with wattmeters that may be used on arc circuits. Two or three voltmeters may be used in series, if necessary, to measure the voltages involved. A source of error is the necessity of taking readings of the various voltages in quick succession, rather than simultaneously. This, of course, would not be the case if sufficient number of instruments were at hand, a condition not very often found. If a number of readings be taken and averaged, it is not likely that this source of error will be any greater than errors in wattmeter and ammeter transformer ratios.

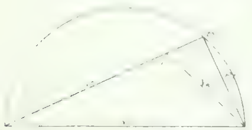


FIG. 2.—METHOD OF FINDING POWER FACTOR

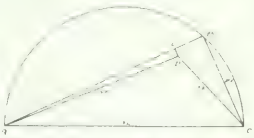


FIG 3.—POWER FACTOR WITH OHMIC DROP TAKEN INTO ACCOUNT.

Below are given two sets of readings that were taken on a certain arc lamp circuit:

V_t	V_a	V_r	Power Factor.
5480	4050	2600	70.5
5060	4100	2120	79.0

A value of 72.5±2 was calculated from wattmeter and ammeter readings made at the same time that the first set above were taken; it will be seen that the results are in accord, probably within the limits of the variations of the power factor of the circuit.

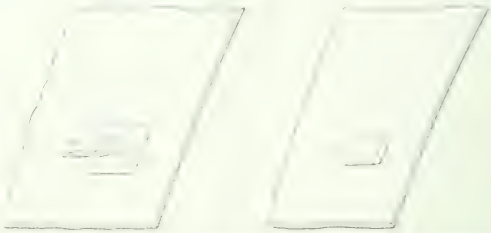
CHICAGO, ILL. M. E. CARR.

"CRAWLING" OF STEAM BOILERS

Considerable trouble, which necessitated the resetting of a horizontal tubular boiler, was experienced by the writer, during the erection of a small power house. The boiler was set according to Hartford specifications, or if there was any variation from the specifications it was between the brick mason and his work, certainly not for lack of instruction. The manner in which the mason failed to make his work good is shown by the following sketches. Fig. 1 shows the manner in which the boiler was supported by means of a pressed steel bracket, which in turn was carried by a lug riveted to the shell of the boiler. Four lugs and brackets were used, the small lugs offering little resistance to, rolling the boiler into place when the pressed steel brackets had been removed.

The end view of the boiler shows the transverse arrangement of one pair of the lugs at d and c respectively. The chief advantage to be derived from this method of attaching brackets, is the case with which they may be removed for handling the boiler, and the possible saving in cost of metal by the substitution of a light steel affair for the heavy cast iron bracket frequently employed.

[illegible] brackets were slipped loosely upon the lugs and the rear bracket



FIGS. 1 AND 2 [illegible]

was fitted with rolls in the usual manner, in order that the boiler shell might expand in the direction of the rear end of the shell. Instructions were given the mason to have the blacksmith wedge the front lugs and brackets very tightly, in order that they might not slide, thereby defeating the purpose for which rolls were placed under the rear brackets.

Notwithstanding these instructions, it was found later that

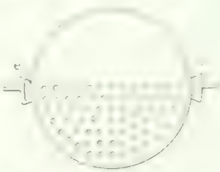


FIG. 3.—LUG AND BRACKET ARRANGEMENT

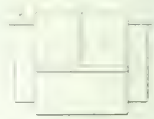


FIG. 5.—MANNER IN WHICH LUGS WERE WELDED

the brackets had not been wedged. It was also found that the arch castings, i, Fig. 4, were so placed that the upper end of each casting bore against the boiler head, or against the angle n, which was fixed to the rear head for the purpose of receiving the arch castings in question. The bricks m, which were to be placed on and between the arch castings, were also laid tight against angle n, no space whatever being left between the castings and the angle on the end of the boiler, where there should be a space of at least one inch, as shown at p.

As a result of this arrangement, the rear end of the boiler was most securely anchored, notwithstanding the fact that the

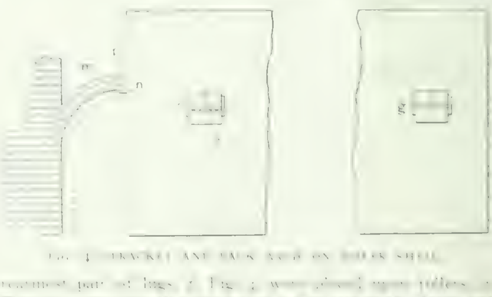


FIG. 4.—BRACKET AND BACK WALL ON BOILER SHELL

[illegible] of the boiler which had only a very light wall in front of it. To be sure the front was anchored to the side walls by means of hook bolts, but the expansion of the boiler tore these bolts loose and the boiler moved forward, carrying with it, such [illegible]

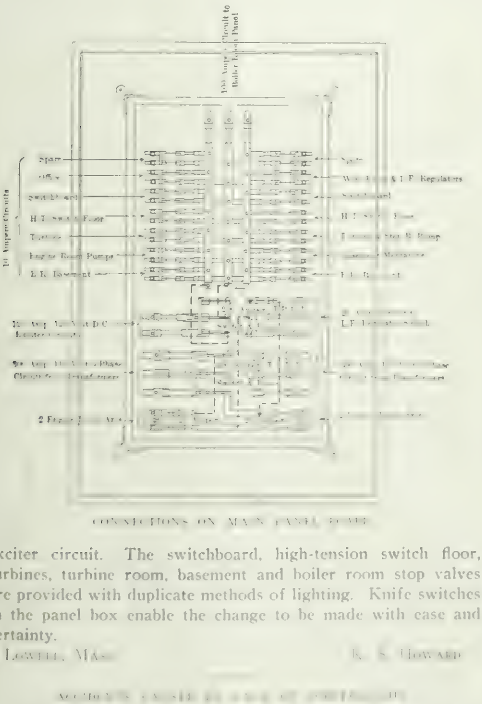
casting anchor bolts. As a consequence, the masons had to be called in again, the walls torn down to the level of the brackets, the front walls demolished far enough back to get at the boiler-front hook anchor bolts. The back arch had to be torn out, the arch castings moved back so as to leave one inch between them and the angle *n*, and the walls laid up again. This time, the front pair of lugs were made fast to their respective brackets, as shown by Fig. 5.

Four thin wedges were forged from 1 in. x ½ in. flat iron, and two of these wedges were driven into each of the brackets at the front end of boiler, as shown in Fig. 5, at *k* and *l*, *h* representing the bracket, and *j* the lug, which as shown, is somewhat longer than the bracket which it carries. The result of these changes was all that could have been desired.

NEW YORK CITY. JAMES FRANCIS.

SCHEME FOR CONTINUOUS LIGHTING OF CENTRAL STATION.

One of the most interesting features of the new station being erected in this city is the provision made for insuring continuous lighting of the station in case of trouble. The manner of grouping the circuits in the main distributing lighting panel of the station is shown herewith. The panel is designed to receive alternating current from one or two sources and to connect all important lamps with direct current in case of emergency. Separate circuits are run to the lamp groups in the same general important locality, so that if one line fails for any reason whatever, the other line will still be in use. Electricity is available from the 110-volt sides of the station transformers, split in separate lines, and from the 125-volt



CONNECTIONS ON MAIN PANEL BOARD.

exciter circuit. The switchboard, high-tension switch floor, turbines, turbine room, basement and boiler room stop valves are provided with duplicate methods of lighting. Knife switches in the panel box enable the change to be made with ease and certainty.

LOWELL, MASS. R. S. HOWARD.

[illegible]

The following instance shows how accidents, breakdowns and [illegible] machinist, belonging to that class which never takes the trouble [illegible] told to remain after working hours to reset a 6-in. steam valve on the main steam line. As soon as the whistle blew, the machinist went to the boiler room and carefully shut off the main steam valve. He sent a helper for his reseating tools and in the meantime rigged up a temporary platform so as to get at the valve more easily. When the helper returned with the tools, they both mounted the platform and began to take out the screws which held the top part of the valve in place. When all the screws were removed the helper took hold of the top of the valve to remove it; but it would not budge. The machinist then took a hammer and gave it a sharp blow when the top blew off without warning and with a tremendous roar a great volume of steam blew out, severely scalding the machinist and his helper. This almost fatal accident could have been prevented had the machinist thought for a moment about what he was doing when he shut off the main steam valve. Although the main steam supply had been thereby stopped, the line still held a volume of high pressure steam which would take some time to condense, and after it had condensed could be run off through the drip valve.

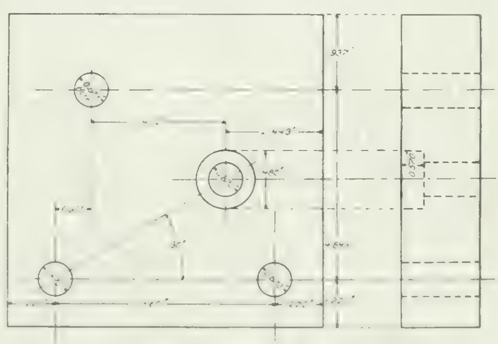
WILLIAMSPORT, PA. GEORGE P. PEARCE.

THE TOOL CHEST AND THE MECHANIC.

There is a good deal of satisfaction for the attorney for the defense, when the attorney for the prosecution admits, even in a roundabout way, that his opponent has proved his point.

While Mr. Rafferty has carefully avoided saying personally that to judge a mechanic by the tools he does or does not carry is all wrong, he does say that an acquaintance of his, "eminently successful" and long since retired in affluence, owes his whole success to his system of selecting his mechanics, which was nothing more or less than to judge them by the quantity and quality of work turned out in a given time. If Mr. Rafferty will read the last paragraph of my letter under the above caption in the July issue I think he will find that his informant and myself have expressed practically the same thought.

In one sense all mechanics are specialists, inasmuch as nearly all have some one branch of the business at which they have



PROBLEM IN PLATE BORING.

had more experience; but a man who is master of his trade would balk at no job in the mechanical line that came his way and he will generally make a success of it after starting. These mechanics are sometimes called all around men and sometimes tool-makers, but they are primarily mechanics.

I herewith submit a sketch of a gray iron plate 8 ins. square and 2 ins. thick. We will assume that this plate has been accurately planed on sides and edges, which would require but a few tools. I have shown four holes to be bored in this plate at specified points, one of which holes is counterbored. Will Mr. Rafferty kindly tell us how to do this simple job without tools, or if he finds that impossible, kindly outline his method of doing the job with tools, naming the tools he would use in the process? I think every reader who is a mechanic will be interested in the reply and doubtless many will profit by it.

[illegible], R. I. [illegible]

QUESTIONS AND ANSWERS.

[illegible] relations of the currents and voltages in the auto transformer, rectifier and sustaining coil of a mercury arc rectifier device? C. F. S.

See article on single-phase vapor converters in the ELECTRICAL WORLD, Feb. 10, 1906.

Can you give me any information as to a metal used for contacts in place of platinum? I understand that a German product called latinum is used by some telephone manufacturers. It is somewhat cheaper than platinum. [illegible]

There are many substitutes for platinum on the market. The chief constituent of most of them is silver, and while they answer fairly well for contacts they have not the lasting qualities of platinum-iridium, than which no better contact alloy is known.

A shunt-wound motor is installed on a street railway circuit, and the voltage dropping 30 per cent or 40 per cent at times causes the motor to flash over when the voltage rises again and gives considerable trouble. Could this not be done away with or at least greatly alleviated by placing a properly designed choke coil in one leg of the circuit? R. D. C.

A choke coil having a very large reactance and extremely small resistance would doubtless remedy the trouble. The introduction of commutating poles would also get rid of the trouble, or if the efficiency is of no great moment a resistance inserted in the armature and in the field circuit would lessen the sparking.

I note when opening an arc lamp circuit that there is seldom more than a very small arc at the switch. Considering the current taken, why should this be so? M. W. T.

It has been found that any arc, however small, quickly introduced in series with an arc lamp will immediately break the circuit, the circuit being open at the arc first and not at the switch. For this reason a considerable number of arc lamps will cause no more sparking at the switch when the circuit is opened than a number of incandescent lamps. By reason of this feature considerable economy may oftentimes be effected by using snap switches; this type of switch having a longer life than the knife switch.

Would it be advisable to use three single-pole switches on the primary side for a three-phase, 2400-volt system supplying two 25-kw transformers connected three-phase, two-phase according to the Scott system? What effect, if any, would there be on the transformers or system in general if the switches be thrown in one at a time when the secondary side carried no load? What effect would result with the secondary loaded? F. F. F.

It is not advisable to use three single-pole switches on a three-phase system in preference to a three-pole switch. With no load on the secondary no effect is produced by throwing each single-pole switch in separately, and if thrown in a certain sequence with the secondary loaded no detrimental effects result. It is possible, however, to throw the switches so as to distort the voltage.

Will you please give me some information concerning the use of a resistance in shunt with the series field coils of a 60-cycle rotary converter? This resistance is cut in and out by a switch on the side of the frame; but as we never use the switch, I would like to know the reason for its presence. C. J. C.

The shunt to the series coils is used to adjust the compounding effect of the rotary, just as in a direct-current generator. In starting up a rotary converter the switch should be opened, since otherwise the heavy alternating current sent through it and the series coils may cause excessive heating. Rotary converters are not always provided with series field coils, and many rotaries previously provided with them are now used without them, but where a shunt is used with the series coils the switch should be opened at starting.

In insulating coils and wood by boiling in paraffin, at what temperature is the bath kept and how long should it be continued? J. A. G.

Paraffin melts at from 113 to 140 deg. F., depending on the quality; the cheapest having the lowest melting point. At a temperature of about 570 deg. F. it is as thin and as transparent as water, and it boils at about 680 deg. F. For ordinary purposes a temperature of 200 deg. is sufficient to render it thin enough for impregnating wood, etc. The best results are obtained by having the wood, coils, etc. perfectly dry and also hot. The bath is then not chilled when the material is immersed and the occluded air and moisture having by this means been driven off, the material readily absorbs the paraffin. When thus treated the wood need not be immersed longer than about 15 minutes, otherwise immersion for a much longer period is necessary.

[illegible] reservoir in which the oil becomes quite thick and soapy at the bottom, so that the contents have to be changed very often. Analysis shows no adulteration. The oil circulates under a slight pressure and a little water gets into the reservoir at times. I have tried to keep out this water, but without success. Can you suggest a remedy? L. P. V.

The oil is without doubt adulterated with either vegetable or animal oil, or both. Vegetable oils have no lubricating qualities worth mentioning and oxidize at a comparatively low temperature becoming thick and gummy. Animal oils also thicken and become sticky and gummy when exposed to the atmosphere and the warmth of rubbing surfaces. Both are often compounded and used with a mineral oil in order to produce an engine oil of high viscosity and fire test. In order to detect the adulteration, mix a portion of the oil with some caustic soda and agitate the mixture well. If it clouds up and looks soapy this is an indication of the presence of animal oil.

The frequency of cloud lightning is supposed to be as high as one million cycles per second. Its harmful effects on the human anatomy are well known. How do you reconcile this fact with the experiments of Elihu Thomson, Mr. Ovington and others who allow currents of extremely high frequency and voltage to flow through their bodies apparently without any injurious effects? C. F. H.

The approximate values of the magnitude of the electric quantities in a lightning flash have been estimated by Dr. Steinmetz as follows: Average potential difference between different points in the cloud, 50,000,000 volts; average current in the discharge, 10,000 amperes; average frequency of discharge, 500,000 cycles; average energy of the discharge, 10,000 kw-seconds. The fatal effects from lightning are due to the enormous current passing and not to the frequency or voltage. In the experiments of Messrs. Thomson, Tesla and others high frequencies and high voltages were used but the current was infinitesimal.

We have a large number of trees through which our wires pass, and we experience trouble from this cause very much of late. We are desirous of trimming the trees; but wish to do so in a proper manner so as not to kill them and to incur by this means the enmity of the public. Could you advise us how to trim trees properly and when the trimming should be done? H. E. Co.

It is generally recognized that the secret of obtaining a complete cure in all operations requiring the removal of a branch, either living or dead, consists in cutting close to and perfectly even with the trunk. Only the sharpest tools should be used and the cut surface should be perfectly smooth. Projecting stubs and ragged edges should never be left, since they are almost certain to induce decay. Wounds made by trimming of branches should be at once painted with coal tar, white lead, or some similar preservative substance, and when this has thoroughly dried a second coat should be applied. Loosened bark will never become united to the wood again and should be cut away cleanly as far as the injury exists. Nailing loosened bark on the tree simply invites the attacks of insects and fungi and inevitably leads to decay. Too much pruning should not be done at one time, but where considerable pruning is necessary it should be distributed through a period of several years. The removal of large, live branches, is of course particularly dangerous and should be avoided as much as possible. If the work is carefully done, however, even very large scars will in time heal over completely. Pruning can be safely done at any season of the year except in early spring, just as the sap begins to flow.

CENTRAL STATION SALE OF CURRENT.

Figures on Electric Cooking.

We have published within the past year considerable information on the actual experience of various families with electric cooking and the number of kw-hours required per person per meal in different sized families. While the information before published has thrown some light on the character of the load that electric cooking gives a central station, there has been lacking information as to the probable total or composite load caused by a number of such customers connected on the

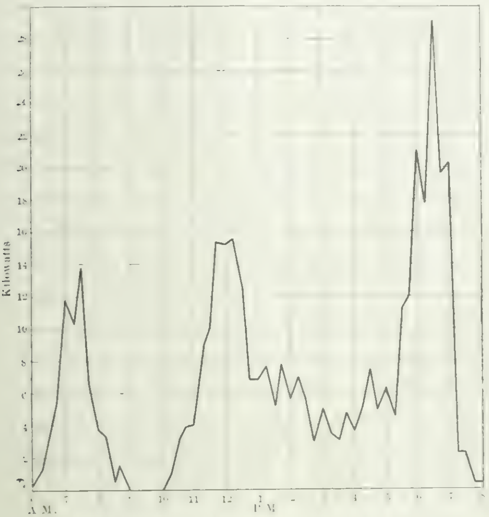


FIG. 1 —COMPOSITE LOAD ... LARGE CITY.

same feeder or transformer. In other words, there is yet to be determined for this class of business what is commonly known as the "diversity factor," or the ratio between the actual maximum demand on a station or feeder and the sum of the maximum demands of the various customers. All of the customers will never make their maximum demands at the same instant if there is any considerable number of customers. This statement is fully substantiated by electric-railway experience where a number of cars are operated, and by experience on common electric power circuits supplying stationary motors. Electric cooking load is manifestly different from common stationary motor loads, however, for the reason that it has certain peaks just before meal times.

As many central stations are considering the question of what rate per kw-hour can safely be made on electricity for cooking supplied through a separate meter, it is a matter of very great importance to know at what time the maximum demands come from such circuits, in order that the proper interest on investment and depreciation may be charged against this class of service. If the rate for electric cooking is too high, the central-station company will not get the business; and if it is too low and the company pushes hard for this business, it is likely to wake up some day to find that it has made a large investment upon which the income is not sufficient to pay interest and depreciation.

In order to throw some light on the readiness-to-serve charges which should be made against electric cooking service, the following analysis of the character of the electric-cooking load is made from records obtained on electric cooking in the home of Mr. J. R. Cravath, western editor of the ELECTRICAL WORLD, at Chicago, where all the cooking, baking and ironing have been done electrically since Jan. 1, 1907. A description of the cooking outfit used and figures on the energy used for the month of January appeared in these columns in the first issue in March. The figures for the months of May and June, 1907, which are considered in this article, are more representative of normal conditions than those given previously for January. The figures for the months of May and June are as follows:

MAY.

Kw-hours, 106.8.
Maximum demand in kilowatts by Wright meter, 2.8.
Person meals, 364.
Average number of persons per meal, 3.9.
Kw-hours per person per meal, .294.

The family varied in size from four to six. A chafing dish supper, given for ten, was not counted as a meal in the foregoing figures, although its energy consumption is included.

JUNE.

Kw-hours, 103.6.
Maximum demand in kilowatts by Wright meter, 3.0.
Person meals, 385.
Average number of persons per meal, 4.3.
Kw-hours per person per meal, .268.

The family varied from four to five, and for 25 days the cooking was nearly all done by a servant who had no previous experience in electric cooking, but who is naturally careful and economical.

In order to determine what the probable effect on the central station would be of having a number of electric cooking cus-

FIG. 2.—COMPOSITE LOAD CURVE SMALL TOWN.

tomers connected, the following analysis has been made. For the month of May, recording ammeter records were kept for each day. The records for Sundays and holidays were excluded, and only those for regular week-days taken.

The readings of the recording ammeter chart were totalized for every 15-minute interval of the day. For example, all the 6 a. m. readings for the week-days of the month were added and so on for every 15 minutes of the day between the hours

[illegible] Fig. 1 [illegible] probably represent very nearly what the daily cooking load would be on a residence feeder in a large city like Chicago, with 24 families having complete cooking outfits connected and in operation on that feeder. This is on the assumption that the energy demands of the family under consideration varied from day to day as much as would those of 24 ordinary families in a single day. This assumption is probably not entirely correct, especially as regards energy used during forenoons and afternoons, although, as there was considerable variation in the time of most of the meals from day to day, it is very nearly correct as to peak demands at meals. There is, as a matter of fact, a great variation of the load curve as shown by the recording ammeter charts from one day to another.

The curve in Fig. 1 shows conditions approximately as they would exist with 24 electric cooking customers in a large city where the principal meal is in the evening, and the man of the house is never home for the mid-day meal. The hours of maximum demand are, therefore, in the evening between the down-town winter lighting peak and the evening residence lighting peak. The peak on the residence feeders in a large city like Chicago is between 7 and 9 p. m. The station peak on the darkest December days is likely to be about 5 p. m., due to overlapping of motor and lighting loads.

In small and moderate sized towns of the West, where electric cooking seems to be finding its most rapid introduction at the present time, the different portions of the load curve would be shifted around. The load would very likely be something like that shown in Fig. 2, where the evening meal load of Fig. 1 has been moved to the mid-day meal and vice versa. This curve is, however, purely theoretical and not based on actual tests. While city office hours are considerably later than those in the smaller towns, breakfast hours are not because of the much longer time required to get from house to office.

Analyzing these curves still further, we see that while the maximum demand required by a customer is as high as 3 kilowatts, the combined demand at peak load is only 29.1 kilowatts, so that the station demand per customer with 24 customers would probably be only 1.2 kilowatts, owing to the diversity of demand.

In the case of a small town, this kilowatt investment in station capacity per customer should not be charged entirely against the electric cooking load, as the same station capacity would be used later in the day for lighting load. The charge should either be divided between the cooking and lighting rates, or not figured at all against the cooking rate, as the investment has to be made anyway to carry the lighting load.

In a large city, where the evening cooking load overlaps the lighting peaks, the analysis is more complicated. Inasmuch as the cooking peak does not come at the time of the station peak, the station capacity required to supply the maximum demand of this load should not be entirely charged against this load unless there is a possibility that the cooking load will some day increase so as to be the cause of the maximum peak on the station. In the case of feeders and transformers, a larger share of the total investment would probably have to be charged against the electric cooking.

Best Ways to Meet Gas and Gasoline Competition.

An interesting paper with the above title was presented before the Ohio Electric Light Association at its Toledo convention. The paper was a composite one, F. H. Golding, Samuel Rust, W. E. Russell, Arthur Pomeroy, E. T. Selig and W. C. Anderson contributing to it. As a preliminary to the conduct of a proper and energetic campaign against gas and gasoline, F. H. Golding [illegible] users be obtained by a house to house canvass, if necessary, and that from the [illegible] prepared and business sought after in a systematic and thorough manner. As a majority of central stations furnish free incandescent lamp renewals and free maintenance of fuses, and also any other slight repairs, the expense and maintenance of gas mantles are good talking points for the solicitor, and in many cases make the cost of lighting by gas higher than that of lighting by electricity. Additional arguments in favor of electricity are cleanliness, coolness, convenience, freedom from danger of fire or axphyxiation, elimination of redecorating at frequent intervals due to the presence of burning gas, ability to use an electric fan, an electric iron, sewing machine motor, or other convenient appliances, when electricity is available. The solicitor should be aided in impressing the prospective customer with the general desirability of electricity by pertinent literature mailed at regular intervals. The most serious obstruction met with in gas competition is the expense of installing electrical work, particularly in old houses, but a judicious handling of the subject by the central-station management will easily overcome this obstacle. One plan which is productive of good results is the installation of a certain number of outlets at slightly above cost, furnishing everything complete and ready for use, in order to introduce electricity on the premises. Mr. Golding quotes a letter submitted by one central-station company which has been productive of much good. Another plan which has been found successful by some of the Ohio stations is an arrangement whereby the prospective customer may pay for the work in six, 12 or 18 monthly payments. In some cases the company contracts directly with the customer as agent for the electrical contractor, and in others the contractor deals directly with the customer, the central station guaranteeing the contractor against loss, as a consideration for carrying the long-term account. It is, of course, necessary that the credit of the person to whom this proposition is submitted be good. A room equipped with gas and electricity for purposes of comparison also adds greatly in competing for store and factory lighting. In one comparison room belonging to an Ohio company one-half the room is equipped with an open-flame burner, a Welsbach burner, an inverted mantle burner and a gas arc, all so arranged that any one fixture will give its maximum light without shadows from the others. The other half of the room is equipped with incandescent and Nernst lamps so arranged that any desired combination can be obtained by manipulating switches. At one end of the room watt-hour meters and also gas meters are installed, so that the comparative lighting and cost values may be readily demonstrated. In competing with gasoline, the added insurance hazard makes a good talking point and a statistical compilation of fires and explosions resulting from the use of gasoline is an excellent thing for the solicitor to have with him.

Mr. Samuel Rust stated that he found the best thing to do with gasoline competition was to go to the man and make a plain statement of what one knew as to the cost of gasoline installation, maintenance, depreciation and trouble, as compared with electricity. This statement may not bring results at the time, but the customer will remember what has been said and every time there is anything wrong with his gasoline system he will call the facts to his mind. When the system begins to clog and give poor light, and when the repairing cost, constant care and expense are considered, the customer will again think of the statement and wonder if after all it were not right. In the meantime the central station companies should make a special effort to be friendly and courteous to the prospective customer, with the result that in time the latter will acknowledge that his plant is not a success and will consent to the installation of electricity. If at this time any inducements can be offered they may result in the acquisition of a permanent customer.

Mr. Rust stated that in his city they had competition with artificial gas at $1.30 per 1000 cu. ft., and with natural gas at [illegible] per 1000 [illegible] lamps free. Natural gas, however, was not a serious competitor because of the inferior quality of its light, together with [illegible]

outfits is always a strong factor against their use and the complicated nature of the apparatus and the inexperience of its users gives a constant opportunity to urge the substitution of electricity.

W. E. Russell suggested that gas competition could be killed in a measure by suitable advertisements based upon the information obtained from clipping bureau service, which would furnish abundant ammunition to fight both acetyline and gas. He also suggested that some attention should be given to rates and gave a form of contract used in Massillon, Ohio. Since there is no immediate danger of gas companies furnishing free mantles, plus the cost of the mantles, plus the damage that gas does to the air, wall covering, curtains and the house in general, when compared with the cost of electricity with free lamp renewals, this is an argument in favor of the latter from which the closest calculator cannot possibly escape. In order to cope with natural gas, the wiring of new and old houses should be done at a minimum rate. Mr. Russell also called attention to the numerous household articles using electricity which might also be employed as a wedge for overcoming gas opposition.

Arthur Pomeroy's contribution was devoted chiefly to the gas engine. He showed that in endeavoring to substitute an electric motor for a gas engine it was often advisable for the central-station manager to confine himself at first to questions which would enable him to determine whether the prospective customer is fully acquainted with all the expenses of gas-engine operation. After making sure that such is the case, an excellent opportunity is afforded for bringing up convincing facts that an electric motor supplied with energy from a central station is ultimately the most economical and advantageous prime mover to be obtained. The perfect cleanliness of electricity, and the small amount of attention required by electric motors, together with the comparative noiseless operation of the motor, should be sufficient to recommend this form of prime mover to many manufacturers.

W. C. Anderson related his experience with natural gas competition in Canton and showed that notwithstanding that nearly every building is equipped with natural gas, electricity has shown a considerable increase each succeeding year. He entertained great hopes in entering the natural gas field with the new high-efficient incandescent lamps. He gives the following as a few of the best ways to meet natural gas competition: 1. Make rates giving the long-hour burner rates in proportion to the cost of the long-hour service. 2. Develop decorative lighting to the fullest possible extent to which this can be developed. 3. Give the customer the greatest possible amount of useful light with the smallest possible cost for energy and maintenance. 4. Go after business like the sewing machine agent goes after business. There is no reason why the electric companies should take a back seat for any one in commercial enterprise. Our profits depend greatly on the quantity sold and we can afford to spend four times the money in getting the second $3 per capita business than we can afford to spend in getting the first $3.

Mr. E. T. Selig stated that his company had competition with natural gas in Mt. Vernon at rates varying from 27 cents per 1000 cu. ft. down to free gas for illuminating purposes. In fact, during a period of nearly one year, while two gas companies were at war, it was only necessary to contract for a gas stove at a flat rate of 50 cents a month to secure all the gas lighting desired, free of charge. In order to meet the competition his company overhauled its entire system, eliminating antiquated machinery and making each department reliable and efficient. After obtaining satisfactory service conditions his company adopted the following scale of rates: For the first kw-hour consumed each month for each lamp or equivalent of maximum demand, 15 cents per kw-hour; for the second kw-hour, 10 cents per kw-hour; for all over two kw-hours per lamp, 6 cents per kw-hour; a minimum bill equal to 15 cents for each lamp of maximum demand, but in no case less than $1; [illegible] lowed on all bills at the above rates, if paid by the tenth of the month.

His company used the usual arguments for electricity and proceeding along the lines outlined was not only able to hold its own during the free gas siege, but increased its load at the same time, changing from a flat rate system to a metered system. With gas at 13½ cents per 1000 cu. ft. his company several months ago reached the capacity of its electric power plant, twice during the past five years additional machinery having been added. He stated that many people attracted at first by cheap gas soon became dissatisfied with it and turned to electricity. His company used gas under the boilers and by this means cut down its fuel cost about one-half, so that in this respect it regarded natural gas as an advantage rather than a detriment to its business.

Factory Lighting.

In a paper with the above title, read before the Ohio Electric Light Association, at Toledo, Ohio, Aug. 20, 21, 22, 1907, Mr. A. P. Biggs pointed out that from the standpoint of illumination, the lighting of factories may be divided into space and applied lighting. For general space and floor lighting there must be some large source of artificial light, and the sources now available are the electric and gas arcs, the Cooper-Hewitt and the Nernst lamps. The incandescent lamp in large sizes is still inefficient as compared with these others, and in ordinary sizes does not give the necessary illumination.

An arc requires minimum cost for installation, has the greatest efficiency per watt expenditure and lowest maintenance cost. The unsteadiness of an arc is not serious in space lighting, and while the shadows from a single arc are apt to be annoying, the arc on the whole is the best unit for such work as above noted.

The Nernst lamp is desirable in small space lighting, in low-ceiling machine shops, and in foundries. In one instance where the Nernst lamp is giving excellent results, the lamps are spaced from 8 ft. to 10 ft. apart at a standard height of 9 ft. The light is soft and pleasant, and energy consumption low.

For particular application of artificial light, single incandescent lamps are the sources used. Although the installation of a lamp at each machine in every kind of business is not sanctioned by all illuminating engineers, it has the sanction of custom, the recommendation of the wiring contractor, and enjoys the hearty endorsement of those responsible for getting the same amount of work out of the machine by artificial light as is expected by daylight.

In a shop having low ceilings and much window surface, illumination may be good from natural sources for the first six months or so, but after that, by continuous process, the windows, ceilings, walls, posts and everything blacken and cease to let in or to reflect any light. The lighting installation fares the same way, and the workman shades his eyes by covering the lamps with anything available, until there is almost no light available.

An example of shop practice with individual lamps—uncommon because definite data accompany it—was presented by Mr. K. C. Keech, before the Chicago Section of Illuminating Engineering Society in May last. A bare lamp, 13 ins. above the face-plate of a drill press, and 7 ins. from the center, gave 3.7 ft.-candles at the center of the face-plate. The dirtiest lamp in the shop when substituted, gave 1.55 ft.-candles, while a new clean lamp in the socket gave 5.7 candles.

When the customer gives us the opportunity of making recommendations upon his equipment, we generally advise him to place at every machine a drop or bracket lamp with reflector, and that he use 8-cp lamps wherever possible. Often, to satisfy the customer that the economies pointed out are worth securing, we loan him a half dozen styles of shades and reflectors, and he purchases when he has determined the kind most suitable. Further—and here the policy of the company may seem [illegible] lighting is often disposed of by advising and

urging the use of gas arcs. All possible short-hour burning is turned over to the gas company, and the electric light company is relieved from the "lighting bill" complaint which formerly afflicted us for several months each winter. As this policy results from our differential rates, its presentation may be comforting only to those who make high prices per kw-hour for lamps burned but few hours per year; unless the "Flat Rate" man wishes to mend his way.

The usual factory lighting can be considered by central-station men as none other than unprofitable business, which is to an extent a necessary evil. By reason of its character, it requires all of the attention and all of the equipment which more respectable branches of the industry necessitate, but refuses to make adequate return on the investment and work to supply its need.

The assumption is not to be made that the Detroit Company is securing proper and adequate return for its service in this branch of lighting. The company has certain rates and is, as a public service corporation, required to furnish and does furnish service for all customers. Further, it is needful that this unprofitable business have a fairly low rate in order that we get the profitable business that goes with it.

The rates at which this class of lighting is sold in Detroit are as follows:

First—Open Order—Sixty hours' use per month of the demand at 16 cents per unit, balance at 4 cents per unit. This agreement is not a contract, having no definite term.

Second—Demand Contract—Thirty hours' use per month at 16 cents per unit, balance at 4 cents per unit; minimum bill 30 hours' use per month of maximum demand at 16 cents; term, one year.

The following discounts for prompt payment are allowed on both agreements: On bills less than $50, 10 per cent; on bills of $50 and less than $100, 15 per cent; on bills of $100 or more, 20 per cent.

Under "open order" we furnish standard incandescent lamps and renewals—and trim and care for arc lamps and Nernsts owned by the customers. Under "demand" we furnish all incandescents, arcs, Nernsts, renewals and maintenance.

The "open order" is the most common prescription for factory lighting. It cares for that class of customers whom we term "short hour," who use our service as auxiliary to sunlight and daylight; who have a few places which, due to poor construction of building, blackened windows, or later construction by their neighbors, need light occasionally during the day, but whose principal service is from dusk to 5:30 p. m., and who either cannot or will not make nor pay us for making the investment necessary for good lighting.

The "demand contract" is suited to the lighting conditions of but a small portion of factories, inasmuch as it is designed for the satisfaction of long-hour burners. The factory whose conditions are met by it is probably one in which there is a requirement for a large number of individual lamps, and for small lamps in isolated parts of the factory, for which there is necessity for service all through the day.

To illustrate that under our rates, factory lighting is unprofitable to us, the following cases have been figured to show cost to consumer under "open order" and under "demand contract," and the amount the business should have brought in in order that it might just begin to be profitable, the later amount being arrived at as fixed charge per kw-year plus operating costs per kw-hour:

	[illegible]	Connected Kw	Demand Kw	Earnings Open Order	Income per Year Demand Contract	Minimum [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$632.00	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	815.6[illegible]	[illegible]
3	1800	5.6	2.2	220.00	157.00	172.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1410.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1262.[illegible]
6	3052	16.6	9.16	416.70	492.93	500.40
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Nos. 1, 2, 3, 4, 5—On Open Order, 60 hours' use of the demand.
No. [illegible]
No. [illegible]

The first three calculations are for a carriage manufacturer, in successive stages of his business. For two years he did all his lighting by clusters; at the end of that time, by reconstruction of building, the electric lighting was reduced from 13 kilowatts demand to 2 kilowatts, and all general floor lighting was done by gas arcs. Only on this third year, after the changes had been made which took from us the pleasure of serving 650 lamps, did we make any profit on the business.

The fourth and fifth calculations are successive years in a cigar factory—a six-story building lighted throughout by incandescent lamps. At the end of the first year given, the customer was persuaded to change 300 individual lamps from 16 candle-power bare to 8 candle-power lamps with reflectors. Demand was reset and he was billed upon 60 hours' use by its readings—as he was an open-order customer. He saved considerable and we only lost 10 per cent on the lighting business, against 60 per cent the year before. His motor business in the last year amounted to 30,800 kw-hours, with a demand of 11.6 kilowatts.

The sixth is a manufacturer of shirt waists, skirts, etc.; has all electric equipment, using electric arcs for general floor lighting. His lighting business, which was on demand contract, lost us but $8. During this year we had the profit from the sale of 20,000 kw-hours for motors with demand of 8.5 kilowatts.

The seventh, which is a bathtub factory, has wood-working, sheet metal and brass foundry departments. For space lighting gas arcs are used, and the business gave us some respectable return.

As a public service corporation having established rates we must sell at these rates whether the customer causes us to lose on service or brings us revenue from it. We tell customers that by our experience his lighting will be cheapest for him, say, on demand, but inform him that there are so many conditions of surroundings, location of lamps, faults of building design, amount of natural lighting, etc., that he must fix his conditions and try it out for himself. Usually we install such service on open order—if we find later that demand contract rate will be to the customer's advantage, we offer it to him.

Our rates are based on customer's demand even when the open order is taken. If demand is same as connected load, and the customer signs the open order, we will bill him at 60 hours' use of the connected load at 16 cents. If his installation is greater than his demand, we install demand indicators and bill on showing of indicators. If he has many empty sockets in his installation, we install demand indicators, and probably bill on connected load until demand shows that customer has fitted empty sockets with foreign lamps and would have us continue to bill him without increasing his rate.

By the same method of figuring as used above, a business begins to be profitable to us when the customer has paid for 480 hours' use of demand per year at 16 cents, say, 40 hours per month. As an approximation—to get at classification of business as profitable or unprofitable—the consumption of energy per year of factories as found in several customers' ledger accounts, has been divided by 12 times demand, giving hours' use of demand per month. All of these factories are operating on a regular 10-hour day.

Number of Cases		Average Hours' Use of Demand [illegible]	
[illegible]	Bakeries, Wholesale	[illegible]	
[illegible]	Brass Works	[illegible]	
[illegible]	Breweries	[illegible]	
[illegible]	Brush	[illegible]	
[illegible]	Candy	[illegible]	
[illegible]	Chemical	[illegible]	
[illegible]	Cigar	[illegible]	
[illegible]	Clothing	[illegible]	([illegible] cases average [illegible])
[illegible]	Engravers	[illegible]	
[illegible]	Harness	[illegible]	([illegible] cases average [illegible])
[illegible]	Knitting	[illegible]	
14	Machine Shops	31	(7 cases average 13.4)
[illegible]	Paper Box	[illegible]	
[illegible]	Printing	[illegible]	
[illegible]	Sheet and Metal	[illegible]	
[illegible]	Sheets	[illegible]	([illegible] cases average [illegible])
[illegible]	Toys	[illegible]	
[illegible]	Upholstering	[illegible]	
[illegible]	Wire Works	[illegible]	
[illegible]	Woodworking	[illegible]	(4 cases average [illegible])

From their nature, several kinds of business are invariably profitable. The wholesale bakers use some lighting for 24 hours per day. Breweries have many small motors about their establishments which are shut down about 4 p. m., and the

lighting load up to that time continues quite uniform throughout, making the lighting demand negligible.

Machine shops and brass works need electric lamps for individual machines only, and give a good lighting load summer and winter. The clothing manufacturer, whose record makes the best showing of his class—to our way of thinking—in the above list, has on each machine a movable arm carrying a lamp of low candle-power with parabolic reflector, permitting operator to bring source of light close to work without unpleasant effect on eyes; all his space lighting is by gas arcs.

We persuaded one customer operating a brass foundry to put in gas arcs for all lighting, and further satisfied him that, with little hardship, his air compressor could be shut down in the afternoon at such times as would prevent any increase of total load due to shop lighting. As a matter of general policy, in addition to giving other advice, we recommend to the manufacturer that a fraction of the amount spent this last year for lighting be turned over to a window cleaner and a man with a hand-pump and a tank of whitewash, expecting that both of us will then be better satisfied with his factory lighting.

Our conclusions are: That an electric light company cannot afford to take on all factory lighting offered to it; that it is obliged to take a certain amount which is inherently unprofitable; that it should minimize this amount (first) by advising the customer how to reduce his demand by utilizing light to best advantage; that is to say, by good illuminating engineering; (second) advocating the transfer to daylight hours of any motor load that can be dispensed with during the evening hours, and (third) by passing over to the gas company such factory space lighting as can be profitably furnished by gas arcs, retaining for electricity the long-hour localized lighting.

It is worth while to note that the new metal filament incandescents may modify these conclusions. They will not change the rates of demand to sales, but they may make gas so comparatively expensive as to put it out of competition either partially or altogether.

In a paper with a similar title, J. T. Kermode stated that many manufacturing concerns are vacating their old premises to enter buildings of more modern construction, with saw-tooth roofs and windows on practically four sides, which is evidence that better lighted workrooms are essential and that the demand for a higher standard of artificial illumination is rapidly increasing.

The short-hour use and usually heavy demand on the station peak has brought about a condition where there is some question as to the advisability of factory lighting from a supply company's standpoint; it is, however, very important when combined with the supply of electricity for motors. In conjunction with this latter business considerable work has been done in Cleveland, where it has been the policy to make surveys, plans, specifications and to obtain bids for this class of wiring with special reference to the best and most economical method of illumination for the various kinds of work in different processes of manufacture.

The average factory requires artificial light during 10 to 20 per cent of the working hours, not including overtime or night shifts; therefore, the illumination should be sufficient and the lamps so arranged that the quality and quantity of work accomplished during these hours can be as well and economically done as that which is performed by daylight.

The amount of light required varies, first, with the size of room, relative position of machines and the general shop conditions, and, second, with the character of work to be done. The arrangement that will effectively light a clothing factory cannot be efficiently applied to industrial plants, where the atmosphere is filled with smoke and dust.

Experience has taught that no general rule can be laid down to govern the many different situations that present themselves, but each factory must be studied separately to determine the amount of light, style of illuminant and the method of its installation, to give the best results.

For instance, large units cannot be successfully operated in roundhouses or car shops. The principal parts of locomotives that need special attention are so located, that, to be of value, the source of light must be reflected from each side of the engine. Five 100-watt Gem lamps, spaced 15 ft. apart, at an elevation of 7 ft., will light in a very satisfactory manner one side of two engines. Oil torches so commonly used in cabs, boiler and floor pits, can be conveniently done away with by the use of portable incandescent lamps.

In foundries, forges, steel mills, structural iron works and boiler shops, where the walls are dark and the work does not require concentrated light, a lamp is needed that will give good general illumination. Enclosed arc lamps, giving a white light, combined with shadows, are undesirable for this class of work, as the dark walls and dense atmosphere absorb a large percentage of their penetrating powers.

The color and brilliancy of light produced by the flaming arc has attracted the attention of many manufacturing concerns, and, notwithstanding the cost of lamps and carbons, they are being extensively used to light large areas.

In a large mill operating steel presses, 16 enclosed arcs were installed. On account of the dense atmosphere these lamps were hung below the tops of the presses, resulting in heavy shadows being cast around each machine. The 16 enclosed arcs were recently substituted by six flaming arcs. With slight changes in the wiring these arcs were placed 22 ft. from the floor, resulting in the entire shop being flooded with a warm, bright light.

The use of flaming arcs reduced the connected load, and averaging two hours use a day, these lamps would save 234 kw-hours per month, which at the usual prevailing rate for energy would more than compensate for the cost of carbons, without considering the increased amount of illumination.

It is generally conceded that the best uniform illumination can be obtained by distributing small units over the space to be lighted, but this is not always practical, for one must consider the building construction, and purpose for which the space is to be used.

The use of higher candle-power arc lamps for factory lighting is rapidly increasing and the advantage that can be obtained by their use and efficiency must be recognized. The efficiency with which the light is produced and utilized, are two important factors, with which a supply company is intimately concerned.

In machine shops it is common practice, together with large units for general illumination, to furnish each workman with a single incandescent lamp, which when new, and at average height from his work, usually gives a fair amount of light. Oil and dust soon reduces the illumination one-half.

But it is not expected that the amount of work should reduce in the same proportion. Some reasons why this practice has become so popular are:

First. That up to a few years ago the majority of industrial shops were equipped with generating apparatus, but the cost of electric lighting was charged against the operation of the shop, and not against the cost of electricity, as it should have been.

Invariably, I have found, that where light is obtained in this manner, the generators, feeders and branch circuits are heavily loaded with inefficient apparatus and there is no incentive to economize.

Second. Wherever a large installation is necessary, the manufacturer usually employs a man to look after the operation, repairs and additions to the electrical equipment.

These men, as a rule, are not familiar with the improvements that are continually being made on the various devices that go to make up a modern electric installation. Consequently, inefficient light facilities are unintelligently installed.

Third. Employees have been educated to believe their work cannot be successfully performed unless each individual is furnished with an incandescent lamp, and realizing the flexibility of electricity, it seems comparatively easy for one to convince the foreman that an additional lamp should be added here or there, resulting in an overlamped room for the number of machines operated and also in a poorly lighted room at an excessive cost.

In machine shops where lathes, drill presses, planing ma-

chines, milling machines, screw machines, punches, etc., are used good general illumination of uniform intensity is required. Nernst or Gem lamps are well adapted for this class of lighting.

The size and number of lamps to be used depends upon the size of the room, height of ceiling, color of walls, location of machines, belts and shafting. In estimating the size and number of units it might be of service to consider 50 watts per operator, or machine, as an average amount for all ordinary machine work and general illumination. For special machines or work needing bright light, individual incandescent lamps with reflectors should be used. Machines that are automatic in their operation are many times provided with unnecessary individual lamps. Appreciating that these machines do need good light for changing their adjustment, the use of portable lamps that can be connected to receptacles near each machine will, if intelligently used, save energy.

The general evenness of illumination with the absence of glare, together with the easy shadows and searching quality of the light produced by mercury-vapor lamps makes them especially adaptable for factory lighting by direct current. Unfortunately the alternating-current lamp up to the present time has not been successful, due to its inability to readily start.

Manufacturers of clothing require an even, shadowless, well diffused light of considerable brilliancy. Nernst lamps with prismatic reflectors can be utilized for this purpose with a comparatively low consumption per operator.

The difficulties that exist in factory lighting are familiar to all men engaged in the sale of electricity and it should be the duty of each central station to educate its men to successfully overcome these conditions by encouraging the use of lamps, shades and reflectors that have been produced for scientifically converting wasted energy into useful light. Recent discoveries in the production of electric lighting are of revolutionary nature, the same principles which have been utilized in the cheapening of gas light, that is, the use of the peculiar properties of rare earths and metals, have been appropriated by the electrical interest and the recent developments indicate the efficiency of electric lamps will be doubled in the near future.

Recently I have read an article in which a supply company recommends the use of gas for factory lighting that they might be successful in retaining power business.

Is there a more exaggerated case of false economy than that of requiring people to work by poor illumination? In comparison with the cost of labor, the cost of lighting is trifling. Take, as an illustration, the case of a skilled workman receiving $3 or $4 a day (say, an average of 30 cents an hour or ½ cent a minute), figure the cost of a 16-cp lamp burning 10 hours, and see how many minutes of the man's time it requires to pay for the light. Yet there are thousands of skilled mechanics handicapped with insufficient and ill-directed light.

In presenting this paper my idea has been to bring out the fact that industrial plants can be lighted by electricity in a satisfactory manner and at an expense that would compare favorably with any other form of illumination provided the equipment consists of the highest efficient units, installed according to modern practices. Electricity supply companies should devote more time to practically demonstrating to manufacturers the benefits to be derived from the use of higher efficient units, with the idea of introducing a more intelligent mode of factory lighting as a valuable factor in assisting to secure and retain motor business.

In the discussion following the reading of the above papers, Mr. J. B. Foote, of Jackson, said that he was enough of an electrical man not to like to see "gas arcs" in a factory where he was furnishing electric light and power. Mr. George D. Westover, of Cadillac, thought that the tendency in some small towns was away from discounts based on a maximum-demand system. President Chandler, of Sault Ste. Marie, said that his company used the maximum-demand system, but that it took much of the time of one fairly high-priced man to explain it to [illegible] which would have given him a better net rate. This customer was one of the kind who liked to be able to read his meters and tell from day to day just how much his current was costing, and he was willing to pay for that privilege. President Chandler's opinion on the proposition of using "gas arc" lamps for general lighting in factories was that if he had a solicitor who was not able to persuade a customer that he ought to have electric lighting throughout, even though it cost him more than general lighting by "gas arcs," he would at once seek a new solicitor. This sentiment appeared to meet with the approval of the audience.

Mr. E. F. Phillips, of Detroit, explained more fully the reason for advocating the use of "gas arcs" for general lighting in factories. For the lighting of a factory the company was obliged to invest in apparatus, power stations, lines and transformers which were used in factory lighting a total time of not to exceed 150 hours per year. This means that even if the factory is charged the highest rate made for any class of lighting business in a community, the company would still lose money on such business on account of the high investment charges.

Mr. Biggs said that the electric light company could keep this business if customers were sufficiently urged, but that it did not want to keep business at a loss or have dissatisfied customers. Mr. A. C. Marshall thought that in small towns where a company had more capacity than it needed, the question of investment charges against factory lighting could be left out of account. The principal thing he objected to in factory lighting was the investment the company had to make in arc lamps in a factory in order to get a small number of hours' use per year. Mr. Phillips replied that a central-station company did not want unprofitable business whether it was in a large or a small town. The facts were the same everywhere. The company's generating capacity should be utilized on profitable and not unprofitable business, and in many instances the latter may be changed over to gas.

Mr. John A. Cavanaugh, of Benton Harbor, asked what a central-station company should do if a manufacturer would reply, if asked to pay for lighting at high rates, that he would put in a dynamo of his own and run it from the motor. For the motor he was purchasing current at low power rates. Mr. B. J. Denman replied that with a maximum-demand system the use of the dynamo on the motor would increase that customer's maximum demand, so that this practice would prohibit itself. If there was a straight power rate, most companies had a rule against doing lighting at this rate, which would prohibit use of the dynamo. Mr. J. B. Foote said that his company supplied many large manufacturers, and if the user was large enough, the company practically had to supply him his entire demand at the wholesale power rate.

Mr. George C. Osborne criticized the paper for omitting any mention of the Gem incandescent lamp as a possible efficient illuminant in the general lighting of a factory. He quoted from Cravath & Lansingh's "Practical Illumination," to the effect that the mean spherical candle-power per watt for the Gem lamp is higher than the corresponding figure for the three-glower Nernst lamp.

Mr. J. R. Cravath explained further the comparative figures quoted, and said that for general factory lighting the light falling below 70 deg. from the vertical was that which should be considered. In comparing Nernst and Gem lamps, therefore, each lamp should be considered after being equipped with the proper reflectors for delivering the maximum amount of light within that zone. The Nernst lamp naturally delivered much of its light within that zone, while the Gem lamp had to use the reflector. Taking both lamps, equipped with glassware as they would actually be used, the amount of light delivered in the useful zone was a little higher per watt for the Nernst lamps than for the Gem.

Mr. A. C. Marshall thought that the presence of "gas arc" lamps in a factory would have a bad influence on the public by advertising the use of gas, the very thing the central-station company is trying to displace.

Helps to a Solicitor.

Two papers bearing this title were presented at the Toledo meeting of the Electric Light Association, Aug. 20, 21 and 22, one by A. S. Miller and the other by J. D. Kenyon. Mr. Miller drew attention to the fact that the getting of new business is of such vital importance to the life and growth of a central station that every town which could support a lighting-plant was also big enough to justify the central station in maintaining a new business department. The various uses to which electricity readily adapts itself were pointed out, and suggestions made as to how to interest various individuals in electrical devices appropriate to their comfort, or in the case of manufacturers, to the better conduct of their business.

Mr. Kenyon devoted the major portion of his paper to the science underlying salesmanship. He pointed out that the electrical engineer knows all about the different parts of machinery that are used in connection with electricity, knows how the machine is put together, how it operates, how to connect the wires, how to switch on the electricity and how to generate it. In like manner, the salesman must be familiar with all the elements entering into the power of persuasion. The salesman should, first of all, know himself, know what his powers are, how to train the undeveloped powers and how to apply them. He must also be a student of human nature, since he is dealing particularly with human minds, and since his mission is to convince or persuade others to agree with him. He must also have a knowledge of his goods and the ability to express that knowledge logically. The more thorough his knowledge and the more thorough his mastery of the technical details of the goods he is handling, the better salesman he will make. His ability to inspire confidence rests primarily on his personality, and this, in turn, is the result of the visible expression of character and health. The scientific salesman must not trust to natural conditions or to the natural development which will come from ordinary contact with the world, but must train his intellect by conscious and systematic exercise if he expects to outdistance his competitors. The ability to read his fellow men correctly is one of his greatest assets. In order to convey a correct impression to another he must possess a good knowledge of it himself; since it is manifestly impossible to transmit a good mental picture when the transmitter himself possesses a poor one. A man with a poor knowledge of the selling points of any proposition cannot fail to be a poor business-getter and a poor business-builder. A salesman must be able to analyze his proposition and to put his knowledge into selling points that will prove effective, and in explaining the selling points it is necessary for him to place them in the proper sequence so that the mind of the prospective customer grasps the point and is able to follow him and to become enthused by the natural growth or development of the points brought out. The art of expression should also be cultivated by a salesman. Some salesmen talk so fast that it is impossible for minds that act slowly to grasp the points, while, on the other hand, there are salesmen who talk so slowly to people whose minds act quickly that the latter lose patience. A salesman should have his points so marshaled that he is able to use them when occasion demands, much after the manner as a general marshals his troops to strategic points. There are four cardinal points to be observed in persuading a customer to purchase goods: The first is attention, and if the salesman does not obtain the attention of the customer he is losing time. The next is interest, and a customer without interest will never become a buyer. [illegible] goods, and the fourth is resolution or decision. A salesman who is not able to detect this latter point, which is the so-called [illegible] are also the law of confidence and the law of mutual benefit [illegible] their own initiative, and it has been demonstrated that concerns which realize that education is a necessary part of their business and who institute a method of co-operation with their employees have made it pay greater than any other expenditure of time and money that they have made. The management must encourage financially and morally methods of study along the lines which not only are of benefit to the sales department, but to every department. Employers must be willing to spend money to get results, and since they have spared no expense in the productive end of their business to perfect it, neither should they spare expense and personal co-operation in the development of efficiency in salesmen, and, in fact, in employees in every department. They should be willing to reward proportionately the development which is shown on the part of the individual. Therefore, they should go hand in hand with the employees in order to obtain true progress based upon the law of mutual benefit.

Letters to the Editors.

Hopkinson Method of Charging for Electricity.

To the Editors of Electrical World:

Sirs:—Mr. Henry L. Doherty's letter in reference to the Hopkinson or Manchester method of charging for electricity, in the first issue of August, has attracted widespread attention. For printing it, and for reprinting that portion of Dr. Hopkinson's presidential address of 1892 relating specifically to rates you place many of your readers under very great obligation.

It would not be entirely correct perhaps to assume that Dr. Hopkinson's method of charging for electricity has not been well understood in this country. Mr. J. W. Lieb, Jr., stated it in full in his paper on "Methods of Charging for Current" presented at the Edison Convention at Niagara Falls, in 1897. His statement includes the following reference to the Doctor's address:

"That paper should be the station manager's text book on this subject, as it contains a clear statement of the underlying principles on which the establishment of a logical system of charging for electricity supply should be based."

Dr. Hopkinson presented this method to the Manchester authorities in 1883. I believe, however, it was not used in that city until some time afterwards. Mr. Lieb points out that, at the suggestion of Prof. G. Colombo, the method was used by the Italian Edison Company, at Milan, in 1885. The basis was a fixed charge of 35 lire—$7.00—annually for each 16-cp lamp connected, and an additional charge of .9 cent per 16-cp lamp-hour—approximately 60 watts—which is about 15 cents per kw-hour.

The Hopkinson or any similar method under which a minimum charge is placed upon the installation, as Mr. Lieb suggests in his Edison paper, places a premium on the use of the service in other than the most necessary manner—and to that extent retards the development of the industry. Generally speaking, it eliminates the possibility of the consumer enjoying one of the chief advantages of the electric light—its convenience, its value for decorative purposes, and the possibility of having light momentarily where other forms of illumination are not practicable.

If this method can now be justified, is it profitable or desirable either from the standpoint of the consumer or of the supplying company? In the early days of Dr. Hopkinson's work it was not as true as now that the cost of the service depends, not on the size of the instaliation, but upon its "maximum demand" during the maximum load of the general system from which it is supplied. This may not be absolutely exact in every detail, but where it is not, the investment differences would seem negligible

[illegible]

men present at the Cincinnnati meeting of the National Electric Light Association, he was unable to obtain an adequate explanation of the Hopkinson method. If he will kindly look over the records of that meeting, he will find an outline of this method, at least in its essential features. Presiding over a convention, as he was at the time, and in so able a manner, it is not surprising that some details should have escaped his memory.

Arthur Williams.

The Slide Rule as a Substitute for the Wire Table.

To the Editors of Electrical World:

Sirs:—Mr. Falch's article under the above caption in your first issue of August is interesting; and it has suggested another means for finding wire gauge diameters without in any way marking the slide rule. Mr. Falch's method gives exact results at the large end of the series, but introduces a large error in the smaller sizes; at least, I find it so on my Faber rule.

For instance, by applying the method given, the diameter of No. 29 wire is found to be .01045 in.; whereas the diameter is .01126 in. The result is, therefore, 7.2 per cent too small and this percentage is increased to 8⅓ per cent in the case of a No. 40 wire.

In the following method, if the setting be made exact for No. 0 wire, the diameter for No. 40 wire will be found to be only 3.23 per cent too large. The central slide containing the B and C scales is reversed so that the equal-division or logarithmic (L) scale is face outward and right side up. By placing the right-hand end of the L scale under 32.5 on the A scale, any whole number engraved on the L scale is directly under the diameter on the A scale of the wire four times that gauge number. For instance: If the index be placed over 2 on the L scale, .129 on the A scale is the diameter of No. 8 wire. Similarly, the index over 3 on the L scale would show .0815 as the diameter of No. 12 wire. Of course, the diameter of No. 9, No. 10, and No. 11 wires are given by the quarter positions between 2 and 3 on the L scale. All wire sizes from No. 0 to No. 30 can be read without changing this setting of the slide.

In order to obtain the remaining sizes the L scale is set with its left end under 32.5 on A. The diameters of wires including No. 40 as .00325 in. can then be read off. Since the rule is already set for No. 0 at the end, the diameters of No. 00, No. 000, and No. 0000 are on the quarters between the left end of the L scale and 9. If the smaller sizes are required exclusively, it is better to set the L scale at 31.5 instead of 32.5, thus transferring the error to the larger sizes and making the diameters of the latter wires 3.26 per cent too small.

Referring to Mr. Falch's proof of the method, if the equation of the B. & S. gauge is taken as

$$\text{cir. mils} = 211{,}600 \times .79305^{n+3}$$

where n is the gauge number, the sizes No. 00, No. 000, and No. 0000, being a negative continuation of the series and having values of -1, -2 and -3 respectively, there will be no necessity for expressing the same law by two different equations for different portions of its range.

Philadelphia, Pa. Carl P. Nachod.

Grounding the Secondary.

To the Editors of Electrical World:

Sirs:—In your first issue of July, we note an editorial on the subject of grounding alternating current secondary circuits, in which you state that the underwriters should have made this grounding compulsory long ago.

You undoubtedly have good and sufficient reasons for making such a statement, and it is always the earnest desire of our Electrical Committee to take any action toward the improvement of the code which can be shown to be desirable from any point of view and safe and proper from the underwriters' view point. Your statement thus interests our committee very much in that it indicates that the committee has either been negligent or wrong in not making the grounding requirement compulsory. We think it will be admitted that the underwriters have no right to enforce a requirement by the only method in which they can enforce any requirement—that is, an advance in rate for insurance—unless they can show that failure to comply with the requirement increases to some extent the fire hazard. We also believe that it is an admitted fact that the principal argument, it not the only one, in favor of grounding secondary circuits, is a safeguard to life, and that it does not in any way reduce liability to fire, but may perhaps in some installations increase the fire hazard, if it has any effect whatever on that hazard. It is also a fact that some electric light companies are opposed to being compelled to ground their secondaries.

It would therefore assist our committee, and the underwriters in general, very materially, if you would kindly advise them what reply to make to an electric light company, or to a property owner, who declined to have the secondary circuit grounded, and objected to any increase in rate on the ground that as there was no increase in fire hazard, the underwriters had no right to make this requirement compulsory. It is the lack of a suitable and satisfactory answer in such cases that has led the underwriters, up to the present time, to decline to make this a requirement. At the same time, owing to the fact that the preponderance of opinion seems to be that such grounding is a safeguard to life, and therefore an advantage both to the company supplying the current and the consumer using the same, the underwriters have for some years past allowed and recommended such grounding when installed in such a way as not to increase unnecessarily the fire hazard.

C. M. Goddard, *Secretary, Underwriters' National Electrical Association,* Boston, Mass.

[A comment on the letter of Mr. Goddard will be found in our editorial pages [illegible]]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors, and Transformers.

Compensated Single-Phase Shunt Motor.—J. Bethenod.—The conclusion of his mathematical paper on the compensated single-phase shunt motor. In the present instalment the author discusses the influence of the displacement of the brushes and the conditions of commutation. His chief conclusions are that the Latour single-phase shunt motor has a practically constant speed like the direct-current shunt motor; that the power factor is adjustable so that it is possible to operate with unity power factor; that the no-load current is small; that the starting torque is small (which is not thought to represent a serious disadvantage); that it has a high overload capacity like a good polyphase induction motor, and that the commutation is excellent.—*L'Eclairage Elec.*, Aug. 3.

Armature Winding.—An illustrated description of mechanical details of a new armature winding for alternating-current machines of the Oerlikon Company.—*Elek. Zeit.*, Aug. 1.

Lamps and Lighting.

Incandescent Lamps.—L. Gaster.—A paper read before the British Association for the Advancement of Science reviewing recent developments in electric incandescent lamps. The author dealt briefly with the graphitized carbon lamp, Nernst

lamp, osmium lamp, tantalum lamp, tungsten lamp, titanium lamp, iridium lamp, helium lamp and the zirconium-tungsten lamp. Concerning the latter, the author drew attention to some of the improvements which have been made during the last few months, which are thought to represent a great advance over the lamps previously exhibited. The filaments are mounted on spring hooks made out of tungstenized carbon, the hooks having the effect of maintaining the filaments rigid and in shape, while in service, and of preventing them from touching, also of allowing of a greater number of filaments in the bulb, and consequently, of reducing their length, and that of the lamp. The lamps can be burned in any position, and the breakage of filaments is considerably reduced. On account of the elasticity of the spring hooks, the breakage of filament in transit and in service has been reduced. Another improvement over the old type of lamp is the adoption of electrical soldering of the filament to the leading-in wires, thus doing away with the inconvenience caused by the use of graphite paste, which was a partial cause of the blackening, the giving off of gases, and the defective contacts met with in the previous lamps. The improvement also avoids much extra labor, and also the danger of oxidation of the filament, if the paste is not very carefully burned away. The electrical soldering process takes place in the open, and an experienced operator can carry out the soldering of about 500 lamps daily. In the discussion, Sir William Preece said that he had adopted osram lamps with success at his own house, where he uses a small transformer to get the necessary low voltage and that the saving in the cost of energy was sufficient to pay for the cost of the transformer in the first year.—Lond. *Elec. Eng'ing*, Aug. 8.

Incandescent Lamps.—J. T. MORRIS, F. STROUD AND R. M. ELLIS.—The conclusion of their paper on osram, wolfram, zirconium and other lamps. In the present instalment they describe a new method for obtaining the specific heats of filaments and give in two tables the physical constants of the different lamps tested, especially the length of filament, the diameter of filament, intrinsic brilliancy, watts per unit of surface, efficiency, specific resistances in hot and cold state, density, temperature, coefficient, etc. The watts per horizontal candle-power varied between 1.60 and 2.07 for four tantalum lamps, between 1.23 and 1.37 for five osram lamps; they were 1.13 and 1.29 for two Just tungsten lamps, 1.35 for a zirconium lamp, and 1.42 and 1.46 for two zirconium-tungsten lamps.—Lond. *Elec.*, Aug. 2.

Electric Incandescent Lamps.—H. LUX.—Continuations of the author's long serial on the real efficiency of electric incandescent lamps. As the equivalent specific consumption for one spherical hefner candle (for 100 per cent efficiency) he finds 0.102 watt, which is very near to Angstrom's figure, 0.108.—*Zeit. f. Beleucht*, July 30 and Aug. 10.

Mercury-Vapor Lamp.—O. BUSSMANN.—An article on the mercury-vapor lamp of Küch made of fused quartz, which can be used at high voltage, has a long life and consumes a small amount of power per candle. The curve of the specific consumption of power per candle-power of the ordinary mercury-vapor lamp has a minimum at about 0.6 watt per candle. If the supply of power is increased the candle-power increases very much less than in arc lamps, and when the power is raised to such an extent that the glass gets soft, the consumption becomes 1 to 1.2 watts per candle. Küch, in substituting fused quartz for glass, was able to increase the power still further, and it was then found that in accordance with theoretical predictions the specific consumption in watts per candle begins again to decrease and long before the fused quartz begins to get soft, a consumption of 1/6 watt per candle can be obtained. While 110-volt mercury-vapor lamps made of glass are about 110 cm long, with a diameter of 3 cm to 4 cm, 110-volt quartz lamps are about 8 cm long for a diameter of about 1 cm to 1 [illegible] cm. [illegible] a length of 15 cm. This fact greatly facilitates their construction. The spectrum is also stated to be much better than that of the ordinary mercury-vapor lamps. While the ordinary mercury lamp is a vacuum [illegible] pressure within the quartz lamp is much higher during operation. The following results were obtained from tests at the Reichsanstalt, with a voltage of 174 at the terminals of the lamp (excluding the series resistance) and with a current of 4.2 amperes, the power consumption was 0.24 watts per horizontal hefner candle and 0.27 watts per mean spherical hefner candle. The tilting device is stated to be simple. The lamp is believed to be specially suitable for lighting railway stations, offices, drafting rooms, parks, for the treatment of skin diseases and for photographic purposes.—*Zeit. f Beleucht.*, July 30 and Aug. 10.

Mercury-Vapor Lamp.—K. NORDEN.—An article on calculating the illumination of horizontal surfaces by means of the Arons mercury-vapor lamp of the Allgem. Elk. Ges. Two formulas are given, of which the first, and simpler one, does not take the length of the mercury lamp into consideration and assumes that the light is concentrated in the center of the lamp. The author's second formula takes the longitudinal extension of the lamp into consideration. He shows how far the results of both formulas, when applied to practical problems of illumination, differ from each other, and he recommends the use of the more exact formula.—*Elek. Zeit.*, Aug. 1.

Enclosed Arc Lamp.—An illustrated description of the "Siba" enclosed arc lamp, which is a differential lamp and is

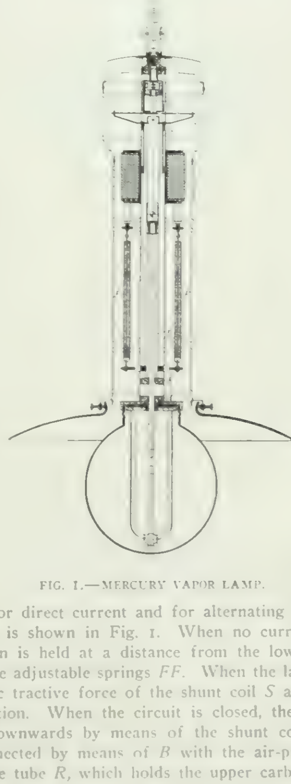


FIG. 1.—MERCURY VAPOR LAMP.

built both for direct current and for alternating current. The construction is shown in Fig. 1. When no current flows the upper carbon is held at a distance from the lower carbon by means of the adjustable springs *FF*. When the lamp is lighted the magnetic tractive force of the shunt coil *S* acts in the opposite direction. When the circuit is closed, the iron core *E* is drawn downwards by means of the shunt coil. The iron core is connected by means of *B* with the air-pump piston *P* and with the tube *R*, which holds the upper carbon. As a result of the iron core moving downwards the carbons make contact and the arc is started. The main current then flows through the carbons which are removed from each other by means of the springs *L*. The regulation of the lamp is as follows: When the arc resistance increases, due to combustion of the carbons, the magnetic tractive force increases and the iron core *D* is gradually drawn downwards until *K* touches the plate *A* and permits the carbon to slide downward. A con-

[illegible] the carbon is [illegible] and the upper carbon holder has reached its lowest position, a contact in the shunt circuit is broken. This breaking of the contact is sparkless, since the main circuit through the carbon still exists. Immediately after interruption of the shunt circuit, the two springs at the sides begin to act and draw the upper carbon holder together with the open contact device upwards so that the arc is broken. Some results of tests are [illegible].

[illegible]—A description of [illegible] arc lamp in which the lower ends of the carbon rods rest on stops. In this type of lamp, the trouble has hitherto been that the carbons burn to a tapering form, so that they have a tendency to slip down past the stops further than they should. This is overcome by the use of a shield surrounding the carbons above the arc, which limits the amount of air admitted, and causes the formation of a layer of burnt gases around the parts of the carbon immediately above the arc, thus preventing them from being attacked above the burning points. As is shown in Fig. 2, the carbons *a* are fed by gravity through the tubular converging guides *b* and *c*. The tube *c* is pivoted at its upper end on the upper frame of the lamp, the lower end passing through and being free to oscillate in a slot *g* in a plate or disk of insulating refractory material, the slot *g* being closed by means of a plate *h* attached to the swinging frame. The arc is struck and controlled by a solenoid having its core linked to a lever *i* connected by a link i^2 to an angle lever [illegible] pivoted to a bracket secured on main frame of lamp

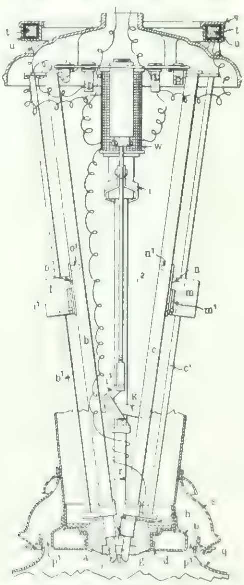


FIG. 2.—ARC LAMP.

and connected by a link l_2 with the pivoted carbon guide or frame *c*. Each carbon rod is fed by gravity, being secured at its upper end in spring carbon holders *c* and pressed downwards by means of weights *l m* mounted to slide on guide rods b^1c^1, and which are connected by plates l^1m^1, with links *no* and with the carbon-holders by means of pins n^1o^1; the carbons are supported by inclined metallic stops a_1. In order to facilitate the insertion of the carbons into their guide tubes from the bottom, the stops a_1 are mounted to slide in sleeves a_2 against [illegible] spring [illegible]. The sleeves [illegible] are screw-headed externally and held in screw-threaded bosses a_4, so that the sleeves a_2 and their stops can be readily adjusted, as the stops wear away. When the current is switched on, the movable frame or carbon guide *c* is operated to swing its carbon towards and against the non-swivelling carbon, and the shunt coil *w* then separates the carbon. Around the disk *d* an annular shield *p* is fixed to the lamp frame and extends to within a short distance of the neck of the globe *q*, so that air can only enter through the somewhat restricted annular space p^1 between the shield *p* and the globe *q* and slowly drift towards the carbons to feed the burning points, the rarefied air or burnt gases being kept in a stagnant condition to prevent the oxidation of the carbons above the points. A deflecting magnet *r*, wound on one leg only, as shown, is arranged above the plate *d* and extends through the lower plate of the lamp level with the carbon points. The glove casing *s* is provided with ventilating holes, the gases from the arc passing between the globe and shield and out through the holes. A compensating or circuit resistance coil *t* is arranged outside the top frame or cover of the lamp enclosed in an annular casing or trough *u*, lined with mica or other insulating material, and having a cover *v* to protect the coil from the effects of the weather.—Lond. *Elec. Eng'ing*, Aug. 1.

Power.

Steam-Driven Generating Stations.—H. G. STOTT.—Tables giving in concise and complete form the principal dimensions and data of the power stations, sub-stations and transmission system of the Interborough Rapid Transit Company of New York City. In an editorial note by W. K. Dunlap it is remarked that while these power stations mark the highest development of the upright steam-driven type, it is also very probable that they are the last stations containing units of this type and magnitude which will be built. The great success which has attended the operation of turbo-generators, both from the standpoint of efficiency and economy of operation, will in all probability insure the adoption of that type of prime mover for all large installations of the future where steam is used.—*Electric Journal*, August.

British Railway Generating Station.—The generating station which the Great Western Railway has established at Park Royal is equipped with a large number of three-phase alternators of moderate size, driven by reciprocating engines. Electricity generated here at 6300 volts is fed to three sub-stations, where motor converters of the "cascade" type supply the track at 600 volts with continuous current. Large storage batteries controlled by automatic reversible boosters are employed at the sub-stations. The station supplies energy for traction purposes and for lamps and stationary motors.—Lond. *Elec. Eng'ing*, Aug. 1.

Gas and Petrol Engines.—D. CLERK.—A paper read before the British Association for the Advancement of Science and discussing mainly the development of the large gas engine.—Lond. *Elec. Eng'ing*, Aug. 8.

Traction.

Single-Phase Versus Direct Current Systems.—M. MacLAREN.—An article discussing critically some of the comparisons made by Parshall and Hobart in the book on electric railway engineering between direct current and single-phase traction. The present author's conclusions favor the single-phase system.—*Electric Journal*, August.

Railway Signals.—W. E. FOSTER.—A continuation of the long illustrated serial on railway signals. In the present instalment automatic block signalling by means of direct current is discussed.—*Electric Journal*, August.

Installations, Systems and Appliances.

Synchronous Motors for Improving the Power Factor.—W. NESBIT.—An article in which the author discusses by means of diagrams the method of introducing leading currents into circuits of low power factor for the purpose of improving the latter. There are two possible remedies for raising a low power factor. One is to increase the capacity of the generators and other electrical apparatus to provide for the increased current caused by the low power factor. The second is to install synchronous motors to raise the power factor; they may be loaded mechanically or may be operated without load solely for their corrective effect. The chief results of the author are as follows: In some cases where the plants are small, and there is no use for a large synchronous motor, it is advisable

to install generators having a kilovolt-ampere rating at the power-factor likely to be obtained. The erroneous practice, however, is to install generators rated at 100 per cent power factor and thus greatly cut down the available capacity of the plant. This is possibly largely due to the fact that a great many purchasers of electrical apparatus for small alternating-current plants do not understand or appreciate the question of power-factor, and also that if a generator salesman bids on a generator rated on a 70 or 80 per cent power-factor basis he will be likely to find it difficult to convince the purchaser that his generator is worth more than his competitors', who are advocating a generator with a 100 per cent power-factor rating in order to get the selling price down. The result is that salesmen, as a rule, do not advocate large enough alternating-current generators for the engines or waterwheels which are to drive them. The more mechanical power that synchronous motors give out in addition to furnishing leading current, the more economical will be the installation, and for this reason it is desirable to make them do as much mechanical work as the case under consideration will warrant. It rarely pays to attempt to raise the power-factor by the use of synchronous motors to values higher than 90 or 95 per cent. Synchronous motors in order to keep down the drop in wiring should, of course, be installed near the end of the lines. When induction motors are replaced by synchronous motors in order to improve the power-factor the exchanges should be made on the larger sizes so as to reduce to a minimum the number of synchronous motors required. Rotary converters may be operated at leading current and made to assist in improving power-factor. Spare generators, which may be disconnected from their prime movers, may also be used as synchronous motors and floated on the line. In an editorial note by F. D. Newbury, in the same issue, it is pointed out that for such purposes synchronous motors should not be installed where they are not adapted to the mechanical load available, or where they will not receive intelligent care. The power factor regulation secured by the use of synchronous motors is not automatic, but depends on the adjustment of the field current. There are only a few cases in which the installation of synchronous motors, running light in order to improve the power-factor, will prove more economical than increasing the generator capacity necessary to obtain the same result. Synchronous motors used in this way simply act as generators to supply magnetizing current to the system, and hence the problem is one of the relative cost of one large generator, and of one large generator and a smaller generator. Usually one generator can be installed for less money than two smaller ones. If, however, the main generators are of low speed on account of their prime mover, two smaller generators will probably cost less on account of the high speed at which synchronous condensers may be operated. Another factor that may be favorable to the installation of the synchronous motor running light, will be be the relative cost of generators and of the transformers and feeders. Since the synchronous condenser when installed at the end of a line reduces the required capacity of all of the electrical equipment, if the transformers and feeders represent a large investment compared with the generator, the saving in the former may easily be sufficient to pay for a synchronous condenser.—*Electric Journal*, August.

[illegible] mission.—C. F. HOLMBOE.—An article in which the author gives [illegible] have a considerable influence on the efficiency of energy transmission. An old direct-current plant was to be changed to three-phase current for transmitting energy at 5000 volts [illegible] placed in the old station to change the direct current into three-phase currents while an identical motor-generator for changing the three-phase currents back to direct current was [illegible] current the power factor was unity. When the magnetizing [illegible] the power factor was somewhat less than unity. After this plant had been in operation for about a year and a half, the new three-phase generators had been installed in the power plant and the motor-generator set in the power plant could therefore be disconnected. A three-phase generator now supplied three-phase currents directly to the old motor-generator in the sub-station. It was then found that the efficiency of the latter had dropped to 79 per cent and that it was impossible to bring the power factor up to unity. The fault could not be in the motor-generator in the sub-station, since when the old motor-generator set in the power plant was again placed in operation and supplied three-phase currents to the motor-generator in the sub-station, the efficiency was again 84 per cent and the power factor unity. By exact tests it was found that the wave forms of the e. m. f.'s of the generator in the power plant and of the synchronous motor in the sub-station were different, the difference between the two curves having triple frequency. Since the eddy current losses increase with the square and the hysteresis losses increase proportionally to the frequency the author believes that the decrease of efficiency was mainly due to the different wave forms. This diminution of efficiency cost the power plant about $500 a year.—*Elek. Zeit.*, July 18.

Electrolytic Lightning Arrester.—R. P. JACKSON.—The electrolytic arrester, consisting of two aluminum plates in a suitable electrolyte acts like a safety valve since it does not permit any current, either alternating or direct current, to pass as long as the voltage is below the critical value. With present known electrolytes about 400 volts represents the maximum which the film will sustain. Used as a lightning arrester on high-tension lines a large number of aluminum plates must therefore be placed in series and the easiest method is to assemble them in tray form so that one may rest within another, insulated from each other, but all containing the electrolyte. If connected directly to the line the slight leakage current will cause considerable heat which will evaporate the solution and soon damage the plates. If, however, a gap is placed in series of such a nature as to have some ability to suppress an arc, such a gap may be set very close to the break-down value at the operating potential. In commercial apparatus for potentials above 13,000 volts this gap takes the form of two diverging horns similar to that commonly known as the "horn arrester." When thus arranged in series with a suitable "horn" air-gap the electrolytic lightning arrester has all of the qualities of a safety valve as applied to electric circuits. At the ordinary operating potential it takes no current whatever, but as soon as any abnormally high potential surge or wave appears, it permits, through its freedom of discharge, a sufficient flow of energy to maintain the potential of the circuit at practically the value at which the device begins to take current, *i. e.*, to discharge. As soon as such a wave has passed, however, the arrester at once ceases to take current. Moreover, such a very small value of current is taken from the generator during discharge that the other parts of the circuit are not disturbed in any way, as in the case with arresters which at the time of discharge take a large value of generator current.—*Electric Journal*, August.

Electricity on Shipboard.—C. SCHULTHES.—A profusely illustrated paper read before the German Association of Electrical Engineers, describing and discussing the different applications of electricity on board of commercial vessels and warships. Examples of installations are given with illustrations. The equipment of the generating station is discussed in special detail and wiring drawings are given. There are also statistical data on the amount of the use of electricity on German ships. [illegible]

Electrophysics and Magnetism.

[illegible] the properties claimed to belong to the N-rays, the N_1-rays, the physiological rays and the heavy emission, with a history [illegible]

istence of these rays, together with the bibliography on the subject.—*Journal Franklin Institute,* July and August.

Discharge of Electricity.—G. WINCHESTER.—An account of an experimental investigation of the effect of temperature upon the discharge of electricity from metals illuminated by ultra-violet light.—*Physical Review,* August.

Magnetic Observatory.—J. E. BURBANK.—A description of the temperature control of the Cheltenham magnetic observatory of the United States Coast and Geodetic Survey. This observatory is built entirely above ground and sufficient heat insulation is provided to reduce the annual range of temperature to a reasonably small amount. The observatory is essentially a building within a building. The walls of the outer building and also of the inner rooms are packed with sawdust.—*Physical Review,* August.

Electrochemistry and Batteries.

Storage Batteries.—V. KARAPETOFF.—The conclusion of his illustrated article. The present instalment deals with floating batteries, battery boosters, differential boosters, carbon-pile booster regulators, booster regulation by counter e. m. f., and vibrating-contact booster regulators.—*Electric Journal,* August.

Dissociation Theory.—H. E. ARMSTRONG.—A paper read before the British Association for the Advancement of Science, on "The Nature of Ionization — Ionomania." The author thinks that the word ionization is improperly used and that dissociation is really all that is usually implied. The main part of the paper is polemics against the dissociation theory.—Lond. *Elec.,* Aug. 9.

Units, Measurements and Instruments.

Localizing Cable Faults.—F. SCHULTZ.—The Berlin Electricity Works have been using for years a method by which cable faults are made visible in the station. The method, the principle of which is illustrated in Fig. 3, makes use of the testing wires

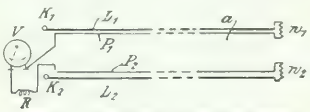


FIG. 3. LOCALIZING CABLE FAULTS.

for measuring purposes. If a fault in a cable develops at a point *a,* a short circuit is produced between the cable core L_1 and the testing wire P_1 in the same cable, so that the voltmeter resistance w_1 provided at the end of the feeding cable is shunted and the relay R inserted in the testing-wire circuit is supplied with more than its normal current; a special circuit is thereby closed which gives the signal. The present author describes a method which renders visible in the station the place where a fuse has blown. The principle is that at the feeding point the electric connection between feeding cable and its testing wire is broken as the result of the heat developed by the blowing fuse. For this purpose a thin wire is placed in the form of a loop between feeding cable and testing wire so that it passes over all fuses. Whenever one fuse blows the arc melts the wire and the testing wire is without current. By means of the station voltmeter this special testing wire and therefore the place where the fuse has blown can be easily determined, or the blowing of the fuse may be automatically signalled by means of a relay in the testing-wire circuit.—*Elek. Zeit.,* July 25.

Resistance of Coils and Frequency.—L. COHEN.—An abstract of an American Physical Society paper. The change in resistance of a coil due to frequency is different from that of a straight wire of the same length as the winding of the coil. The difference arises from the fact that the distribution of the current in the wire is different in the two cases. The author has worked out the theory which agrees closely with experimental results obtained by Wien. According to his theory the increase in resistance is proportional to the radius of the coil, diameter, pitch, frequency and conductivity of material of the winding.—*Physical Review,* August.

Telegraphy, Telephony and Signals.

Transmission of Pictures.—A. KORN.—An account of the experiments of transmitting photographs over a telephone line between Munich and Berlin. The Korn system is used, and it has been found advantageous to place the selenium compensation in the transmitter rather than in the receiver. The principal connections are shown in Fig. 4 in which the synchro-

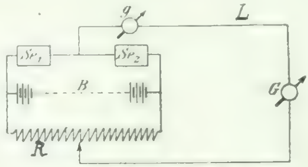


FIG. 4. TRANSMISSION OF PICTURES.

nizing device is, however, omitted. Se_1 is that selenium cell of the transmitting cylinder which is subjected successively to the different light effects of the picture which is to be transmitted. Se_2 is the compensation selenium cell, R a resistance, g the compensating galvanometer in the transmitting station, L the line and G the receiving galvanometer in the receiving station. The experiments are said to have been thoroughly successful. To what extent the method will be used in the future will depend chiefly on the cost of using telephone lines. It is pointed out that while a picture is transmitted over a telephone line it is possible to use the same line for a telephone conversation, but it is not desirable to ring up a party during transmission of a picture. The time of the transmission of pictures in these experiments was between 6 and 12 minutes, but it is hoped that this time will be reduced. It is stated that besides the stations in Berlin and Munich for transmission of pictures similar stations are to be equipped in Paris and London, and in Copenhagen and Stockholm.—*Elek. Zeit.,* Aug. 15.

Miscellaneous.

Electricity in Mining.—A description of the electrical plant lately installed by the Calumet & Hecla Mining Company at Lake Linden to replace worn-out steam engines which were formerly used. Three-phase current is generated at 13,200 volts and a frequency of 25, and is transmitted 5 miles by overhead lines to a sub-station, where the e. m. f. is reduced to 2300 volts for distribution. This sub-station also contains two 350-kw motor-generators, which convert the 2300-volt, 25-cycle current into current at 2200 volts, with a frequency of 60 for lighting purposes. In the stamp mills the motors are supplied with current at 440 volts. They are 40 in number, and vary in rating from 20 horse-power to 50 horse-power. There is also a 700-hp induction motor geared to a 60-ft. sand wheel. This wheel is used to elevate water and sand as it passes out of the mills. At the mine itself 2300-volt motors are used instead of the small steam engines previously installed. There are one of 27 horse-power and three 100-hp motors. The underground pumping is done electrically, four 100-hp motors being provided for this purpose.—*Eng. and Mining Jour.,* August.

BOOK REVIEW.

HOW TO MAKE AN EXPERIMENTAL WIRELESS TELEGRAPH OUTFIT. By A. Frederick Collins. New York. W. L. Hedenberg Publishing Company. 18 pages, 5 illustrations. Price 25c.

This little pamphlet gives full and detailed instructions for making, at little expense, a practical wireless telegraph outfit. Descriptions are given of the transmitter, the receiver, the coherer and the aerial circuits, not only as to constructive details, but as to operating features as well. The outfit, constructed as described, would doubtless prove instructive for the amateur wireless telegraph operator. Moreover, the necessary material can be obtained at a small outlay, estimated at about $20, and it can be assembled without difficulty if the instructions given are carefully followed.

Possibilities of Electricity in Metal Mining.

By G. M. [illegible]

IT is very interesting to note the tremendous strides which have been made during recent years in the application of electricity to all descriptions of mining machinery. To-day one finds pumps, fans and haulage systems all electrically operated and giving the utmost satisfaction. There are still fields, however, where electricity is having a hard fight to supplant its older rivals. Steam still holds its own for large hoisting engines, although it is beginning to lose ground in localities where fuel is a large item of expense; and compressed air continues to be favored by the majority of engineers for the operation of rock drills despite the many electric machines on the market.

In the following paragraphs only the most salient features of this most interesting subject will be touched upon, and comment made upon those pieces of apparatus which are susceptible to improvement and which are worth careful consideration at the hands of designers. Developments during the past ten years in long-distance transmission of energy and the alternating-current system as a whole, clearly indicate that the restrictions and limitations inherent in direct-current apparatus have been eliminated, or, at any rate, materially lessened, opening up new fields which heretofore it has been impractical to reach. Again, the demand for efficient mining machinery embodying improved principals has never been so great as it is to-day; and since this is essentially an age of economy in which we live, any saving that can be secured by the use of electricity will certainly be taken advantage of.

One of the many uses to which electricity can be put in metalliferous mines is that of illumination. No one can deny that for such purposes it has no equal; its freedom from foul air and the steady light emitted by it make it a most desirable addition to certain parts of the mine, while its advantages on the surface are obvious. Despite these many attractive features, its use is not half as great as one might be led to suppose. On small properties the permanent workings are not sufficiently extensive to warrant its installation although in

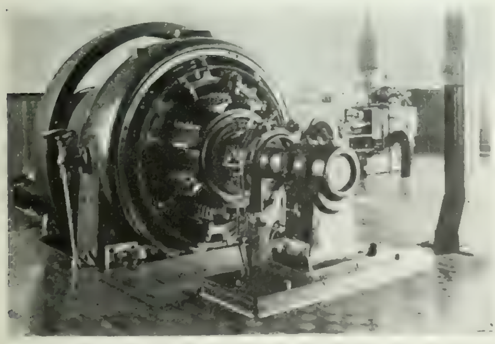


FIG. 1.—THREE-WIRE DIRECT-CURRENT GENERATOR.

special cases it may be found, but where there are long drifts and cross-cuts in a continual state of activity it becomes almost a necessity.

Lamps should be placed at regular intervals along the tunnels, while stations, chutes and turn-tables should be well lighted to enable car men to work to better advantage. Unnecessary delays caused by cars jumping the tracks are often thus avoided. Its use in stopes or temporary workings is not advisable, since the likelihood of caving ground breaking the wires and subsequent failure of light when most needed, renders its use in such places undesirable. Dangerous gases are seldom if ever encountered [illegible] to protect the lamps on this account, but all fittings should be of substantial design and waterproof. The actual method of wiring needs no particular comment, the cables being strung on insulators fastened to the roof or walls of the tunnels. If a simple two-wire system of distribution be employed, a high line voltage is to be recommended with several lamps in series; but more economical results can be obtained through the use of a three-wire system supplied by a single generator. In this manner the lamp and motor circuits can be very effi-

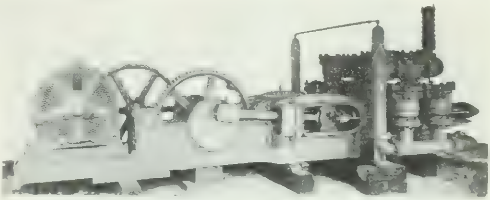


FIG. 2.—DUPLEX PUMP DRIVEN BY AN INDUCTION MOTOR.

ciently combined and considerable saving effected. Fig. 1 illustrates a Westinghouse three-wire generator especially designed for such service.

The large volume of water encountered in some mines necessitates the most improved form of pumping machinery, while the motors required to drive the same have to work under any but ideal conditions. Providing the flow of water is not too large, it is customary to cut tanks or sumps in various parts of the mine and allow the water to drain into these from which it is pumped at regular intervals. This permits of the motor being placed in a fairly dry and accessible position, and being worked between shifts when other machinery is lying idle, resulting in a more uniform load on the generators. If necessary, a float can be installed so as to start and stop the pump automatically.

Although direct-current motors are used very largely for pumping purposes, yet the polyphase induction motor has played a most important part in the developments of recent years. Its simplicity and continuity of service which it insures have placed it in a unique position in this respect.

Fig. 2 represents a Westinghouse induction motor driving a duplex plunger pump through double reduction gears. Great attention is given to the insulation of these motors, all coils being thoroughly impregnated with moisture-proof varnish. This is of great importance as many otherwise good motors will show defective insulation after several months service in the damp atmosphere of a mine. Fig. 3 shows a portable mine pump driven by a direct-current motor.

The presence of water in any shaft during sinking operations seriously affects the speed at which the work can be carried out, and it is, therefore, of great importance to remove all water as fast as it accumulates, pumping it directly to the surface or to a tank higher up in the shaft where it can be taken care of by some station pump. Steam and compressed air are both used for driving these sinking pumps, but conditions are such as to render such drives both uneconomical and unsatisfactory. Hence, the increased use of electric motors wherever conditions warrant their installation. No one who has had experience with both these systems can deny that the latter on account of its inherent flexibility shows up to very great advantage.

The little attention that is given to the ventilation of many metalliferous mines is often commented upon, for since dangerous gases are very rarely encountered, care is not always taken to provide the workings with a bountiful supply of fresh air, resulting in losses which, although not altogether apparent, are yet none the less real. This is particularly the case in the dead end of drifts or raises where compressed air is indiscriminately used after blasting. Apart from engineering reasons the good will of the miners which is secured by at

tending to their personal welfare and comfort is an item of some consequence in the efficient handling of a large body of men.

Some of these vexed problems in ventilation can often be solved by the judicious use of electrically-driven fans, which are peculiarily adapted for such service. They are easily controlled and require remarkably little attention when once placed in position.

[illegible] the supply of fresh air to the underground

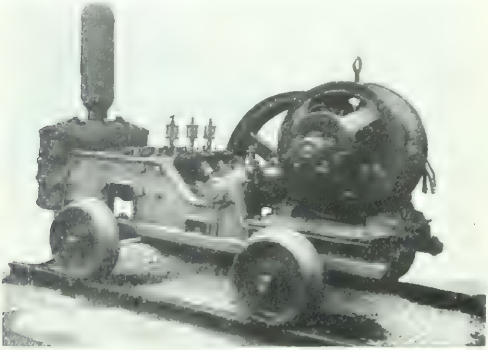


FIG. 3.—PORTABLE MINE PUMP DRIVEN BY A DIRECT CURRENT MOTOR

workings is usually accomplished by one of the following means:

I. Natural circulation of air. II. The installation of a blower or exhaust fan on the surface, and piping to various parts of the mine. III. A system of fans independently operated at different points underground, aided by natural circulation of air currents.

Of these the first does not come within the scope of this article, and the second is open to the objection that it is far from efficient and should a break-down occur ventilation stops. Besides it necessitates large quantities of cumbersome piping which occupy considerable space in the shaft and tunnels. The third system is subject to criticism on the ground that it re-

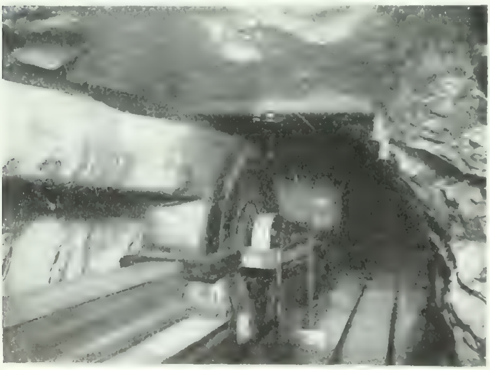


FIG. 4.—MOTOR-DRIVEN FAN IN A CROSS-CUT

quires power to be brought to each individual unit, but this is offset by the increased efficiency of the entire system and the more effective ventilation that is secured. Again, if one fan should fail, the remainder are not necessarily put out of commission. Another feature of more than passing interest is that fans can be installed when and where they are wanted according to the growth of the mine, and should any part be abandoned their removal to a more advantageous place is a very simple matter. Fig. 4 shows an induction motor driving a fan in a cross-cut.

The question of driving rock drills by electricity has engrossed the attention of engineers for the past 15 years and the diversity of opinion which exists at the present day respecting the merits of such machines is somewhat astonishing, considering the amount of time which has been devoted to their development. After so many years one would suppose public opinion to have crystallized out into some definite shape, but this is far from the case as is evinced by the conflicting reports heard on all sides relative to their use. One man will tell you that they are the only machines to use, another with equal confidence will assure you that they should all be relegated to the scrap heap, while a third will declare that pneumatic drills are good enough for him, since they perform their allotted work in a satisfactory manner.

Such differences of opinion can only be accounted for on the supposition that electric drills have a field of their own, and whenever they get outside of this trouble is apt to ensue. The time has come, however, when designers of such apparatus should aim at producing a machine capable of handling all kinds of work, whether it be stoping, drifting or sinking, remembering that rugged and substantial designs are imperative and that the insulation of the motors should also receive particular attention. In the past failure has often resulted by makers failing to realize the severity of the service to which such machines are subjected, having based their calculations to a great extent upon quarry and open-cut work which is, as a rule, less hard on a drill than stoping.

Engineers are apt to criticise the motors and electrical connections as being too delicate for any but ideal conditions, and while, no doubt, there was a certain amount of truth in this in the past, radical changes have beeen made in the more recent types and the majority of these defects remedied. The difficulty of protecting cables is certainly no greater than that encountered with flexible hose, while leaky joints are avoided.

While it is not possible to ventilate a mine thoroughly by compressed air, yet its ability to dilute and even expel foul gases from long cross-cuts and raises is well recognized by those who have had to work in such places; and although such practice is not to be commended, yet it is often very convenient and some objection might be raised against electric drills on this account. On a moment's reflection, however, it is evident that when once a mine is wired up it is an easy matter to install a fan for that particular part and much better ventilation results.

The small power consumption of the electric drill (as compared with the pneumatic drill) is possibly the strongest recommendation in its favor, a three or four horse-power electric being equivalent to a 12 horse-power air drill. Besides, the line losses on the electric system are small compared with those found in the average pipe line, which usually will not bear too close inspection. With this in mind, drills have been produced operated by air supplied by a small compressor, driven by an electric motor in close proximity to the drill, thus combining the stolid qualities of the air drill unattended by the usual transmission losses. As a rule, it takes less skill to actually manipulate an electric drill, but a thoroughly competent repairman is required. The employment of men untrained in their profession is, however, to be depreciated.

A contract has recently been let by the Delaware & Lackawanna Railroad Company for the driving of a tunnel 4300 feet in length and 25 ft. x 30 ft., in which electric drills are to be used throughout. The machines in question were built by the Critten Manufacturing Company and represent the most advanced type of electric drill construction. The motor is mounted on the body of the drill, the whole forming a remarkably compact arrangement. The mechanical features involved are unique and of special interest. Great attention is given to details and springs are entirely done away with, while the rotation of the drill is positive and it is impossible for the motor to become stalled.

In developing a mineral property the surface and under

ground workings are laid out with a view of securing minimum expense in handling the ore, and although the forces of gravity are brought into play wherever possible, yet topographical conditions compel haulage systems of considerable length either from the shaft house or direct from the mine to mill or smelter. In such cases the use of electric locomotives will, as a rule, be accompanied by marked reduction in working expenses, and in some cases the financial success of an undertaking may rest largely upon this one item.

There are no hard and fast rules that can be laid down respecting their use, since local conditions are never the same; but there are certain factors which must always be studied and conclusions drawn from them as a whole, the most important being cost of energy, fuel and labor, probable life of mine, number of tons hauled per day, length of haul, grades, etc. Fig. 5 shows a typical example of locomotives for underground haulage.

Electricity has so many advantages over compressed air and other systems that it deserves particular attention, and as an example of up-to-date and progressive mine management a case may be cited of a well-known mine in Placer County, California, where the ore was being hauled through a long adit out to the mill. Mules were being used and the mine was on a paying basis. Despite this fact the management were of the opinion that profits could be increased, and after a

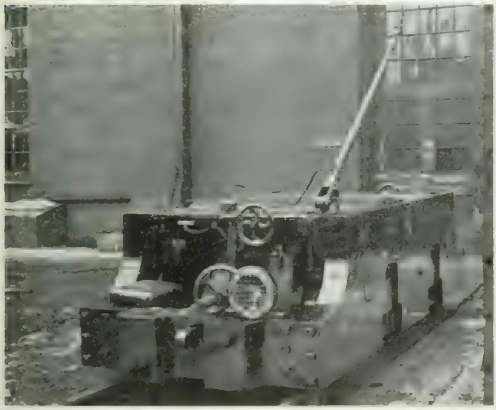


FIG. 5.—ELECTRIC MINING LOCOMOTIVE.

careful investigation of the situation decided to replace the mules with electric locomotives. The total cost of mining was subsequently reduced 13 per cent, and 12 per cent of the men's time formerly occupied in entering and leaving the mine was turned to the advantage of the company.

In smelters electric locomotives afford unusual facilities for handling slag, etc., with an ease and dispatch that could hardly be secured by any other means. Fig. 6 shows a Baldwin-Westinghouse locomotive used for such work at the Tennessee Copper Company's plant.

During recent years the use of electric hoists in stopes and raises for handling tools and timbers has become very general. They are easily controlled, seldom get out of repair and free from the many troubles met with in compressed air hoists of similar capacity.

If the performance of any modern hoisting engine be carefully analyzed it will be seen that the continuous running efficiency leaves much to be desired; the reason for this being apparent when one considers the nature of the load. For this reason electricity has been resorted to in order to secure better economy of operation, as well as increased flexibility and ease of control. In case of emergencies the multiplicity of levers on a steam hoist are apt to be confusing, whereas when electric motors are used, one or two levers can be made to control all the movements of the hoist and with a system of interlocking, liability of error is reduced to a minimum. Safety appliances can also be used to advantage so as to eliminate the personal element to a very great extent.

It is a noticeable fact that while engineers in this country have developed small hoists to a remarkable degree of excellence yet it has remained for our European brethren to take the lead in the design of those of 400-hp and upwards. So long as one is confined to the building of small machines, no great difficulties present themselves, but with the larger sizes the

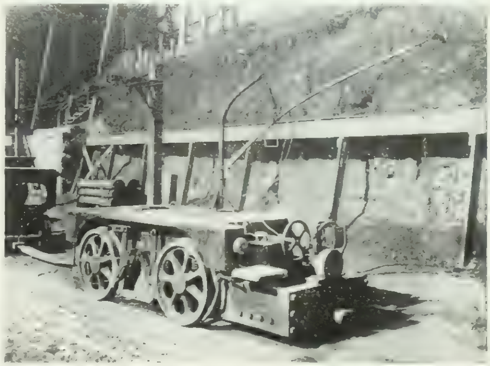


FIG. 6.—ELECTRIC LOCOMOTIVE AT A SMELTER.

question of control and supply of energy becomes a very important item.

In starting up a large hoist from rest, an abnormally large current is drawn from the line which in some cases might seriously affect other apparatus on the same circuit. Thus, it becomes necessary either to supply the hoist through a separate line and in some cases by a special generator or provide some means for storing energy in the line on light load and returning it to the circuit when the occasion demands it. To this end, numerous devices have been tried, most of which employ storage batteries, but these are a large item of expense and have been abandoned on many occasions as unsatisfactory.

The most practical device at the present time consists of an induction motor and a direct-current generator mounted on the same shaft with a massive flywheel, and an automatic slip

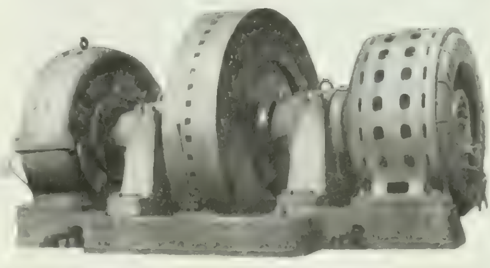
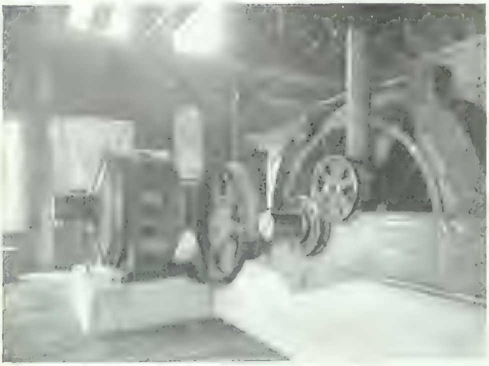


FIG. 7.—[illegible]

regulator so adjusted to keep the current consumption of the motor constant. The flywheel is of such proportions that the kinetic energy stored in it can supply the surplus power required at the moment of starting, while the actual current drawn from the line remains constant. The armature of the generator and hoist motor are permanently connected together and their fields excited by a small exciter mounted on the same shaft as the motor generator set. By varying the current flowing in the field coils, the speed of hoisting can be

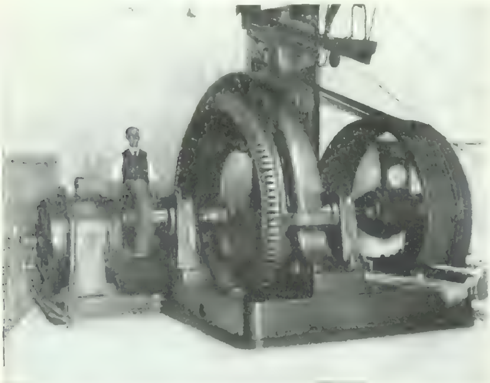
[illegible]



[illegible]

but as far as the writer is aware that supplied by the Westinghouse Electric & Manufacturing Company to the El Oro Mining Company in Mexico is one of the few on this continent. The motor-generator set, the flywheel of which weighs 20 tons, is shown in Fig. 7.

Fig. 8 illustrates an induction motor, geared to a hoist capable of handling 500 tons of ore daily from a depth of 2800 feet. It is of the endless-rope variety, speed regulation being secured by varying the resistance in the secondary circuit of the motor. It has shown a net efficiency of 75 per cent. including all electrical and frictional losses since its installation.



[illegible]

It has the advantage of using alternating current direct without the medium of a motor-generator set, but it js doubtful up to what horse-power such a machine would prove satisfactory unless supplied by a special circuit.

The number of uses to which electricity can be put in the various mills and shops forming the surface plant of any mine are so numerous that space does not permit of giving each due consideration. Stamp mills, concentrating machinery, rock crushers, saws, air compressors, etc., all are well suited for electric drive. Fig. 9 shows a 350-hp synchronous motor in use at the El Oro Mines, Mexico.

Summing up the situation it is obvious that electricity is becoming more and more indispensable for the economic operation of metalliferous mines. In California, as far back as [illegible] number of properties and interest was revived in districts which formerly it had been unprofitable to develop. In those days, power plants were not as reliable as they are at the present time and although the service was remarkable when one considers the difficulties under which they labored, yet interruption of service, due to various causes, was of frequent occurrence. This necessitated holding steam or water power in reserve in case of emergencies, but to-day one finds motors working continuously day and night with no provision made for possible shut-downs, so reliable is the source of supply.

When speaking of electric power and its application to mining, great stress is always laid on the economies effected where fuel is a large item of expense and while this is undoubtedly a very attractive phase of the subject, yet economies affected in the coal bill are not the only advantages claimed for its adoption; for it possesses a convenience, flexibility and efficiency out of reach of any other system. There is one factor which is often overlooked and one which should be given considerably greater attention; namely, the accuracy with which electric power can be metered out. How many mine superintendents could give exact figures covering the amount of power taken by various pieces of apparatus, such as drills and hoists? Only rough calculations can be made and while they answer the purpose more or less, yet in these days figures must be accurate to be satisfactory. Take for instance a mine using compressed air and steam; losses occur in all directions simply because there is no accurate means of checking up the power consumption except that for the whole plant at the end of regular periods, and it is hard to say whether air is being wasted under ground or whether it is in the boiler room that losses occur. In the past, most attention has been given to the metallurgical side of the business and unless the cost of power was unreasonably high no very serious attempt was made to improve conditions.

Contrast the foregoing with an up-to-date mine using electricity throughout. Unless the company purchases power from the outside, the plant is arranged under one roof and situated so as to produce power under the most favorable conditions, be it either alternating current or direct current. From thence it is conveyed to the various points of consumption and if necessary each circuit can be provided with a meter and thus the kilowatt-hours consumed in that particular circuit accurately determined. If now it is advisable to install additional apparatus, a glance at previous records would enable the extra power required to be calculated exactly.

If electric power is used for all purposes it is possible to secure a very high load factor as such machines as pumps, etc., can be run during light load only, thus affording the engineer in charge ample opportunity of displaying his ingenuity and understanding of power-house economics.

Mining is to a large extent somewhat of a gamble and it behooves the engineer to reduce it to an absolute science so far as possible, doing away with all the unknown variable quantities. The consumption of power perhaps offers the largest field for improvement and the ultimate solution of this problem can undoubtedly be secured by the judicious use of electricity.

Patent Insurance.

The generally known fact that a patent of invention grants but little more to the inventor or owner than the right to sue if he believes his patent infringed, and that the actual strength of a patent cannot positively be settled until it has been litigated, has doubtless caused a desire for some form of protection that would relieve the patentee of all harassment and expense necessary to terminate the infringement.

Such protection is now offered by the Industrial Surety Company of New York, 41 Park Row, New York, whose purpose is the furnishing of an efficient service giving to its contractholders every protection possible under the laws of this country. When precedents are established, this company intends in-

suring the validity of patents and it believes that its strength and fairness will place it in a position where disputes as to infringement may be settled, through its offices, and expense and annoyance saved contending parties.

The officers and directors are all New York men of recognized standing and responsibility in the business community, the president, Charles M. Ams, of the Max Ams Machine Company; William H. Fischer, of the American Encaustic Tiling Company, vice-president; Gustave H. Kolb, of the Mauser Manufacturing Company, secretary; Charles M. Diefenthaler, of B. Fischer & Company, treasurer, who, with Carl Reinschild, of the Reinschild Chemical Company; Emil Kohler, of the American Encaustic Tiling Company, and Pierre V. R. Key, general manager of the Industrial Surety Company, form the board of directors.

The organization also provides protection to patentees and others in their right to make, sell or use an article, machine or device without molestation, including, when necessary, the services of its legal department and the payment of all costs in the defense of a suit of infringement brought by claimants of prior or adverse rights.

Patent litigation is costly, and it is an accepted fact that many owners of inventions often submit to barefaced infringement rather than to assume an expense which, in advance, is an unknown quantity and which must, under most favorable conditions, run into four figures. A strong company which will, for a moderate premium, furnish such protection, as above noted, should find a large field for its activities.

Electric Saw Mills in British Columbia.

During the next few weeks construction will be commenced on the tenth electric saw mill in the vicinity of Vancouver, B. C. Few people realize the importance of this recent application of electrical energy to the cutting of lumber and shingles, which is due, in this instance, to the British Columbia Electric Street Railroad Company. There is nothing similar to it on the continent, and when Mr. E. Rummel, manager of the light and power department of the company, was at the National Electric Light Convention, held at Washington in June, delegates from other parts of the continent were incredulous when he told them that British Columbia was turning out lumber and shingles wholesale by electricity. In August the 310-hp mill of the Western Corporations made a trial run with most satisfactory results. This mill is located in the tall timber to the northeast of the city of North Vancouver. Other mills in the vicinity of Vancouver, with their horse-power, are as follows: J. Maddaugh's mill, Boundary Road, shingles, 85 horse-power; Gibbon's Shingle Mill, Pole Line Road, 30 horse-power; B. C. Mills Company, Burnaby Lake, 200 horse-power; C. T. E. Piper, Burnaby Lake, 100 horse-power; George Doran, Deer Lake, 50 horse-power; McDonald & [illegible], [illegible] Road, 125 horse-power; C. B. Champion, Eburne, 40 horse-power; Western Corporation, North Vancouver, 310 horse-power; W. S. Stuart, Front Street, 65 horse-power; W. S. Stuart, McGee Street, 40 horse-power (under construction).

The majority of [illegible] sawing by electric [illegible] By simply stringing a wire from tree to tree the mill can be moved on as the timber is cut, and instead of the expense of hauling the logs to the mill, the mill can be moved cheaply to the logs, there being no furnace with boiler and heavy machinery as fixture impediments. Another point is the greater safety from fire around the mill. The electric portable mill promises also great developments in the profitable clearing of farming land throughout the Fraser Valley.

New York Electrical Trade Schools.

The New York Electrical Trade Schools, which institution [illegible] building [illegible] Street, New York. In this school all branches of the electrical trade are taught. While the instruction is essentially practical, elementary theory is not neglected, the plan being so to combine practice and theory in the instruction that a graduate is provided with a mental equipment that fits him to meet any situation that is likely to arise in practice. A set of tools takes the place of a set of books, and each student is required to do the work himself, under the guidance of a competent instructor.

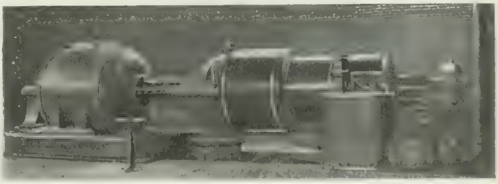
The schools originated in a suggestion made by a prominent electrical engineer who found great difficulty in obtaining skilled workmen to carry out his plans, and it is stated that the graduates readily find employment. The schools have a complete equipment of machinery and accessory apparatus, storage batteries, etc.

The management keeps in close touch with the latest developments in the various branches of the school work, thus giving the students the benefit of up-to-date methods in accomplishing results. Each individual receives personal instruction, and no time-limit is placed on any of the courses. This enables the relatively slow pupil to derive the full benefit of the instruction and become more thorough in his work.

The instruction covers the following subjects: Dynamo-electric machinery; interior lighting and power wiring; armature and motor winding and construction; installation and care of alternating and direct-current generating and motor plants; electric elevators, pumps, fans, motors and heating appliances; wireless telegraphy; telephones, telegraph, annunciators, bells; storage batteries, automatic block signals, etc.

Steam Consumption Test of a 1000-kw Turbo-Generator Unit.

In view of the increasing importance of steam turbines in electric generating equipments, it is believed that the following report of a test made upon a turbo-generator unit installed in the Kokomo, Ind., power house of the Kokomo (Ind.), Marion & Western Traction Company will prove interesting. The unit consists of an Allis-Chalmers Parsons standard horizontal turbine, direct connected to a standard Allis-Chalmers 1000-kw, 60-cycle, two-phase, 2300-volt alternator designed for a speed of 1800 r. p. m. The turbine was built to operate nor-



[illegible]

mally with a steam pressure of 140 lbs. per sq. in. gauge pressure at the turbine throttle, dry-saturated, and a vacuum of 28 ins. of mercury, referred to a 30-in. barometer pressure at the exhaust nozzle. The unit is designed to carry an overload of 50 per cent when operating under the above steam conditions and at 100 per cent power-factor.

During the test the generator was subjected to the greatest load obtainable, which amounted to only about one-half of the rated output of the machine. The results of the tests were as follows:

[illegible]	[illegible]	[illegible]	[illegible]
8.	Vacuum at turbine referred to 30-in. barometer....	27.66	
[illegible]	[illegible]	[illegible]	[illegible]
15.	Actual consumption of dry steam per kw hour....	21.90	"

[illegible]

[illegible] 24 [illegible] showed that the actual steam consumption was 2.1 lbs. less than [illegible]

Lighting an Old New York Bank.

The practice in New York City is to tear down any building over 25 years old, no matter how solid and substantial it may be; but there are exceptions. A recent renovation, saving one of these buildings, is that effected in the home of the Seamen's Bank for Savings at 74 and 76 Wall Street, which has also been furnished with a new and complete lighting system, for which Mr. P. G. Watmough, Jr., has been consulting engineer.

The building is an old-timer for New York, being 30 or 40 years old, but bids fair to stand as many years more, walls, partitions and floors being of stone or brick laid in Portland cement. The new lighting system is taken from the New York Edison circuit and will ultimately probably embrace eleven or twelve hundred lamps; the present installation providing for some 600 lamps.

Generally speaking, the halls and basement lamps are shielded by ground-glass globes, the question of eye ease being considered a dominant factor. Movable bookkeepers' desks are equipped with desk standards, each carrying half a dozen or more lamps shielded by deep porcelain shades, green finish. The desk standards are provided with attachment plugs connecting with a drop from the ceiling. This arrangement was deemed preferable to floor connections, permitting of subsequent changes in desk location without the necessity of altering the electric conduit circuit.

Owing to the short banking hours, general illumination in the main banking room will usually be unnecessary, but provision is made from ceiling fixtures carrying high-power Gem lamps; the directors' room and lunch room being similarly treated. The various banking windows, cashier, paying teller, etc., are equipped with trough Frink reflectors, carefully designed to shield the bookkeeper's eyes, but shining into customers' eyes, it being desirable to illuminate faces of the latter for better purpose of identification.

The entire system of wiring is carried in rigid iron conduit, run semi-exposed. The main service panel is supplied with a double set of bus-bars. All the banking lights are taken through one meter, which feeds to one of the busses. Six three-wire feeder switches tap therefrom supplying as many independent distribution cabinets located in various parts of the building.

The remaining set of bus-bars connect directly to feeders for tenants of the building, the latter having their own meters.

In addition, several small motors are operated for ventilating fans, book carriers, etc. A 16-station inter-communicating telephone system is also installed for the officials and clerks.

The Nernst Lamp in Relation to Artistic Treatment.

Through the illuminating engineer's influence to-day two tendencies are particularly prominent—the one to get full benefit from the light through proper distribution and diffusion, which is leading to a selection of lamps and glassware that throw the light where it is wanted; the other to define artistic treatment and to bring it within the proper limitations. Though the illuminating engineer has plenty of problems to work out he is singularly fortunate in that he has an infallible authority for his guidance—the sun. The popular slogan, "back to nature," does not apply to any phase of our civilization more forcibly than to lighting. The eye has been accustomed to sunlight too long to fail to protest against any scheme of artificial lighting that produces a widely different effect. The sun not only shows how artificial light should be directed and diffused, but it has a lesson to teach in artistic treatment as well. It teaches that the sources of light should be preferably out of view, and in lieu of this, as few as possible and as unobtrusive as possible. Careful observers will agree that the invisible source is the best, from an artistic point of view, and that the use of few fixtures, subordinated to the decorative scheme, is next best.

Artistic treatment has been given considerable attention by architects for many years, but has, unfortunately, in the majority of cases dominated both utility and the relationship of light to the eye. The earlier tendency upon the part of architects and decorators towards an almost unlimited number of light sources has now through the aid of the illuminating engineer been reversed; and to-day we find either the minimum number of sources well out of the field of vision or a concealed system of lighting in the best buildings.

A concealed system is generally expensive and frequently impracticable. A system of a few large and efficient units, on the other hand, is less expensive than one of many small units and can, with little thought, be so worked into the general decorative scheme as to become a part of it and add to its general attractiveness.

Since provision for a lighting system is necessary in planning any decorative scheme, lighting fixtures have perforce become an essential part of decoration. They are necessary from a

MARSHALL FIELD & COMPANY'S STORE

utilitarian point of view, but it is only the fixture designed in regard to the harmony of the general scheme that would be considered necessary to artistic appearance alone. A good test is this: If the fixture adds to the appearance of the room when the lights are not burning, it is properly artistic; if it detracts from the appearance, it is either inartistic in itself or inartistic in its relation to the rest of the decoration. In most rooms and especially in those which are small or have plain ceilings, an unbroken field is better than one which is broken up by low hanging pendants. Highly ornate ceilings in large rooms will often permit the use of pendants, but invariably a few, supporting large single units, are more artistic than many, supporting small units either singly or in groups.

Few will question the general proposition that medium sized or large units are more desirable in producing artistic effects, but until the advent of the Nernst lamp, there was practically no choice, for the inadaptability of the arc to interior decorative treatment left the entire field to the incandescent. At any rate, the choice of a system for use in fixtures at the present day lies virtually between the incandescent and the Nernst—between a system of small units and a system of units of all sizes, even up to the size of the arc. That the use of units of intermediate and large size is growing in favor is to be seen in the efforts of many advocates of the incandescent system to group a number of lamps within a single piece of glassware, so as to reduce the number of sources. While this treatment improves the artistic appearance, it does so at the expense of efficiency for general illumination; and only a very limited number of incandescent lamps can be grouped in this manner.

Taking no account of the questions of efficiency and color, it would seem that the Nernst system is a logical one for attaining such effects, permitting always the use of a single unit instead of a group of units.

Alive to the demands for more artistic fixtures of the large unit type and aware of the possibilities of the Nernst system, owing to its extreme flexibility, the engineers employed in the development of the Nernst lamp have never lost sight of the artistic in connection with its improvements. Husks and canopy housings of excellent pattern have been in use for some time, the housings being used for lamps placed directly against the ceiling and the husks for lamps suspended, preferably by means of single chains. Though the latter treatment is extremely simple for a pendant lamp, it is doubtful if any low-hanging fixtures more generally pleasing to the artistic sense have ever been brought out. To allow a wider latitude of choice, a great many new types of pendant and bracket fixtures, both for single units and for groups, have recently been designed, and the standard lamp bodies and canopy housings have been revised in pattern to conform to the artistic demands of the day.

While the various elements of the standard lamp are arranged so as to fit into a cylindrical body, this shape is by no means imperative, as may be seen in the design of the new ceiling bowl type of Nernst lamp. For artistic effect in use on ceilings of medium height, there is no fixture more pleasing than the ceiling bowl, consisting as it does of nothing more than a glass hemisphere with a supporting band attached directly against the ceiling. These fixtures have been in use for some time in connection with incandescent lamps, with low intensity illumination, unless placed very close together. Now the same effect is attained for high efficiencies and intensities by the adaptation of the Nernst lamp to this fixture. The result is accomplished by simply spreading out the elements in a lateral direction, retaining all the characteristics of the standard lamp. Thus a ceiling bowl that would only hold three or four incandescents is made to contain a multiple glower Nernst.

Electrically-Heated Tools.

Very few central-station men realize the possibilities for the introduction of electrically-heated soldering irons, branding irons and other special tools used in various industrial operations within the reach of the central-station company. Such devices have been commonly looked upon as useful, but not of wholesale enough application to be taken up very seriously by the central-station company that is pushing for profitable business. The number of soldering irons in use in any community is little realized. Hardware dealers in moderate-sized cities order soldering coppers by the ton. This in itself ought to give an insight into the possible extent of this business. Furthermore, branding is becoming more and more common among manufacturers as a means of quickly and indelibly labelling goods.

The advantages of electrically-heated soldering irons, like the advantages of electrically-heated flatirons for household use, are much more apparent to industrial establishments which have made extensive use of them, than to the casual observer. It is, therefore, not out of place here to point out specifically some of these advantages in order that central station companies and electric supply dealers may be able to advocate intelligently the use of electric soldering irons. To begin with, the electric iron does away with open gas or gasoline flames or charcoal fires in a plant. This in itself is frequently enough to get it introduced on account of its safety. The great inherent advantage of the electric soldering iron, however, is that heat is steadily supplied to it, and if the iron is properly adapted to the work to be done, it is kept at the right soldering temperature continuously, so that there is no stopping to change irons and no defective work due to the iron getting down below soldering temperature on the one hand, and, on the other hand, having the tinning burned off by overheating while over the fire. How great an effect this has on the work is illustrated by the experience of a manufacturer of oil lanterns, who by using electric soldering irons reduced the percentage of leaky oil cans from 5 per cent to ½ per cent, and this ½ per cent was not due to defective soldering. The output was also increased about 5 per cent per man, as compared with the previous gas-heated tools. The soldering iron with a gas burner in the iron is clumsy and an expensive thing to maintain, because of its size, the extra air pressure needed and the accidental burning of the rubber hose connection with hot irons. The gas-heated soldering iron, like the gas-heated flatiron, can never hold its own against electrically heated irons. Where several irons are used, the vitiation of the atmosphere and the

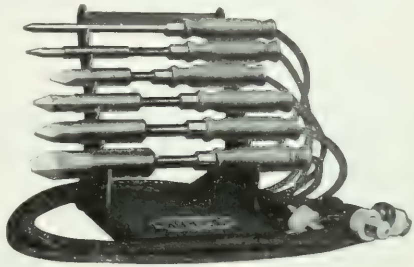


FIG. 1.—ELECTRIC SOLDERING IRONS.

excessive heat from the open flame used for heating irons have driven this method out of many a factory. In places where a large amount of delicate soldering work is done, as in a telephone switchboard factory, the electric soldering iron finds very extensive use. Telephone factories in Chicago use hundreds.

One thing must always be remembered in the introduction of electric soldering irons, however, namely, that while no engineering ability is required in connection with an installation of flame-heated irons, it is important that certain engineering principles be regarded in connection with electrically-heated irons. An electrically-heated iron has electrical energy continuously put into it at a certain rate. If the work required of the iron is too rapid for this rate of input, cold irons and poor soldering will result. On the other hand, if an iron which is adapted for continuous work is allowed to stand, there is but little opportunity for heat to be conducted away from it, and its temperature will rise to a very high point. Different irons are, therefore, required for continuous and for intermittent work. An iron for intermittent work should be wound for a wattage which, when the iron is standing with current turned on, out of use, it will be but little higher than soldering heat. When used, its temperature will, of course, drop rapidly; but for intermittent work this is not objectionable. For continuous work the wattage must be such that the iron can be kept at soldering heat while its heat is being constantly conducted away into the work that is being soldered. These characteristics of the electric soldering iron which make some engineering judgment necessary in their selection for any given work, are on

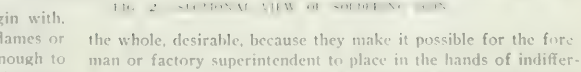


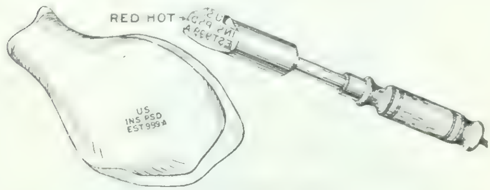
FIG. 2.—SECTIONAL VIEW OF SOLDERING IRON.

the whole, desirable, because they make it possible for the foreman or factory superintendent to place in the hands of indifferent workmen irons of such size and wattage that faulty soldering cannot be done because of insufficiently heated irons.

There is a constant temptation for some workmen to use flame-heated irons which have cooled beyond the point where thoroughly good soldering can be done, no matter how much instruction they may receive from the foreman. With an electrically-heated iron adapted to the work so as to maintain soldering temperature no matter how rapidly workmen may use it on a given operation, this uncertainty is eliminated

[illegible]
been before mentioned. In fact, in all kinds of work with the iron maintained at a high enough temperature, poor soldering becomes almost an impossibility, because the high, even temperature of the iron insures a good job with but a touch of the iron.

The Vulcan Electric Heating Company, 71 West Jackson Boulevard, Chicago, to which we are indebted for the interesting data above, has made a specialty of electric soldering irons, branders and similar tools for industrial purposes for the past three years. The various sizes of soldering irons regularly made are shown in Fig. 1. These range in power consumption [illegible]



[illegible]

mittent telephone switchboard repair work to 350 watts for the largest size, equal to a 6-lb. soldering copper. The heating element is made up on a copper core, into which the soldering tip screws with a conical contact to insure good heat conductivity. The heating element has a copper core with mica insulation, on which the fine wire heating coil is placed, and over which a steel shell is placed and brazed. The leading-in wires are taken out to binding posts in the handle through lavite parts which keep the conductors absolutely separated. Fig. 2 shows a cross-section of the iron showing the arrangement of binding screws inside of the handle and the way in which the handle can be unscrewed and slipped off over the cord to expose the binding post. This is a very substantial mechanical arrangement. The heating element is entirely surrounded with a shell brazed shut, so that no soldering flux fumes can enter. The same heating element and handle can be used for a variety of purposes, most notably for branding tools of various kinds. Figs. 3 and 4. The temperature required in the brander is, of course, higher than that required in a soldering tip, consequently the branding tip is considerably lighter and of less radiating surface than the soldering tip for a given sized handle. Fig. 4 shows a form of brander with a heating element in the tip, this brander being too large for the usual construction. It is made for branding butterine tubs to conform with the recent New Jersey law. An amusing example of the time-wasting make shifts that manufacturers will resort to is the practice of one

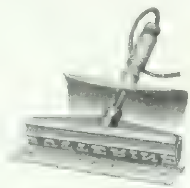


FIG. 4.—BRANDING IRON.

shipper of butterine, who is branding his tubs with coal heated block letters, the letters being heated and applied one at a time. Electric branding tools for packers are meeting with an especially large sale at the present time, as they can be used in any position and interfere the least with the rapid handling of meat [illegible] and branding tools, the Vulcan Electric Heating Company is frequently called on for special applications where electrically-heated parts are required in industrial establishments, and this company is making a specialty of meeting such industrial requirements.

Insulator for 100,000-Volt Transmission Lines.

The accompanying illustrations show respectively a unit of a 100,000-volt suspended insulator and an insulator in place, the insulator being the product of the Locke Insulator Manufacturing Company, of Victor, N. Y. Mechanically, the insulator is said to have an ultimate strength ranging from 11,000 lbs. to 14,000 lbs., the former being the lowest value obtained under test and the latter the maximum value. Electrically, the

[illegible]

insulator relies upon two pieces of porcelain—a short inner shell and an outer flaring one. These shells are tested individually at a potential of approximately 60,000 volts before assembling and the assembled insulator is tested at a potential in excess of 90,000 volts, for a period of five minutes. In order to approximate actual operating conditions in the face of a rain, the first test applied upon this suspended type of insulator was carried out by throwing water from above at an [illegible]

[illegible] MISSION LINE.

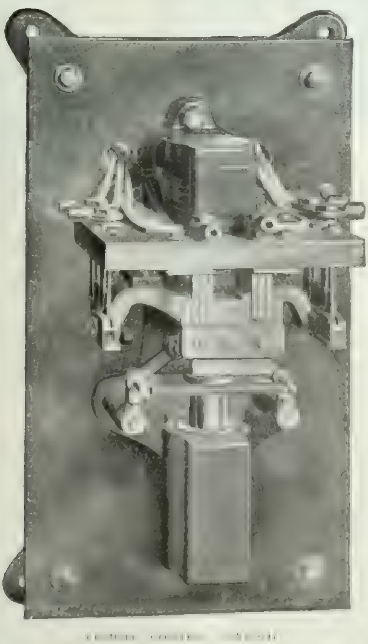
was found later, however, that water could not be thrown in an evenly distributed manner by this means and six nozzles were arranged to throw water against the suspended insulators consisting of five units. Repeated tests showed that if [illegible]

would ultimately wet the entire surface of the insulator so that one, two or twenty minutes was no reliable test under precipitation. Three other nozzles were, therefore, placed along the floor immediately below the insulator and directed so as to throw the water up under the shells, causing the insulator to drip at every point within a minute or two after the water was applied. The insulator under this condition possesses, of course, no property other than would be possessed by the film of water extending from line to line and the resistance of this film of water is all that can reasonably be expected to limit the flow of electricity. To determine the current flowing under these conditions an ammeter, capable of measuring currents as low as .015 ampere, was inserted in the high-tension circuit. Under a tension of 150,000 volts, and with water thrown from every direction and the insulator entirely wet, no appreciable leakage was shown upon the ammeter and the potential was raised to very nearly 200,000 volts before any marked disturbance could be observed. Assuming that five units would be employed and that the insulator would be subject to rain as in practice, it was found that the insulator could operate without disturbance at 225,000 volts, and that ultimate breakdown was somewhere between 240,000 volts and 250,000 volts. With a star-connected 100,000-volt line, with grounded neutral, the factor of safety would, therefore, be over four. The leakage distance of each of the units is 24 ins.

Remote Control Switch.

The Sundh Electric Company, 113 Cedar Street, New York City, has just introduced a new form of switch, which is herewith illustrated. This switch has been designed for the remote control of lighting and motor circuits, and can be used for either direct or alternating current. By its use the running of heavy conductors to the point of control can be avoided.

The switch is designed for either one, two, three or four poles. The action is as follows: The closing of one side of



[illegible]

[illegible]

[illegible]

solenoid after the work has been completed, and closes the circuit to the other solenoid. This latter action prevents arcing at the controlling switch, as it will never have to open a circuit. By the closing of the other side of the pilot circuit, the opposite effect is produced.

Electric Train Lighting.

An electrically lighted train is one of the advertised luxuries of modern railway travel and the safety and convenience of individual electric lamps has resulted in many schemes for the generation of the necessary electricity. In practically all the methods in use an axle-driven generator or single steam-driven unit on the baggage car or engine is employed, generally in connection with an auxiliary storage battery. The General Elec-

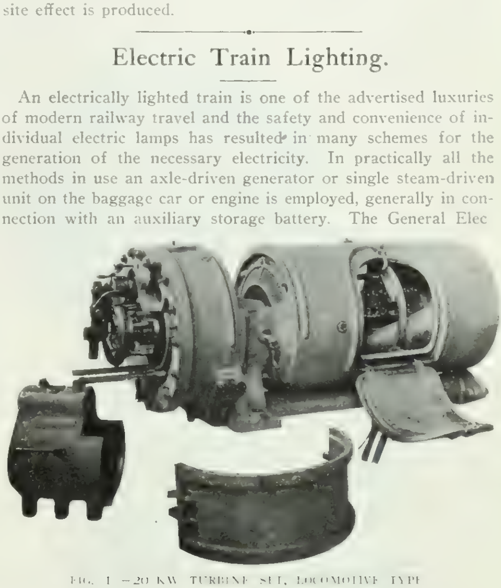
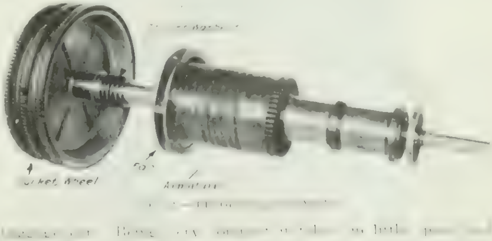


FIG. 1.—20 KW. TURBINE SET, LOCOMOTIVE TYPE.

tric Company manufactures and has in successful operation on several of the leading railroads, a small Curtis turbo-generator set as the source of electricity. For suburban service or continuous runs, where the locomotive is not detached, this set may be used without the storage battery, thus appreciably reducing the first cost and maintenance.

The inherent simplicity and the freedom from reciprocating parts, which are characteristics of this set, make it of value in train lighting. Two types of turbines have been devised, one intended for operation directly on top of the locomotive boiler and the other built to fit compactly in the baggage car. By mounting the turbine on the locomotive it is possible to make the steam connections very short and all flexible steam connections are eliminated. On the other hand, if the design of the locomotive is such that there is not room for the turbine, the absence of vibration makes it feasible to place the unit in the



[illegible]

[illegible] even when the train is not in motion there is no vibration such [illegible]

Three sizes of turbine are available for locomotive service, namely, 15, 20 and 25 kilowatt sets. These sets have only two bearings, the revolving element being a single unit without couplings. The bucket wheel is machined from a solid blank [illegible] iphery. It is forced with a taper fit on the shaft just outside of [illegible] yond the wheel, acts as a nut to hold the wheel in place.

[illegible]

packed with a special form of metallic packing and screw glands are provided for taking up wear on the packing. The bearings are ball seated and babbitt lined. The main bearing is provided with thrust washers at each end to maintain the alignment of the buckets and to take up thrust due to shocks in coupling cars. Lubrication of the bearings is effected by oil

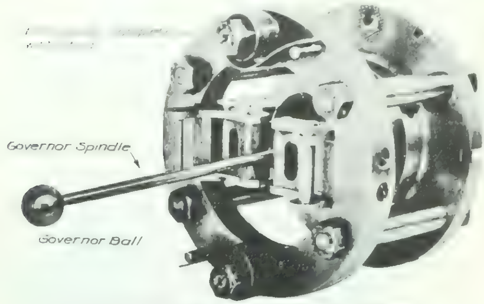


FIG. 3.—GOVERNOR, NON-CONDENSING TURBINE.

rings dipping in wells of large capacity, and special means are provided to prevent oil throwing.

The governor is of the centrifugal type and operates a valve through an oil lubricated ball and socket joint and a single lever of simple construction. This valve controls the whole supply of steam to the nozzles. In order to guard against excessive over-speed in case of accident to the main governor, an emergency valve is also provided. This is tripped by centrifugal device called the emergency spring, two of which are mounted on the governor frame.

As this set is exposed to the weather, it is entirely enclosed and is provided with a fan for ventilation. Special precautions have been taken to exclude rain and snow. Large covers are provided over the governor, main bearing and brushes. These are similar to those used on railway motors, being packed with

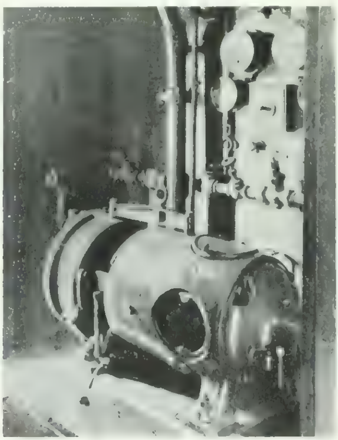


FIG. 4.—TRAIN LIGHTING SET INSTALLED IN BAGGAGE CAR.

felt and fastened with special clamps requiring no tools to loosen.

For the baggage car the sets are of the same general construction as the locomotive type machines, except that no rain shields or special ventilating features are provided. The 25 and 35 kilowatt sets have forced lubrication. Oil rings are also provided as an auxiliary.

While it would be absurd to contend that the introduction of steam turbines on locomotive or in baggage cars does not increase the coal consumption, it is quite true to say that this increase in the consumption is so little as to have caused no comment by railroad officials, or complaint from locomotive firemen.

Conditions vary widely in different installations, and the extra duty imposed upon the fireman on account of matters entirely apart from the lighting of the train, such as the weight of the train, condition of the weather, condition of the track, etc., entirely overbalance the amount of extra coal he has to handle on account of the insignificant steam consumption of the steam turbines.

Alternating Current Arc Lamp for Multiple Circuits.

The multiple circuit alternating-current arc lamp made by the Westinghouse Electric & Manufacturing Company is of the rocker arm type as distinguished from lamps operated by a direct lift. The magnet consists of a single coil with an E-shaped armature. The fireproof winding is suspended from the central tube by phosphor-bronze springs and is also provided with loops, each loop changing the current by one-half ampere when cut in. The armature is designed to give a uniform pull throughout its entire range and is suspended from the rocker arm by a spring. The rocker arm is supported on the phosphor-bronze pivots, the bearing itself being supported from the central tube. The dash pot is of the vacuum type

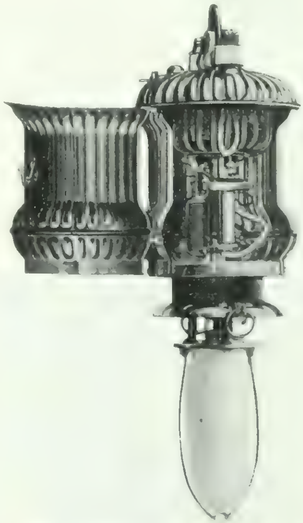


FIG. 1.—LAMP WITH DOOR OPEN.

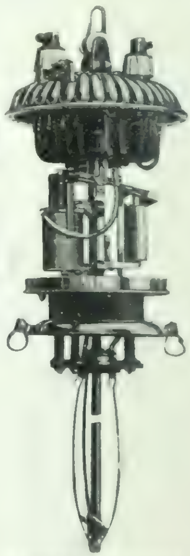


FIG. 2.—LAMP MECHANISM.

with a hollow graphite plunger. The clutch rod and balance weight are attached to the opposite end of the rocker arm from the armature. The clutch consists of a porcelain ring enclosed in a copper band. The door shown in Fig. 1 forms one-third of the case and affords ready access to all parts of the mechanism. It is strengthened and braced to insure rigidity and when closed, forms a water-tight joint. The lamp switch is shown in Fig. 3. The handle of the switch is pressed from composition metal and an inverted cup which forms part of the handle covers the opening in the cap and prevents leakage at this point. The switch blade is formed of vulcabeston with a copper button moulded in its end and so placed that a movement of the handle brings it in contact between the head of a brass bolt to which one binding post is secured and a heavy piece of spring brass attached to the central tube. The choke coil is attached to a metal punching which forms the base of

the hanger so that the housing of the central tube is relieved of its weight. The coil is made up of a number of separate coils on a laminated iron core and provides sufficient reactive resistance for use on 120-volt circuits. The voltage adjustment is shown in Fig. 2. A flexible cord connected to one lamp terminal has upon its lower end a screw connector which is connected to one of the loops between adjacent windings of the choke coil. Each loop gives a variation of from 3½ to 5 volts, depending upon the line voltage and the current for which

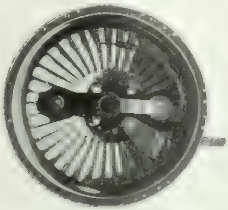
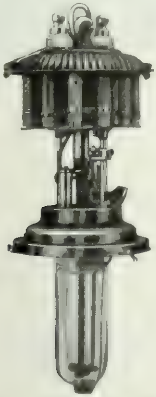


FIG. 3.—INTERIOR OF LAMP CAP, SHOWING SWITCH.

the lamp is adjusted. The lamp may, therefore, be adjusted in small steps for operation on potentials between 100 and 120 volts. Both the voltage adjustment and the adjustment for 7200 or 16,000 alternations are within easy reach of the door. The upper carbon sheath is electrically connected to the central tube by means of a flexible cord. The gas check is made of metal with a lava center and also serves to carry the single side rod and inner globe support.

Miniature Arc Lamp.

The accompanying illustration shows a miniature arc lamp brought out by the American Arc Lamp Company, of Kalamazoo, Mich. A feature of the lamp, aside from its size, is the fact that the unit system of resistance is employed in its construction. There are many lamps now on the market employing this system of resistance; but these are composed mostly of from two to four units. In the American lamp the resistance is made up into 12 units, any one of which can be detached and replaced with the same ease as a cartridge fuse. This



MINIATURE ARC LAMP.

makes the replacement and adjustment of the resistance an easy matter. Another feature of the lamp is a rotary switch having four points of contact so as to guard against arcing. The lamp is equipped with either 5/16-in. carbons or ⅜-in. carbons and has a nominal rating of from [illegible] to [illegible] candle-power. It thus fills a gap between the highest candle-power incandescent lamp and the standard enclosed arc lamp. The lamp is built for multiple circuits only and for direct current, the alternating current lamp not having been developed as yet.

Recent Improvements in Electroplating Apparatus.

Although electro-deposition is one of the oldest arts in which electricity is practically employed, some remarkable improvements have been made in it during the past few years. One of the most novel of these is a mechanical device for plating small articles, such as screws or pins, which formerly had to be strung by hand on wires or plated in baskets. These are now dumped into a porous barrel placed into the plating solution and revolved by machinery. While plating barrels are not entirely new, the one shown in the illustration is noteworthy in being a commercial device depositing metal uniformly and reducing the time of operation.

The electroplating apparatus of the Hanson & Van Winkle Company, Newark, N. J., consists of a tank containing the solution, in which a barrel made of perforated wood, wickerwork or other suitable material is completely submerged. Into this barrel the articles to be plated are dumped, and, consequently, make contact with the cathode terminals which are suspended from the conducting shaft inside the barrel by means of short sections of chains. The barrel is revolved by a pulley outside of the tank, and while the deposition of the metal on the articles is going on, they are being tumbled about, until, by the time the work is completed, they have taken on a comparatively bright polish. This polish, which is incidental to the plating, and which may be called a by-product, is a very valuable feature, since it saves buffing in many instances and therefore the further handling of the pieces.

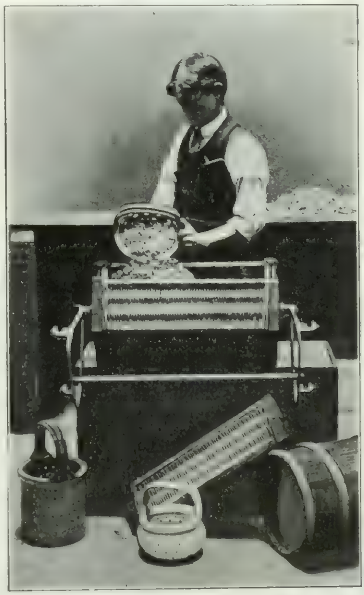


FIG. 1.—MECHANICAL ELECTRO-PLATER.

All of the faults found in previous apparatus of this kind have been remedied, the working parts having been greatly simplified and the exposed conducting surfaces reduced to a minimum. Although the drive is on the outside, which eliminates running the belt in the solution, the plating barrel is easily and quickly removable at any time without throwing off the belt or in any way interfering with the drive. This result is accomplished by the use of a feather and clutch on the shaft just inside the tank—that is, the end of the pulley-shaft is slotted and the end of the shaft to which the basket is attached slips into it so that when they are thus joined

[illegible] metal portions sustaining and rotating the barrel are covered with hard rubber, the electrical contact between the source of current and the shaft or work rod carrying the flexible cathode, contacts being made through the hangers and shaft

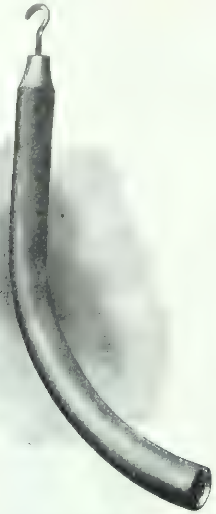
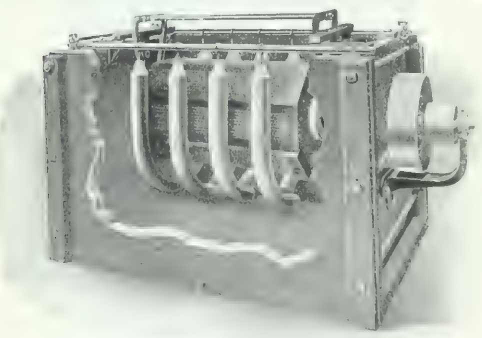


FIG. 2.—CURVED ELECTRO-PLATER.

connections. Where very light work it to be plated, celluloid barrels, with small holes punched very closely together, are used. For medium-sized work, wood barrels are generally used, and if the articles require a heavy deposit, so that they can be buffed and polished, the barrels are cylindrical in form; if, however, it is only necessary to impart a preliminary polish to the articles to be plated, baskets octagonal in shape give the best results. For heavy work, such as parts of stoves, etc., barrels of wood are employed.

Silver, nickel, copper, brass and zinc, in fact, all solutions, with the possible exception of gold, have been successfully operated with these electro-mechanical plating devices, and



[illegible]

for galvanizing small articles, such as bolts, nuts, washers, etc., there is no quicker or cheaper method.

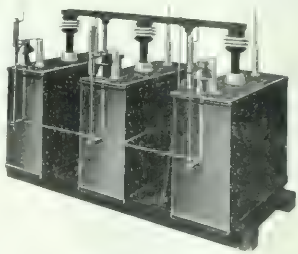
The dimensions of the barrels vary from 14 ins. in diameter and 24 ins. in length to 24 ins. in diameter and 48 ins. in length.

With the increased demand by manufacturers for nickel-plating equipments the tendency has been to use larger tanks and these require anodes of increased dimensions. To meet these conditions properly many arrangements have been tried, the usual ones being to crowd a large number of plates into the tanks or to use irregular forms of anodes with cumbersome attachments. These experiments led to the invention of anodes having elliptical cross-sections by the Hanson & Van Winkle Company, and where its mechanical electroplating apparatus is used the free ends of the elliptic anodes are curved as shown. It is obvious that these curved elliptic anodes are practically equi-distant from the work at all times, for they practically surround the barrel or basket, while their peculiar shape and relatively small cross-section permit of a much more even distribution of the metal and a better circulation of the solution. Two speeds are provided for the mechanical electroplater, the high speed being used where the articles to be plated are without sharp edges and can be tumbled very rapidly. The slower speed is used for more delicate work.

High Voltage Switch and Circuit Breaker

The Kelman high-voltage switch and circuit breaker, illustrated herewith, is the result of careful research and rigid tests under all conditions arising in constant service on systems of large capacity. The switch is made with any number of poles desired, each in a separate tank, and with a double horizontal break in each. The fixed contacts are mounted on porcelain insulators of special design, giving very high insulation and ample mechanical strength, the insulators being mounted on a wooden support placed well down in the oil. The movable contacts are attached to a rod of treated wood, and between this rod and the operating mechanism is a porcelain insulator. The leads, which are thoroughly insulated with varnished cambric, are brought out through the cover in porcelain tubes extending well above the surface.

The operating mechanism consists of a simple arrangement of levers, perfectly counterbalanced, making the switch or circuit breaker very easy to operate. The contact blades are part



HIGH-VOLTAGE SWITCH.

of a simple pantograph by means of which, while the movement of the operating mechanism is in a vertical direction, the break is in a horizontal direction and occurs well down in the oil. The circuit breaker is the same as the switch, except for the addition of the tripping mechanism, and springs for opening the breaker when tripped. The tripping mechanism is very simple in design and is so made that it is necessary for the trip coils to exert only a slight pull to release it while at the same time it is secure against accidental opening. It cannot be held in a closed position when an overload or short circuit exists on the line, as the instant contact is made, the action of the trip coils disconnects the handle and the breaker opens.

A radical departure from the general practice of using expensive series transformers in the line and energizing the trip coils from their secondaries, is made in placing the trip coils directly in the line, the movable core being thoroughly insulated from the tripping mechanism. For star-connected systems a coil is placed on each leg of the circuit, any one of which will trip the breaker in case of trouble on that wire only. For delta-connected systems two coils only are necessary with each breaker.

This is probably the first high-voltage circuit breaker to be operated by means of trip coils placed directly in the line, dispensing with the need of series transformers. All parts are

accessible. The entire construction is such that repairs can be made in the shortest possible time.

These switches and circuit breakers are manufactured by J. N. Kelman, Los Angeles, Cal.

The Electric Soldering Iron.

In order to heat the tip of a soldering copper electrically one must depend upon the thermal conductivity of the metal, which means that the heating element must be raised to a temperature somewhat in excess of the required temperature of the tip—about 550 degs. Fahr. In the Economy electric soldering iron, illustrated herewith, the heating element is a wire of special alloy insulated with mica. It is so placed in a hollow section of the copper that the heat produced is rapidly conducted to the tip of the iron with the minimum amount of loss. The temperature elevation of the heating element above the tem-

ECONOMY ELECTRIC SOLDERING IRON.

perature of the tip being low the useful life of the iron is long. Moreover, the surface for radiating the heat being properly proportioned for the power normally consumed in the heating element, the temperature of the tip cannot rise above a certain safe value, even when the iron is left in circuit continuously. Each iron is equipped with flexible leads of the best approved cord, the terminals of which are brazed directly to the heater. The plug to which the other terminals are attached is also of an approved form, and it is stated that the entire construction has been approved by the fire department.

This type of iron is being put on the market by the electrical department of the Art Machine Company, Fulton Street, Brooklyn, N. Y.

Insulators for High Potentials.

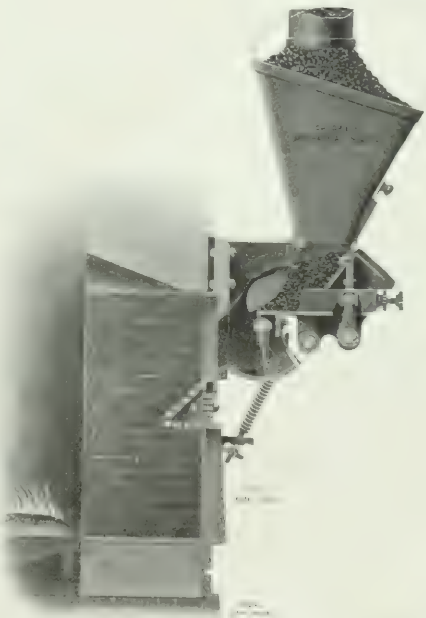
The insulator shown herewith, made by the Lima Insulator Company, of Lima, N. Y., is intended for use on lines carrying electrical energy at pressures of 100,000 to 150,000 volts. They have been designed and patented by Mr. F. M. Locke for service above the 100,000-volt potential. They have been tested up to

INSULATOR FOR HIGH [illegible]

[illegible] volts [illegible] showing the usual static stresses, and are approved as efficient by electrical engineers for this class of work. Mr. Locke has installed at Lima, N. Y., a 450,000-volt transformer of large capacity for the testing of these insulators intended for extremely high voltages upon which the Lima Company is concentrating its attention.

Automatic Mechanical Coal Shovel.

The accompanying illustration shows the Caldwell automatic mechanical coal shovel, brought out by the Sarco Fuel Saving & Engineering Company, Cedar and West Streets, New York. Unlike other stokers on the market, the shovel strews the coal on the grate much after the manner of hand firing. A reciprocating arm deposits small charges of coal on an apron in front of a pendulous shovel, the edge of which swings close to the bottom of the apron. The shovel is drawn backward by a cam and tappet to a point of release, when it is swung swiftly forward under the action of a spring. In passing, the shovel swipes the coal lengthwise a distance depending upon the tension of the spring onto the grate. A stronger degree of tension is imparted to the spring at each throw by a simple mechanism so that the coal is thrown at each throw to a correspondingly farther distance upon the grate. The change from greatest to least tension, as well as the many intervening degrees of tension, is made automatically. With an allowance of one



[illegible]

shovel to about each 3 ft. width of furnace, the result is said to be a very uniform distribution of the coal to all parts of the grate regardless of its length or width. It is evident from the above description that the shovel bears no relation whatever to the grate and hence differs radically from the usual stoker. Its function is merely to replace hand firing by mechanical firing and any type of grate whatever may be used in the furnace. Cleaning, ash removal, etc., are performed exactly as in the case of hand-fired furnaces. The shovel is adapted for all kinds of coal, from the best to the poorest, and is especially useful in firing the smaller sizes of anthracite. [illegible] furnished as in hand firing, the latter can be resorted to at any moment. The shovels may be operated from a motor or steam-driven shaft as in the case of mechanical stokers.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Commercial activity was generally satisfactory, and negotiations for fall and winter trade show no loss of confidence as to the future. At a few points the weather has not favored crops. Extremes of abundant moisture, cool weather, or continued drouth are noted in different sections, causing improvement in some instances, arresting development in others, and in places working damage of a more or less serious character. Fall jobbing trade has improved at most large centers, yet there is a noticeable undercurrent of conservatism in buying. Several New England mills lack adequate water power because of the prolonged drouth, and the money market retards numerous undertakings. Collections are also slower in some cases because of the financial situation. Railway earnings thus far reported for August exceed last year's figures by 7.1 per cent, and foreign commerce at the port of New York for the week shows gains of $5,211,691 in imports and $874,571 in exports as compared with the corresponding week last year. The metal markets experienced no particular changes during the week. New business in structural material, mostly for bridge work, is good, and further heavy orders are pending. Demand for steel rails was slack. The slowness of collections, particularly from the railroads, is a source of complaint throughout the entire iron and steel trade. Copper is lower. Electrolytic is quoted at as low as 17½ cents, which quotation is 1 cent per pound under the figures at this time last year. Some business was done with Europe, where stocks are said to be short, but domestic trade is light. Consumption here has declined, and it is stated that producers' stocks are very heavy. The closing quotations are: 18¼c. for Lake; 17¾c. for electrolytic and 17¼c. for casting stock. *Bradstreet's* reports 167 business failures during the week, against 153 in the week previous and 138 in the corresponding week last year.

INSULATED WIRES.—A series of articles on insulated wire manufacture is appearing in the *India Rubber World*, from the pen of a "practical man." The following passage is of interest to users of wires and cables: "The chemist is of the greatest value in disclosing adulterations when they occur in the various minerals used in compounding. He can tell you a whole lot about percentages of resins in new gums, and has assisted materially in the selection of such as are peculiarly suitable for wire insulation. To him are sent samples of all the factory compounds, that the percentage of free sulphur and acetone extract may be of record. He is also interested in the specific gravity of each compounded stock, and knows to what extent a given gum, or mineral, or shoddy, affects its insulation qualities, elasticity and durability. Always he has to keep in mind that compositions that do not make for good insulation are of no value in this business, however great their qualifications in other directions may be. Consequently he favors compounds containing zinc, lime, magnesia, antimony, pentasulphide, etc., because they tend to improve insulation. His laboratory experience makes him acute in diagnosing hard cases. An illustration: A superintendent went to his chemist, much perturbed because a certain standard stock had, in less than a year's use on wire, shown marked signs of deterioration. Review of the history of the compound checked up all right to a date when a new gum costing somewhat less than the first used had been substituted. Early samples and electrical tests had been satisfactory, but chemical analysis now discovered an unusual percentage of free sulphur in the insulation, and that the new gum contained a large proportion of resin. In view of the fact that the compounder could not have leased his formula on the possible resin in the gum, the chemist suggested that the extra resin had absorbed such a proportion of the sulphur item in the compound as to leave an insufficient quantity for vulcanization; hence it followed that the insulation, being under-vulcanized, lacked the one element necessary to its durability, and 'perished' prematurely."

STEAM RAILROAD STATISTICS.—That useful publication, Poor's Manual for 1907, just issued, contains 2000 pages, and its statistics of the American railway systems for the year ending 1906 are highly interesting and instructive. The average receipts per passenger per mile in 1906 was 2.011 cents, as against 2.028 cents in 1905. The average revenue per ton per mile in 1906 was 0.766 cents, as against 0.784 cents in 1905. The total length of steam railroads completed on Dec. 31, 1906, was 222,635.18 miles, as against 217,341.02 miles at the close of 1905, an increase of 5,294.16 miles. The actual construction during the year was 5,516.70 miles, but the net increase was smaller owing to mileage abandoned, transferred to side track, or equipped with electricity. The increase in bonded debt during 1906 was $425,845,877, the total funded debt of the steam railroads of the United States being $7,851,107,778 at the close of 1906, as against $7,425,261,901 at the close of 1905. The increase in capital stock was $364,452,151, total stock at the close of 1906 being $7,106,408,976, as against $6,741,956,825 at the close of 1905. The total increase in liabilities of all kinds, including stock, mortgage bonds, real estate and equipment bonds and floating debt, was $1,199,615,367. The total assets of the steam railroads of the United States at the close of 1906 was $17,534,381,633, an increase of $1,241,500,810. The surplus of assets over liabilities was $766,014,237, an increase of $41,885,443 during 1906.

THE STEEL TRADE is an index of general conditions. Mr. C. M. Schwab, discussing it, says: "I am optimistic and my optimism is based on the fact that during the past 30 years in which I have been identified with the steel and iron business, there has been a constant increase, almost year by year, and it is not going to stop now. Bear in mind that the more steel there is in use the more there is required. It takes 2,000,000 tons of rails each year to replace the worn-out rails. Increased railroad facilities which the normal growth of the country requires means increased demand for rails. The extension of our railroads is obviously necessary, and the increase in our steel-producing capacity follows as a matter of course. The increase in demand will most assuredly go on, and those who saw 1,000,000 tons of steel used in 1880, 14,000,000 tons in 1900, and nearly 25,000,000 tons in 1907 will live to see the time, not so many years hence, when we shall need 50,000,000 tons of steel. I am bullish on the future, extremely bullish. All records in the steel and iron trade will be eclipsed in the not too distant future. Do not misunderstand me. We may have, we shall have, recessions, but the ultimate result is never in doubt. There will be continued increase in demand and increase in output."

LARGE CAR SHOPS.—The New York & Queens County Railroad will develop a tract of about ten acres of meadow land on the north side of Jackson Avenue, about an eighth of a mile west of the new Flushing bridge, which was recently purchased from the Degnon Contracting Company. It is the intention of the company to spend about $250,000 in establishing at this point a large and complete storage yard and repair shop for cars in Queens Borough. The plant is to care for the cars on the Jackson Avenue, Corona, Jamaica and College Point lines, and on the Whitestone and Bayside extensions when completed. These lines are the most important belonging to the company.

McKESSON & ROBBINS, of New York, have commissioned Dodge & Day, engineers and constructors, of Philadelphia, to make the additions to their present power plant. The addition will include a new engine, generator and necessary changes in the piping, wiring, etc. Messrs. Dodge & Day made a report on power requirements for this concern some time ago, and the present work is the result of that report.

TROLLEY IN ASIA.—An American consul in Asia writes that permission for the construction of an electric railway has been granted in his district. The length of the proposed line is about 70 miles, and the estimated cost is about $700,000. Details can be obtained from the U. S. Department of Commerce and Labor, Bureau of Manufactures.

BIG CUT IN COPPER.—On Tuesday of this week, the United Metals Selling Company reduced its quotation on electrolytic from 22 to 18 cents a pound. At the same time, Lake copper was cut to 18⅛ cents. The same quotations were announced by Phelps, Dodge & Company. Both these concerns have adhered to the quotations announced, when the price of copper was cut from around 26 cents a pound in July, and the consequence has been that they have seen the metal accumulate while their rivals sold at reduced prices all that the narrow market would take. The United Metals Selling Company, which markets about 60 per cent of the copper output of this country, has sold very little copper since last February and March, when the manufacturers, fearing a shortage of supply, loaded up with sufficient metal to last, as they thought, until the end of June. About that time the demand from the consumers began to fall off, and the metal then contracted for by the manufacturers has lasted them ever since. A considerable number of the wire and sheet-metal makers have copper enough to last until October, it is thought, and the prediction is heard that the selling companies may have to come down still further before the users of the metal felt inclined to buy in quantity. It was said at the office of Phelps, Dodge & Company that large lots of electrolytic copper had been sold for September delivery at 18 cents, and that the offer held good for October delivery. The largest part of the copper sold at this figure is for export. On the New York Metal Exchange, copper was quoted on Tuesday at 17½ to 18 cents for Lake and 17¼ to 17¾ for electrolytic.

POWER IN SOUTH CAROLINA.—Dr. W. Gill Wylie, president of the Southern Power Company, has been South in conference with Mr. W. S. Lee, vice-president of the company. Dr. Wylie says it is impossible for the Southern Power Company to develop power quickly enough for the demand. The 45,000 electrical horse power of the Catawba and Great Falls stations has already been contracted for and new calls for power are received almost daily. He says all the men that can be advantageously worked are now busy at Rocky Creek, S. C., and that the output of this plant will be double that at Ninety Nine Islands, S. C., on the Broad River. When the Rocky Creek plant is completed the company will in a measure be able to supply the demand of cotton mills in North and South Carolina for power, and will give more time to the development of the smaller power sites at Fishers Creek, Watteree, etc., which in all totals about 150,000 hp. The Southern Power Company is selling its output at $20 a hp-year, which is only half that the mill owner is paying for service to-day. An idea of what this means may be got by estimating the total capacity of the mills in North and South Carolina at 200,000 hp, for which the mill owners have been paying $8,000,000, but with the power at $20 a hp-year a net saving of $4,000,000 per annum will be made in these two states, which will cut some figure in the competition with Northern mills.

AMERICAN ELECTRICAL WORKS.—It is announced that the American Electrical Works at Phillipsdale is to be enlarged, the E. K. Watson Company having just received the contract for the erection of three large buildings and a 175-foot chimney. The erection of these additional buildings on the Seekonk has been made necessary by the Washburn Wire Company's intention to vacate the present Auburn buildings, recently purchased by the General Fire Extinguisher Company. The Washburn Wire Company is a subsidiary company of the American Electrical Works and the location chosen is close beside that of the latter company. The new buildings will include a wire mill 164 feet long, 71 feet wide and two stories in height, an annealing mill 90 feet long and 84 feet wide and one story in height, and a large boiler house 150 feet long and 50 feet in width. In conjunction with this a brick smokestack will be erected which will be 173 feet in height with a flue of 7½ feet. The wire mill is to be of standard mill construction with a steel truss roof so as to have a clear span and the building will contain many wire doors in order to furnish an abundance of light. All the modern appliances will go into the construction, including up-to-date sanitary accommodations. The boiler house will have a steel truss roof supported on steel posts with a 12-inch curtain wall.

DOWNIEVILLE, CAL., POWER.—Work has commenced on a large dam at Gold Lake for the Sierra Mercantile Mining & Power Company, a corporation that proposes to furnish power to operate a short line electric railroad between Marysville and Reno, through the Yuba pass. A similar dam is to be constructed at Long Lake, in Plumas County, and the pipe will be laid down Gray Eagle Creek, which will converge at the power plant with a similar pipe line down Fraser Creek from Gold Lake, where all the waters will be combined and utilized. The contour of the ground permits of this being done with facility. There is no record, it is claimed, of any fall equaling this yet in any electrical construction, and it will require but a small volume of water to accomplish under such tremendous head results that would require many times larger volume of water under lower pressure. The power plant will be located on the Feather River, near Denton, on the line of the Western Pacific Railroad. In addition the company owns the waters of the Four Bear Lakes and Long Lake in Plumas County. These waters are situated about 2000 feet above the power plant, and six miles distant. The combined waters of these lakes are capable of generating about 20,000 hp.

WESTERN ELECTRIC AND COPPER.—The Western Electric Company is alleged, in the Boston *Advertiser*, to have been largely responsible for the change in sentiment among the copper consumers. The American Brass Company furnishes the bulk of the copper wire for the Western Electric Company and it had covered that company's prospective wire requirements with the metal up to July 1. The Western Electric Company, however, last June cancelled all its wire orders and left the American Brass Company with more copper on hand than it needed. The result was that the company immediately asked the refineries to defer shipments, a situation which disarranged plans all along the line. The Edison Company, of Boston which uses about 1,000,000 pounds of copper a year in its finished form, will not be in the market as a purchaser of copper again this year. Early in March the company purchased about 450,000 pounds of finished copper at high prices which places its supplies in such a position that no further copper will be needed until the new year.

LIGHTING IN SAN FRANCISCO.—The Board of Supervisors of San Francisco have awarded the contract for furnishing light to the municipality to the San Francisco Gas & Electric Company. The rates are as follows:—Each separate gas lamp per night, $0.087. For each separate arc lamp per night, $0.20713. For gas for public buildings per 1000 cubic feet, $0.60. For electric energy for public buildings and for motor purposes, per kilowatt hour, $0.04. The company is to light the streets with no less than 4210 gas lamps and 1616 electric arc lamps or more. Of the arc lamps 1366 shall burn all night and 250 may be extinguished at midnight, but only with the Supervisor's consent. The total payments made to the company must not exceed the amount of the appropriation, $275,000.

A LARGE SIGN.—One of the largest electric signs in the world has just been erected by the Oliver Chilled Plow Works at South Bend, Ind. This sign surmounts the plow company's new five story warehouse, extending the entire length of the building, a distance of 250 feet. The highest point in the letters in the trade-mark portion of the sign is at the center, 42 feet above the base line, and the letters in the word "Oliver" and "Works" are each 81 feet high and 14 feet wide. The trade-mark is also shown in a plow 59 feet in length. A total of 3200 lamps is required to properly illuminate this mammoth sign and the light sent out casts its rays over the entire quarter of the city in the neighborhood of the Oliver factory.

KANSAS CITY ENGINEERING.—The engineering firm of Burns & McDonald has removed its offices from the Dwight Building to 821-3 Scarritt Building, Kansas City, Mo. At its new location it is desirous of securing new editions of all trade catalogues that bear on waterworks, sewers and electric lighting and power. It has recently received bids for sewers at Fayetteville, Ark., and is now preparing plans and specifications for the remodeling of the waterworks at Concordia, Kan.

EXPORTS TO GERMANY.—In July, 1906, the value of American electrical apparatus exported to Germany was $20,992; in July, 1907, it was $20,906. The corresponding values of electrical machinery were $4,321 and $5,495.

DEVELOPMENT IN INDIA.—The Bombay Government is granting a license to Killick, Nixon & Co., of Bombay, for the supply of electrical energy for all purposes, including traction, in the cantonments of Poona and Kirkee.

[illegible] plans just noted for operating the Sacramento Division of the [illegible] Stockton, Cal., has special interest: "The unlimited manner in [illegible] in Tuolumne county has led to the belief that the Southern Pacific Railroad officials are preparing to operate their trains by electricity. They have been quietly working on the proposition for months under cover, but the tip is out here that the railroad owns all four of the big Sierra systems. For months money has been spent in Tuolumne county in large sums. Some assert that the expenditures on the new power line have already reached over $3,000,000. The work has been carried on regularly on a most expensive scale. Large reservoirs are being constructed and a costly power line is being completed. Large towers will be used instead of the usual poles. It is estimated that $10,000,000 will be spent on this undertaking alone. While it has been surmised that the Southern Pacific has had in view suitable points for establishing large electric plants, it has only just become known that work was being carried on with that end in view. The four large systems will be located as follows: One just east of Sacramento, the second in Tuolumne county, the third in Fresno county and the fourth in Kern county. The latter will supply power for the southern part of the state, while the others will give power for the northern part of California, as well as all of the branch lines in this state. It has been learned that E. H. Harriman has plans for a fifth station in the Sierra, west of Lake Tahoe, to supply power for the trains crossing the mountains. About $6,000,000 is to be expended on this plant. It will be located on the Rubicon River, which empties into the American River, and will supply the Lake Tahoe Railroad. It will be known as the Rubicon Power & Water Company, and has already a permit from the Bureau of Forestry, which controls the reserve in the cañon. This particular system will also bring power to Stockton, Sacramento, Marysville, Oakland and other points. When all of these plants are completed the Southern Pacific will have an exceptionally strong chain of electric system throughout California and can supply an immense amount of power, in addition to operating all of its railroads."

GERMAN TRADE ACTIVITY.—Lieut. G. L. Carden, of the U. S. Revenue Service, has been investigating German trade conditions with a party of American manufacturers and professors. The two principal conclusions reached, in which all the members of the American party agree, are the extraordinary prosperity and extreme industrial advancement of Germany. All of the thirty-five works visited were crowded with orders, some of them having orders for years ahead. The Alsatian Construction Company of Mulhausen, employing 9000 persons, has orders until late in 1910. It was at Mulhausen that the Americans found gas engines being constructed up to 3000 horse-power. Lieut. Carden, who visited 350 German works in 1903 as a machinery expert for the St. Louis Exposition, was able to contrast what he saw during his present tour with what he saw four years ago. He said that the workshop effiency here had increased almost up to 100 per cent, the manufacturers everywhere having applied American methods of getting the highest capacity out of tools and machines. He found, however, that the Germans employ fewer American machine tools, most of those now in use having been made in Germany, although the highest class American tools are still imported. The feeling among the manufacturers of the party was that the United States will experience difficulty in beating Germany, and that the American superiority in systems of work and machinery of a few years ago has well-nigh been overcome.

WESTINGHOUSE ELECTRIC.—The July business of the Westinghouse Electric & Manufacturing Company was considerably above the average. The latest information from East Pittsburg stated that the railway department alone showed a record for orders booked approximating about $2,500,000. Among these were two of more than ordinary importance. The Brooklyn Rapid Transit Company contracted for 400 electric railway motors, 200 of which, of 200 horse-power each, are for the elevated railroad cars, while the balance of 60 horse-power each, will be surface car equipment. In connection with the elevated car equipment, the company will also furnish the Westinghouse multiple unit control. The other large order came from the Schoepf interests of Cincinnati, which control one of the largest urban and interurban electric railway systems in this country, operating cars in eastern and central Ohio and southern Indiana. This order includes a complete equip- [illegible] rotary transformers, transformers and switchboard appliances, as well as four Westinghouse turbo-generators aggregating 25,000 horse-power.

[illegible] plant of Greater Seattle, now supplying energy to 2000 incandescent street lamps of 30 cp each, 520 arc lamps of 2000 cp, in addition to lighting all municipal buildings, including the city hall, police station, public library, water stations, public school buildings and 6691 private consumers, will be trebled in capacity by Feb. 1. The lighting plant was completed in January, 1906, when the street lighting contract was taken over from the Seattle Electric Company, the 11 street lighting circuits being gradually increased until now there are 24. Establishment of the plant was made possible through a bond issue of $840,000. The constant demand for an increase of service became so insistent that a bond issue of $600,000 was deemed necessary in order to bring the plant up to the requirements, and it is from this issue the present additions will be made. The plant now has a capacity of 3000 kw and the addition of two new machines will increase this to 11,000 kw. Half of this increase in capacity will be available by the first of the year, and the remainder a month later. Mr. L. B. Youngs is superintendent.

APPARATUS FOR INDIA.—United States Consul-General W. H. Michael writes as follows from Calcutta: The Punjab Government has, under the Indian Electricity Act, granted a license to the Punjab Power Association for the supply of electricity to the city civil station and suburbs of Lahore. In the Government order granting the license the Association is stated to be represented by the following gentlemen: Maj.-Gen. Beresford Lovett, C. B., C. S. I., R. E., of Simla; Sir Thomas Highham, K. C. I. E., of Clifton, Bristol; Mr. W. R. Shaw, of Upper Norwood, London, and Prof. C. A. Carus-Wilson, of Westminster, London. The two former are retired Indian officials who had long service in this country.

WESTINGHOUSE ORDERS.—A large contract for lighting plant at Milan, Italy, has been allotted to the Societe Anonyme Westinghouse. The machinery to be supplied will include 5000-hp steam turbines, with three-phase generators. Another Italian order has been received from the Société Anonyme d'Electricité Rag. Carlo Zanichi et Cie., of Bergamo, Northern Italy, calling for the installation of a power generating station. The machinery will include two 2000-hp turbo-alternating sets, three-phase. The Westinghouse Company has also received a contract in competition with British firms for the electrification of the East India Railway Company's shops at Lillooah, British India.

NEW PLANT FOR COLUMBUS, OHIO.—Broad plans are said to be contemplated by the People's Municipal Power & Light Company, which was incorporated on Aug. 15. The promoters expect to use the surplus water power from the municipal storage dam north of the city to operate a generating plant, with an auxiliary steam-power plant for use when water is low. In return for this power the company plans to furnish energy at a low figure, perhaps five cents per kilowatt-hour, the price for which the city contended some time ago with the Columbus Railway & Light Company. The municipal pole lines would also be utilized by the company, thus eliminating another item of expense.

LONG DISTANCE TELEPHONY.—Advices from Boston state that the American Telephone & Telegraph Company has opened its long distance line between Kansas City and Denver, thus closing what has been known as the "gap" between the Eastern and Western telephone regions. The opening of this new line, however, will not make possible a coast-to-coast telephone service. In fact, the new route will be almost entirely used for local long distance service between the terminal cities.

NAPHTHA-DRIVEN DYNAMOS.—The Bureau of Manufactures is in receipt of a request from a New York business man that he be placed in communication with firms manufacturing naphtha motors with dynamo attachment for electric lighting. The apparatus is to be shipped to Russia.

The American Telephone & Telegraph Company has no lines in the extensive Western and Pacific States territory beyond Denver, so that, while it would be physically possible to get a telephone message from Denver to Seattle or San Francisco, it would be over the circuitous routes of the toll lines of the various local Bell companies, thus requiring one or more relays. At the present time telephone communication between Boston and Omaha, which is a little further West than Kansas City, is no uncommon occurrence over the long distance wires of the American Telephone Company. As matters stand to-day, even were a long distance line run from Denver to the Pacific Coast, it would not be possible to talk from Boston to San Francisco without relays unless a Pupin circuit does it in the near future.

NORTHWESTERN ELECTRICAL COMPANY.—According to Seattle, Wash., papers a large electrical manufacturing plant will be erected by the Northwestern Electrical Company, in the south end of the city, somewhere along the line of the Interurban, within the next few months. The articles of incorporation have been taken out. The capital stock is $250,000, and the incorporators are: A. Chilberg, E. C. Kilbourne, Nelson Grimsley, L. B. Steadman, F. A. Ernst, E. W. Forrester, A. E. Ransom, G. E. Smith, S. A. Flower. The company takes over all the patents, property and rights of the Seattle Electrical Heating & Manufacturing Company, a concern that has been doing business for some time. A. E. Ransom has been retained as general manager of the company, and J. E. Smith will be secretary and sales manager.

POWER FOR OREGON.—It is stated that plans have been practically completed for the erection of a $1,000,000 power plant on the headwaters of the Sandy River, a few miles east of Portland, Ore., to furnish electric power for the United Railways, which is building an interurban line between Portland and Salem. Negotiations are said to be now on with Eastern capitalists for the purpose of financing the construction of the plant.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was strong and showed some disposition to respond to the influence of promised relief to the money situation from the United States treasury. The prospective success of the new 4½ per cent issue of New York City bonds was also a factor, and the general list was not influenced materially by the adverse position of the New York local traction combination. Metropolitan Street Railway touched a new low point on Friday, going to 35, several points lower than on Aug. 17, when it made its sensational drop of 39 points from the last previous sale several

NEW YORK.

	Aug. 27	Sept. 3		Aug. 27	Sept. 3
[illegible]	[illegible]	[illegible]	General Electric	124	[illegible]
[illegible] pfd	[illegible]	[illegible]	Hudson River Tel...		
Am. [illegible] Tel	—	—	[illegible]	[illegible]	[illegible]
American Locomotive	[illegible]	[illegible]	[illegible] pfd	[illegible]	[illegible]
Amer. Locomotive pfd	[illegible]	[illegible]	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable	[illegible]	[illegible]	Mackay Cos. pfd	[illegible]	[illegible]
American Tel. & Tel...	104	[illegible]	Marconi Tel.	—	[illegible]
[illegible] Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry...	42*	[illegible]
[illegible]	[illegible]	[illegible]	N. Y. & N. J. Tel...	[illegible]	[illegible]
[illegible] pfd	[illegible]	[illegible]	Western Union Tel.	[illegible]	[illegible]
[illegible]			Westinghouse com...	[illegible]	[illegible]
[illegible] pfd			Westinghouse pfd...	[illegible]	[illegible]

BOSTON.

	Aug. 27	Sept. 3		Aug. 27	Sept. 3
[illegible] Tel. & Tel.	[illegible]	[illegible]	Mass. Elec. Ry. pfd...	50	[illegible]
[illegible] Telephone	[illegible]	[illegible]	Mexican Telephone..		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	108	[illegible]
General Electric	—	[illegible]	Western Tel. & Tel.		[illegible]
Mass. Elec. Ry.	13	[illegible]	West. Tel. & Tel. pfd..	67*	[illegible]

PHILADELPHIA.

	Aug. 27	Sept. 3		Aug. 27	Sept. 3
American Railways....	47	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Phila. Rapid Transit.	[illegible]	[illegible]
Elec. Storage Battery..	44	[illegible]	[illegible]	[illegible]	
[illegible] Battery pfd	[illegible]				

CHICAGO.

	Aug. 27	Sept. 3		Aug. 27	Sept. 3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	130	National Carbon pfd.		
[illegible]	[illegible]	[illegible]	Union Traction......		
[illegible]	[illegible]	[illegible]	Union Traction pfd..		
[illegible]		[illegible]			

[illegible]

[illegible] The [illegible] New York City Railway [illegible] per cent dividend [illegible] Metropolitan [illegible] stock subsequently [illegible]

was paid to the speeches made by Governor Hughes of New York, criticizing hasty methods in legislation or administration in connection with business, as well as to the opinions of the federal judges in North Carolina and Alabama, wherein the powers of the national courts in such matters as the controversies which have arisen in those states are firmly upheld. Trading was mainly confined to a few leading issues, Reading, Union Pacific and Amalgamated Copper being the most prominent in the active list. Electric and traction stocks showed firmness and strength, most of them closing at the highest quotations of the week. General Electric made a net gain of 6⅜ points; Brooklyn Rapid Transit 5½ and Interborough-Metropolitan, common and preferred, 1⅝ and 7¼, respectively. The closing quotations of Sept. 3 are given in the accompanying table.

ELECTRIC LIGHT EARNINGS.—Stone & Webster report the earnings of the following companies for the month of June, and for the twelve months ended June 30, 1907, compared as follows:

[illegible]				
June gross	$[illegible]	$[illegible]	Inc.	$[illegible]
June net	5,476	3,824	Inc.	1,652
June surplus overcharges	4,065	3,083	Inc.	982
12 months gross	[illegible]	[illegible]	Inc.	[illegible]
12 months net	[illegible]	[illegible]	Inc.	[illegible]
12 months surplus overcharges...	58,584	40,629	Inc.	17,955
[illegible] ELECTRIC COMPANY.				
June gross	$36,520	$32,165	Inc.	$4,355
June net	[illegible]	[illegible]	Inc.	[illegible]
June surplus overcharges	[illegible]	[illegible]	Inc.	[illegible]
12 months gross	345,979	286,612	Inc.	59,367
12 months net	[illegible]	[illegible]	Inc.	[illegible]
12 months surplus overcharges...	89,930	57,017	Inc.	32,913
[illegible] ELECTRIC LIGHT COMPANY.				
June gross	$15,570	$14,467	Inc.	$1,103
June net	5,407	5,358	Inc.	49
June surplus overcharges	[illegible]	[illegible]	Inc.	[illegible]
12 months gross	247,165	226,271	Inc.	20,894
12 months net	123,456	116,736	Inc.	6,720
12 months surplus overcharges...	89,705	82,986	Inc.	6,719
HOUSTON ELECTRIC COMPANY.				
June gross	$59,076	$51,158	Inc.	$7,918
June net	19,909	21,020	Dec.	1,111
June surplus overcharges	8,883	10,955	Dec.	2,072
12 months gross	634,521	558,301	Inc.	76,220
12 months net	221,290	211,655	Inc.	9,635
12 months surplus overcharges...	94,310	82,906	Inc.	11,404
JACKSONVILLE ELECTRIC COMPANY.				
June gross	$34,161	$26,846	Inc.	$7,315
June net	13,068	10,248	Inc.	2,820
June surplus overcharges	9,213	6,823	Inc.	2,390
12 months gross	366,765	296,125	Inc.	70,640
12 months net	134,713	110,810	Inc.	23,903
12 months surplus overcharges...	92,622	70,890	Inc.	21,732
LOWELL ELECTRIC LIGHT CORPORATION.				
June gross	$23,401	$19,733	Inc.	$3,668
June net	7,021	4,384	Inc.	2,637
June surplus overcharges	5,912	3,148	Inc.	2,764
12 months gross	294,952	267,547	Inc.	27,405
12 months net	[illegible]	[illegible]	Inc.	[illegible]
12 months surplus overcharges...	95,227	84,463	Inc.	10,764
WHATCOM COUNTY RAILWAY & LIGHT COMPANY.				
June gross	$27,362	$20,310	Inc.	$7,052
June net	10,588	6,345	Inc.	4,243
June surplus overcharges	3,931	2,586	Inc.	1,345
12 months gross	318,131	237,462	Inc.	80,669
12 months net	123,201	71,221	Inc.	51,980
12 months surplus overcharges...	59,617	32,201	Inc.	27,416

It will be noted that there was a good increase in every case.

FINANCIAL CONDITIONS.—According to Edey, Brown & Sanderson, the bankers and brokers, foreign financial authorities estimate that our obligations abroad are only about one-fourth as large as they were at this time a year ago, and consequently that when payment is made for this year's exports of agricultural and manufactured products, the net proceeds in excess of about $100,000,000 can be placed to our net credit, whereas last year at this time in the neighborhood of $450,000,000 would have been required to cancel our obligations to Europe. If the foregoing figures are only reasonably correct, it is easy to see that the American foreign trade position is remarkably strong and will enable us to draw heavily upon Europe if the occasion should arise, provided, of course, that European money markets at the time would warrant such action.

THE GENERAL ELECTRIC POWER COMPANY of California, at a recent meeting, created a bonded indebtedness of [illegible] Trust Company of New York. The amount is stated to be required for the development of the company's properties for the transmission of electric power, and also for the purpose of completing the Clear Lake and Southern Railroad Company's line. The bonds are payable in gold, maturing in thirty years, and [illegible]

SPRINGFIELD, MASS., UNITED.—The annual report of the United Electric Light Company, of Springfield, Mass., for the year ending June 30, 1907, shows that the company enjoyed a profitable 12 months. In summarized form the report compared with that of 1906, follows:

	1907.	1906.	Increase.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

W. A. Lincoln, treasurer of the company, points out after the payment of dividend, interest on indebtedness, payments into sinking fund and charging off for depreciation, the surplus amounted to only $7,000 to $8,000. The fixed charges, he said, total some $31,000, while over $70,000, or 5 per cent of the valuation of the plant, was charged off to depreciation. The company carries a floating indebtedness of about $300,000 and a bonded indebtedness of about $200,000, a total of $500,000. The plant is carried on the books at $1,400,000, and has cost, he stated, all of $2,000,000. The sum of $600,000 has thus been charged off to depreciation within the past 15 or 20 years, a sum probably larger than the total amount of dividends paid. At present the company has under way improvements, largely in the line of increased power-producing plant, that will cost in the neighborhood of $200,000. From the report it appears that the business of the company increased about 17 per cent within the year, while the expenses increased some 24 per cent, and the net income nearly 10 per cent.

CANADIAN GENERAL ELECTRIC.—At a special meeting of the shareholders of the Canadian General Electric Company, in Toronto, on Aug. 15, the capital was increased from $5,000,000 to $8,000,000. Mr. Frederick Nicholls, second vice-president and general manager, read the by-law authorizing the above change. Of the new issue, 20,000 shares were to be 7 per cent preferred stock. Each holder of the old preferred stock was given the option of selling his holding, or of having it redeemed with the new issue of this description of stock. Mr. Nicholls said that the company had an uninterrupted share of prosperity, and the last annual report contained every balance sheet of the corporation for the past 16 years. At present their company, he said, had $5,000,000 worth of work on hand, and $5,000,000 in liquid assets. The directors wanted to apply for letters patent to increase this stock and they could finance it in several ways. The company might stop taking orders for a time, and its $5,000,000 liquid assets would thus be worked up. He thought it would be wiser to increase the capital than to give business to the competitors of the company. The profits last year were over $800,000, and this year it seemed that they would be equally good or better. With profits of $853,000, the company was left $713,000, after the payment of deferred dividends. Mr. Nicholls stated that he had received an offer from England for the whole amount of the preferred stock at par, but he thought that the shareholders of the company might want it. The present issue of preferred stock had to be redeemed and the directors desired power to do it.

GENERAL ELECTRIC.—It is stated that stockholders of the General Electric Company have increased no less than 24 per cent in number since Jan. 1, 1907. At the opening of the year the General Electric Company had about 5400 stockholders. On Aug. 1 this number had grown to 6700, a gain of 1300 in seven months, or at the rate of about 200 per month, a remarkable increase. This increase is due in part to the January and April payments of 50 per cent each on account of the $10,861,200 new stock offered to stockholders in the early part of last December. It is also to be attributed to liberal investment buying in the recent decline to 120, at which price the stock yields nearly 6¾ per cent. On Jan. 1, the average number of shares of General Electric stock held by each shareholder was 117. On Aug. 1 the average had declined to 95 shares per stockholder. The company has a considerable potential increase in new stockholders in the subscribers to the recent issue of $13,000,000 convertible bonds, which, of course, will become known only as the bonds are converted. The new capital requirements of the General Electric have been averaging about $12,000,000 per annum in the last few years. An increase of 24 per cent is, therefore, of the greatest importance as indicating a broadening constituency upon which the company may draw.

SEATTLE ELECTRIC REFUNDING.—The Seattle Electric Company has filed a consolidation and refunding mortgage for $25,000,000 to the Old Colony Trust Company. The mortgage is given to guarantee a new issue of bonds to renew $5,000,000 worth of securities issued in 1900, and to provide funds for construction work whenever it may be authorized in the future. The mortgage covers all the holdings of the company. The Seattle Electric Company has been spending large sums on extensions, and the new work has cost far more than the earnings of the corporation can cover. The company has made short-time loans to pay the expenses of the new work, but for financial reasons desires to consolidate all its obligations in a single mortgage and bond issue. By the terms of the mortgage the company is authorized to take up the old bonds and issue new securities bearing 5 per cent interest. Then, as money is needed to pay the expenses of new extensions, extra equipment and development work, bonds may be issued, with the big mortgage as security.

AMERICAN LIGHT & TRACTION.—The privilege of subscription to $1,500,000 6 per cent collateral trust notes of the company at par and interest on or before Sept. 14, has been offered to stockholders of the American Light & Traction Company. The notes will be dated Oct. 1, and will be secured by collateral owned by the company of more than double the value of the notes issued. The notes, which are payable after two, three and five years from date, may be converted into either the common or preferred stock of the company at par. Subscriptions are to be paid as follows: One-third of the amount on Oct. 1 next; one-third on Jan. 1, 1908, and one-third on April 1, 1908, with interest at 6 per cent per annum from Oct. 1 next on deferred payments, but any subscriber may pay in advance of the dates named and receive interest from date of payment.

OHIO TROLLEY MERGER.—The Ohio Electric Railway Company, which was incorporated last week with a capital of $25,000,000, will absorb the Indiana, Columbus & Eastern, the Cincinnati Northern, and the Lima & Toledo Electric railroads. W. Kelsey Schopf, head of the Cincinnati street railway system, is president of the Ohio Electric Railway Company, and Benson Foraker, son of Senator Foraker, is vice-president. The lines absorbed include the old Appleyard line, the Columbus, London & Springfield, the Dayton, Springfield & Urbana, the Buckeye Lake and other lines throughout Ohio. The Elkins-Widener syndicate is said to be back of the company. Half of the new capitalization is preferred, on which dividends are to be 2 per cent until 1908, 3 per cent in 1909, 4 per cent in 1910 and 5 per cent thereafter.

KENTUCKY MERGER DOUBTFUL.—It is stated from Louisville, Ky., that the offer made to the stockholders of the Kentucky Electric Company, viz., $175 for their stock, has been rejected by more than a majority. This, if true, will probably put a check upon the merger plans, which it is alleged that outside parties have been working at for six months or more past. The object of these outside parties is understood to be to consolidate the Kentucky Electric Company, the Kentucky Heating Company, the Louisville Gas Company and the Louisville Lighting Company, though upon what basis has never been made known.

FORECLOSING TELEPHONE MORTGAGE.—A Rochester, N. Y., on Aug. 28, action by the Security Trust Company to foreclose the mortgages against the United States Independent Telephone Company and the Independent Telephone Securities Company was started. Service for the telephone company was made on President Thomas W. Finucane, and for the securities company upon Fred W. Zoller, secretary. The amount for which mortgages are held against the telephone company is about $15,000,000, and against the securities company about $1,500,000. If no answer is made by the defendant companies, judgment will be taken and the sale of property held within a few weeks.

DIVIDENDS.—The Savannah Electric Company has declared its semi-annual dividend of 3 per cent payable October 1, on the preferred stock. The Seattle Electric Company has declared its semi-annual dividend of 3 per cent on the preferred, payable October 1. The Twin City Rapid Transit Company has declared the regular quarterly dividend of 1¾ per cent on the preferred, payable October 1.

ROCKLAND LIGHT & POWER.—The Rockland Light & Power Company, of Nyack, Rockland County, New York State, was authorized by the Public Service Commission in the second district to issue a general mortgage 5 per cent 30-year gold bond to the amount of $500,000, out of a total authorized issue of $1,000,000.

GENERAL NEWS

Construction News.

EUFAULA, ALA.—The Eufaula Gas, Electric Light & Power Company has disposed of its plant in this city. The new owners will take possession Sept. 1. E. E. Mandeville, of Philadelphia, Pa., will be at the head of the new corporation.

GADSDEN, ALA.—At a meeting of the City Council on Aug. 19 a petition was presented by the Etowah Light & Power Company asking for a franchise for the purpose of selling energy for lamps and motors.

MONTGOMERY, ALA.—The Alabama Legislature has passed a law exempting water power companies from taxes for ten years. This is in the interest of a number of power schemes that are pending on the Tennessee and Alabama Rivers. It is also in line with the promotion of several plants to manufacture lime nitrogen, which also has been exempted for the same length of time.

VALDEZ, ALASKA.—Over $100.000 has been subscribed by the citizens of Valdez toward the organizing of the Alaska Home Railway Company for the purpose of building an electric railway from Valdez to the interior.

HOT SPRINGS, ARK.—A site outside of the city limits has been chosen for the electric light plant to be erected here.

FRESNO, CAL.—The Fresno Home Light & Power Company, recently incorporated with $250,000 capital stock, will erect a $280,000 power plant in this city.

PASADENA, CAL.—Opposition has already manifested itself against the proposed issuance of bonds to a value of $200,000 for the completion of extensions of the municipal lighting plant. It is understood that the $200,000 is to be used exclusively on the extension of the electric lighting plant and for inaugurating a purely commercial system. This would mean the continuance of poorly lighted streets with an incomplete department for handling commercial business.

REDDING, CAL.—William Ellery, of San Francisco, has filed a claim to 120,000 miner's inches of water of the McCloud River. Mr. Ellery contemplates building a dam 80 feet in height and diverting the waters of the McCloud with this and with two canals on the east and west banks to two powerhouses.

SAN FRANCISCO, CAL.—The Bay Counties Railway Company is planning a branch electric railway to tap Mill Valley. It has procured a right of way from Tiburon to Alto from the Diffenbach estate and intends to apply for a right of way in Mill Valley. A branch line will also tap Belvidere and Tiburon.

SAN FRANCISCO, CAL.—The General Electric Power Company, of California, at a meeting held Aug. 22, authorized a bonded indebtedness of $9,000,000 and executed a deed of trust to the Carnegie Trust Company, of New York, N. Y. The proceeds will be used for constructing and equipping the Clear Lake & Southern Railroad and for the construction of canals, reservoirs, power plants, etc. The directors of the company are Kent J. Seymour, Joseph P. [illegible], Albert H. [illegible], Albert J. [illegible], [illegible] Hewett, Guy C. Calden, Henry C. [illegible], J. W. Dorsey, W. J. [illegible], A. E. Ladewig and M. E. Logan.

STOCKTON, CAL.—The Central California Traction Company has practically completed its interurban line between this city and Lodi and will operate cars over the system on a regular schedule early in September.

ASPEN, COL.—The Colorado Telephone Company will build a toll line from this place to Crested Butte.

DENVER, COL.—[illegible] Trust Company of New York, N. Y. [illegible]

TRINIDAD, COL.—A new [illegible] is being [illegible] in the plant of the Trinidad Electric Railway Company, at a cost of $30.000.

BANTAM, CONN.—[illegible] company at Bantam has been compelled to resort to steam for power purposes throughout the day. A new boiler has just been installed.

HARTFORD, CONN.—[illegible] of New York, N. Y., have secured the contract for erecting a steel frame and [illegible]

WASHINGTON, D. C.—Bids will be received [illegible] Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yards [illegible] Boston, Mass. [illegible] New York, N. Y. [illegible] [illegible] San Francisco [illegible] wireless telegraph station. [illegible] schedule desired by number. [illegible] Paymaster General, U. S. N.

JACKSONVILLE, FLA.—Bids will be received until Oct. 4 by the Board of Trustees of the Water Works and Improvement Bonds, addressed to B. F. Dillon, chairman, for furnishing, set up in running order on foundations furnished by the board in the city electric light station, one 1500-kw steam turbo-generator, one 50-kw motor-driven exciter. Turbines to be run condensing, steam pressure at boiler 150 lbs., no superheat, 27 inches of vacuum. Generator to be of the revolving field type, 3-phase, 60-cycle, 2300 volts. Bidders must furnish detail blueprint of the machinery they propose to furnish, with complete specifications and guarantee of efficiency. For further information apply to R. N. Ellis, superintendent.

AMERICUS, GA.—The Americus Railway & Light Company, recently organized with a capital of $250,000, has taken over the entire plant of the present light company and intends rebuilding it and equipping it with new machinery.

ATLANTA, GA.—In the face of considerable opposition the Southern Bell Telephone Company has been granted a franchise for a period of 33 years. Provision has been made for an annual tax of one per cent. on the gross receipts of the company.

ATLANTA, GA.—The Board of County Commissioners has granted the application of the Georgia Railway & Electric Company to construct an electric railway to Buckhead. The new line will be about five miles long, extending from Brookwood to Buckhead.

BELLEVILLE, ILL.—The Bell Telephone Company has moved into its new Belleville exchange, which has just been completed at a cost of $60,000. All of the latest devices in telephone science have been installed, and the comforts of the employees have not been forgotten. A fully equipped electric kitchen with a model dining-room is provided for the operating force.

CHANDLERVILLE, ILL.—The county has granted a 20-year franchise to F. P. Sheaf and others for the installation of an electric system in the village.

DALLAS CITY, ILL.—J. H. Cole, of South Bend, Ind., has secured the contract for installing a system of water works and constructing an electric lighting plant.

ELGIN, ILL.—Clarence A. Knight, president of the Chicago & Oak Park Elevated Railway, has stated that work will begin on the proposed new surface line within one year.

BICKNELL, IND.—Owing to a disagreement between the Town Board and the Bicknell Light & Power Company on the terms of a new franchise, the town is in darkness. The company has been furnishing street lamps for nearly two years, under individual contract with property owners, operating under a franchise granted by the County Commissioners. The company has turned off the current and left the town in darkness with a view of forcing the Town Council to grant a franchise permitting the company to extend its service to all parts of the city and requiring the town to pay for the street lighting. An attempt is being made to organize a new company, to which a franchise will be granted. The old company is opposing this movement.

CONVERSE, IND.—The Converse Electric Company has been placed in the hands of L. O. Arnold, as receiver. The bonds issued to pay off all the small creditors failed to sell, and it was decided to place the company in the hands of a receiver.

INDIANAPOLIS, IND.—The Sanborn-March Electric Company, 115 North Illinois Street, has secured the contract for installing an electric generating station in the Woman's Prison at $6,279.

JEFFERSONVILLE, IND.—The Home Telephone Company, recently incorporated, has applied to the Board of Public Works for a franchise to operate an exchange and system in this city.

LOGANSPORT, IND.—Plans are being made to construct an interurban railway between this city, Rochester and Lake Wan-a-tale. It is proposed to secure power from the plant of the Rochester Light & Power Company.

MADISON, IND.—The Madison Telephone Company is in the market [illegible]

NEW ALBANY, IND.—Georgetown, a progressive little town on the Southern Railroad, eight miles west of this place, is planning for the [illegible]

PLYMOUTH, IND.—Improvements are contemplated at the Plymouth electric light plant at a cost of $10,000. Day service will be established if the city will extend its franchise and contract. C. D. Snoeberger is the president.

WARSAW, IND.—The Warsaw Gas & Light Company, controlled by a syndicate operating plants at Goshen and Niles, has decided to accept [illegible]

WASHINGTON, IND.—The City Council has ordered an election to [illegible] remodeling and improving the city electric light plant.

[illegible]

HAWARDEN, IOWA.—The New State Telephone Company is arranging to build a new toll line from this place through Ireton, Maurice and [illegible]

ONAWA, IOWA.—C. A. Thurston has secured the contract for the lighting plant for the Olier Manual Training School.

LEAVENWORTH, KAN.—It is stated that John W. McDaniels has purchased the interest of the Kansas City Western Electric Railway in the right of way of the Kansas City-Bonner Springs Railway. This gives Mr. McDaniels full control of the right of way. He contemplates building a line from Bonner Springs to connect with the Kansas City Western and with other lines to Kansas City.

ASHBURNHAM, MASS.—The Town Board is reported to have under consideration the establishment of a municipal lighting plant.

BEVERLY, MASS.—The Claremont Power Company is rushing to com- [illegible] obtained.

BLACKSTONE, MASS.—The City Council has entered into an agreement with the Blackstone Electric Light Company for arc lighting at the [illegible] per lamp less than the old rate.

FALL RIVER, MASS.—The Fall River Electric Company has submitted a contract to the city by which it proposes to light the streets with the magnetite arc lamp. It is believed that the new contract will save the city about $15,000 a year.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has contracted with the Aberthaw Construction Company, of Boston, for the erection of an addition to its plant. A new switchboard, five times the size of the present board, will be erected. A new 800-hp McIntosh & Seymour cross-compound steam engine will be installed, direct connected to a 600-kw, three-phase generator. New machinery was installed in the plant last year, but the growth of business makes it necessary to enlarge the plant again. A new condensing pond, five times the capacity of the present one, will be built.

MARLBORO, MASS.—The Marlboro Electric Company, of which L. P. Howe is the general manager, has been granted permission to issue $[illegible] additional capital stock, and it intends to make improvements to its plant.

NORTH ADAMS, MASS.—The Schaghticoke Power Company, which has applied for an increase in its capital stock from $30,000 to $50,000, has begun actual operations in the development of water power for the production and transmission of electric energy to Schaghticoke and other places, including this city. The president of the company is Mr. Geo. E. Green, of Hoosick Falls, N. Y.

NORTHAMPTON, MASS.—The Northampton Electric Lighting Company is installing a 500-kw turbo-generator set.

PITTSFIELD, MASS.—The Pittsfield Electric Company has expended $2,000 in new grates and a blower system for its boilers, so that hard coal may be burned instead of soft coal. The company consumes about 350 tons of coal a month and it will require fully 10 per cent more coal than formerly to fire the boilers, but the company feels that the elimination of the smoke nuisance justifies this extra expense. The company has also installed about fifty tungsten lamps on two of the avenues, and if these are found to be satisfactory the company expects to replace about 690 incandescent lamps used for street lighting by the newer lamp.

PLYMOUTH, MASS.—The Plymouth Electric Light Company which has been considering the enlargement of its plant has decided not to make the contemplated addition on account of the high prices of labor and material. The company has contracted with the Brockton & Plymouth Street Railway Company for a supply of electricity for the next two years.

SALEM, MASS.—The Salem Electric Light Company is building a $20,000 addition to its power plant on Peabody Street. The contractors are J. M. & D. S. Peterson.

TAUNTON, MASS.—Work on the foundation for the new engine to be installed in the electric lighting plant has been started and it is expected to have the engine in operation within a few weeks.

BEMIDJI, MINN.—Application has been made to the City Council for a franchise to construct and operate a street railway system in the city. The promoters ask for a franchise for 25 years, and in return agree to give the city two per cent. of the gross receipts of the system. Carl Gowran, of Grand Rapids, Mich., George Teitsworth, of Minneapolis, Minn., and A. A. Carter, of this city, are interested in the enterprise.

MANKATO, MINN.—The Mankato Citizens' Telephone Company is erecting a line from Mankato to Judson, and is considering the advisability of establishing an exchange at Madison Lake.

BILOXI, MISS.—The City Council on Aug. 20 awarded to the Gulfport & Mississippi Traction Company the contract to light the city with electricity for a period of 10 years.

HATTIESBURG, MISS.—The Street Railway, Electric Light, Gas & [illegible] solidation of the Hattiesburg Traction Company, the Hattiesburg Electric Light & Power Company, and the Hattiesburg Gas Company. A. F. Thomasson has been elected president of the merger and Z. C. Stevens has been elected general manager. The immediate purpose is the completion of the unfinished railway system and the construction of a new electric generating station. The company also proposes to handle water.

BOONVILLE, MO.—Stockholders in what was formerly known as the Pazy Bend Telephone Company held a meeting at this place and voted to incorporate in the name of the Pilot Grove Independent Telephone Company with a capital of $4,000. J. V. Merceroe is the president.

ST. LOUIS, MO.—A franchise has been granted to the St. Louis, Lakewood & Grant Park Railroad Company.

ST. LOUIS, MO.—The Board of Public Improvements on Aug. 23 approved plans for a municipal lighting and heating plant for the Quarantine Hospital, the building and machinery to cost about $10,000. A heating plant is also to be installed at the greenhouses in Forest Park.

ST. LOUIS, MO.—President O'Reilly, of the Board of Public Improvements, has completed blueprints of the territory to be lighted under the new contract. The location of every city lamp, arc or mantle, as well as the location of 4000 new lamps to be installed, is shown. There are now 18,000 mantle lamps and 1100 arc lamps, costing the city approximately $504,000 and $107,800 per year, respectively. In addition, there are 800 incandescent lamps used to light alleys. The new arc lamps will add about $50,000 and the new mantle lamps about $100,000 a year to the city's light bill, based on the present charge of $98 for arc and $28 for mantle lamps, making the total contract price approximately $860,000. The Board expects to have an ordinance ready to send to the Municipal Assembly soon.

TECUMSEH, NEB.—Contracts for constructing an electric light plant (bids for which were opened Aug. 19) have been awarded as follows: To the Buckeye Engine Company, Salem, Ohio, one 80-hp tandem comp. engine, 225 r. p. m., and one 8-hp simple engine, 257 r. p. m. To the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., one engine, type 125-kw, 3-phase, 60-cycle, alternating; one engine, type 50-kw, 3 phase, 60-cycle, alternating; 1 switchboard complete, street lighting equipment and lighting transformers. To the English Iron Works, Kansas City, Mo., one 150-hp boiler, Cookson heater, injector and Snow pump. Western Electric Company, Kansas City, Mo., all line material and poles. Total cost, $16,000. John Martz, engineer, Seward.

CARSON, NEV.—The Nevada Consolidated Telephone Company has been granted a franchise to operate in competition with the Rocky Mountain & Sunset service. The Nevada Consolidated new has lines running to many near-by towns. It will give the city 2 per cent. of its gross income after two years and will have its lines completed within a year.

RYOLITE, NEV.—The new power transmission line from Palmetto to Ryolite, recently constructed by the Nevada-California Power & Mining Company at a cost of $1,000,000, is nearly completed and the current will soon be turned on in Ryolite.

PETERBORO, N. H.—The Electric Light Commissioners have contracted with the Rodney-Hunt Machine Company, of Orange, Mass., for a pair of 24-inch Hunt-McCormick horizontal turbines, which will be installed in the electric lighting plant.

MORRISTOWN, N. J.—The directors of the Morris & Somerset Electric Company have authorized the finance committee to start work on the plant and lines at once. Plans have been prepared for construction of the power house, to be erected on Whippany Street, and contracts for construction of the power house and the machinery, etc., will be let soon. The company will lay seven miles of conduits, work on which will soon commence. The work of constructing the plant, which, it is estimated, will cost $150,000, will be in charge of Peter V. Stryker, the general manager of the company.

RUTHERFORD, N. J.—The Reading Railway Company has awarded to Augustus Wildman, of Harrisburg, the contract to construct a building for an electric generating plant for its freight-distributing yard at Rutherford. The power house will be 56 x 58 ft., built of brick on concrete foundation. The contract includes the building of a sewer to carry off the drainage. The entire cost is to be about $12,000.

BROOKLYN, N. Y.—Bids will be received until Sept. 9 by C. B. J. Snyder, Superintendent School Buildings, New York City, for completing the abandoned contract for the electric equipment in School 109, Borough of Brooklyn.

BUFFALO, N. Y.—Bids will be received until Sept. 6 by the Board of Supervisors (Henry D. Feist, clerk) for furnishing labor and material required in furnishing and installing lockers, gun cases, electric light fixtures, etc., in the armory of the 74th Regiment, N. G. S. N. Y., Buffalo.

CONKLINGVILLE, N. Y.—The Hudson River Electric Power Company, of Glens Falls, has applied to the Public Utilities Commission at Albany for permission to issue $3,323,000 in bonds, and it proposes to build [illegible] reservoir for electrical generating purposes.

DUNKIRK, N. Y.—The Board of Water Commissioners has decided to build an extension 15 by 45 feet to the municipal power plant. The board estimates that after paying for boilers, turbo-generator and other new machinery already ordered, and rearranging the electric light system, and altering and enlarging the building, there will be remaining approximately

a balance of $10,000. The question [illegible] meeting all requirements for an [illegible] by the board, and has been referred to committee on engines, boilers and machinery.

ELLIS ISLAND, N. Y.—[illegible] Robert Watchorn, Commissioner of Immigration [illegible] materials and installing an electric generating station at the Contagious Disease Hospital Group at the Ellis Island Immigration Station.

HERKIMER, N. Y.—The [illegible] village, will soon make an enlargement in the municipal lighting plant to increase the incandescent lighting facilities by the installation of a 325-hp engine direct connected to a 200-kw generator. The engine was ordered of the American Ball Engine Company, of Bound Brook, N. J., and the generator of the Crocker-Wheeler Company, of Ampere, N. J.

HOOSICK FALLS, N. Y.—The Schaghticoke Electric Company has applied to the Public Service Commission for consent to increase its capital stock from $30,000 to $500,000 and to issue the entire amount of the increase, and for further consent to the issue of $1,750,000 of first mortgage bonds. The company has been making preparations to develop about 20,000 horse-power on the Hoosick River near Schaghticoke. The company also proposes to erect a high tension transmission line from Schaghticoke to Schenectady.

IRONDEQUOIT, N. Y.—The Rochester Railway & Light Company has been given a franchise and will supply electricity to the town of Irondequoit. Permission is given to erect poles and lay conduits and the estimated cost is $[illegible]

JOHNSTOWN, N. Y.—[illegible] Everest, [illegible] representative of the McCaffrey Water Motor & Power Company of Troy, was in Johnstown recently. Mr. Everest has been securing options on the water privileges along the Caroga and Peck creeks. It is understood that the Troy firm has secured the control of the water privileges from Varoga Lake to the Mohawk River and from Peck's Pond to its connection with the Caroga Creek. Just what the Troy firm intends to do with its valuable water privileges is not stated at this time, but it has been intimated that several large power stations are to be erected for a general distribution of electricity in Montgomery, Fulton and Herkimer counties.

MT. VERNON, N. Y.—The Westchester Lighting Company has made a further reduction in the price of electricity and after Sept. 1, 1907, the price will be 13 cents per kw hour, making a reduction of 35 per cent from the former price.

NEW YORK, N. Y.—Stockholders of the Jersey City, Hoboken & Paterson Street Railway, the North Jersey Street Railway and the United Street Railways of Central New Jersey, at a meeting ratified their agreement entered into by the directors of the three companies named to consolidate the properties into one corporation, to be known as the Public Service Railway Company, [illegible]

NIAGARA FALLS, N. Y.—[illegible] steel penstock in Station No. 3 of the Niagara Falls Hydraulic Power & Manufacturing Company [illegible]

ROCHESTER, N. Y.—Bids will be received until Sept. 30 by the Commissioners of Buildings of Monroe County (G. L. Meade, chairman) for furnishing and putting in place a 150-hp 130 lbs. per sq. in. working pressure internal furnace boiler in the Monroe County power house at Rochester; and also on the same date and place for furnishing and installing an electric lighting plant in the basement of the Court House at Rochester.

WEST POINT, N. Y.—[illegible] Jr., Q. M. U. S. M. A., until Sept. 30 for furnishing and installing combination gas and electric lighting fixtures in the old and the new cadet [illegible]

[illegible]

CINCINNATI, OHIO.—[illegible]

CINCINNATI, OHIO.—[illegible]

CINCINNATI, OHIO.—[illegible] cent preferred.

COLUMBUS, OHIO.—[illegible] Company, of Milwaukee, Wis., has secured the contract for an exciter to be installed in the [illegible] pal electric light plant at $2,035.

COLUMBUS, OHIO.—The Municipal Power & Light Company has been incorporated with a capital stock of $100,000. The plans of the company contemplate a proposition to the city to utilize the surplus power at the storage dam and to string its wires and cables on the city's poles, in return for which the company will furnish electricity for lighting and power at a maximum rate of five cents per kw-hour. The company will covenant with the city to place its entire capital stock in the hands of trustees, and agrees to sell its plant to the city in case it is empowered by the Legislature to own a municipal plant, at the net cost price of installation with six per cent. interest. It also gives the city the privilege of inspecting its works at stated intervals, and that reductions in the price of current shall be made on an agreed-on sliding scale, as the profits of the company may exceed a certain stated amount. That the entire capital stock of the company shall be held in trust, and that no part of it shall be sold; that no combination looking to the restraint of competition shall be entered into, and that the company's franchise shall be forfeited if it enters into a combination with the existing monopoly. Within a short time experts will begin the work of making estimates of the available power at the storage dam, and will prepare plans for the entire plant to be submitted to the city authorities. It is contemplated that the auxiliary plant—steam-driven or otherwise—to supplement the power from the dam, shall be constructed immediately; and in case Council grants the franchise it is intended to begin the delivery of electricity from this plant within 12 months.

TOLEDO, OHIO.—The property of the Toledo, Ann Arbor & Detroit Railroad Company will be sold at receiver's sale Sept. 16 by order of the Michigan and Ohio courts. Mr. John O. Zabel, of Toledo, is the attorney for the receivers.

LA GRANDE, ORE.—The Grande Ronde Electric Company has disposed of its Oro Dell power plant to the Wallowa Mercantile Company, and the work of removing the plant is now under way.

SALEM, ORE.—The managers of the Salem-Portland electric line are said to be negotiating for the purchase of a tract of land about two miles northwest of Brooks, where they propose to establish an electric power plant, to cost $10,000. It is understood that several stations are to be erected on the road between Salem and Portland.

ALLEGHENY, PA.—A bill has been introduced in the Select Council for the issuing of $75,000 in bonds for buying a turbo-generator outfit, condensing equipment and all necessary electrical apparatus for the extension of the arc lighting system at the municipal lighting plant on Braddock Street.

LANCASTER, PA.—Bids will be received until Sept. 20 by Walter A. Miller, clerk, Thaddeus Stevens Industrial School Commission, at his office, Court House, for erecting a power plant and two cottages for above school; also the mechanical work at the power plant; also sewers and tunnels from buildings and heating plant for all buildings; also same name and place for erecting a shop for the Stephens Orphans' Home.

MANAYUNK, PA.—Wm. H. Dechant, of Reading, has secured a contract for building an electric generating plant in Manayunk for supplying [illegible] River and will cost about $100,000.

PHILADELPHIA, N. Y.—A. F. Nims, of Philadelphia, is reported to have secured the contract for constructing a concrete dam for the municipal electric light plant for $4,561.

PITTSBURG, PA.—The Southside Electric Manufacturing Company [illegible] capital and enlarge the plant for the purpose of furnishing electricity for lamps and heaters in residences and stores and factories on the Southside. [illegible] sident and Peter M. Lippert secretary and treasurer.

PITTSBURG, PA.—[illegible] Company, of which Robert C. Hall is chief owner, will extend its lines throughout the city and will also bid for the city contract. A large plant and power house will be built along the Monongahela River. The company [illegible] a like amount to build the plant and carry out the company's plans. The company has secured four acres along the Monongahela River and Second [illegible] in the city equipped with act[illegible]

[illegible] electric railway between Mercer and Greenville. The Mercer Construction Company has been chartered with a capital stock of $25,000 under the laws of West Virginia. The incorporators are: T. P. Filer, L. W. Orr, [illegible] Greenville to Sharpsville, connecting Sharon and Sharpsville.

[illegible] Company, is damming the Shetucket River and preparing to erect a power [illegible]

[illegible]

[illegible]

[illegible] pany for the purpose of installing an electric lighting equipment.

[illegible] materials and labor, separately or together: Turbines, dynamo, induction motor and arc lamps; centrifugal or triplex pump, steel tower and tank, cast iron pipe, hydrants and valves, cyclopean or reinforced concrete dam, reinforced concrete penstocks and power house, installing machinery, electric line construction, pipe laying. For specifications address Walter G. Kirkpatrick, Engineer, Jackson, Miss.

NEWPORT, TENN.—Bids are wanted until Sept. 14 for $37,500 of water works and $7,500 of electric lighting bonds.

BROWNSVILLE, TEX.—The City Council has awarded the contract for the construction of the electric light plant and water works to Henry C. Ellen, Jr.

MANASSAS, VA.—Bids will be received by O. E. Newman, chairman of the Improvement Committee of the Council, until Sept. 28 for furnishing material and installing a water works and electric lighting plant and macadamizing the streets in the town. Bids may be submitted as a whole or separately on the above work. Pressey & Weller are the engineers, 1416 F Street N. W., Washington, D. C.

SALEM, VA.—Bids will be received until Sept. 16 by W. R. Hester, of the finance committee, for the purchase of water, electric light, sewer and improvement bonds valued at $25,000.

SEATTLE, WASH.—The City Council has granted a franchise to the Loyal Railway Company to construct and operate a street railway in the city.

SNOHOMISH, WASH.—The Snohomish Valley Railroad Company has awarded the contract for the construction of its road from Snohomish to Renton, a distance of 55 miles, to the Continental Engineering & Construction Company, of New York, N. Y. Charles A. Barron is general superintendent of the railway company.

TACOMA, WASH.—Since the sale of the Howe ranch local interests at Twisp are investigating the Howe water right on the Twisp just above the Brown ranch where the water rushes with terrific force between two high and solid rocky walls. The project is to dam the river at this ideal point and generate electricity for the town of Twisp. After the investigations are complete an effort will be made to interest outside capital.

DE PERE, WIS.—The Fox River Valley Telephone & Telegraph Company has purchased the Wolf River Telephone Company's exchanges and lines at New London and Weyauwega for $6,500. The local independent company will make extensive improvements in its lines.

MADISON, WIS.—It is reported that the Madison Gas & Electric Company (John Corscot, general manager) intends expending $75,000 for new machinery and new buildings.

MILWAUKEE, WIS.—The Milwaukee Western Electric Company, of which William Ross is president, has given a trust deed for $35,000 to the Citizens' Trust Company, the proceeds of which will be used to promote an electric line from Milwaukee to [illegible] and other places.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has decided to expend $1,500,000 in improving its system, and building a new toll line to Northern Wisconsin and Michigan, Iron Mountain, Rhinelander, Tomahawk and Hurley will be given additional service. More than 600 miles of new wire will be strung, and between 200 and 300 miles of new territory covered.

MUSCODA, WIS.—This village will vote on the question of bonding itself in the sum of $10,000 for the purpose of acquiring the electric lighting plant.

NORTHFIELD, WIS.—It is stated that the Northfield Light, Heat & Power Company is seeking a franchise.

STEVENS POINT, WIS.—The Wisconsin Telephone Company is putting up a new 50-wire cable on Clark Street.

WEYAUWEGA, WIS.—The telephone deal between the Wolf River Telephone Company and the Interurban Telephone Company, which has been pending for several years, has been closed, and the Wolf River system, which embraces the exchanges at Weyauwega and New London and toll lines from New London to Waupaca and from Weyauwega to Tustin has been transferred to the Fox River Valley Telephone & Telegraph Company, which now controls the independent exchange in Green Bay and Appleton, with connecting toll lines, and the Waupaca exchange.

SHERIDAN, WYO.—The Rocky Mountain Bell Telephone Company will make improvements in its line.

VANCOUVER, B. C.—James A. Moore and associates, of Seattle, Wash., are here making arrangements for the construction of an electric smelter on Vancouver Island for the treatment of iron ores.

WINNIPEG, MAN.—The Civil Board of Control has approved a number of plans for extensions to the lines of the Winnipeg Electric Street Railroad Company. Wilford Phillips is general manager of the company.

WINNIPEG, MAN.—Bids will be received by the chairman of Building Control until Oct. 1 (extension of date from Sept. 3) for the construction [illegible] Point du Bois, for a transmission line between Point du Bois and Winnipeg, and for a receiving transformer station in Winnipeg.

[illegible] electrical energy shortly from the circuits of the Cataract Power Company. [illegible] manufacturers.

[illegible]

Company Elections.

EUREKA MILLS, VA.—[illegible] tain A. J. Terry, president; W. G. Williams, secretary-treasurer; W. G. Williams, general manager; [illegible] W. M[illegible], directors.

FREDERICKSBURG, VA.—The [illegible] Thomas J. Weller, C. A. Bryan, R. A. M[illegible] Stead and A. J. Pyke, directors.

New Industrial Companies.

ATLANTIC CITY MONORAIL AND AMUSEMENT COMPANY, Atlantic City, N. J., has been incorporated by E. J. McWhiney, F. A. Kunz and H. Clay. The capital stock of the company is $250,000, and its purpose is to operate amusements.

THE AUTO IGNITER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000. The directors are William F. Holcombe, Emma B. Holcombe, Richard E. [illegible], of New York, N. Y.

THE ELECTRIC GARAGE COMPANY, of Utica, N. Y., has been incorporated. The directors are Leslie F. Ashley, John J. Schimmel, Jr., and George M. R[illegible], all of Utica. The company will deal in heating apparatus.

THE JOHN GOOD & GORDON COMPANY, [illegible] Philadelphia, Pa., has been incorporated with a capital stock of [illegible] by John Thomas Gordon, Ezekiel Gordon.

THE MONTEREY HYDRO-ELECTRIC POWER COMPANY has been organized at Ellsworth, Me., for the purpose of owning, operating and dealing in water sites, power and privileges for various purposes. The capital stock is $5,000,000, of which nothing is paid in. The president is Percy Langley and the treasurer, R. M. Whiting, both of Ellsworth.

UNITED STATES CHANGEABLE SIGN COMPANY, of New York, has been incorporated with a capital stock of $25,000 for the purpose of manufacturing signs. The directors are S. H. Martel, Jr., C. Presbrey and C. J. Hardy.

VAN BERGH ELECTRIC PROTECTION SYSTEM COMPANY, of New York, has been incorporated with a capital stock of $100,000 by C. Tielenius, F. A. Rengler and C. Van Bergh.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the El Dorado Power Company. The company is capitalized at $1,000,000, and the directors are Paul A. McCarthy, F. H. Curry, A. B. Weiler, R. K. Barrows and C. H. Patterson.

COLORADO SPRINGS, COL.—The Monarch Electric Company has been incorporated with a capital stock of $20,000 by W. J. Squire and others.

DOVER, DEL.—The American Suspension Railway Company, of Philadelphia, Pa., has filed articles of incorporation with a capital stock of $5,000,000. The object of the company is to acquire improved railway traction and rapid transit lines. The incorporators of the company are: D. M. Prantz, W. H. Tigerman, George W. Schriner, Frank O. Butler, J. W. Wilson, Theodore Barrett, J. George Schemff, all of Philadelphia, Pa.

WILMINGTON, DEL.—The Oglahoma Fuel, Light & Power Company has been incorporated with a capital stock of $500,000 by James S. Cummings and others.

BELLEVILLE, ILL.—The East St. Louis & Eastern Railway Company has been organized. The capital is $2,500, and the incorporators are L. C. Haynes, T. W. Gregory, G. C. Pierce, F. H. Thomas and F. H. Kruger.

DAHLGREN, ILL.—The Dahlgren People's Telephone Company has increased its capital stock from $10,000 to $12,500.

LOWELL, IND.—The Lowell Light & Power Company has been incorporated to construct and equip light and power plants in this and other [illegible] C[illegible] W[illegible], E. L. S[illegible] and J. M. Jones are the directors.

SERGEANT BLUFF, IA.—The [illegible] Telephone Company has been incorporated with a capital [illegible] by A. J. Westfall and others.

ELLSWORTH, ME.—The E[illegible] Supply Company has been incorporated with a capital of $450,000 for the purpose of generating electricity for manufacturing purposes. Henry M. Hall, of Ellsworth, is president of the company.

JERSEY CITY, N. J.—The Merchants' Electric Light & Power Company has been incorporated with a capital stock of $250,000 by Frank H. Lowrie and others.

PANAMA, N. Y.—The Panama Power Company has been incorporated with a capital stock of $4,000. The directors are: Walter Parner, G. G. Burnham and I. N. Britton, of Panama.

VAN ETTEN, N. Y.—The Van Etten Telephone Company has been incorporated with a capital stock of $500 by J. W. Gee, G. Banfield and B. U. Osborn.

WALTON, N. Y.—Walton Public Service Company has been incorporated to do electric lighting, etc. The capital is $50,000. E. L. Gung and others are interested.

DEMOCRAT, N. C.—The North Bucombe Telephone Company has been incorporated with a capital stock of $5,000 by James N. Morgan, J. D. Murphy and James C. McElray.

KNOX, N. D.—The North Knox Telephone Company has been incorporated with a capital stock of $6,500 by C. J. Markstad, and Martin Steen, of Knox, and others.

McHENRY, N. D.—The McHenry Telephone Company has been incorporated with a capital stock of $15,000 by Anton Jenson, E. J. Horn and others.

MEKINOCK, N. D.—The Turtle River Co-operative Telephone Company has been organized with a capital stock of $50,000.

NEW ROCKFORD, N. D.—The Air Line Telephone Company has been incorporated by A. J. Ritcher, J. P. Knoack and J. A. Paulson, of New Rockford.

BUTLERVILLE, OHIO.—The Harlan Telephone Company has been incorporated with a capital stock of $5,000 by J. T. Sharp, E. H. Smith, E. D. Jones and J. E. Spurling.

CINCINNATI, OHIO.—The Fitzsimmons Telephone Company has been incorporated with a capital stock of $5,000 by Harry Burkhardt, James Mullaney, Charles Baker, Ferdinand Bassan and others.

COLUMBUS, OHIO.—The Massillon, Wooster & Mansfield Traction Company, Cleveland, has been incorporated with a capital of $1,000 by G. A. Bartholemew and others.

COLUMBUS, OHIO.—The People's Municipal Light & Power Company has been incorporated with a capital stock of $100,000 to acquire franchises, do construction work and furnish electricity for lamps and motors. The incorporators are E. W. Taylor, T. C. Morphy, S. T. Davies, G. Counter and F. W. McCue, all of Cleveland.

DOVER, OHIO.—The Snyder Electrical Manufacturing Company has been incorporated with a capital stock of $25,000 by Edward Snyder and others.

GEORGETOWN, OHIO.—The Georgetown Electrical & Supply Company has been incorporated with a capital stock of $20,000 by Philip Polasky and others.

NEW PHILADELPHIA, OHIO.—The Valley Transit Light & Power Company has been incorporated with a capital stock of $100,000 by C. J. Kneisley and others.

NORWOOD, OHIO.—The Norwood Telephone Company, with a capital of $13,000, has been incorporated by Peter Brooks and others.

QUAKER CITY, OHIO.—The Farmers' Telephone Company has been organized with a capital stock of $3,000 by W. A. White, F. T. Webster and others.

ARNETT, OKLA.—The Arnett Telephone Company has been incorporated with a capital stock of $10,000 by C. O. Shaffer, J. O. Ralston and J. J. Henry.

EL RENO, OKLA.—The Canadian Light & Power Company has been incorporated with a capital of $100,000 by J. W. Maney and others.

GEARY, OKLA.—The Maple Telephone Company has been chartered with a capital stock of $600 by A. C. Gilmore, Byron Baker and S. S. Schymore.

GRACEMONT, OKLA.—The [illegible] Telephone Company of this city has been incorporated with a capital of $1,900 by J. F. Prewitt and others.

LAWTON, OKLA—The Lawton Lighting Company has been incorporated with $100,000 capital stock. The incorporators are C. S. Stephenson, of Lawton; J. E. and D. E. Stephenson, of Ansonia, Ohio.

LOOKEBA, OKLA.—The Farmers' Central Rural Telephone Company has been chartered with a capital [illegible] M. N. Stewart, of Lookeba, and N. J. Walling, of Binger.

LOUIS, OKLA.—The Louis Farmers' Co-operative Telephone Company has been incorporated with [illegible] and others.

SALON, OKLA.—The Salon Telephone Company has been incorporated with a capital stock of [illegible] W. J. H[illegible] and [illegible] Pittman.

STELLA, OKLA.—The Farmers' Independent Telephone Company has been incorporated by L. S. Wheeler and others.

TEXHOMA, OKLA.—Articles of incorporation have been filed for the Texhoma Electric Light, Water & Ice Company with a capital stock of $15,000. The incorporartors are J. J. Osborne and others.

WARREN, OKLA.—The Warren Central Telephone Company has been incorporated with a capital stock of $2,000 by T. S. Woody, A. F. Hendricks, T. F. Baird and S. A. Biddy.

FINLEYVILLE, PA.—Charters have been granted to the Finleyville Electric Light Company and the Courtney Electric Light Company each with a capital of $5,000. The incorporators are the same in both companies, as follows: Jacob V. Van Wagener, John F. Cockburn and Clarence W. Scheck, all of Pittsburg.

UTICA, S. D.—The Central Farmers' Telephone Company has been incorporated with a capital stock of $25,000 by L. A. Bruce and others.

CHATTANOOGA, TENN.—The Locust Mount Telephone Company, Washington County, has been incorporated with a capital stock of $5,000 by S. T. Martin, R. A. Walker, Jesse Hunt, Dr. George C. Horn and J. H. Hale.

COLLIERVILLE, TENN.—The Collierville Telephone Company has been incorporated with a capital stock of $10,000 by S. Hinton, W. W. [illegible]

MEMPHIS, TENN.—The Economy Electric Company has filed an application for a charter. The capital stock of the concern is named at $5,000. The incorporators are J. B. Hutchison, E. A Palham, J A. Rose, J. H. Lucas and Clarence Nelson.

MEMPHIS, TENN.—The South Memphis Light & Traction Company has been incorporated with a capital stock of $50,000.

VENUS, TEXAS.—The Venus Telephone Company has been organized at this place, and the following officers have been elected: A. D. Frost, president; A. J. Florey, vice-president; John W. Bassett, secretary, and C. L. Barker, treasurer.

BUCHANAN, VA.—Articles of incorporation have been filed for the James River Water Power Company with a capital stock of $500,000 to construct a power plant on James River. O. C. Huffman, of Buchanan, is interested.

RICHMOND, VA.—The Union Telephone Company, of Branchville, has been incorporated by W. R. Sykes, W. W. White, C. B. Vick, J. G. Stancill and J. B. Rogers. The capital stock of the company is $2,500 and its purpose is to construct a telephone line.

AMBOY, WASH.—The Amboy Telephone Company has been chartered with a capital stock of $2,000 by W. F. Gerber and others.

CHELAN, WASH.—The Chelan Electric Company has been incorporated with a capital stock of $500,000 for the purpose of building an electric railway from Wenatchee to the northern end of the state. The company also contemplates furnishing electricity for lighting purposes and water privileges to all towns along the Chelan River. J. T. McChesney is president of the company, and E. C. Mony, secretary.

GOLDENDALE, WASH.—The Klickitat Light & Power Company has been incorporated with a capital stock of [illegible] by H. W. [illegible] Frank Lehn and J. H. Tilsey.
tered with a capital stock of $3,000.

OROVILLE, WASH.—The Sililkameen Power Company, of Oroville, has been incorporated with a capital of $1,200,000 by Monroe Hartman, Charles A. Andrus and others.

OLYMPIA, WASH—The Amboy Telephone Company, of Amboy, Clark County, has been incorporated by W. F. Gulber, B. A. Curtice, J. Hooper, W. Healy and I: Siesecker.

SPOKANE, WASH.—The Big Bend Light & Power Company has been organized to furnish light and power to cities and towns in Big Bend County. The incorporators are D. B. Fotheringham, H. G. Bleeker, of Spokane, and Eugene Menlo, of Medical Lake.

PRINCETON, W. VA.—Princeton Power Company has been incorporated with a capital of $30,000 by L. H. Perkins and others.

PRUNTYTOWN, W. VA.—The Pruntytown Telephone Company has been organized to operate telephone lines in Pruntytown and other parts of the western section of this county. The officers are: W. E. Carter, president; C. T. Reynolds, secretary, and C. B. Kinsey, treasurer.

BALDWIN, WIS.—The Baldwin Electric Light & Fuel Company is reported incorporated with a capital of $15,000 by E. J. Cave, O. K. Haw[illegible]

DELL, WIS.—The Dell Co-Operative Telephone Company, Dell, Vernon County, has been incorporated with a capital of $2,500 by Edward Clark and others.

DURAND, WIS.—The Intercounty Telephone Company has been incorporated with a capital stock of $8,000 by W. H. Clifford and others.

MADISON, WIS.—The Intercounty Telephone Company, of Durand, filed articles of incorporation with the Secretary of State. The capital stock is $8,000, and the incorporators are W. H. Gifford, Ward E. Loodell, P. Fox, N. P. Ward, W. Will and C. Winget.

MENOMONIE, WIS.—The Menomonie [illegible] Light Company has been incorporated with a capital stock of $15,000 by Richard [illegible] and others.

Legal.

[illegible]

Olympia and the town of Tumwater, and also maintains an electric lighting system. The company has a generating plant on the Des Chutes River at the town of Tumwater, the plant being run by water taken from [illegible] year there is not enough water in the river to furnish power sufficient to operate the railway and lighting systems, and during those months it had frequently become necessary to suspend the railway service. The company proposed to overcome this difficulty by diverting part of the water which came down the river during the rainy season by means of a canal to Lawrence Lake, a body of water located near the river, but about twenty-six miles up above the power house. The level of the lake would be thereby raised some 30 feet, and the plan was to hold the water there until the dry season, when it would be released in sufficient amount to give the required power. The raising of the lake level would result in overflowing the land belonging to owners along the shore, and, as they objected to selling, the company was obliged to proceed by condemnation. The landowners claimed that the company was not entitled to take the land by condemnation, because it was authorized by its charter to furnish power to individuals, which is not a public use, and because it was within the reach of the company to evade detection in case such power should be furnished to individuals after the land had been condemned for a public use. While it is the law the land may be taken by a corporation only when needed for a public use and the private property of one person may not be taken for the private use of another, nevertheless, when a corporation is engaged in a public service, the fact that the corporation may devote land to private purposes does not deprive it of its right to condemn. Harris vs. Olympia Light & Power Company, [illegible]

NEARNESS OF LOW POTENTIAL WIRES TO WIRES OF HIGH POTENTIAL AS BASIS OF ACTION FOR NEGLIGENCE—PROPER CONSTRUCTION REQUIRES SUCH WIRES TO BE AT LEAST FIVE FEET APART. The facts in an action against an electric light company, brought by an administrator to recover damages for the death of a lineman in the employ of the company, whose estate he represented, were as follows: The company owned a primary or high potential circuit [illegible] 106 volts. The poles were so placed that the wires passed through the tops of some trees near the home of one Selby, which was lighted by current conveyed by the secondary wire. On the afternoon of the accident Selby noticed a disturbance among the wires in his yard, and observed that the trees to which the wires were attached were smoking and that sparks were flying from the fixtures. He requested his son to go into the cellar and cut the current, and the son, being unable to find the switch, attempted to turn on the incandescent light. But he abandoned this purpose upon receiving a rather severe shock, and Selby notified the company's office by telephone of the trouble. The lineman arrived and, when he observed the trees smoking, it occurred to him that there was a "ground." After cutting the current from the yard lights he was called to inspect the wiring in the house and, upon being shown the lamp from which Selby's son received the shock, he seized it and was instantly killed. Several questions presented themselves for consideration: Was the company guilty of negligence? Was the lineman free from contributory negligence? Was he acting within the scope of his duties? Could it be said that he had not assumed the risk under the circumstances? A negative answer to any of these questions would have been fatal to the right of the administrator to recover damages. As to negligence, it was held that the company was clearly negligent in not seeing to it that the two wires were at least 5 feet apart, and also in permitting them to pass through the branches of trees, thereby endangering contact. It seems that the lineman was one of a number of men who were employed to do "outside" work, and that the "inside work" was taken care of by a different group of employees. It was held that, as no inside man was sent along with the unfortunate employee, he was justified in remedying the trouble at the Selby residence, no matter where he found it. The company then contended that the accident resulting in the lineman's death was one of the ordinary risks incident to his employment. It is true that a servant, by his contract of employment, assumes the ordinary risks incident thereto. A servant, however, does not assume the risk incident to his master's negligence, and, under this rule, it was held that the lineman had assumed no risk which could deprive his estate of the right to [illegible]

Educational.

[illegible] on plans for application of power to various types of machinery. Supplementing this course will be another in industrial chemistry, which will deal with the chemical processes in the manufacture of extensively used commodities, a course in industrial values, to enable the manufacturer or selling agent to interpret his market, and a special course in business [illegible] under varing conditions of trade.

Obituary.

[illegible] Carter was dead when found. He had been set at the task of polishing a combination electric and gas chandlier in the university dairy. He had been working for some time when a piercing scream was heard by C. C. Potter, a fellow-student employee. Potter rushed to the aid of the young man and found that he had received a current of electricity in his body. Carter had been standing upon a small stationary engine while reaching up to the chandelier. The engine was fastened with bolts driven through the concrete floor and this completed the circuit. A ladder was leaning near by, and when Potter rushed into the room Carter's lifeless body had fallen against it, but the hands of the dead man were still clutched tightly over the chandelier, which had been partly wrenched from its fastening in the ceiling. Daring possible electrocution, Potter seized the body and it fell to the floor, thus breaking the circuit."

MR. E. R. COFFIN.—It is with extreme regret that we note the death of Mr. E. R. Coffin, son of Mr. C. A. Coffin, president of the General Electric Company, who, with members of his family, is now traveling in Europe. It appears that Mr. E. R. Coffin was taken ill while traveling from San Francisco to New York, and died at Omaha, in the General Hospital, after an operation for strangulated hernia. Edward Russell Coffin was born in Lynn, Mass., July 28, 1873. After being graduated at Harvard University, where he took the degree of A. B., he entered the Harvard Law School, from which he was graduated in 1896. He was admitted to the bar of Massachusetts, and later practiced in New York City until November, 1904, when he became vice-president of the Electric Securities Corporation. At the time of his death he was also vice-president of the Asheville Electric Company, the Chattanooga Electric Company and the Des Moines Electric Light Company. He was a director of the Animas Power & Water Company, the Central Colorado Power Company, the Duluth Edison Electric Company, the Grand Rapids Edison Company, the Omaha Electric Light & Power Company and the Le Grange Mining Company. Mr. Coffin was a member of the Puritan Club of Boston, the Fort Orange Club of Albany, and the Metropolitan, City, and University clubs of this city. He was unmarried and lived with his father. He was a young man of great promise and ability, a most delightful companion, and of fine physique that indicated a long life. His death will be deeply deplored in electrical circles.

Personal.

MR. [illegible] PORTER [illegible] construction business. Mr. H. H. Lunsford has been appointed superintendent to succeed Mr. Porter.

MR. H. P. MAXIM, formerly chief engineer of the Electric Vehicle Company, New York, N. Y., who resigned on Aug. 1 to begin the manufacture of motor cars on his own account, has been retained by the Electric Vehicle Company as consulting engineer, and will represent that organization in the mechanical branch meetings of the Licensed Association. Mr. Maxim designed nearly all the Columbia gasoline and electric cars built since the company started in business.

PROF. [illegible] the management of the Brookline Motor Car Company, of Brookline. [illegible]

Trade Publication.

[illegible] either the indicating or the recording type.

TRANSFORMERS of the single-phase shell type are discussed at [illegible] Wayne, Ind. The standard transformers are built for ratings varying [illegible]

VARIABLE-SPEED MOTORS.—The Electro-Dynamic Company, Bayonne, N. J., has issued an illustrated booklet dealing with interpole variable-speed motors for machine tool drive.

BELTED ALTERNATORS of the self-contained type for ratings not exceeding [illegible] kw are treated at length in Bulletin No. [illegible] of the Allis-Chalmers Company, Milwaukee, Wis. These machines are provided with revolving field members, and are so constructed that no bed plate is required and no pedestal bearings are used.

SINGLE-PHASE INDUCTION MOTORS.—The Century Electric Company, 404 North Fourth Street, St. Louis, Mo., has issued Bulletin No. 8 devoted to single-phase motors. These motors are of the self-starting combined repulsion and induction type and are intended for either constant-speed or variable-speed work.

SHOW WINDOW ILLUMINANT.—The Linolite Company of America, 24 Stone Street, New York, has issued a bulletin calling attention to its Linolite (line o' light) lamp, which consists of a continuous filament in a trough reflector, which is adapted for the illumination of show windows, public buildings, hotels, art galleries, theatres, street cars, signs, etc.

STANDARD DIRECT-CURRENT MOTORS.—Publication No. 56 of the Robbins & Myers Company is entitled, "Information Book of the Standard Motors for Direct-Current Circuits." It contains full descriptions of the constructional features and operating characteristics of constant-speed and variable-speed motors for ratings varying from [illegible] hp.

INSULATING MATERIAL.—A pamphlet issued by the D. M. Steward Manufacturing Company, Chattanooga, Tenn., is devoted to Lavite, an insulating material, which is stated to combine high dielectric properties with mechanical accuracy and good heat-resisting qualities, having great mechanical strength and can be machined as accurately as brass.

SINGLE-PHASE VARIABLE-SPEED VENTILATING FAN OUTFITS are discussed in Bulletin No. 76 of the Wagner Electric Manufacturing Company, St. Louis, Mo. The motors are of the combined repulsion and induction type, the speeds below normal being obtained by the use of an auto-transformer that allows the impressed voltage to be varied at will.

TELEPHONES FOR FARMERS.—An interesting bulletin entitled, "How the Telephone Helps the Farmer," has been issued by the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Instructions are given for organizing a farmers' telephone company and much valuable information concerning installing and operating telephones is also given.

BLUE PRINTING BY ARC LAMPS.—What is stated to be a copy of a speech by "Prof. A. C. Tinic before the National Federation of Blue Printers" is given in a booklet issued by the Buckeye Engine Company, Salem, Ohio. Incidentally, mention is made of the excellent qualities of the Buckeye electric blue printing machine, which is automatic in its performance.

MACHINIST TOOLS.—The latest edition of the catalogue of the Pratt & Whiney Company, Hartford, Conn., devoted to small tools, standards and gauges, comprises 214 duodecimo pages and several hundred illustrations. [illegible] dimensions of twist drills, screw threads, etc., adds largely to the value of the publication.

MAGNETO SWITCHBOARDS.—Bulletin No. 104 of the Dean Electric Company, Elyria, Ohio, gives an excellent discussion of the constructional features and operating characteristics of magneto switchboards. All of the details and their functions are treated fully, numerous photo-diagrams being used for explaining the circuit connections and duties of the several parts.

ELECTRIC HOISTS.—[illegible] the Sprague Electric Company, 527 West Thirty-fourth Street, New York, gives an excellent description of the design, construction and operation [illegible] where these hoists are in use. A supplement to this catalogue gives a [illegible]

JAMESTOWN EXHIBIT.—An attractive card showing the Pennsyl- [illegible] the Sprague Electric Company. The building is wired with the Sprague [illegible] Independence Hall, Philadelphia. The card is printed in two colors; on [illegible]

[illegible]

[illegible]

ELECTRIC EQUIPMENT OF RAILROAD SHOPS.—[illegible] of improvement in methods of operating tools and handling work in railroad repair shop practice, the Westinghouse Electric & Manufacturing Company has issued a well-prepared pamphlet dealing with the electrical equipment at the Hornell shops of the Erie Railroad. In these shops there are used 39 direct-current motors, varying in rating from 6 hp to 50 hp.

STORAGE BATTERIES.—Catalogue A of the General Storage Battery Company, 42 Broadway, New York, gives an illustrated description and price list of "high-duty" type Bijur storage batteries for stationary service. This company has issued a folder containing condensed instructions for the installation and operation of transportable batteries. The plates of both the stationary and the transportable batteries are of lead, and the instructions for the most part are directly applicable to either of these types.

CRANE CONTROLLERS.—The Cutler-Hammer Manufacturing Company, Milwaukee, manufacturers of electric controlling devices, has just issued a booklet—pigeon-hole size—descriptive of its line of electric crane controllers. In addition to full descriptions and illustrations of five types of crane and hoist controllers, the booklet contains connection and dimension diagrams, repair part charts, prices, net weight and shipping weight of apparatus, etc. An improved form of contactor for handling heavy currents is also described.

GRAPHITE BRUSHES.—A bulletin recently issued by the Jos. Dixon Crucible Company illustrates and describes its line of graphite brushes for dynamos and motors. After the installation of a large electric motor plant in the Dixon works some trouble was encountered in the use of the ordinary carbon motor brush, which led to experiments that resulted in that type of brush being superseded with most satisfactory results by a graphite brush; and it is this new type, which is now being manufactured for general sale, to which the catalogue refers.

WESTINGHOUSE DESCRIPTIVE PAMPHLETS.—Two of the latest issues in the industrial series of pamphlets issued by the Westinghouse Electric & Manufacturing Company have for subjects, respectively, the electrical equipment of the Bath Portland Cement Company and the electrical equipment of machine tools in the plant of the Firth-Stirling Steel Company. In both cases a well-written description is given of the electrical installation, the interest of which is increased by some account of the processes to which the electrical equipment is applied.

RESISTOR UNITS.—Bulletin No. 107 of Charles E. Wirt & Company, 4901 Stenton Avenue, Philadelphia, Pa., deals with Di-el-ite resistor units. These units are wound with resistor wire solidly embedded in a homogeneous material which possesses the qualities of mechanical strength, electrical insulation and durability under extremes of heat and cold. The insulating material is an artificial stone, which is able to withstand temperatures not exceeding 800 degrees Fahr. It is moulded to the form desired from a very soft state, and is then hardened by chemical and heat treatment without change of form.

ELECTROQUARTZ, which is obtained by fusing quartz in the electric furnace, is a material which it is claimed will resist cracking, no matter how suddenly or violently it is heated or cooled. It is stated that "electroquartz" softens only when the temperature is above 2550° Fahr. It melts above 2900° Fahr. Up to from 2150° to 2350° Fahr., it may be used safely in contact with molten metals. The material is milky white in appearance, of vitreous texture, hard and strong. A price list designated as No. 26 relating to this substance has been issued by the Wilson-Maeulen Company, 110 Liberty Street, New York.

TUNGSTEN LAMPS.—Mr. J. Auerbach, president of the Electrical Accessories Company, New York, expressed himself as agreeably surprised at the demands made upon him for Tungsten lamps which this company was the first to introduce in this country. While it has been making shipments for a little more than two months, the company has sent out over 70,000 Tungsten lamps to all parts of the United States and Canada, and many repeat orders is convincing proof of the success of the lamp. The breakage of these lamps in transit has proved very small. This company [illegible] has this figure been exceeded.

BROOKFIELD INSULATORS.—The Brookfield Glass Company, New York, have just issued a very handsome catalogue of their standard Brookfield glass insulators. These are of the screw type, in regular cone and [illegible] special types are made to order and specification, particularly for power transmission. A great merit of the catalogue is that all the insulators are shown full size, "shadow," bringing out every exterior and interior detail. [illegible] groove, weight and quantity per barrel, etc. A page is also devoted to the standard thread itself, from threads to the inch.

ELECTRICAL MEASURING INSTRUMENTS.—The Electrical Apparatus Company, Claxton House, Westminster, London, has issued a [illegible] alogue A is devoted to round pattern direct-current ammeters and volt- [illegible]

[illegible] greatest possible satisfaction. Although the company make it extremely easy to secure duplicate parts, it reports that the number of parts that have been required so far for the 4000 lamps in use amount to a very small fraction per mill on the value of the individual lamp. The list received is rather ingeniously arranged and is accompanied by a diagram, so that any part of the lamp may be intelligently ordered by number.

THE CHICAGO PNEUMATIC TOOL COMPANY, Fisher Building, Chicago, is mailing two new catalogues, Nos. 23 and 24. No. 23 is a book of more than 100 pages and is devoted exclusively to Franklin air compressors. It contains descriptive matter and information relating to air compressors and is embellished with half-tone engravings of the machines and parts. Catalogue No. 24 is also a book of more than 100 pages and covers elaborately the company's widely known line of pneumatic tools and appliances, including "Boyer" and "Keller" hammers, "Little Giant" drills, sand rammers and hoists. Both books are printed in colors, conveniently indexed and strongly bound, thus making them books of reference [illegible]

HOLOPHANE GLOBES.—Bulletin No. [illegible] Holophane Company (sales department) will be found of much interest by all having to do electrical illumination, or who wish to know details of the recent great advancement in the art of illumination through the use of globes whereby the fixed distribution of the naked incandescent lamp may be transformed to give any desired distribution of light. About four-score globes of different shapes and types are illustrated, and the accompanying text points out the various specific uses for which they are designed. A distribution curve is given for each type of lamp, which with other technical information contained renders the publication of much more intrinsic interest than the usual trade bulletin.

COAL HANDLING MACHINERY.—The latest catalogue of "Hunt" coal handling machinery, issued by the C. W. Hunt Company, West Brighton, N. Y., consists of 64 large octavo pages and several hundred cuts. Hunt coal handling plants of all different types are illustrated, from one operated by a single horse to great installations laid down by railroads and the U. S. navy. Following pages of the pamphlet are devoted to descriptions of the details of plants, including hoisting engines, conveyors, buckets, cut-off valves, chutes, weighing hoppers, blocks and ropes. The final pages describe the Hunt industrial railway and electric haulage locomotive. It is stated that the catalogue is published for the use of engineers and architects, and contains the necessary information for installing the machinery described.

CONSTRUCTION ENGINEERING.—Pamphlet No. 16 of their series concerning recent work has lately been issued by Dodge & Day, Drexel Building, Philadelphia, Pa. The pamphlet illustrates and describes in a striking manner the work of the above engineers for the Lehigh Coal & Navigation Company, the Wagner Electric Manufacturing Company and the Arthur Koppel Company. According to the plans for the plant of the Wagner Electric Manufacturing Company at St. Louis, Mo., which is now being erected, the pig iron and coke enter the buildings from the rear. After the castings have passed through the machine shops, the finished parts are taken to the erection shop, from which the completed machines are delivered to cars on a siding in front of the shops. Immediately in [illegible] buildings.

THOMSON POLYPHASE INDUCTION WATT-HOUR METERS are made for the specific purpose of measuring energy in any two-phase, three-phase or monocyclic circuit, and consists of two single-phase motor elements, each acting upon its own disk with both disks mounted upon a single shaft actuating the register. The meters may be applied to a circuit feeding energy to a mixed load of lamps, motors, or other devices, and record accurately irrespective of load conditions. Bulletin No. 4527, issued by the General Electric Company, Schenectady, N. Y., describes the latest form of these meters, which are made in three types; one for house service with metal cover, and two for switchboard use, one having a metal cover and the other a glass cover. The bulletin gives catalogue numbers and capacities, etc., of the various sizes, and a large number of connection diagrams showing the method of installation on different classes of circuits.

Business Notes.

THE NORTHWEST ELECTRIC COMPANY, of Seattle, Wash., will soon begin the erection of a large plant for the manufacture of all kinds of electrical appliances. The factory will be located in the south end of the city and will absorb the Seattle Electrical Heating & Manufacturing Company. A. E. Ransom will have general supervision of the plant.

FAHN & McJUNKIN, New York, have recently purchased from [illegible] D. Carpenter the business of the Packard vacuum pump, which has been in extensive use for many years. Almost every incandescent lamp factory has one or more of these pumps. Messrs. Fahn & McJunkin manufacture almost every kind of machinery for equipping lamp factories and the acquisition [illegible]

[illegible] picnic of the drafting departments of the Western Electric Company, of [illegible] large number present at Riverview Park, Aurora, Ill., where the sixth annual outing took place last Saturday, Aug. 24. Good weather prevailed. [illegible] after a hotly contested ball game with the Hawthorne nine, by the close score of 3 to 2. The 100-yard dash was won by Mr. Houck. The pick-a-back race was won by Messrs. Graff and Baginski, the potato race was scooped in by Mr. Baginski, Mr. Hanzlick won the broad jump with a large margin, Messrs. Graff and Baginski also won the three-legged race, Mr. Hanzlick took the sack race. The Clinton Street heavyweights—Messrs. Krivanek, Novak, Taylor, Roth, Houts and Blume walked away with the honors in the tug-of-war. Two sparring events which terminated the entertainment on the athletic field, were easily captured by the Hawthorne whirlwind, Mr. Tracey, in the preliminary, and by Mr. Shelstrom of the same department in the wind up. After dinner the prizes were awarded, with remarks, by Mr. Percy Nichols, chief draftsman of the Hawthorne Works. Music was rendered by the Draftsmen's Orchestra, led by Mr. C. L. Osgood.

A. GILBERT & SONS.—Owing to the increase of business of the A. Gilbert & Sons Brass Foundry Company, St. Louis, Mo., we are informed by its president, Mr. Chas. F. Gilbert, that in order to keep pace with the demands for its goods, especially in Velox bronze, a metal for wearing parts, and its different grades of Babbitt and anti-frictional metals, it has purchased a site for a new plant on Forrest Park Boulevard, between Vandeventer and Sarah Streets, being 75 ft. on Forrest Park Boulevard, with a depth of 180 ft. The building will be a one-story structure, with a two-story front. The second floor will be used for offices. The building will have a roof of the saw-tooth pattern, with 18,000 sq. ft. of skylight. The roof will be supported on iron beams, leaving the ground floor clear of pillars. On the ground floor will be private lockers and shower baths for the use of employees. The new plant will cost in all about $25,000. The firm started business in 1899, and after the first year it was compelled to build an addition to its factory in order to make prompt shipments. The building now under construction is the fourth expansion it has made in the eight years of its existence [illegible] it has more than doubled its output. It is at present turning out from 9 to 10 tons of brass and bronze castings, and 10 to 15 tons of solder, Babbitt and anti-friction metals a day. Its Jovian Babbitt metal and Velox bronze are the two principal brands. The Velox bronze is used extensively for wearing parts of locomotives, such as driving journals, connecting rods, street railway armatures and axle bearings. The Jovian Babbitt metal is manufactured especially for extraordinary fast-running machinery, such as dynamos, locomotives and wood-working machinery. It will stand great crushing strain, and according to test is the most economical thing on heavy bearings. The company also manufactures about nine or ten different grades of Babbitt and anti-frictional metals for all purposes. It is an extensive manufacturer of solder, ingot metals and aluminum castings.

AN OLD AD.—The Boston Journal reproduces in a recent issue an advertisement of the American Steam Gauge & Valve Manufacturing Company, of over 50 years ago, and gives an interesting account of the growth of the corporation. In 1851, at the Crystal Palace Exposition in London, there was exhibited an improved steam-gauge, patented and owned by Bourdon, of Paris. The American rights to manufacture this gauge for one year, with the privilege of purchasing, were secured by a Boston company. At the expiration of the year, the American rights were purchased by Mr. George H. Fox, who associated with him Mr. H. K. Moore, an expert machinist, and others, and from that date the success of the Bourdon tube was assured in the United States. In 1854, Mr. Fox purchased from his associates their entire interests and rights to manufacture, and organized the American Steam Gauge Company. As it was, in 1854 and until the expiration of the patent, the American Steam Gauge Company was the only steam gauge company in the United States that made the Bourdon spring gauge. [illegible] American manufactured gauges were found to be superior to those of European make. During the past fifty years there have been many improvements in the construction of the Bourdon gauge, but the original idea is still retained. The American Steam Gauge & Valve Manufacturing Company started with a limited production, employing a few men and forced to hand work in producing much of their material. This company had its real beginning at 4 Charlestown Street, employing three men and seven boys, and their output was sold as fast as it could be made. In 1863 the firm moved to larger quarters at No. 2 Linden Street, where they remained until burned out in the Boston fire of 1872. New and more commodious quarters were secured at 36 Chardon Street, and in 1890 the plant was moved to Jamaica Plain, where the business was continued in several plants until 1904, when all departments were combined at 206-220 Camden Street, its present location, and where to-day nearly 500 skilled mechanics are engaged in the manufacture of valves and gauges. In the early 80's the American Steam Gauge Company began to manufacture a complete line of spring loaded pop safety and relief valves [illegible] and hydraulic, water and cylinder relief valves for general purposes. This company was the first to place on the market the "American Thompson" indicator, and has been the exclusive manufacturer of this indicator in this country since its introduction [illegible] ing gauge is one of its most successful products. The valve business has increased year by year to such proportions that additions have been made continuously to meet the demand.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutical Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, fourth Friday of each month.

American Street and Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Detroit, Mich., third Wednesday, September, 1907.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, Atlantic City, N. J., October 14-18, 1907.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Montreal, September 11, 12 and 13, 1907.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, September 18, 19 and 20, 1907.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 1537 Old Colony Building, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 7, 1907.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting, October, 1907.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New England, Philadelphia, Pittsburg and Chicago. Meetings in New York, second Friday of each month.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, [illegible]

International Independent Telephone Association. Secretary, Charles West.

Iowa Electrical Association. Secretary, L. B. Spinney, Iowa State College, Ames, Ia.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., Oct. 16, 1907.

Kentucky Independent Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Missouri Independent Telephone Association. Secretary, Houck McHenry, Jefferson City, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 24 Genesee St., Utica, N. Y.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

National Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Charles W. Ford, Oklahoma City, Okla.

Old Time Telegraphers and Historical Association. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., September 16, 17 and 18, 1907.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

South Dakota Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont and New Hampshire Independent Telephone Association. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electric Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

[illegible]

ered on the outside with [illegible]

[illegible]

trolley is supported from a single messenger cable, rigid bracket arms being provided at the curves to balance the radial strain between the conductor and the messenger wire.

[illegible] East Orange, N. J. [illegible] modifications of the above.

[illegible] Hammond, Ind. App. filed May 9, 1906. An electric hammer having a series of solenoid coils and means by which the current is intermittently reversed through a coil at each end of the series in the operation of the hammer.

[illegible] East Pittsburg, Pa. App. filed Nov. 22, 1906. A porcelain box has a cover with a bayonet joint connection and has a plurality of metallic clips between which ordinary lead fuse wire is clamped.

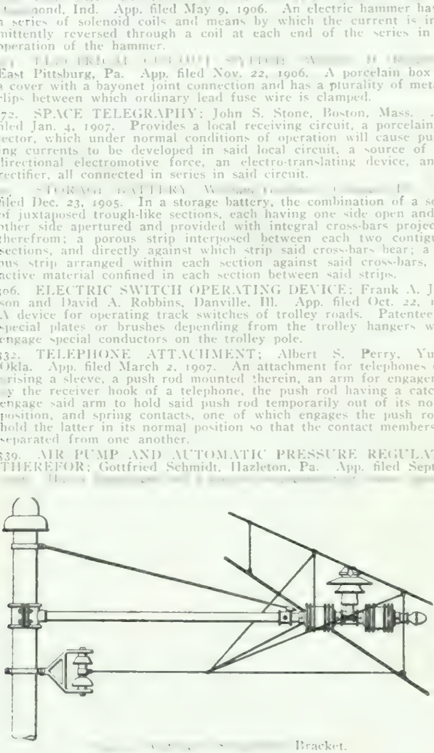
864,272. SPACE TELEGRAPHY; John S. Stone, Boston, Mass. App. filed Jan. 4, 1907. Provides a local receiving circuit, a porcelain detector, which under normal conditions of operation will cause pulsating currents to be developed in said local circuit, a source of unidirectional electromotive force, an electro-translating device, and a rectifier, all connected in series in said circuit.

[illegible] STORAGE BATTERY [illegible] filed Dec. 23, 1905. In a storage battery, the combination of a series of juxtaposed trough-like sections, each having one side open and another side apertured and provided with integral cross-bars projecting therefrom; a porous strip interposed between each two contiguous sections, and directly against which strip said cross-bars bear; a porous strip arranged within each section against said cross-bars, and active material confined in each section between said strips.

864,306. ELECTRIC SWITCH OPERATING DEVICE; Frank A. Johnson and David A. Robbins, Danville, Ill. App. filed Oct. 22, 1906. A device for operating track switches of trolley roads. Patentee has special plates or brushes depending from the trolley hangers which engage special conductors on the trolley pole.

864,332. TELEPHONE ATTACHMENT; Albert S. Perry, Yukon, Okla. App. filed March 2, 1907. An attachment for telephones comprising a sleeve, a push rod mounted therein, an arm for engagement by the receiver hook of a telephone, the push rod having a catch to engage said arm to hold said push rod temporarily out of its normal position, and spring contacts, one of which engages the push rod to hold the latter in its normal position so that the contact members are separated from one another.

864,339. AIR PUMP AND AUTOMATIC PRESSURE REGULATOR THEREFOR; Gottfried Schmidt, Hazleton, Pa. App. filed Sept 12, [illegible]



[illegible] Bracket.

by the diaphragm by which the circuit which controls the electric motor for the air pump is automatically closed or opened according to the pressure in the tank.

[illegible],341. ANNUNCIATOR; Fredric Sidler, West Pullman, Ill. App. filed Nov. 14, 1904. An annunciator particularly for use by barbers by which the operator may audibly announce and indicate that a subsequent customer is in line to receive attention.

[illegible],344. FLUID PRESSURE SYSTEM; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed May 20, 1903. Complete system for controlling an electric motor for an air pressure brake system. Includes among other features a power-driven rheostat having a worm [illegible]

[illegible],348. ELECTRIC WELDING CLAMP; William E. Williams, Chicago, [illegible] welds, particularly adapted for making chairs and tables. The weld is made between vertically movable pressure jaws forming the ter[illegible]

[illegible]

filed March 8, 1906. In addition to the usual trolley wheel journaled on the harp there are provided two disks with convex faces disposed toward the trolley conductor and which are yieldable downwardly and laterally.

[illegible],426. LAMP RECEPTACLE; [illegible] threaded shell, the central stud contact and the terminals being permanently associated therewith so [illegible] ing screwed in place wherever desi[illegible] sign. In this way incandescent lamps may be conveniently connected or grouped in any desired relation in a very ornamental way.

864,42[illegible]—Lamp Receptacle

864,427. LAMP RECEPTACLE; Harry W. Lawrence, Denver, Col. App. filed Jan. 5, 1907. In order to provide a very compact lamp receptacle of neat and ornamental appearance, and having only porcelain in the exposed parts, patentee has a form of base which supports the circuit wires at a plane considerably elevated above the central cavity in which the threaded shell is contained. In this way the circuit wires are suitably placed away from the supporting surface on which the receptacle is placed, while at the same time the lamp is set very low and in a highly ornamental manner.

864,446. CONTROLLING MECHANISM; Herbert W. Cheney, Norwood, Ohio. App. filed June 30, 1906. A controlling mechanism for single-phase electric railway systems of the type having auto transformers and adapted under some circumstances to operate the direct signals. Provides a safety means by which the controller cannot be left in an improper position.

[illegible] TESTING SYSTEM FOR TELEPHONE [illegible] Dean, Chicago, Ill. App. filed June 29, 1903. In a telephone system, the combination with a cord circuit for establishing connections, of a test relay normally disconnected from said circuit, means for connecting said relay with said circuit an operator's telephone, and means to connect said telephone with the said circuit after the connection has been established, and for preventing the connection of said test relay therewith during said connection, substantially as described.

[illegible] SIGNALING APPARATUS FOR RAILWAYS [illegible] Renson, Liege, Belgium. App. filed Nov. 14, 1906. Has two boxes placed upon a track slightly in advance of the junction with a single track section. Each box establishes a signal whenever a car passes from the double track to the single track and vice versa.

864,520. TROLLEY WIRE HANGER OR EAR; Harry G. Dyer, Gloucester [illegible] in which it is sufficiently bent to preclude accidental displacement.

864,571. TROLLEY HARP; Thomas W. Small, Cleveland, Ohio. App. filed Dec. 5, 1906. The trolley harp is swiveled at the upper end of the pole, the wheel axle being connected with the pole by a flexible conductor.

864,576. ALARM; Thomas H. Troland, New London, Conn. App. filed March 8, 1905. A sprinkler system of the type having a lever carrying a vane in the path of the water jet so as to be displaced and close an alarm circuit whenever the water escapes.

[illegible] INSULATOR [illegible] Beckett, Little Rock, and William R. Beckett, Rose Bud, Ark. App. filed May 21, 1906. A casting grooved and formed to be tied upon an insulator post and having a setscrew to hold the line conductor in place.

[illegible] APPARATUS FOR TREATING ORES [illegible] Goldfield, Nev. App. filed April 8, 1907. In an apparatus for the treatment of ores, the combination of a tank, a plow or muller movable over the bottom of the tank to and fro in the direction of the length of the tank, a frame similarly movable on the tank and having a hollow portion adapted to be connected with a source of liquid supply, and a plurality of pipes connecting said hollow portion of the frame and the plow or muller and extending downward through the latter and having discharges at the under side thereof.

[illegible] ELECTRIC RAILROADING [illegible] App. filed April 15, 1907. Patentee provides trolleys between adjacent tracks, each train being equipped with collector shoes or trolleys on both sides so as to engage both adjacent conductors simultaneously. The circuits are so arranged that alternate trolley wires or conductors are of opposite electric potential.

864,694. ELECTRIC SWITCH; James J. Ross, Detroit, Mich. App. [illegible] of telegraph instruments with any one of a series of instruments in a telegraph office without interrupting the circuit, thus eliminating sparking.

[illegible] RECTIFYING AND INTERRUPTING ALTERNATING CURRENTS [illegible] An electrolytic rectifying cell, consisting of an a[illegible] suitable electrolyte and an inert electrode, adap[illegible] same capacity in some second device which is [illegible] with said rectifying cell.

[illegible] TELEPHONE REPEATER SYSTEM [illegible] apparatus, the combination with a local circuit, of a bridge conductor [illegible] local circuit.

[illegible] PROCESS FOR THE PRODUCTION OF ELECTRIC RESISTANCE BODIES [illegible] many. App. filed Dec. 29, 1904. The herein described process for producing electric resistance bodies, which consists in molding and [illegible] jecting it to a temperature at which the carbid only becomes soft [illegible]

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

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NEW YORK, SATURDAY, SEPTEMBER 14, 1907.

CONTENTS.

MUNICIPAL OWNERSHIP VERSUS PRIVATE OWNERSHIP.

The report of the municipal ownership commission of the National Civic Federation, to which allusions have recently been made in our columns, promises to be a valuable although a somewhat lengthy publication in its completed form. The gist of the committee's conclusions has already been printed in our issue of Aug. 3. Although those conclusions are not unanimously subscribed to by the members of the committee, yet it is remarkable that substantial agreement should have been reached upon so large a subject by 20 men representing not only business interests, but also labor unions, education and the press. There is no social question of greater importance at this time than that of municipal versus private ownership. There is no larger question than this, and certainly no question which admits of a greater range of opinion. At one extreme viewpoint of this subject are the believers in despotic authority and in universal ownership by divine right of kings. At another extreme viewpoint are socialists favoring the abolition of all private property. Somewhere between autocratic dictatorship and communistic possession, all modern communities strive to find a stable equilibrium.

Since the great coal strike of two years ago, public opinion in the United States has indicated marked opposition to the continuance of private ownership of public necessities on the same terms as previously existed. To many persons, a solution of the difficulties of social and commercial aggregation seemed to be obtainable by Governmental operation of all utilities. The report of the National Civic Federation calls attention, however, to some of the dangers which beset municipal omniownership. We can well believe that under certain conditions the remedy might be worse than the disease. If we consider, for instance, the electric lighting and power supply of a large city, we know, from experience, that this is a business calling for trained management and operation. The best of judgment and direction are needed for the proper conduct and development of the business. The best at the head and the most intelligent cooperation in every post and department are needed for the most successful operation of this complicated service. The report points out that municipal ownership can only be expected to be successful when the conditions in a city are such as will bring into the service of the city the most energetic, most faithful and best trained specialists for each post in the service. Up to the present time, however, general experience in American municipal affairs has not shown a tendency to attract the most fit and loyal servants as a class, although many honorable individual exceptions to this rule have presented themselves. Until, therefore, public affairs in our cities have so changed that better and more reliable men can be organized for highly complex technical public service, such as electric supply, than a private corporation can enlist, it will be to the public advantage to continue private ownership under suitable regulation, rather than to attempt dangerous quests for Utopia. Publicity of management by private individuals can be trusted to accomplish better results than the privacy of management [illegible]

[illegible] committee, that full publicity should be required of the accounts of private companies under a uniform system of accounting.

Diffuse Lighting.

There seems to be at present, as we have noted within the past few months, a reactionary sentiment as regards lighting by diffuse reflection from ceilings by means of lamps concealed in coves or other devices. The necessity for suppressing too bright sources of light and of getting to moderate intrinsic brilliancies has unquestionably led to some very crude attempts at diffuse or indirect lighting, the effects of which have been bad. A reaction from these wasteful designs is natural and necessary. In an interesting paper before the Illuminating Engineering Society Convention at Boston, Mr. Preston S. Millar pointed out some of the sources of inefficiency in diffuse lighting. The points made against it were that too large a percentage of light is absorbed by the ceiling and walls; that there is a loss due to unnecessary intensity at unimportant points; and that with ceiling and walls lighter than the working plane, the eye requires a higher intensity on the working plane than when the ceiling and walls are less brilliantly illuminated than the working plane. It is evident from the figures given relating to the cove lighting in the convention hall in the Boston Edison Building, that to those elements of inefficiency which Mr. Millar mentioned should be added another which is often of more importance than all the rest combined, namely, bad design. In other words, most of the diffuse lighting systems that have been so far tested accurately were of inherently inefficient design. We wait with much interest the complete figures promised on the Boston Edison installation mentioned where the design is evidently such as to greatly reduce the elements of inefficiency mentioned by Mr. Millar. The Boston Edison installation is designed so that a large proportion of the light is reflected only twice before reaching the working plane, which is a much less number of reflections than is frequently found in diffuse lighting. The size of the reflecting surfaces is also small enough so that the necessity of abnormally high illumination on the working plane is not felt, since so small a portion of the ceiling is used for diffusing that the greater part of the ceiling and sidewalls are not abnormally light.

There can be little doubt that where economy is the controlling factor in the design of illumination and all other considerations are thrown to the winds, the plan of furnishing a mere ground-work of general illumination, reinforced where necessary and nowhere else by localized light, furnishes the largest working illumination for the least money. In certain cases this is undoubtedly the best procedure, yet it is not always desirable or convenient. In fact, it is usually inconvenient where large numbers of lamps must be dealt with, as in large offices and industrial establishments. In spite of its inconvenience, it may be the only feasible method. Where general illumination is wanted in all of the room, diffuse lighting comes into consideration as one of the possible methods. It is yet too early to predict the outcome. We think the possibilities of diffuse lighting have not yet by any means been fully thrashed out. There must always be loss in diffuse lighting due to diffuse reflection. For instance, a beam of light coming from a lamp equipped with a reflector must inevitably suffer loss by reflection from anything whatever, yet this loss is of determinable amount and is not greatly in excess of that which has to be met in cases where the source of light must be screened to lower the intrinsic brilliancy. The beam of light in question may readily be reflected with a loss of no more than 40 or 50 per cent, while an opal or other globe to reduce the glare might lose 20 or 30 per cent. The very great loss in indirect lighting which Mr. Millar quotes as 70 per cent or so, is clearly due mainly to improper design. Incidentally, we may remark that in his direct lighting Mr. Millar apparently used bare lamps, which in most places where diffuse lighting would be used are inadmissible, while frosted lamps, when used, suffer very severely in useful life.

A very interesting and curious feature of the paper of Mr. Millar is found in the tests to determine how much higher intensity of illumination was required for reading in a room lighted with indirect lighting than with direct lighting. The diffuse lighting system with which this room was equipped should certanly serve as an example of how not to attempt diffuse lighting, the walls being excessively light with diffuse reflection from the lamps, the ceiling being dark and the sources of light being denied the privilege of reflectors. A string of bare lamps around the wall, for instance, would have tended to the same result as far as reading is concerned. We understand, of course, that these bad conditions were selected purely for the purpose of showing by an extreme case the possible magnitude of some of the adverse factors in diffuse lighting, and the results were therefore of value. It should not, however, be taken as representing the best that can be done with diffuse lighting. This class of lighting probably offers a wider opportunity for technical skill in its design than any other familiar method. But it certainly is not to be condemned at this stage of the game on the strength of some of the blunders that its advocates have made in the past. It is a good thing, however, to have some of its failings brought home to us.

Abnormal Conditions in Transformer Operation.

That a momentary rush of primary current takes place upon connecting an unloaded transformer to its mains has been previously recognized, and it is known that this rush of current is affected by the residual magnetism of the transformer core. Attempts to measure this excessive current having given erratic results, the determination of its precise nature was made the subject of a special investigation in the electrical laboratories of the University of Illinois, the results of which are outlined in an article by Mr. Tyrgve Jensen, elsewhere in this issue. It was found that under uniform conditions of previous magnetization of the core, the closing of the primary switch at a predetermined definite point on the supply e. m. f. wave gave uniform results. Changes in the point of wave at which the closing took place made a definite change in the rush of current in the primary, and changes in the previous magnetism of the core had a definite effect, although less pronounced. It was found to be impossible to connect [illegible] a transformer to the supply mains without producing from 6 to 16 amperes of current momentarily, in a transformer whose normal exciting current is only 1.5 amperes. Excessive initial secondary voltages also were always obtained, but their values varied from about 10 to about 30 per cent above the normal, the most abnormal values of primary current coinciding with the

least abnormal values of secondary voltage when the switch was closed at the zero of the supply e. m. f. wave. Furthermore, the secondary e. m. f. values were not appreciably affected by any previous magnetic condition of the core, showing that the laws governing the primary current values differ from those governing the secondary e. m. f.

The oscillograph curves accompanying the paper show that the impulsive rush of primary current is practically unidirectional, being maintained almost exclusively upon one side or the other of the zero current line, depending upon the value and direction of the residual magnetism of the core at the moment of closing the switch. It has often been assumed that sluggishness of iron in becoming magnetized is the cause of the primary rush of exciting current in a transformer. The experiments seem to show that this theory is fallacious, since the oscillograph records prove that the secondary e. m. f., which must depend upon the core magnetism, may assume a normal value coincident with entirely abnormal values of primary current. In suggesting methods for the operation of high-tension transmission lines these experiments may prove of value, since they indicate a way for the bringing into service of a large transformer unit without shock to the system. When the coils of a transformer are connected into circuit, it is evident that a large rush of current may occur, possibly causing a dangerous surge. The experiments show that when a reactance coil is placed temporarily in series with an incoming transformer, just as a resistance is placed in series with an incoming direct-current motor armature, excessive primary current and secondary e. m. f. may be restricted. Such a method of "synchronizing" a transformer before fully connecting it directly to the supply circuit would seem to promise good results in the operation of large units.

European Methods of Operating Mountain Railways Electrically.

[illegible] Switzerland has nearly secured a corner, or monopoly, of the mountains of the central European area. This topographical peculiarity, together with the acquired national propensity of the Swiss to be the model hotel-keepers of the world, has developed the electric mountain railways with particular advantage in Switzerland. The electric energy for these railways is obtained by a seeming inversion of the second law of thermodynamics—that is, by working from a lower temperature to a higher, or by the water falling from the melting mountain glaciers above the snow line, to the more genial temperature of the valleys. Two essentially distinct systems of operating the mountain railways are in use, the direct-current system and the alternating-current system, the latter being the more generally used, and the three-phase system the most popular. A [illegible] railway in two salient particulars. First the gradient is usually about 20 per cent, so that a rack and pinion method of propul- [illegible] sary for converting the motors into generators when descending [illegible] ventilated wire resistor is provided on the electric locomotive for absorbing the energy from the generators. In this way the speed of descent of the train is kept down to five miles an hour on the 20 per cent grade, without the application of mechanical brakes. Automatic arresting brakes can, however, be released, to stop the train within a few yards, in case of any accidental release of the electric generator brake action. By this method, the energy of the descending train is not available for assisting in the driving of rising trains, but is expended locally in heating the locomotive resistor. There would, however, be little or no commercial advantage in utilizing the descending train energy for lifting the ascending train, because the traffic is very limited and the energy from the waterfalls would be wasted in any event. Moreover, the local expenditure of the energy of the descending train makes a more simple arrangement than a regenerative system, and simplicity of system is conducive to safety.

In the three-phase motor system, the usual method of operating during the descent is by allowing the three-phase motors on the locomotive to become three-phase generators, by their negative slip, or speed slightly in excess of synchronism. The machines thus act regeneratively, or restore energy to the line, and means must be provided in the system for absorbing this energy in order to permit the machines to exert brake action. A concrete case is offered by the mountain electric railway ascending the Gorner Grat, from Zermatt in the Swiss Alps. The railroad is a single-track, rack-and-pinion road, 5½ miles in length, with an average gradient of 18 per cent and a maximum of 20 per cent. The total lift is nearly 1 mile. Each electric locomotive has two 90-hp, three-phase motors taking current from two overhead trolley wires in the same horizontal plane, the track being the third conductor. The energy is generated at 5000 volts in the hydraulic power house near Zermatt, and is delivered to the trolley lines at 600 volts between lines, through step-down transformers stationed along the route. When only one train is being lifted, at five miles an hour, the turbines in the power house supply the lifting power plus the losses in the system. When this train has reached the summit, and commences to descend, it tends to act as a generator, and to help the turbine drive the generator in the power house. The attendant at the power house switchboard observes the turbine accelerate, and restores its normal speed by providing a triple water-rheostat load on the low-tension system at the station. This load absorbs the energy of the descending train, and keeps the turbine working under load as a prime mover. If, however, there is one train going up at the same time that another train is coming down, there is a partial utilization of the regenerated energy and the water-rheostat load may be reduced. In all normal cases, however, there is an expenditure of energy in the water rheostat when a train is descending, and the principal difference between the direct-current system and the alternating-current system in this respect, is that in the former the energy is wasted in a rheostat on the locomotive, while in the latter it is wasted in a rheostat at the station. In each case it does not pay to utilize all of the regenerated energy because a mountain stream pours steadily into the power-house reservoir day and night. If the water is not taken into the penstocks for driving the turbines, it flows over a bye-pass fall, [illegible]

Visit of Germans to Schenectady.

[illegible] have been sent by the German government as a commission to visit America to inspect the electric railways and high-tension transmission systems of this country and Mexico. Numbered among the party are Privy Councillor Wittfeld, of the Prussian government; Prof. Dr. W. Reichel, of the Royal Technical University, Berlin; Director Frishmut, of the Siemens-Schukert Works; Mr. Pforr, of the Allgemeine Electricitaets Gesellschaft Railway Dept.; Director A. Elfes, of the A. E. G. Brunnenstr, and Director Jordan, of the Lahmeyer Works.

The party left Europe via Geneva, on the North German Lloyd liner "Moltke." The work of studying the power houses and locomotives of the New York Central lines, the Long Island Railroad, the New York, New Haven & Hartford system, and the plants of the Interborough Rapid Transit Company, was interspersed by entertainments given by the officials of the above mentioned plants, and by the officers of the General Electric Company. Boston interested the visitors with its big Lincoln Street power house of the elevated lines, the Curtis steam turbine equipment of the Edison Illuminating Company, and the equipment and service of the Boston traction system including the well-known East Boston tunnel under the Charles River.

Mr. C. B. Davis, general manager of the Boston office of the General Electric Company, entertained at luncheon at the Exchange Club. Those attending included General Bancroft, president of the Boston Elevated Company; Mr. Sullivan, president of the Massachusetts Street Railways, and Mr. C. L. Edgar, president of the Edison Illuminating Company.

The successful trip was continued to Albany, where the members of the commission put up at the Hotel Ten Eyck. They reached Schenectady on Sept. 5, and were shown through the various departments of the works and then entertained at the Mohawk Club. The reception committee consisted of Vice-President E. W. Rice, Jr.; Vice-President J. R. Lovejoy; General Manager G. E. Emmons; General Supt. E. B. Raymond; A. E. G. Representative Wm. S. Hulse; Asso. Mgr. Foreign Dept. M. A. Oudin; Engineer Railway Department W. B. Potter; Engineer P. & M. Department D. B. Rushmore; Engineer J. E. Noeggerath; Consulting Engineer Eugen Eichel.

All day the German flag floated over the works in honor of the occasion. The commissioners were surprised at the size of the works and the extent of the production in progress in the various shops. The huge shop No. 86, where the Curtis turbine generators are manufactured, impressed the visitors most, and they spent considerable time in the galleries watching the work in progress. They also found much of interest in the railway department, the wire and cable shops, the power house, and the foundries.

The Pay of British Telegraphers.

A report has just been made in England on the condition of the post office employees of Great Britain. It has been laid before the House of Commons, and the recommendations are likely to be adopted. A résumé of the report, forwarded by U. S. Consul-General R. J. Wynne, of London, is as follows:

"A careful analysis of the various recommendations of the committee leads to the conclusion that their acceptance will involve an ultimate annual cost to the nation approaching $2,500,000, although the increase per individual may appear small. A demand on the part of the organized carriers, clerks, telegraphers and telephonists for a 42-hour week has been rejected, while a weekly half-holiday is only recommended where the exigencies of the service permit. Free medical attendance or a small money grant given where the official doctors are not easy [illegible]

"The London telegraphists, who now rise to a maximum of [illegible] recommend that their maximum should be $10.25, with an excess allowance of 75 cents a week till promoted for passing a searching examination in technical telegraphy.

"The provincial postal and telegraph servants made large claims, in many cases asking that the maximum salary should be nearly doubled, but the increases actually recommended are not very great, though the lowest paid officers are recommended for considerable advances. The telegraphists and sorting clerks at these offices, the committee suggests, should be graded into five scales (instead of seven) with maximum salaries of $10, $11, $12, $13 and $14, respectively. A long list of alterations is suggested in the wages of other classes of postal servants. Women sorters, for instance, are recommended for a more rapid advance to the maximum of $7.50, and women telegraphists to a maximum of $10. An important change suggested is that women of all grades in the service should be no longer exempt from Sunday duty.

"Most of the changes recommended in wages are more in the nature of redistribution on the rate of progression than actual increases. The maximum has been raised to those em- [illegible]

Investigation of New York Lighting Companies.

Although in the last three years the conditions of the various lighting companies of Greater New York have been thoroughly investigated, the Public Service Commission proposes to do practically all the work over again, as shown by its adoption, on Aug. 20, of the following resolution:

Resolved, That the following be adopted and that it be served upon the various gas and electric companies in this district:

You are hereby required to furnish within 30 days from the 23d of August, copies of the following documents relative to each and every company operated or controlled by you, whether by lease or sub-lease, by stock ownership or by joint agreement. These documents called for may be sworn copies or verified copies of the originals, and if filed in a public office that fact should be so indicated with the date of filing.

1. Certificate of incorporation.

2. Supplemental or amended certificates of incorporation.

3. Any act of the Legislature granting, confirming or limiting any right or franchise of the corporation, or affecting the right of the corporation to use or exercise any franchise.

4. Certificates relative to changes in the capital stock.

5. Any consolidation or merger agreement between companies now operating in connection with your plant.

6. Consents of local authorities constituting franchise rights.

7. Certificates from the state or municipal authorities, including departments, affecting your franchises.

8. Copies of all mortgages executed by you or by companies [illegible]

9. Copies of all leases, deeds, contracts, or other documents in the chain of your title.

10. Location of all real estate owned in fee, described by metes and bounds.

11. Location of all real estate leased, described by metes and bounds.

12. Copy of any contracts executed between companies in your system or other companies as to the purchase or the sale of gas or electricity.

13. Reference to court decisions affecting the validity of your franchises.

14. As of July 1, 1907, the location of your plant or plants, and system, with a full description of your property and franchises, stating in detail how each franchise stated to be owned was acquired.

15. A map drawn to a scale of at least 2500 feet to the inch, showing all pipes, conduits, and other structures constructed or now maintained by you in the public streets.

The foregoing refers in each case to each company in your system except where otherwise noted.

Our New Home.

The accompanying illustration gives a view of the façade of the new building which last week became the future home of this journal. Situated about a half block west of Broadway, on Thirty-Ninth Street, the building is within a few blocks of the Times Square subway station and of the Sixth and Ninth Avenue elevated stations, and convenient to Broadway, cross-town and adjacent avenue surface lines. Its advantage of easy accessibility will be further increased upon the completion, several blocks south, of the Pennsylvania and McAdoo North River terminals and of the East River Belmont tunnel, which latter will land passengers at Times Square, three blocks north. A particular advantage of the location to the editorial staff is the neighborhood of the Engineering Societies Building, a block east, with its fine technical library at their service.

The over-crowded condition down-town is yearly becoming more aggravated, the streets even at the present time being crowded to an extent that interferes seriously with circulation. It appears to be only a short time when there will be an exodus up-town of certain lines of business, and the vicinity of Thirty-Fourth Street and Forty-Second Street, owing to ideal transportation facilities, promises to become a Mecca for this hegira. It was largely in view of this consideration that the present location was chosen for the future home of the several journals published from this office.

The building, which is known as "The Thirty-Ninth Street Building" has a frontage of 126 ft. on the north side of Thirty-Ninth Street with a depth of 98 ft., and consists of 11 floors and a basement. The front is flanked by pavilions which provide for the elevators, stairways and toilets, thus leaving unobstructed the main floors. There are recessed courts in the rear of the pavilions, the interior of the building thus being lighted from all sides. The building is entirely of reenforced concrete and probably the most advanced example of its type in the world. Prof. William H. Burr, of Columbia University, had charge of all the engineering details connected with the design and construction of the building, and it therefore goes without saying that the crudities are absent which characterized the earlier specimens [illegible] The steel re-enforcement of the columns is sufficient in itself to carry the load of the building. The floors, which are formed of re-enforced concrete slabs, are carried by re-enforced con[illegible] their molded connection with the columns give to the ceilings a symmetrical and attractive appearance which recalls the beamed interiors of [illegible]

The external walls are finished entirely in concrete, the front façade having its surface carefully floated. To those who have had doubt as to the appearance of a large exterior entirely in concrete it will be an agreeable surprise to learn from this example that it is possible to produce an effect as handsome with a carefully worked concrete surface as with the use of the most attractive stone or brick.

In a future article the electric installation will be described in detail. For the present it will suffice to say that high-speed electric elevators are installed, there being two passenger elevators in the East pavilion, and one passenger and one freight elevator in the West pavilion. Current for all purposes—lighting and power—is taken from the street mains. The boiler equipment for heating is of such a character, and has sufficient capacity, to furnish steam for power should it become desirable at any time in the future to generate electric current on the premises. At the present, however, there does not seem to be any probability that an individual generating plant will have to be installed.

It is of interest to note that approximately 10,000 barrels of concrete and 1500 tons of steel were used in the construction of the building. Each of the floors of the building has an area of 10,500 ft. The offices of this journal are on the eleventh or top floor, where every modern office convenience has been provided. A large printing plant is now in course of installation in the building for the service of the several journals published by the McGraw Publishing Company and will occupy three entire floors, namely, the second, third and fourth floors. Sev[illegible] will be occupied by other publishers and by the American Institute of Social Service; the remaining space will be let for business purposes.

In the past third of a century, The Electrical World has never wandered far from the general post office in its change of quarters, and upon the completion of the Pennsylvania terminal will again be just a few blocks from its mailing point. From the time of its foundation in 1874 as The Operator, until 1886 The Electrical World occupied modest quarters in an old building at 9 Murray Street. In the last-mentioned year extensive quarters were secured in the Potter Building in Park Row, one of the first large New York office buildings. Growing demands for space led successively to removal three years later to the new Times Building on Park Row and to the Postal Telegraph Building in 1894. In 1898 the address again became 9 Murray Street, in a large building erected on the site of the former modest home. A year later, upon consolidation with the Electrical Engineer, the quarters of the latter journal at 120 Liberty Street were occupied, to be vacated in 1902 for larger space in a new building next door, [illegible]

Recent Electrical Development in Europe.

Extensive plans are on foot in Germany and Switzerland for great electrical generating plants in connection with water powers, and also for applying electrical traction to railroads now operated by steam. The great success of the numerous great dams in Western Germany, like the Urft Valley Dam in the Eifel region, has created a strong movement for combining forces and erecting similar storage reservoirs on many of the rivers of the country. A society of German water-power owners was organized some time ago, and it is taking steps to form local branches wherever a number of owners having common interests in a water power can be got to pull together. Manufacturers of the most varied branches belong to these organizations; and in many regions they are the dominating element in the movement. This society began its operations in Western Germany, where most of the great reservoirs of Germany hitherto have been built. Special subsidiary societies have been organized for a number of the valleys of streams descending into the Rhenish-Westphalian industrial district from the highlands to the east. Some of the biggest reservoirs of Germany for the development of electrical energy have already been built in that part of the country, and still greater ones are planned. One of the latest and most promising is in the valley of the Möhne, which falls into the Ruhr at Neheim, with a dam 131 feet high and holding nearly 26 billion gallons, making it the largest reservoir on the Continent.

This society is working to extend its influence into other parts of the country. It is about to organize power-owners in the Nidda Valley in Hesse. The Nidda falls into the Main several miles below Frankfort, and the electrical energy generated from its waters would find a large market in the large industrial region of which that city is the center. Efforts are also making to organize in several of the Black Forest valleys. Organizations are also planned in Bavaria for the Lech, on which is situated the city of Augsburg, one of the leading cotton spinning and machinery centers of Germany; and for the Pegnitz, which would supply the numerous industrial establishments of Nuremberg and Förth with power. Later on it is intended to organize in the numerous valleys of other parts of Bavaria, as well as in the Thuringian Forest. One of the purposes of the society is to get all the water-power owners together so that they can throw their combined influence in favor of suitable legislation for carrying out great dam-building schemes.

Among the big dams about to be built in Central Germany may be mentioned one on the Eder in Waldeck, not very far from Cassel; while north of the same city the Diemel will be dammed at Helminghausen, near where that stream empties into the Weser. A meeting has been held in Karlsruhe in Baden to discuss the erection of two dams on branches of the Murg River, which emerges from the Black Forest at Rastatt. Here it is estimated that a maximum of 50,000 horse-power could be generated at an extremely low cost, and it could be easily carried to a number of manufacturing towns in the vicinity, or could be used for electrifying a part of the railways of the Duchy. Another and greater scheme in which that state is interested is a dam across the Rhine between Wyhlen on the Baden side and August on the Swiss side, several miles above Basle. The contracts have already been placed for building there, and work is to begin this year. The Bank für Elektrische Unternehmungen of Zurich, the stock of which is nearly all in the hands of the Allgemeine Electricitäts-Gesellschaft, of Berlin, is interested in the undertaking, which is to be one of the largest of the kind in Europe.

The city of Basle is taking action to build a dam on the Rhine to supply itself and its industries with electrical power. The idea was at first to build several miles below the city, but as this would have caused the water to rise into some of the lower streets it was finally decided to build above the city. The point at which the dam will be built is also mentioned as Augst, and it is not clear from the material at hand whether this is the same project as the one above mentioned. Another Rhine project of much promise is a dam still further north of Basle under the auspices of the Alsatian Government. It is to be built at the little town of Kembs. The energy to be generated here will be carried to Mihlhausen, some eight miles distant, where there will be a great demand for it in the numerous cotton and other mills of the place.

The problem of introducing electrical traction on standard gauge railways is receiving practical attention in Germany. This summer it has been stated that the Prussian railway authorities will electrify the railroad that runs from Cologne by Treves into the Saar Valley, using the numerous water powers of the Eifel region to generate electrical power. This would be an almost exclusively freight-hauling road, the purpose being to cheapen the cost of transportation between the great coal and iron region of the lower Rhine on the one hand and the Saar and Luxemburg-Lorraine industrial districts on the other. The last-named district produces vast quantities of low-grade iron ores, which will hardly stand the cost of transportation by steam railway to the iron furnaces on the lower Rhine; and it also has a great number of furnaces, the coke for which must be hauled from the Essen region. This electrical broad-gauge road is therefore designed to carry a very heavy traffic both ways; and it is expected that the cost of transportation will be materially reduced, as compared with the present steam locomotive system.

The kingdom of Bavaria has taken up the subject of electrical traction on ordinary railways, and it seems now quite within the possibilities that such a change will be made within a comparatively near-by period on all the roads in the southern part of the kingdom. A memorial has been prepared for presentation to the next Diet, or State Legislature, in which it is calculated that the introduction of electricity, generated by water-power, on the southern roads will result in a considerable saving of money in operating expenses. The total saving is reckoned at $1,660,000 a year, which means a saving of nearly $18 a year per horse-power used. It is estimated that the railways in question would call for about 200,000 horse-power, but the total amount of electrical power that could be obtained from the streams of the kingdom, as an official inquiry has shown, is about 700,000 horse-power. This would leave 500,000 horse-power available for industrial purposes. The plan of the Bavarian Government to change to electrical traction has been helped forward by the decision of the Austrian authorities to adopt electrical traction on the Arlberg Railway, which passes through the celebrated tunnel of the same name.

The idea of using electricity on standard-gauge roads continues to gain support in other parts of Germany. A suburban road at Altona and Hamburg was opened some months ago with electrical traction and is understood to be very successful. Another scheme that has been in the air for above a year is a road connecting Cologne and Düsseldorf. According to the last reports the experts of the two great manufacturing electrical companies at Berlin were working out the details of this scheme, under the sanction of the Prussian railway authorities; but it is not known what stage of progress has as yet been reached.

At Berlin several interesting electrical traction plans are being worked out. The Underground & Elevated Railway Company, which opened an electrical road through parts of Berlin and Charlottenburg about six years ago, is now engaged in extending an underground line through the central business section of the city, from the Potsdamer Platz to the Alexander [illegible] (underground) to the remote western side of Charlottenburg and will eventually be carried on to Spandau. Meanwhile the municipality of Berlin is slowly working out plans for building a subway on a north and south line through the Friedrich Strasse.

A still more ambitious plan, from the standpoint of cost and the amount of electricity to be required, is the proposed electrification of the so-called Stadtbahn, the great ring of steam road that encircles the city, with a connecting line through the heart of the business section from east to west. A conference was recently held under the auspices of the Minister of Railways [illegible]

pared and presented to him within a year. The Stadtbahn is now a double-track road; and a part of the electrification plans is to put in two more tracks above the present two, as a second story. Still another electrical project in Berlin is a so-called suspended railway, similar to the one that has been in operation at Elberfeld for some years. This road, for which ground was broken this week, will be built through the streets in the eastern part of the city, connecting some of the large suburban towns with the business and manufacturing quarters.

The success of electrical traction in the Simplon Tunnel has given a new impetus to the use of electricity on standard-gauge roads in Switzerland. It is reported that electricity will soon be introduced for hauling all trains from Domodossala, on the Italian side, up the mountain to Iselle, the southern entrance to the tunnel. It is said that the Swiss Government is considering proposals for turning over to several big electrical companies certain stretches of the state railways for the experimental introduction of electrical traction. The most tangible of these projects applies to the important line between Lucerne and Zurich, which the Oerlikon Machine Factory wants to electrify. Swiss electricians are confident that within the next two years a number of the railways of the republic will be operated entirely by electricity. The government has recently come forward with a plan to acquire the Gotthard Railway (connecting with Italy through the tunnel of that name); and it has already made an official investigation of the water-powers on both sides of the mountain, with a view to electrify the mountain sections of the road, at least, after it has been taken over by the state.

In Germany larger prospects for electricity are opening up through new inventions. Electrical methods for extracting atmospheric nitrogen for fertilizing and explosive purposes are attracting increasing attention; and it seems highly probable that large plants will be established for this purpose within a few years. A great company at Mannheim which manufactures aniline dyes has recently been negotiating for the acquisition of an immense water-power on the Alz River in Upper Bavaria, which will be used to generate electricity for producing nitrogen from the air. This month the organization of a company for producing nitrogen is reported from Gladbeck in Westphalia.

Still another field for the use of electricity seems to be opening up in connection with the vast peat marshes of Germany and other countries. Professor Frank, who discovered an electrical process for producing a nitrogenous salt ("kalkstickstoff") from the atmosphere, is co-operating with Siemens & Halske in working out an electrical process for partly drying the peat, which will then be converted into gas, to be burnt in gas-engines especially constructed for the purpose. It is hoped that a cheap method can be worked out which will render the immense peat resources of the country cheaply available. An experimental plant is being erected in Westphalia by the company named. Of course the new invention, if it succeeds, will be used in connection with electrical generating plants, distributing the energy to the places where it is needed.

New French Regulations as to Use of Electrical Power in Factories.

By decrees published last month, the French Government has modified the regulations of 1904, regarding the protective measures required in certain classes of work, or in various industries using electricity; new rules of a special nature having been substituted for those hitherto in force. The general intention of the authorities is that electrical installations should be protected in proportion to the maximum normal potential existing between the conductors and the earth; these installations being divided into the two following classes in accordance with such potential: First class: A. Direct current—Installations where the maximum normal potential between the conductors and the earth does not exceed 600 volts. B. Alternating current—Installations where the maximum effective potential between the conductors and the earth does not exceed 150 volts. Second class: Installations with potentials respectively higher than those above mentioned.

It is principally with installations of the second class that the new regulations deal. In such cases the stationary and conducting parts not traversed by the current must be electrically connected with the earth or must be electrically insulated from the ground. In the latter case, the machines are to be surrounded by a boarding which will not slip; also insulated from the ground and so arranged that it is impossible to touch at the same time the machine and any conducting body fixed to the ground. The grounding and electrical insulation must always be kept in good condition. The same rules apply to transformers depending upon installations of the second class, which must only be accessible to the staff in charge of them. When an electrical machine or apparatus is in a place serving at the same time for some other purpose, it must be fenced off or otherwise rendered inaccessible to those not in charge; a notice of the existing danger being posted up.

Uncovered electrical machines, incandescent lamps not doubly covered, and arc lamps or any other appliance producing sparks are prohibited in workshops containing explosive substances, or in those where detonating gas or any inflammable dust may be produced, unless they are provided with a covering insulating them from the atmosphere. The ventilation of places intended for accumulators must be sufficient to insure the escape of gases liberated.

Switchboard distributing currents of the first class must be insulated and arranged so as to prevent all danger. The regulations as to machines of the second class likewise apply to switchboards bearing appliances and metal parts coming under that category.

Other detailed regulations deal with the spaces surrounding electrical machinery and appliances and the installation of conduits. Among the points upon which stress is laid is that the touching of machines of the second class (even with rubber gloves) or working on such machines (even using tools with insulating handles) should be strictly prohibited. Machines of this higher voltage must in future bear distinct marks or signs to that effect in paint or otherwise.

Exposed conductors or other electrical appliances are not to be allowed within reach of the workmen's hands in places where the floor or the walls are of a very conductive nature, by reason of saline deposits resulting from the work carried on or of damp.

CURRENT NEWS AND NOTES.

WIRELESS TELEPHONY.—The Navy Department, it is stated, will equip with wireless telephone apparatus all the battleships going to the Pacific, the apparatus being guaranteed to have a speaking range of five miles in all weather.

OLD TIME TELEGRAPHERS.—Owing unfortunately to the present unsettled condition of affairs in the telegraphic field, it has been decided to postpone until a date to be fixed hereafter the annual reunions of the Old Time Telegraphers and the U. S. Military Telegraph Corps, fixed originally for Sept. 16, 17 and 18 at Niagara Falls.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. —The annual meeting of the Empire State Gas & Electric Association will be held in the Concert Hall, Madison Square Garden, on Oct. 2. The full programme will be announced later. On the evening of Oct. 1, the night before the regular meeting, there will be a joint meeting under the auspices of the Street Railway Association of the State of New York and of the Gas & Electric Association in the Concert Hall. There will be several addresses followed by an informal reception when an opportunity will be afforded to the Commissioners of the first and second districts, whom it is hoped will be present, to meet the representatives of the companies.

TELEPHONE BRIBERY.—At San Francisco on Aug. 31 the jury in the case, after one ballot, found Mr. Louis Glass, vice-president of the Pacific States Telephone & Telegraph Company, guilty of bribing a supervisor in connection with a telephone franchise. It will be remembered that, according to the allegations, the board of supervisors "held up" both the old Bell Company and a new independent company for large sums in connection with their franchises.

RACE NEWS BY WIRELESS.—The New York police raided, on Sept. 2, a full-fledged wireless telegraph plant in the top story of the house of a vaudeville comedian at Sheepshead Bay, just outside the famous racetrack. Since the wires of the telegraph companies were cut out, many attempts have been made to secure news promptly after a race for the poolrooms, but this seems to be the most ingenious effort detected. The apparatus of a well-known wireless telegraph company was found on the premises.

NEW TELEGRAPH COMPANY.—A special dispatch from Chicago of Sept. 8 says: "L. K. Davis, who has an office in the First National Bank Building here, has announced the projected organization of the New American Union Telegraph Company, with $5,000,000 capital. Mr. Davis says that the new company will be ready to begin operations by Jan. 1. The plan, as he describes it, is to lease telephone wires, and use them as telegraph lines. J. P. Hornaday, of New York, is said to be connected with the enterprise."

ABBREVIATING COURTESY.—"Marcus Aurelius," remarks the New York *Tribune*, "held that no man should ever be so busy as to have no leisure. Yet here is the telephone company in Philadelphia requesting that in order to save time subscribers will not say 'please' to operators in calling for numbers, and decreeing that operators shall never use that unnecessary word. There are some places in which such sacrifice of courtesy to curtness would not be surprising. But we did not expect it in the City of Dignified Deliberation."

FIRES IN NEW YORK.—A very interesting chart has recently been completed covering 6357 fires in Manhattan and the Bronx. It is estimated that fires started by carelessly dropped matches and cigarettes cause New York City a loss of about $2,500,000 each year. The city has an average of 23 fires every day, and fire losses in 12 months from all causes aggregate something like $10,000,000. Every time an alarm comes in, whether it is false or not, the cost to the city is $50 for wear and tear of the fire apparatus. Of the 6357 fires charted in Manhattan and the Bronx for the year, 989 of them happened on Tuesdays. Tuesday is ironing day. The chart shows that the busiest hour of the city fire department is between 6 and 7 o'clock in the evening. This is accounted for by the fact that factories and offices have just been closed and stray origins of blazes accidentally left around have time in the hour to flare up and do their work. It is shown that the hours between 6 and 12 o'clock at night are most fruitful of fires.

VERMONT ELECTRICAL ASSOCIATION.—The sixth annual meeting of the Vermont Electrical Association will be held at St. Albans, Vt., Sept. 18 and 19. The first day will be devoted to an outing with games and a shore clambake. On the morning of the second day a visit will be made to the plant of the Vermont Power & Manufacturing Company, at Fairfax Falls, the power house of which is built into solid rock on a bank of the Lamoille River, and supplied with water through a 40-ft. tunnel. A special feature of the meeting will be a discussion on steam heating to be opened by Mr. William J. Cohoon, of Portland. In addition papers will be presented as follows: "Sale of Current for Charging Automobiles," by Mr. Frank J. Stone, of Boston; "Talk on Modern Illumination," by Mr. V. R. Lansingh, of New York; "Notes of a Layman on Electricity and Its Allied Forces," by Mr. E. L. Bates, of Bennington; "Co-operative Commercialism in the Electrical Field," by Mr. J. Robert Crouse, of Cleveland; "Rates and Systems of Charging," by Mr. J. D. Codman, of Boston.

GLASS TELEGRAPH POLES.—U. S. Consular Agent Gustav C. Kothe, of Cassel, an agency of the Frankfort consulate, states that an architect of that city has been granted patents in Germany and other European countries and also in the United States for an invention for the manufacturing of glass telegraph and telephone poles. Mr. Kothe writes: "A stock company has been organized and a factory for the manufacturing of glass poles has been built at Grossalmerode, a town near this city. The glass mass of which the poles are made is strengthened by interlacing and intertwining with strong wire threads. One of the principal advantages of these poles would be their use in tropical countries, where wooden poles are soon destroyed by the ravages of insects and where climatical influences are ruinous to wood. The selling price of the poles has not been fixed yet, but the company is willing to accept 25 marks ($6) for a pole of the length of 7 meters (about 23 feet). The Imperial Post Department, which has control of the telegraph and telephone lines in this country, has ordered the use of these glass poles on one of its circuits."

OAKLAND, CAL., LINES ELECTRIFIED.—Contracts for the electrical equipment of the suburban lines in Oakland, Cal., and vicinity belonging to the Southern Pacific Railroad Company, were let last week at the New York office of the company. The service given is distinctly of a suburban rapid transit character, as the lines serve to connect San Francisco with the large residential communities of Oakland, Berkeley and other important places lying opposite San Francisco, across the bay. The commuter traffic is confined largely within a radius of about seven miles, and the different roads conducting this service converge at Alameda Mole, where they connect with a line of ferry boats which carry the passengers across the bay to San Francisco. The stations on the suburban lines are located on an average of .4 of a mile apart and the system as a whole is said to do a larger suburban business in number of passengers carried than any other in the country, the Illinois Central suburban lines out of Chicago alone excepted. The electrical equipment now decided upon will consist of multiple-unit trains with from three to twelve cars per train, made up in the usual combination of motor and trail cars. The cars seat 80 passengers each. Eighty motor cars have been ordered, which will be equipped each with four 125-hp motors. The power stations will contain two 5000-kw, 25-cycle, 13,200-volt, three-phase generators.

TESTING METERS.—This week the special committee of the Empire State Gas & Electric Association on testing meters, to represent it with the Public Service Commission of the second district of New York State, meets at Albany for the purpose of organization, electing a chairman and outlining the course of work and investigation. The committee are: T. R. Beal, Poughkeepsie Light, Heat & Power Company; H. J. Blakeskee, Bureau of Gas and Electricity, city of Syracuse; G. W. Cunningham, Elmira Water, Light & Railway Company; C. R. Huntley, Buffalo General Electric Company; L. E. Imley, Niagara Falls Power Company; J. C. Langdell, Hudson River Power Company; F. B. H. Paine, Niagara, Lockport & Ontario Power Company; Prof. Robb, Troy Gas Company; R. M. Searle, Rochester Railway & Light Company; J. M. Sheehan, Upper Hudson Electric Company; Silas Tabor, Moravia Electric Company; Arthur Williams, Yonkers Electric Light & Power Company. At the meeting on Aug. 28, of which note has already been made, it was moved by Mr. L. W. Emerick that it was the sentiment of the meeting that the sealing of electric meters was impracticable. The motion was carried. It was later moved by Mr. Hutchins that it was the sentiment of the meeting that the testing of electric meters by the commission on complaint of the customer was welcomed by the companies present at the meeting. The motion was carried. Mr. C. H. B. Chapin is the secretary of the association, which is necessarily deeply interested in this subject.

The Kaministiquia River Water Power Developments.

Before beginning the construction of its hydroelectric plant, the Kaministiquia Power Company made a careful investigation of the variations of the flow of the Kaministiquia River and of other features which would affect the reliability of the service obtainable from it. A general plan was then adopted for the development of the power at Kakabeka Falls on the Kaministiquia River with an initial installation of 14,000 horse-power; plans being made and the greater portion of the work carried out on the basis of continuing the initial installation to an ultimate development of 40,000 horse-power.

The design consists of diverting the water from Kaministiquia River just above Jacques Cartier Rapids, about one-half mile above Kakabeka Falls, and carrying the water by means of concrete flumes 10 ft. 2 ins. in diameter, a distance of 6500 ft. to a reservoir located on a high plateau, and thence discharging by means of steel pipes to the wheels in the power house under a head of 180 ft., the water wheels so driven being direct-connected to the alternators and the electricity so produced transmitted at a potential of 25,000 volts 18 miles to Fort William, Ont.

All water rights and the necessary land abutting on the river from the point of diversion to a point of return were secured, as well as all land necessary for flumes and other structures.

[illegible] To facilitate construction, a siding and temporary station were built on the line of the Canadian Northern Railway about one-[illegible] The first alternator of 7000 horse-power capacity was put into [illegible]

SOURCE OF SUPPLY.

The Kaministiquia River has its source in Dog Lake, situated about 50 miles north of Kakabeka Falls. There are a number of rivers emptying into the Kaministiquia; the principal source, however, is Dog Lake, which covers an area of 51½ sq. miles.

The lake is surrounded by heavy timberland and a large amount of muskeg or bog. The timber retains the snow until well into the summer months, and the muskeg retains the water until the lake falls sufficiently to draw on this source of supply.

The power company has the right to raise the water level of the lake 10 ft. and lower it 3 ft., thereby allowing a storage of 13 ft., which, if required, would give a storage capacity that would take care of the dry season, and if necessary give a constant supply equal to 60,000 horse-power.

UTILIZATION OF ELECTRICITY.

The electricity is used for all branches of service, lamps, motors and for railway purposes in the town of Fort William, and the power company is now negotiating to supply electricity in Port Arthur.

The electricity is distributed as alternating current, three-phase, and is delivered to the corporation of the town of Fort William, who redistribute it to the small consumers. The power company supplies all customers requiring more than five horse-power.

Before the power plant was completed, contracts had been signed for electrical power as follows:

[illegible]	[illegible]	[illegible]
Ogilvie Flour Mills Company	1500	" "
The town of Fort William	600	" "
The Canadian Iron & Foundry Company	350	" "
[illegible]	[illegible]	" "
[illegible]	[illegible]	" "

[illegible]

[illegible]

[illegible]

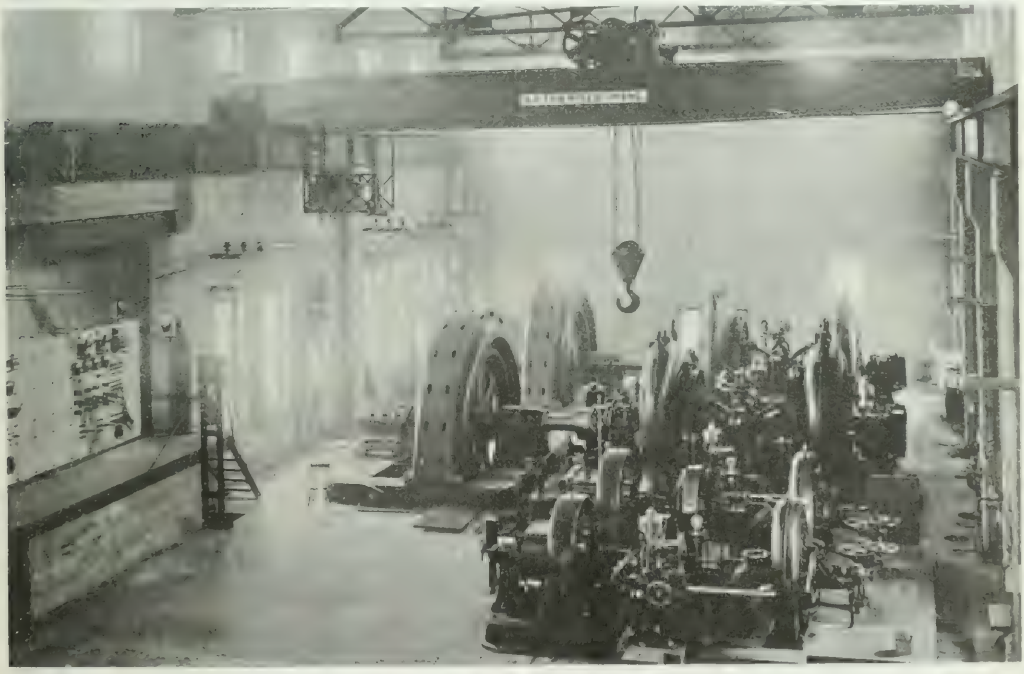


FIG. 1.—VIEW OF INTERIOR OF POWER HOUSE.

inistiquia River, is located the dam and intake of the Kaminis [illegible] operation of its plant is diverted by solidly constructed dams through a concrete intake to flumes, which are constructed on the south side of the river and extend to the forebay a distance of 6500 ft. The main dam is about 300 ft. long and averages 15 ft. high. It is built of concrete on the bed of the river, which is solid rock. The dam is constructed of concrete piers 4 ft. wide by

[illegible]

25 ft. long. These piers carry a bridge and the mechanism for raising and lowering stop logs set in channels in the piers.

The intake is set at almost right angles to the dam and is so constructed that ice and débris cannot readily enter it. The entrance canal is about 125 ft. long; at the end is located a spill way for discharging any ice or débris that may possibly pass the first set of racks. Adjoining the spillway are the small racks protecting the entrance to the concrete flumes.

FLUME.

From the headworks to the reservoir the water is carried in a concrete pipe, which is 10 ft. 2 ins. inside diameter. This flume is built partly on top of the ground and partly below. The pipe is not level, but in a measure follows the profile of the ground. The maximum pressure on the pipe is, at full head, about 12 lbs.

As soon as the concrete pipe was constructed and time allowed for the concrete to set, the pipe was covered to a depth of 2 ft. Drain valves, air vents, etc., are provided at various points along the pipe line and provision is made for lighting and heating the vents, drains, etc., in an emergency and in cold weather.

FOREBAY.

The concrete pipe just described discharges its water into a

[illegible]

forebay located on a high plateau about 165 ft. above the power house floor. This forebay serves as a relay to maintain the plant in continuous operation, to take care of fluctuating demands of the water supply, and is also used to take care of the excess water that would accumulate in the event of a sudden shut-down in the power house. The forebay is a massive structure built of concrete and covered in to protect employees and mechanism from the weather.

Each of the two riveted-steel penstocks is 750 ft. in length, 7 ft. in diameter and ¼ in. thick at the upper end and tapering to 9/16 in. at the power house. These pipes were constructed by the Jenckes Machine Company, of Sherbrooke, P. Q. The penstocks are anchored by massive concrete abutments, and are housed in the entire distance between the power house and the forebay.

[illegible]

The power house is a massive concrete and steel structure built on the bank of the river on a foundation of rock. The

[illegible]

building is completed for the entire development with the exception of an extension of 100 ft. for the additional generators. The transformer and switching arrangement, switchboards and everything necessary to operate the ultimate capacity of the development is complete and the extension will consist of merely the two walls and roof to allow space for the additional units.

The steps, walls, partitions and everything about the electrical apparatus and power house are built of either concrete or steel. The windows are of fireproof construction, the frames and sashes being made of galvanized iron and glazed with wired glass.

Each unit consists of two horizontal turbines mounted on one shaft and direct connected to the alternator. The turbines have a maximum capacity of 7000 horse-power, and were fur-

FIG. 5.—KAKABEKA FALLS

nished by J. M. Voith, of Heidenheim, Germany. They are controlled by [illegible] pressure and driven from the main turbine shaft. The governors are also of the Voith make.

There are two revolving-field alternators, made by the Canadian General Electric Company, of 4000 kilowatts capacity each and having an overload capacity of 25 per cent. They are

wound for three-phase, 4000 volts and a frequency of 60 cycles per second.

Two 150-kw, 125-volt, 600 r. p. m. compound wound exciters are provided, each direct-connected to a Voith water wheel. The wheels driving the exciters are equipped with automatic governors, and the water can be supplied to the exciter water wheels from either penstock. Each exciter is capable of supplying five generators under all conditions.

FIG. 6.—PENSTOCKS FROM [illegible].

There are two banks of transformers installed in the power house, each bank consisting of three 1500 kw, air-cooled transformers with 25 per cent overload capacity. Each bank has a capacity equivalent to one generator. The transformers are star-connected and the system operates with grounded neutral; the maximum pressure on the line to ground being 15,000 volts. The transmission potential, however, is 25,000 volts.

For connecting each generator and transformer bank to the low-tension bus-bars and each transformer bank and transmission line to the high-tension bus-bars a full complement of remote-control, motor-operated switches is provided.

Disconnecting switches are provided throughout the plant so that any part or any piece of apparatus can be disconnected from the system by knife switches in addition to the oil-circuit breakers. Any bank of transformers may be transferred to any line or to any one of the generators. The system is provided

FIG. 7.—VIEW OF INTERIOR OF FORT WILLIAM SUB-STATION.

with time limit relay switches so that in the event of trouble the system will be automatically disconnected. The apparatus at both ends of the system is protected by means of horn arresters, also by means of choke coil and the carbon resistances and spark-gap arrester.

TRANSMISSION LINE.

From the power house two parallel lines run a distance of 20 miles to Fort William. The transmission line is operated at a pressure of 25,000 volts. Cedar poles are used, and the cross-arms are of Southern or yellow pine. Stranded copper conductor is used throughout for the transmission line. Where the line passes through a wooded section, all dangerous timber has been cleared well back on the line adjacent to the right of way on both sides, so as to protect the transmission lines.

No. 4 steel wire is carried on each end of the top cross-arm. This wire is grounded at every third pole by means of a copper conductor soldered to a copper plate 1 ft. sq. and buried under the pole. The transmission poles carry a telephone line supported on cross-arms 5 ft. below the main arm. The telephone line consists of No. 9 steel wire transposed every third pole and is carried on double petticoat glass insulators supported on locust pins. The telephone line operates satisfactorily.

SUB-STATION.

The receiving station in Fort William is built near the western city limits. Here the e. m. f. is reduced from 25,000 volts to 2300 volts for local distribution throughout the town of Fort William. Control is provided by means of motor operated oil switches for the incoming high-tension lines and for the banks of transformers. This station contains a large marble switchboard for controlling the local lines. This switchboard is so constructed that two sets of bus-bars are employed for local lines. The switchboard is sub-divided so that each panel has a capacity of 1000 kilowatts at 80 per cent power factor. Each panel contains a watt-hour meter and indicating wattmeter, three ammeters, curve drawing wattmeters and double-throw oil switches, so that any circuit may be connected to any bus-bar. The bus-bars, switchboard and everything connected with the distributing switchboard is concrete, steel or marble.

While the plant has been in operation only a short while, the company has already secured a load of 5000 horse-power, all of which is sold at the flat rate price of $25 per horse-power for 24-hour service per year. This price is remarkably low for that section of the country. The chief engineer of the company is Mr. R. S. Kelsch, of Montreal. Mr. W. L. Bird is superintendent of the plant.

Fort William is growing very rapidly, being situated at the head of the Great Lakes and a very large number of industries is located in Fort William in order to secure reliable electric energy at reasonable rates, to avoid the long freight haul from distant cities, and because it is possible to secure raw material of every description from Canada and the United States by means of lake freight. Immense elevators are located in Fort William for handling the wheat annually shipped to it. The new Grand Trunk Pacific Railway Company has its main terminus at Fort William, where additional elevators with a capacity of from 10,000,000 to 12,000,000 bushels of wheat will be located. Among the proposed new developments for Fort William is a ship dock, wire and rolling mill, a pipe and car rail foundry, and a car works, etc., etc.

Abnormal Primary Current and Second Voltage on Placing a Transformer in Circuit.

By [illegible]

In elementary treatments of the phenomena of stationary alternating-current transformers it is customary to consider that the secondary e. m. f. on open circuit bears to the primary e. m. f. the ratio of the number of turns in the respective coils, and that the primary current has a small percentage of its full load value. It is well known that the above-mentioned relations do exist after the primary circuit has been connected to the supply lines for a sufficient length of time for the internal reactions to reach their final cycle of changes, but that the conditions at the instant of closing the primary circuit are far from being so well defined as given in the above outline. The present article records the results of experimental observations of the values of the primary current and the secondary e. m. f. when the primary circuit of a transformer is closed at different predetermined time-phase positions of the supply e. m. f. The tests were conducted by Mr. J. W. Andree and the writer in the electrical engineering laboratories of the University of Illinois.

A special slip-ring contact device that could be moved along the shaft of the supply generator in order to close the primary circuit, when desired, and the brushes upon which could be turned circumferentially around the shaft, allowed the exact time when the primary circuit would be closed to be definitely determined in electrical degrees. Both the primary current and the secondary e. m. f. were observed by two different methods, which for convenience can be designated as the "recording" method and the "trial maximum" method. In the former method an oscillograph was used for recording the relative values of the normal e. m. f. and currents and the instantaneous values reached during the starting period. In the latter method the instantaneous maximum value of the e. m. f. was found by trial by adjusting a spark-gap in the high-potential secondary circuit until an arc was formed across the gap when the circuit was first closed; the value of the e. m. f. was ascertained from the known relation between the e. m. f. and the sparking distance between needle points in air. The instantaneous maximum value of the current was found by trial by connecting an electromagnet of great sensitiveness in parallel with an adjustable resistance which was inserted in the primary circuit. The electromagnet was a telephone-switchboard drop-signal, and the arrangements were so made and calibrations so conducted that the maximum instantaneous value of the current through the primary when the signal dropped was definitely known for each adjustment.

The transformer with which the tests were made was a 10-kw, 440-to-100,000 volt, 60-cycle transformer; the tests were so conducted as to afford a maximum secondary e. m. f. of only 50,000 volts under continuous operation. Thus the core was far from being magnetically saturated during operation. The e. m. f. wave of the alternator was approximately sinusoidal, with a slight amount of flattening at the crests.

FIGS. 1, 2 AND 3.—SECONDARY E. M. F. WITH AND WITHOUT INITIAL MAGNETIZATION.

Three series of observations by the "trial maximum" method were made of the secondary e. m. f. on closing the primary circuit. In one of these series the core of the transformer was thoroughly demagnetized before closing the primary circuit; in the second series the core was magnetized (positively) by means of 25 amperes of direct current before each observation; in the third series the core was (negatively) magnetized by means of 25 amperes of direct current. The excessive value of the residual magnetism for the latter two series will be appreciated when it is known that the normal exciting current of the transformer is only 1.5 amperes. The results of these series of tests are indicated in Figs. 1, 2 and 3, where 90° corresponds to the closing of the primary switch when the primary e. m. f. was at its maximum. It will be observed that in each case the secondary e. m. f. reached its maximum value when the primary switch was closed at the maximum point of the primary e. m. f.. The maximum secondary e. m. f. reached values as high as 67,000 volts and never fell below 54,000 volts, although the normal operating secondary maximum e. m. f. was only 50,000 volts. Thus it is evident that it is impossible to close the primary switch of a transformer directly without producing a secondary voltage in excess of the normal. A comparison of Figs. 1, 2 and 3 will show that the three curves are very similar, and that the numerical values are substantially the same regardless of previous magnetization. One is led to conclude that notwithstanding its excessive value, residual magnetism has practically no effect upon the value of the secondary voltage rise.

Two series of observations were made of the maximum instantaneous value of the primary current upon closing the primary circuit at different points on the e. m. f. wave of the generator. One of the series was made under what would be considered normal conditions, by closing the primary circuit directly, while in the other a coreless inductance having a coefficient of self induction of .01 (a reactance of only 3.77 ohms at the normal frequency of 60 cycles) was inserted in series in the primary circuit. The results of these tests are shown in Fig. 4. It will be noted that although the normal primary exciting current is only 1.5 amperes the current on closing the circuit rises as high as 17 amperes without series inductance and even at the best point of closing the circuit it reaches 5 amperes. The rush of current is largest on closing the primary circuit at the zero point of the e. m. f. wave and least on closing it at the maximum. That is to say, when the circuit is closed at the maximum point of the supply e. m. f. wave the rate of change of flux is largest (as seen from the secondary e. m. f. curves in Fig. 4) but the rush of primary current is least; if the switch is closed at the zero point of the supply e. m. f. the primary current rises to higher values but the rate of change of flux is less, and the secondary e. m. f. is smaller. Fig. 4 shows at a glance the beneficial effect of using a coreless inductance in series with the primary. Thus there

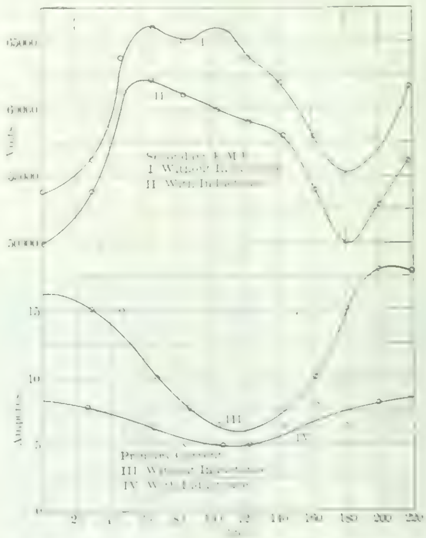


FIG. 4.—SECONDARY E. M. F. AND PRIMARY CURRENT WITH AND WITHOUT SERIES INDUCTANCE.

was a marked reduction in both the primary current and the secondary e. m. f.; the maximum secondary e. m. f. was reduced by about 7 per cent, while the rush of primary current was reduced by about 50 per cent.

In explanation of the causes for the rush of primary current the following considerations may be noted. Suppose in the first case that the transformer core is magnetized (due to residual magnetism) in the same direction as that in which the current will tend to flow on closing the circuit. The counter e. m. f. at the first instant will be negligible because a large value of current is required for increasing the flux already in the core. The current will reach the value required to produce a rate of change in the flux such that the counter e. m. f. due thereto is practically equal to the impressed. When the iron is initially nearly saturated there will be required an enormous rush of current to produce the necessary rate of change in the flux. As the current decreases to zero a large value of residual magnetism will be in the iron, and a small value of current in the opposite direction will produce a large change in the flux, and the resultant counter e. m. f. will immediately limit the value of the current. This small reverse current will decrease the residual magnetism (but will not remove its effects entirely) and the phenomena of the first cycle will repeat itself—in a less degree; the current peaks will gradually decrease until finally the normal value is reached.

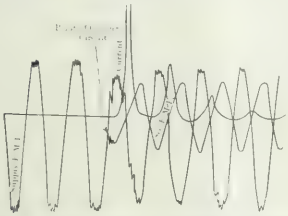


FIG. 5.—CONDITIONS ON CLOSING THE PRIMARY SWITCH AT ZERO POINT OF E. M. F. WAVE.

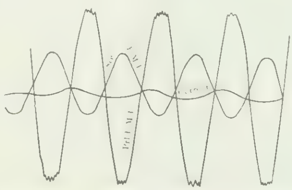


FIG. 7.—NORMAL OPERATING CONDITIONS.

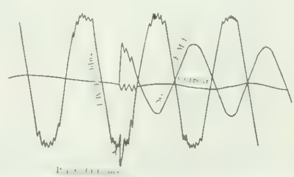


FIG. 8.—CONDITIONS ON CLOSING THE PRIMARY SWITCH ON MAXIMUM POINT OF E. M. F. WAVE.

Consider now the case in which the initial residual magnetism is opposite in direction to that which the initial current would tend to produce. The current during the first half cycle will be much less than normal, while that during the second half will be peaked.

From the above it will be seen that peaks will occur during only one-half of each cycle. The phenomena will be more pronounced on closing the circuit on the zero point or the rising part of the supply e. m. f. wave with the magnetism in the same direction, than on the decreasing part of the wave; in the latter case the residual magnetism will be decreased before the current will tend to flow in a direction to increase the magnetism.

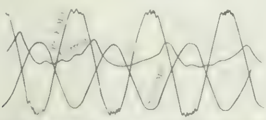


FIG. 6.—CONDITIONS SHORTLY AFTER CLOSING THE PRIMARY SWITCH.

The foregoing conclusions were fully confirmed by the oscillograms, as shown in Figs. 5, 6, 7 and 8. In order to obtain these records use was made of an oscillograph having three galvanometers. A test coil was wound on the transformer core to serve as a secondary for indicating the secondary e. m. f. Records were made of the supply e. m. f., the secondary e. m. f. and the primary current. The curves are self explanatory, since they record automatically the point on the supply e. m. f. wave at which the circuit was closed, and show all of the variation taking place in the three curves represented. Thus Fig. 5 represents the condition on closing the primary switch on the zero point of the e. m. f. wave, and shows an enormous rush of primary current; in this case the transformer probably possessed a considerable amount of residual magnetism. The conditions shortly after closing the switch are shown in Fig. 6, while Fig. 7 indicates the normal operating conditions. Fig. 8 represents the condition on closing the primary switch when the supply e. m. f. was maximum; there was no appreciable rush of primary current, but a violent vibration was noted in the primary (supply) e. m. f.

The oscillogram shows conclusively that when the primary switch is closed the secondary e. m. f. rises at once to its full value and even above. Thus the old theory that the rush of primary current is due to the iron core not becoming magnetized is incorrect. Moreover, the excess secondary voltage is not caused by the rush of primary current; the abnormal current occurs after the excess voltage has disappeared (see Fig. 5). It will be noted that on closing the primary circuit vibrations took place in both the supply (primary) e. m. f. and the current; the number of zigzags was always three. In some instances the primary e. m. f. increased by 25 per cent above normal. Such increase is possible only when a current passes through the generator armature in a direction to raise its e. m. f. The vibrations observed corresponded in frequency to the number of slots on the armature. It seems probable that the armature conductors carrying heavy currents on suddenly leaving the alternator field produced vibrations in the e. m. f. and in the primary current and that the vibrations in the current reacted on the generator field. That the rush of current takes place in only one direction is shown conclusively by the oscillograms. They also verify the results of the experiments by the "trial maximum" method in showing that the rush of current is largest on closing the circuit at the zero point of the supply e. m. f. wave.

Electrical Development in Argentina.

By LEWIS R. FREEMAN.

SHORTLY before I left Buenos Ayres a few months ago, the United States consul sent for me, said that he had recently had inquiry from the States in regard to power development possibilities in Western Argentina, and asked me to look into the matter during my journey through that section and to send to him a report of the results. The facts briefly recorded below were elicited from talks with several of the most prominent residents of Mendoza, and, as far as they go, are of perfect authenticity.

I would first state that there are few places in the world where the development of electrical power, or the discovery of oil in quantity, would meet with so great a reward as in Argentina, and in the western part of that country in particular. With an almost unlimited demand for power, that country produces not a ton of coal, not a barrel of oil, and only a small quantity of hardwood that is generally too valuable in dye stuffs or tannic acid to allow of its being burned for steam. All the railroads and factories use coal that is brought from Newport or Cardiff under a heavy ocean freight, to which, for use in Western Argentina, must be added the cost of 700 miles of haulage by rail. Naturally nothing would be more welcome to that part of the country than the development of power that would permit it to dispense with this high-priced fuel.

I heard it suggested that the railroads, being the parties most

[illegible] had in [illegible]. It is true that the railroads would ultimately be the greatest beneficiaries, but there would appear to be two reasons why their hands are tied; the first of these is that they are young, and full of business, and have need for all of their available capital in the extension of their lines; the second reason is that they are entirely under the thumbs of their London directorates. A London directorate is the bête noire of a progressive Argentine railway manager. It is usually composed of men who know little about railroading, and whose only lookout is to see that their capital yields them the 4 per cent—no more and no less—that they have been taught from childhood is the correct thing to receive from large investments. They are men of the stamp of those of that good old London banking house that will not consider for a moment the use of telephones, typewriters, steel pens or even printed letter heads; men of the stamp of that Chinese mandarin who refused to allow electric light in his province because Confucius had used oil. They are safe, solid and honest to the last degree, but completely fossilized. Thus with the English unwilling, and the Argentinos incompetent, there would appear to be an unusually favorable opportunity for some enterprising North Americans to slip in and make a substantial clean-up.

First a few words in regard to an oil proposition, which, in the right hands, might yield returns quite as handsome as those from the development of electrical power. For many years the existence of heavy oil seepages in the foothills of the Andes at a distance of 33 kilometers—about 20 miles—from Mendoza was known to the people of that city, and for some time the asphalt, where the oil had solidified, had been brought into town and used on a small scale for paving and sidewalks. About 12 years ago it occurred to some of the native Argentinos that possibly this oil could be collected and made of value. A company was formed—composed entirely of Argentine citizens—leases and concessions for the land were obtained from the government and some crude boring rigs purchased and set to work. At the comparatively small depth of 150 feet oil was struck, which, until capped, spouted 20 feet above the ground. Several other wells met with like results.

[illegible]

The difficulty then was to find some one to use the oil. This was not as easy as would appear, and over a year went by before the local gas company could be induced to purchase some of it to use in the manufacture of illuminating gas. For this purpose it was brought to Mendoza in tank carts, the results obtained being most favorable. Another year went by before the manager of the "Great Western" railway would consent to build and experiment with an oil-burning locomotive. When tried, however, the experiments were so uniformly successful that, under pressure, the London directorate was finally brought to permit the closing of [illegible] contract for the supplying of the company with oil for its engines. Thus encouraged, the oil company built a pipe-line from its wells to Mendoza, the elevation of its source being sufficient to make the oil descend by gravity. A large tank—which still stands—was built to receive the oil, and everything was ready for its delivery, when a slight shock of earthquake occurred and the wells stopped flowing. A few half-hearted and badly directed efforts were made by the company to stir them into life again, but without success. At this juncture the London directorate of the railroad, glad of a chance to be rid of the "new-fangled contraptions" that were being forced upon it, brought about the annulment of the contract. This disheartened the easily discouraged Argentinos, and they gave up in despair. That was nine years ago and nothing has been done with the wells since.

A Mendoza engineer—a man without any technical knowledge of oil wells, but a good deal of common sense—told me that in his opinion the earthquake shock has either bent or twisted the casings, or else had caused a cave-in at the oil level and cut off their connection with the oil. In either event, the driving of new casings, which the timid Argentinos behind the company had not had the courage to do, would have remedied the difficulty.

I also learned that there was a considerable oil seepage, of the same nature as the one of which I have just written, on the "Great Western" railway, about two-thirds of the distance from Buenos Ayres to Mendoza. At this latter point no concessions have been granted and no development done.

The facts in regard to the possibility of electrical power development from the Mendoza River I learned from Mr. George Evans, one of the oldest and most prominent residents of Western Argentina. Mr. Evans is a civil engineer, and has long been in the service of the Transandine railway and the government. He claims no technical knowledge of electrical and hydraulic engineering, but for estimating on the fall, the feasibility of constructing intakes, ditches, etc., I should judge that he is quite sound. He has long had in mind the possibilities latent in the Mendoza River, and at the present moment has an application for a concession pending before the provincial government. Not knowing, however, whether he can secure the capital to push his scheme in the event of securing a concession, he seems somewhat reluctant to risk the money needed for preliminary expense. "It stands about like this," he said in a conversation we had concerning the matter: "I will have to spend at least $5,000 in 'palm grease' in order to obtain the concession, and before granting it the government will require a deposit of $20,000, or upwards, as a guarantee that work shall begin within a specified time. All this, of course, I would stand to lose. If I decide to accept the concession on these terms I will take the matter at once to London and see whom I can interest there; I am not oversanguine of meeting with success

in presenting the proposition in England, for it is something they know very little about over there, and they are very slow in taking up a new thing. The States, I suppose, would be the proper place to go with it, but I have no acquaintance there and, besides, I understand you have not a great deal of money as yet that is willing to go to new countries."

I might explain here that nothing is done—or even attempted—in Argentina without the use of "palm oil." There is no attempt made to cover up the practice and no attempt to check it. Every official in any wise involved in the granting of a concession has his price, and, although this is not quoted in the papers, in their stock reports, it is generally known and always has to be considered. Even the English-owned railroads have special funds set aside for no other purpose than "facilitating" favorable legislation.

The facts in regard to the Mendoza River are, briefly, as follows: For upwards of a hundred miles above where it emerges from the foothills of the Andes, near the city of Mendoza, this river has a fall ranging from 1.5 to 4 per cent and there is a large flow of water throughout the year. Exact figures on this flow I could not obtain, but in early May, the fall of the year, the time at which I was in that district, it was said to be at its lowest mark. At that time, at a certain point, it was about 100 ft. wide, from 2 ft. to 5 ft. deep, and flowing at a rate of from six to eight miles an hour. Possibly I can give a better idea of the river's fall in another way. The altitude of Mendoza is 2000 ft., and Las Cuevas, the terminus of the Transandine Railway on the main branch of the upper Mendoza, is close to 11,000 ft. Between these points is less than a hundred miles by railroad, and, I should judge, not more by river. A fall of 9000 ft. for so large a stream in so short a distance is not found in North America outside of Alaska.

The volume of the Mendoza at Las Cuevas is about one-fourth of that of the main stream at the point I first mentioned, and immediately below this station it falls 500 ft. or 600 ft. in what is practically a series of cascades. At this point a fall of 800 ft. could be obtained with half a mile of ditch paralleling the railroad track around the mountain. If it should be necessary to completely dam the river—which I doubt—in order to take out water, some provision would have to be made in the way of gates for drawing off the silt which this, in com-

FIG. 2.—MENDOZA RIVER AT AN ELEVATION OF [illegible]

mon with all other Andean streams, carries [illegible]. Damming, if imperative, could be effected without great difficulty at several points where the river runs not over 10 ft. wide between high walls and with comparatively level open valleys above. I may also say that the general topography of the river valley is such that ditches could be kept to their general level along the hills without resorting to a great deal of tunneling.

As to finding a use for electrical power developed from this river there can be no question. The province of Mendoza is the greatest wine-growing district in the Western Hemisphere. It has a population of about 100,000, of which number 30,000 are in the city of that name. The enormous Italian and Spanish immigrations to Argentina have created an even greater demand for cheap wines that can be supplied, and the lower classes drink the wine of Mendoza simply because it can be supplied to them cheaper than the lowest grades of European wines. In spite of the low price which it brings in the market, however, the value of the wine produced in this province

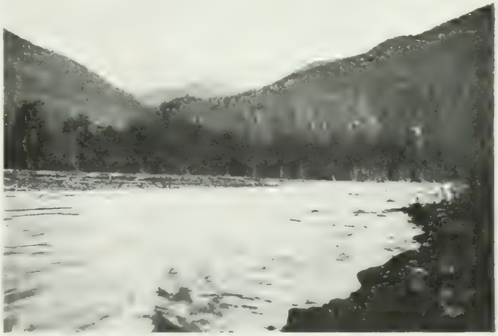


FIG. 3.—MENDOZA RIVER AT AN ELEVATION OF 2000 FT.

last year was close to $25,000,000 in American money.

Those well informed in Mendoza estimate that the two railroads—the Great Western and the Argentine Transandine—and the scores of wineries of that province and San Juan, all within easy transmitting distance, could find use for upwards of 250,000 horse-power, an amount which it is easily within the capacity of the river to supply.

Electricity in Peru.

By [illegible]

On account of its economical, geographical and industrial conditions, Peru offers inviting possibilities for the applications of electricity. There are many large water powers which could be easily and economically utilized. It is true that here and there are coal deposits of great magnitude and very good quality, but means of transportation are so rare and nearly always so expensive that at only a few miles from the mines the price becomes prohibitive. On the other hand, the need of labor in sufficient quantity and at reasonable prices, makes itself felt more and more each day. For the present, at least, proper immigration cannot be counted upon. It is true that of late there has been a veritable Chinese invasion, but apart from the fact that these yellow immigrants remain in Lima, this kind of immigration is not at all desirable: principally, because of the gross lack of education among them. All of them become small retail merchants, and they are far from being honest in their trading.

On account of these facts, electric transmission with modern machines can become of great value. The industrial people of North America were quick to realize this, and they have made great efforts to put themselves on a solid basis in the Peruvian market. Their representatives, who speak Spanish, travel through the different regions and nearly always make acceptable conditions of sale.

As far as the electrical industry is concerned, it is only right to recognize that the United States owes a great deal to the offices of [illegible] & Company, who represent the General Electric Company both in Peru and in the neighboring countries. At the present, however, various European electrical constructors also have representatives in Lima, the consequence of which has been the suppression of the nearly absolute monopoly [illegible]

was formerly held by Grace & Company, and a lowering, truly fortunate for the industry, of the price of electrical supplies and the cost of electro-mechanical installations. Previous to a few years ago nearly all the electricians and mechanicians were foreigners, mostly from North America. Now things are changing completely, with great advantage to the national industry. There have returned to Peru many young men who have been studying mechanical and electrical engineering in the United States. Furthermore, there has been established a national school of arts and trades, which turns out technical specialists and also workmen. In this school there is a section especially for electricians. Next year at the engineers' school there will be opened a special course in advanced electrical engineering.

To return to the interesting question of the electrical market in Peru, it should be added that the North Americans find, and will find, powerful competitors in the Germans. Whatever be the final result of this struggle, there is no doubt that it will be advantageous for the Peruvian industries. It is noteworthy, however, that the people of the United States have studied the local conditions better than have those in Europe, and the former people have more confidence in the brilliant future of this country. To illustrate, it is sufficient to say that while the General Electric Company constructed and sent to a gold mine at Santo Domingo in the interior of Peru a three-phase generator, rated at 300 hp, which could be transported by muleback, many European houses stated that it was impossible to

FIG. 1.—VIEW OF GORGE AND GENERATING STATION AT CHARCANI.

construct a machine larger than 50 hp which could be transported in this manner. There were certain ones, who, instead of studying the special types, seriously advised the construction of special roads to make it possible to transport machinery by wagon.

There are electrical installations all over Peru which are more or less important. Electricity is used principally for public and private lighting and for application in the mines. Electric street railways have been used for city and interurban service only in Lima. As would naturally be supposed, the largest and most important installations are to be found in the neighborhood of Lima. For feeding its distribution system for lighting, power and traction, Lima possesses a number of hydraulic installations, which are probably the most notable in South America.

At present there are two hydro-electric stations and one auxiliary steam station. The first is constructed at the foot of the Andes, and is that of Chosico; it utilizes a fall of 40 meters and a flow of 5 cubic meters per second. The second is at Lima, and utilizes a fall of 25 meters. The Chosico station is about 40 kilometers from Lima. The water is conducted from a concrete dam constructed 200 meters above the station, by a canal 3 meters deep and 8 meters wide; this canal ends in a reservoir where sand and gravel is allowed to accumulate. The water drives three groups of three-phase generators which produce current at 2300 volts, and the transformers raise the e. m. f. to 33,500 volts. At this e. m. f. energy is transmitted to Lima by two independent lines. The poles are made of white cedar, and are from 9 to 10 meters long. The central station of Polvora (Lima), which also serves as a sub-station for the Chosico station, is fed by a reservoir having

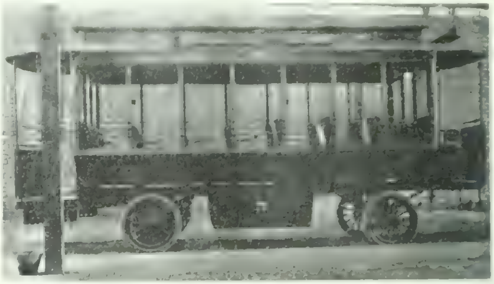


FIG. 2.—[illegible]

a capacity of 54,000 cubic meters, and through a penstock 600 meters long and 75 centimeters in diameter. In the steam auxiliary plant there is, among others, a Curtis turbine rated at 1000 hp; crude petroleum is used as fuel.

There are three sub-stations; one at Legria to feed the Lima Callao Railway; one at Miraflores to feed the Lima-Chorrillos Railway, and one at Lima for the city railways. At Polvora the e. m. f. is reduced to 10,000 volts; the second transformation reduces it to 2080 volts, and the last to 104 volts, which is the e. m. f. of the distribution system.

Arc lamps in series and incandescent lamps are used for the public lighting in Lima. In private lighting, the flat rate of $1.00 a month for each 16-cp lamp prevails. Previously, for different reasons, people have been more or less opposed to the introduction of the watt-hour meter, but now they are becoming more reasonable. By the meter method, energy is sold at 15 cents per kw-hour, while the hp-month costs from $3 to $4, according to the rating of the installation and the number of hours of use per day.

In general, the installations which are in service demand many urgent reforms. This will be possible now that several of the enterprises have united to form a trust. The companies do not receive all the profit that they could from the stations. Besides introducing desirable modifications in the present lighting and power service, they will be able, advantageously, to enter the true field of electrical industry, that is, electrical refining. The city railways of Callao and of Chorrillos will be

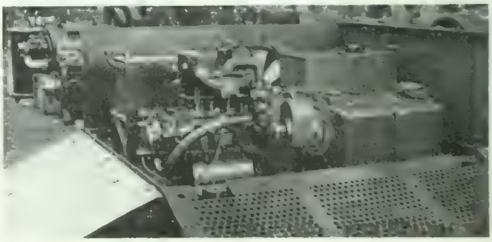


FIG. 3.—GENERATOR UNIT FOR [illegible] THE BATTERIES.

merged in the trust. The first has a network of 38 kilometers and began operation with 35 cars, which number has recently been increased. The Callao Railway is 14 kilometers long, and the Chorrillos Railway, 16 kilometers long. The capital of the trust is about $11,000,000. At present a loan of $5,000,000 is being negotiated for increasing and improving their instal-

lations. In a few months the electrical trust will have finished its third hydraulic station at Chaora Sana, 4 kilometers below the Chosico station. It will utilize the same waters of the Reisnac. It is expected in this manner to develop 6000 addition horse-power with which it will be possible to introduce certain desirable changes in the service and, probably, also, to lower the prices. It may be added that the electrical trust has lately leased for a term of years the steam railway between Callao and Chorrillos, a distance of 30 kilometers. It will pay

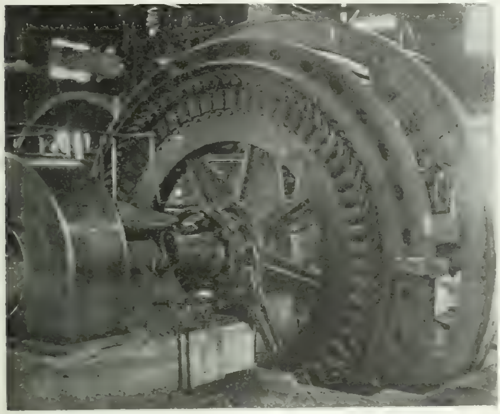


FIG. 4.—THREE-PHASE GENERATOR AT SMELTER.

$70,000 a year, and after having electrified it, much better service will be established for the transportation of freight.

In a short time, also, the railway of the Compañia Nacional de Tranvia Electrico, which, in addition to its city service, will inaugurate a service between Lima and Herradura, three kilometers beyond Chorrillos. The central station is finished and the line is almost completed. The capacity of the central station at Miraflores will be increased by about 1000 hp. The electrical apparatus was furnished for the most part by Siemans-Schuckert, of Berlin. Internal combustion engines are used with crude petroleum as fuel. The installations of this last company have cost up to the present moment about $750,000.

At Arequipa the electric generators which furnish electricity principally for lighting are driven by turbines which receive water from the Chili, under a head of 26.5 meters, through a canal 1900 meters long. The flow of water is about 4 cubic meters per second, corresponding to a gross power of 1413.33 hp, or 1060 hp net, at the turbine shafts.

The station built by the Sociedad Electrica is located at Charcani at a distance of 13 kilometers from the city of Arequipa. It contains two turbo-alternator units, 248 hp each. The turbines require 865 liters of water per second, and the generators produce alternating current at 5400 volts and a frequency of 50 cycles per second. The third unit, rated at 538 hp, which produces three-phase current at the same voltage and frequency, is connected to the power network during the day, and the lighting network during the night. The station at Charcani represents altogether about 1000 hp, or about 730 kw, which is transmitted to a sub-station in Arequipa over a line 12.5 kilometers long, consisting of 8 wires, each having a cross section of 16 sq. cm. carried on 240 poles. The fall of potential in the line is relatively large. Taking into account the loss in the transformation and in the distribution system, the useful power amounts to about 80 per cent of that produced at the station: or,

$$\frac{80 \times 75}{100 \times 100}$$

of the power in the water. These results may be considered as satisfactory, and the hydro-electric station at Charcani is certainly under present conditions one of the best in the country.

For a couple of years experiments have been made at Lima with storage-battery omnibuses, using an American system. The results have been disastrous. The cars were poorly conceived and badly calculated. They were provided with two 2-hp motors, absolutely insufficient to give a moderate speed to a mass of seven tons (passengers included). The storage batteries were ruined in a few months. At present the writer is changing the motive power from storage-battery to the gas-electric system. The car is running very well at present, and will run better still when the electric motors have been changed. The electrical part of the equipment has not been changed; the batteries have simply been replaced by two dynamos and an alcohol motor. The two dynamos can be connected in series or in parallel, as was formerly the case with the two batteries.

Haocho possesses a modest hydro-electric installation, much like that in Porato, at Trujillo. It was installed by the Peruvian representative of Sieman-Schuckert. This last installation was made in 1903. The canal is 2400 meters long, and has a capacity of 1000 meters per second. The fall utilized is 61 meters, the penstocks being 180 meters long and 65 meters in diameter. The station contains two 250-hp units, which produce three-phase current that is transformed to 10,000 volts and used for transmission to Trujillo by a line 35 kilometers long: there being three conductors each 10 sq. mm. in section. The insulators were tested at 40,000 volts. At Trujillo the e. m. f. is stepped down to 220 volts, which is that of the distribution system. The entire installation, which cost $90,000, feeds, besides a few electric motors, 1770 private lamps and 470 lamps for public lighting. In the valley of the Tambo at the works (sugar factory) of M. Lira, is installed a modest electrical installation which during the day supplements the hydraulic power, and during the night lights the factory and the neighboring dwellings.

At Cerro de Pasco, Mr. Solomon Tello, has a small hydro-electric installation for the public and private lighting of this important mining center. Because of the insufficiency and the intermittent character of the flow of the water, this gentleman is building at present another station in which the supply of water will be more constant.

In the same region is located the Rio Blanco station of the Italian mine owner Fernandini, and that of the Cerro de Pasco

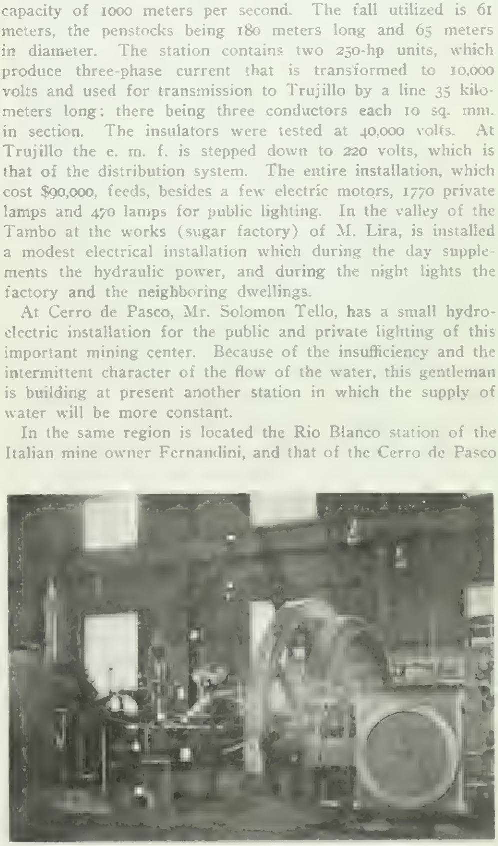


FIG. 5.—[illegible] VIEW [illegible] AT SMELTER.

Mining Company. The former contains two three-phase, 700-hp units. The high-tension system, having a total length [illegible] passes through the mines and the foundry and ends at Cerro de Pasco. The installations of the Cerro de Pasco Mining Company are located at Smelter, about 25 kilometers from Cerro de Pasco. Because of the coal deposits [illegible] steam-power instead of water-power is used in this plant. This was not done because of the lack of water-power, but simply to save time. It would, evidently, be desirable [illegible]

[illegible] the laboratories. In a short time it is expected to double the capacity of these stations. When the stations are finished, the total installed power wil' be 1600 kw. In all electrical installations around Cerro de Pasco great precautions had to be taken to avoid the disastrous effects of atmospheric electricity, the [illegible]

The installation which holds the world's record for altitude is a small 25-hp hydro-electric station which supplies energy to the Alpamina mine. This line is more than 5000 meters above the level of the sea. The electricity is generated directly at 3000 volts and transmitted about 8 kilometers.

In addition to the above mentioned installations there are a great number of electric mining stations. The writer estimates the aggregate ratings of the electrical machinery installed in Peru as about 50,000 hp. Under the favorable conditions which the electrical industry meets in Peru, doubtless it will be greatly increased.

A Year's Operation of the Highest Working Voltage in the World.*

By [illegible]

The Grand Rapids-Muskegon Power Company has been operating its transmission line at 72,000 volts for the past year, with results far beyond expectation.†

This transmission line extends from Roger's Dam, located six miles south of Big Rapids in a southerly direction, to the Casnovia switch house, 40 miles from the dam, where the line branches to Grand Rapids, 26 miles south and Muskegon, 26 miles west, making a total of 92 miles, located entirely upon private right of way, four rods wide, cleared of all trees and underbrush and a large portion fenced. Considerable care was used in obtaining the right of way to get the longest possible tangents and moderate grades. Almost the entire distance from Roger's Dam to Croton, the line runs through the pine stump land which only a few years ago helped make Michigan famous; but now is a dreary waste of blackened stumps and brambles.

In order to have the line properly patrolled, it was necessary to construct a well-made road bed over a greater portion of the right of way; care being used to have it properly drained so that it could be depended upon in all kinds of weather.

In construction, wooden poles were used exclusively, carefully selected, varying in length from 35 to 75 ft. with diameter of tops from 8 ins. to 12 ins. The special 8-ft. and 5-ft. cross-arms were employed, spaced 5-ft. apart, as in Fig. 1, and carrying three 14-in., 4-part insulators, as shown in Fig. 2, mounted on 18-in. wooden pins except on corners and angles, where a galvanized steel tubular pin with cast lead thread forms the pole construction.

No. 2 medium hard-drawn bare copper was used for line conductors together with No. 10 galvanized iron wire grounded every fifth pole for lightning protection.

The 72,000-volt switches used at the dams, switch house and sub-station, were designed and constructed under the direction of Mr. J. B. Foote. The construction is shown in Fig. 3. They are mounted in a wooden case, made as nearly oil-tight as possible, and the case is enclosed in a galvanized iron tank. The finger contacts are mounted on 40,000 volt insulators, placed in opposite corners of the case. A heavy wooden block is so placed in the other corners of the case as to allow the switch-blade a throw of 90 deg. This blade is mounted in the center on a wooden shaft, insulated with porcelain bushings; the shaft extends through the top of the case, where one of the four bevelled gears which operates the device is attached, as shown in the sketch. These switches have given perfect satisfaction, combining two very desirable features—maximum efficiency and minimum cost. Three sets of these switches are located at the Casnovia switch house, so that either the Grand Rapids or Muskegon, or both branches, may be cut out at the will of the operator in case of trouble or for testing purposes.

The patrolling of the line has been done by two men, one located at Roger's Dam, patrolling to the Casnovia switch house, and the second located at the Casnovia switch house, patrolling the Grand Rapids and Muskegon branch alternately. This arrangement has been found quite satisfactory, the entire line being covered four times each week. Each man is equipped with a good, strong, specially made buggy, of sufficient size to carry three or four high-tension insulators together with pins, portable telephone, etc. In order to keep in touch with patrolmen when on the line, they call the Grand Rapids sub-station every half hour over the private telephone line. Thus in case they are needed on short notice they can be easily communicated with.

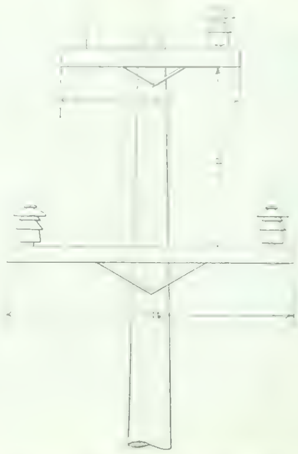


FIG. 1.—ARRANGEMENT [illegible]

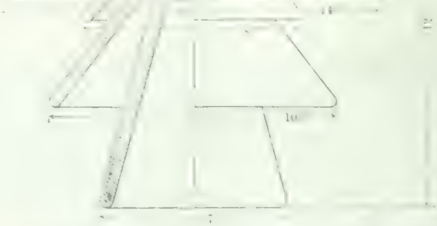


FIG. 2.—PART SECTIONAL ELEVATION OF INSULATOR

The usual amount of trouble caused by insulators being broken by stones and guns was experienced during the first few months, but after several of the culprits were caught and punished in the courts, very little trouble was had, and in the above cases very little damage was done beyond the replacing of an insulator. We find, as with all high-tension transmission lines,

* [illegible]

† [illegible]

lightning is the greatest enemy; but by comparison no greater difficulty has been experienced than with lines operating at 20,000 volts, presumably because of the higher insulation used at 72,000 volts.

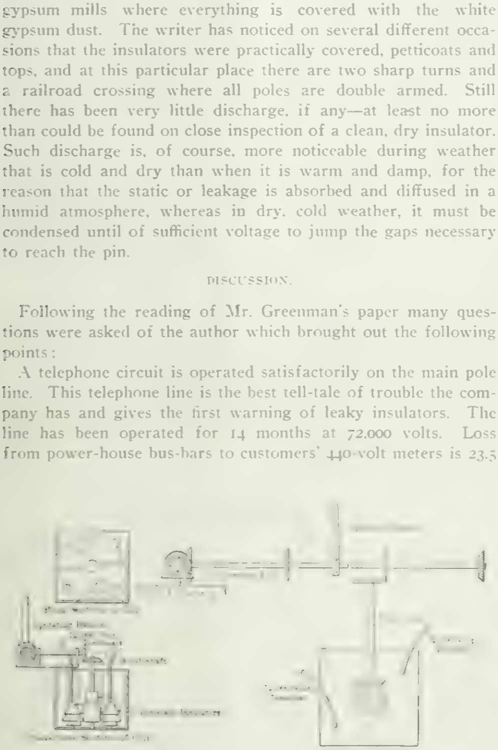
During the year there were two total interruptions caused by lightning demolishing insulators. On two occasions wires were thrown across the line, and one interruption was caused by a broken pin, allowing a wire to rest on the cross-arm, which it burned off. In connection with the last named interruption, the static discharge from the line is gradually charring the wooden pins. While this is not sufficient to cause alarm, Mr. Foote is making preparation to replace them with galvanized steel tubular pins, such as now used on corners, as soon as convenient.

No difficulty has been found with leaking insulators not broken or cracked, as seems to have been experienced on other lines, although in some localities they have been put to a very severe test, such as a portion of the line passing plaster or gypsum mills where everything is covered with the white gypsum dust. The writer has noticed on several different occasions that the insulators were practically covered, petticoats and tops, and at this particular place there are two sharp turns and a railroad crossing where all poles are double armed. Still there has been very little discharge, if any—at least no more than could be found on close inspection of a clean, dry insulator. Such discharge is, of course, more noticeable during weather that is cold and dry than when it is warm and damp, for the reason that the static or leakage is absorbed and diffused in a humid atmosphere, whereas in dry, cold weather, it must be condensed until of sufficient voltage to jump the gaps necessary to reach the pin.

DISCUSSION.

Following the reading of Mr. Greenman's paper many questions were asked of the author which brought out the following points:

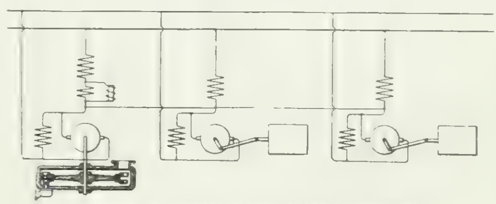
A telephone circuit is operated satisfactorily on the main pole line. This telephone line is the best tell-tale of trouble the company has and gives the first warning of leaky insulators. The line has been operated for 14 months at 72,000 volts. Loss from power-house bus-bars to customers' 440-volt meters is 23.5



per cent average. The losses included in the 23.5 per cent are those in the step-up transformers, high-tension line, step-down transformers at city limits and a second set of step-down trans- [illegible] Electrical Testing Laboratories of New York. On the new steel tower line the company is now building the suspension type of insulator is to be used, the line being designed for opera- [illegible] been sent to the penitentiary for one year. The judge was inclined to be severe because of the great amount of loss of time [illegible] the wanton breakage of insulators. The grounded wire run along the top cross-arm is a plain No. 10 iron wire, which is [illegible] The telephone line is 12 ft. below the transmission line. To use the telephone, operators must stand on an insulated platform. When linemen telephone in, they do it by means of a portable testing set, which they carry up the pole. The static charge accumulating either on telephone or high-tension line wires when the wind is blowing is sufficient to give severe shocks, even when the line is dead. Copper wire is used rather than aluminum on account of its strength. It is easy to tell the difference between insulators broken by stones or bullets and those broken by lightning. Those broken by lightning are fused.

Direct-Current Turbo-Generators.

When a turbine-driven direct-current generator is operated in parallel with generators driven by reciprocating engines, the turbine-driven generator ordinarily has a better speed regulation, and because of its greater speed, is so designed that its armature and series field windings have less self-induction. The turbine-driven generator may be compounded so as to

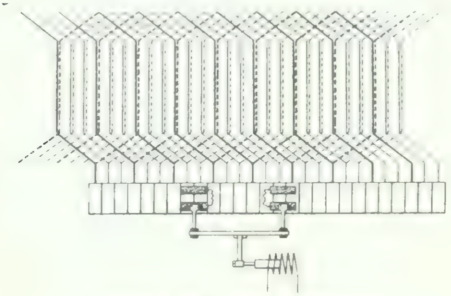


divide the load equally with the other generators under ordinary load variations; but upon the occurrence of a short-circuit or heavy overload, the turbine-driven generator takes the greater part of the load, both because of its better speed regulation and on account of its lower self-induction, so that it may be damaged by excessive current before the circuit-breaker in series with all the generators opens. The accompanying illustration shows a scheme for preventing the proportionate increase of load on the turbine-driven generator when subjected to short-circuit which was patented on Aug. 20 by Mr. E. J. Berg. Automatic means are provided for reducing the relative strength of the field of the generator when the load current suddenly increases. The turbine-driven generator is provided with a series winding, whose m. m. f. tends to oppose the main field magnetization, this winding being shunted by a reactive coil of low resistance. Normally, this opposing series winding carries only a small portion of the load current, but on a sudden increase of load, the self-induction of the reactive coil causes the greater part of the increase of current to flow through the opposing field winding of the generator, thereby momentarily reducing the generator field strength so as to prevent the generator from assuming more than its share of the overload, and to give the circuit-breaker time to open.

Prevention of Sparking in Alternating-Current Commutator Motors.

A method that has frequently been proposed for preventing sparking in an alternating-current commutator motor consists in providing the armature with two or more distinct windings connected to successive commutator segments, and employing brushes of such width as not to bridge two segments connected to the same winding. The above method is effective at starting and at low speeds, but it is disadvantageous at high speeds when interruptions in the current in individual windings occur with great rapidity and produce serious sparking. At high speeds a single armature winding is satisfactory because both the armature current and the field strength are small in value. On July 23, a patent was granted to Mr. Marius C. A. Latour on means for combining in one structure a machine that acts at starting as though there were a plurality of dis-

tinct armature windings and operates at full speed as though there were a single armature winding. The arrangement proposed is shown in the accompanying illustration. At each commutating point there are two brushes, each brush being of a width insufficient to bridge two segments connected to the same winding. At starting, the two brushes are in line, so



[illegible]

that the machine starts like a motor with a plurality of windings and a single set of narrow brushes. When the motor is up to speed one brush is shifted so that the two which are in electrical connection have together sufficient width to bridge two segments connected to the same winding.

New Telephone Patents.

[illegible]

Now that the extension of the limit of telephone transmission through the use of the Pupin coils is well known, it is but natural that simpler methods of accomplishing equivalent results should be sought. The Pupin coils are in practical form rather bulky and space must be provided for them at regular and stated intervals. Of course, the next step in advance would be the production of a uniform conductor with the proper relation of capacity and inductance to gain the same advantage as with the coils. Mr. W. C. Yeatman, of Chicago, has patented a conductor upon this design. He uses a copper core and deposits upon this electrolytically a continuous shell of iron to a determined thickness. He then passes a continuous current over the line so that the permeability will be high, obtaining thus a considerable inductive effect. In his specification, Mr. Yeatman assumes a conductor of No. 16 copper in a paper cable of usual constants and compares this with an equivalent cable of compound conductor in which the copper core is No. 16 gauge having a coating of iron .006 in. thick, and carrying a steady current of .1 ampere. He finds that, assuming a 100-mile length of cable, at a frequency of 1000 p. p. s., the latter

FIG. 1.—SHREEVE TELEPHONE REPEATER.

will conduct 132 times as much of the impressed energy as the all-copper cable, which corresponds to a gain of three and one-half times for commercial transmission.

An entirely different method of extending transmission, namely, the repeater, is the subject of a patent granted to H. E. Shreeve, of Newton, Mass. This patent relates to the method of associating the repeating and main circuits. In such cases a repeating induction coil is used, and it has been customary so to connect this that the receiving circuit of the repeater is bridged across the line. In this case the successful transmission depends upon this bridge being very close to the electrical middle of the line. The new arrangement is shown in Fig. 1. Here the repeating coil *M*, in series with the line, forms the link between the repeater and line circuits. The similar coil *N* forms the balancing branch, the exact balance being obtained by adjustments of the artificial line. The necessity for balance will be understood when it is appreciated that the receiving circuit *R* must connect equipotential points, for all currents generated by the transmitting end of the repeater.

Both of the above patents have been assigned to the American Telephone & Telegraph Company.

[illegible]

In the line of new switchboard circuits we have a two-wire system of the Dunbar type in which the cut-on relay is bridged across the line and the supervisory relay is wound differentially. The line relay coil is left connected in the line and its contact circuits are so changed by the cut-on relay that the line lamp becomes extinguished and a resistance controlling the supervisory relay is connected to the back contact of the line relay. This circuit is patented by W. W. Dean, the patent being assigned to the Kellogg Switchboard & Supply Company.

Another system making use of the differential relay has been patented by M. S. Conner, of Rochester, and assigned to the Stromberg-Carlson Company. In this case the cut-on relay is in series with the line when a call is being made, the current passing through the two windings in differential relation. When a plug is in the jack, the balance is upset and the relay operates, thus connecting the line to the jacks and incidentally short-circuiting one of the relay windings.

A trunking system is the subject of C. S. Winston's invention. The patent covers the broad use of a three-point jack plug and cord at the outgoing end, the third strand for signaling purposes, with a two-strand cord and plug on the incoming end. This patent is assigned to the Kellogg Company.

NEW APPARATUS.

With two-pole receivers it is customary to confine the field area to the middle of the diaphragm. To this end the two

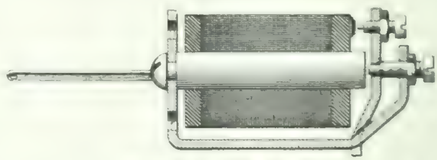


FIG. 2.—[illegible]

polar extremities of the horseshoe magnet are close together and both carry coils. In the receiver now patented by W. R. Bankhead, of Bremerton, Wash., the diaphragm is all in the magnetic circuit, its support forming one polar extremity and a single large section spoke leading from it to the polarizing magnet. A single round pole, carrying the receiver coil, extends from the other pole to a point opposite the middle of the diaphragm.

Fig. 2 shows in section a relay patented by F. R. McBerty. The part covered by the present patent is the adjusting means, the novelty lying in the armature-guiding stud projecting from the end of the back stop screw. This stud keeps the armature from jarring off its seat.

F. B. Craft has invented a self-contained hook switch, the lever being a bell crank pivoted at the angle, the springs being moved by the short arm. The downward motion of the lever is stopped by the lever striking a short stud extending out from the base plate and beneath the lever. The upward motion is limited by the short arm of the lever striking the base plate. The last two patents have been assigned to the Western Electric Company.

Rather a novel receiver support has been patented by W. J.

Mogridge, of Spokane, Wash. The receiver supporting arm has a hinge arranged about the middle of its length. This hinge will only bend upward, and when the receiver is thrown upward after conversation, the front part of the arm guides it to a rest piece. This latter is secured to the hook switch, which operates under the weight of the receiver.

Two patents have been granted to F. B. Cook, of Chicago, covering a new type of pole cable terminal. The arresters for this are made up in units for one line and may be mounted on the terminal as needed, having facilities for connection with the line terminals. With a multiple terminal cable system, it is only necessary to mount an arrester at that terminal of a line where it is actually used. It will be seen that a saving is effected as there are no idle spare protectors.

TESTING APPARATUS.

For testing and patching toll lines, it is customary to provide a test board with a number of jack terminals for each line. These provide facilities for testing for connecting on a branch line, for connecting in desired extra apparatus, for patching, etc. These jacks must be wired in several different relations to the lines, and they require a large test board for mounting. Messrs. T. A. and W. P. Hammond, of Passaic, N. J., have devised an arrangement whereby each line is provided with but one permanent jack. The additional testing jacks required are associated in the base of a plug which fits the permanent jack.

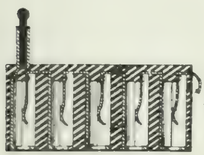


FIG. 3.—HAMMOND JACK.


FIG. 4.—LEWIS CONNECTOR.

These plug combinations may be of different construction to provide jack groups for the individual test requirements. For example, if a looping bridge is desired, a three-jack combination is plugged into the desired line jack. Perhaps a better idea of the arrangement may be had from Fig. 3.

Another patent for testing apparatus has been granted to G. G. Butler, of Oklahoma. This is a test box containing apparatus arranged to accomplish with facility the various customary tests. His patent covers the details of his arrangement.

In Fig. 4 is shown a novel idea in the form of a connector for attaching a branch line to a main line without severing the main line. The use of the device is understood from an inspection of the cut. O. E. Lewis, of Ulysses, Neb., is the patentee.

In most ringing systems using a polarized bell, resort is had to alternating or impulse generators. W. W. Kidney, of Buffalo, has invented a selective system using vibrating polarized bells rung from a battery or other source of steady current. Fig. 5 shows the arrangement of circuits for two stations. It will be seen that normally a condenser is in circuit with each

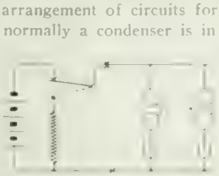


FIG. 5.—REED SELECTIVE SYSTEM.

[illegible] to respond to [illegible] direction of current. It will be seen that the arriving current in charging the condenser causes a kick of the [illegible] the discharges the condenser, assisting the bias spring. A vibration results. Current of the prong polarity fails to give any initial kick to the armature. The patent for this system has been assigned to the Century Telephone Construction Company.

A diagram illustrating the [illegible] system is shown in Fig. 6. This system has been patented by S. A. Reed, of New York City. The bells are biased and polarized, the arm F being vibrated from an outside source. It will be seen that the condensers are rapidly charged through the bells on short circuit and discharged through the bells in series with the high resistance coil. The ratio of parts is such that an entering impulse is sufficient to kick the armatures of the bells against the bias spring, and such action takes place where the poling is

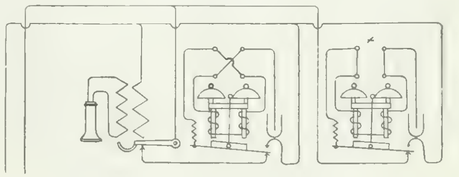


FIG. 6.—KIDNEY SELECTIVE SYSTEM.

correct. The discharged current on the other hand is drawn out by the resistance to a point such that its instantaneous value is never sufficient to start an armature. Thus selection takes place.

A magneto system dispensing with the station hand-generators is the subject of a patent granted to H. M. Eldred, of Milwaukee. A grounded generator is connected to each line through its line drop, so that grounding the line at the station is sufficient to set the line signal. Rings toward the station are metallic. It is probable that such a system would suffer materially from the effects of leakage and induction.

NEW APPARATUS.

A combined jack and drop forms the subject of a patent granted to J. M. Overshiner, of Chicago. A small cam lever projects forward from the mounting plate beneath the shutter and it forms a stop for the shutter. A ring raised upon the shank of a plug rides under the cam lever and raises it. This drives the shutter up to the locked position. The lever is very small, and its action requires no conducting contact between plug and shutter.

Polarized bells are usually built upon a frame. W. Kaisling, of Chicago, has used the cores of the magnets in lieu of this, and supports the armature yoke in annular grooves cut in nuts which engage the threaded ends of the cores. By this means an adjustment is effected. The yoke of the magnets provides a support for the bell posts, for the polarizing magnets and also a means of mounting.

LETTER TO THE EDITORS.

Standardization of Scientific Notation.

To the Editors of the Electrical World:

SIRS:—It seems to me that the time is ripe for the standardization of notations used in electrical engineering. Everyone must agree that it is much easier to read and understand calcalculations and theoretical articles, when the notation accords with the familiar forms. At the present time, however, there is quite a lack of uniformity even in such designations as are used for voltage, current, number of phases, cycles, poles, etc. The Standardization Committee of the American Institute of Electrical Engineers has apparently recognized the importance of standardization in notations, and in its latest report a few rules on this subject are set forth, but rules are desirable, covering more or less broadly all notations used in electrical engineering. For example, in the works of Prof. E. Arnold, having become once familiar with his notation, it is easy to read any of his writings, because each particular character has a certain meaning, always the same, no matter in what part of book or in what book it is cited. Returning to the Standardization rules, as they are printed in the July A. I. E. E. *Proceedings*, we find on two adjoining pages (1081 and 1082), that the character p desig-

[illegible]

The reader of the technical press is quite embarrassed sometimes by this lack of uniformity in writing formulas, as the following examples will illustrate:

In THE ELECTRICAL WORLD (March 30th), we find a very interesting article on the "Leakage Reactance of Induction Motors," by Mr. I. E. Hanssen. This article, by-the-way, represents practically an abstract from Prof. Adams' papers and, to some extent, Prof. Arnold's books, although the author introduces some deductions of his own. This is a very desirable kind of an article for an electrical journal, because it represents in a clear and compact form formulas necessary for practical calculations. Carelessness with the notation, however, nullifies this benefit to some extent. First of all, all of Prof. Adams' notations are changed without any apparent reason, and the author fails to explain what some of his own notations mean, as, for example, what q and p in formulas for end connection and belt leakage mean. Probably p designates the number of slots per pole and q the coil pitch, but then it becomes difficult to understand why end connection leakage depends only upon the number of slots per pole, no matter now long and how thick these connections are. Referring to Prof. Arnold's treatise, we find a beautiful deduction of the formula, where this leakage is expressed by means of the $\log_{10} \frac{}{d_s}$ (designating by l_s the length of the end connection, and by d_s the diameter of the circle whose circumference is equal to the perimeter of the cross-section of the coil end). This expression is strictly in accordance with the theory and apparently cannot be successfully replaced by any single "machine dimension." Log , used in this case by Prof. Adams, is not very convenient for practical calculations. Further, if q is slot pitch, then it becomes impossible to find why Mr. Hanssen replaces γ^2 in Prof. Adams' expression for belt leakage by D and q^2. Probably D^2 is intended.

In the proposed A. I. E. E. "Code of Ethics" there is a very good rule, as follows:

[illegible] engineers by exchange of general information, experience, instruction, etc."

Which might be extended by the addition: "And he should have care that all possible errors in his information, instructions, etc., be eliminated."

I return to Mr. Hanssen's article. I do not see why in citing Prof. Adams' expression for slot constant, he omits the multiplying factor, [illegible] with no explanation, retaining, however, the name "slot constant" for his formula. It seems to me that there will be as many different slot constants as there are technical writers on the subject. There is also a mistake in the above formula, [illegible] should be [illegible]. In the next formula (for zigzag leakage) we find [illegible] instead of [illegible]. In the last equation (6) coefficient 20 refers to all expressions in a parenthesis. This is apparently wrong, because some expressions already contain factor $\left(\frac{4\pi}{10}\right)$ which comes into coefficient 20. If this coefficient refers to the slot leakage only, which is very likely, considering formula (2), then we have the rest of formula (6) expressed per cm. length of core, there being no factor 2.54 for them, which is apparent from formula (3). Formula (5), after being transferred into general equation (6), appears (without any reason) again multiplied by S_0.

I suggest also, that all such expressions as π, 2π, $\sqrt{2}$, $\sqrt{3}$, etc., should retain their original appearance, because then formulæ become clearer and easier to understand, and that also inductance and coefficient of self-induction should not be designated by the same character.

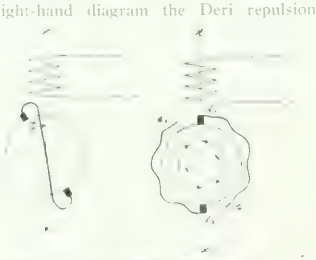
EAST PITTSBURG, PA. J. P. NIKONOW.

[Mr. Hanssen called attention to some of the above-mentioned omissions in a letter which appeared in our issue for [illegible]]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors, and Transformers.

[illegible]—An illustrated description of the Deri repulsion motor built by Brown, Boveri & Company. The left-hand diagram of Fig. 1 shows the ordinary repulsion motor, the right-hand diagram the Deri repulsion motor.



[illegible]

There are two sets of brushes. The brushes b^1b^2, insulated from each other, are mounted on a common brush holder. The brushes f_1f_2 are mounted on a second brush holder which is independent of the other. The brushes f_1f_2 remain stationary at their places in the axle of the stator winding while the set of brushes b_1b_2 can be moved. The bushes b_1f_1 are short-circuited by means of a flexible cable; in the same way b_2f_2 are short-circuited. By the displacement of the one set of [illegible] motors actually built on this principle.—*Elek. Zeit.*, Aug. 15.

[illegible] paper illustrated by numerous diagrams on the size, weights and costs of alternators as effected by the rated speed and periodicity. From a comparison of a number of designs the general conclusion is arrived at that for machines of equal output, the high-speed, low-frequency machine is the best as regards ease in designing, weight, and initial cost as well as requiring lighter foundations, with less initial cost, and considerably less headroom.—Lond. *Elec. Eng'ing*, Aug. 22.

[illegible] in abstract of his German paper on a new method for the artificial loading of transformers which has already been noticed in the Digest.—Lond. *Elec.*, Aug. 16.

Lamps and Lighting.

Train Lighting.—H. HENDERSON.—An illustrated paper in which the author discusses the problem of lighting railway carriages by electricity. After giving particulars as to the cost of the equipment and maintenance he proceeds to describe the various systems which have been proposed and in a few cases adopted. The systems specially described are those of Stone, Vickers & Hall, Moskowitz and Vicarino. The following conclusions are arrived at. Moving parts must be confined to the armature of the dynamo, one commutator being sufficient to have to keep in order. The addition of motors or motor-driven regulators adds chances of breakdown and increases the cost of maintenance, at the same time adding complicated con- [illegible]

man. The pole-changing devices should be in the form of a reversing switch, and not obtained by revolving the brushes. Electrical switching is the safest from the point of view of preventing the batteries sending a reverse current through the armature should the dynamo fail to excite. The switch should be first operated by a shunt coil connected across the dynamo or in series with the field-magnet circuit, as is done in the Vickers-Hall, Moskowitz, Vicarino and Leitner-Lucas systems. On the other hand, mechanical switching has been found reliable, and the number of cases of failure of the dynamo to excite is very small. The voltage should be regulated electrically, thus giving a more efficient working of the dynamo. The use of high-efficiency lamps with metallic filaments would be a great saving in power and first costs of all parts, and this part of the business should be looked into if successful competition is to be carried out against incandescent gas. In bogie coaches, wherever possible, the dynamo should be attached to the bogie, this method of fixing being better for running round curves.—Lond. *Elec.*, Aug. 16, 23.

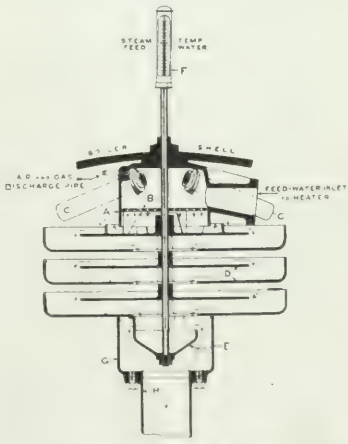
Future of Electric Lighting.—G. Klingenberg.—The author first discusses the underlying principle of the maximum demand system of charging and states that the so-called double tariff has found extended application in Germany, the normal rate being charged at times of maximum load and a much smaller rate at other times. In contradistinction to American practice it has become usual in the last 10 years in Europe to design direct-current works for 2 x 220 volts. The argument is that the lower efficiency of the 220-volt lamps is more than compensated by the saving in interest and depreciation in the cost of the network. Concerning the life of 220-volt lamps he says that the results obtained have been good, probably because the voltage variations in 220-volt networks are smaller than in 110-volt networks. The Nernst lamp is very suitable for 220-volt networks. The author then discusses the new metallic-filament lamps, and points out that on account of their smaller sensibility with respect to voltage variations and their greater overload capacity the line may be designed for a larger voltage drop than is usually admitted at present. At present metallic-filament lamps are made for not more than 110 volts, and upon inquiry the majority of the managers of central stations have expressed their preference for reducing the voltage again to 110. At 110 volts smaller units of light can be used, the efficiency of the lamps is better, and half as many arc lamps can be connected in series as at 220 volts. On the other hand, at 220 volts the first cost of the network is considerably smaller, and it is possible to supply energy to districts where the demand is relatively small. It seems that it will be possible to make new metallic-filament lamps for 220 volts, but that they are not expected to give as good results. The author, nevertheless, thinks that the high voltage of 220 should be retained. In three-phase plants the four-wire system has great advantages over the three-wire system, and the author thinks that three-phase systems should be arranged for 3 x 120 volts in star connection with a neutral wire. In the manufacture of arc lamps small lamps, such as for two amperes and 110 volts, have recently been introduced, but in this field the arc lamp will meet strong competition from the new metallic-filament lamps, and the author thinks that arc lamps [illegible] lamp. An important progress made by its introduction is that [illegible] cost more, but there is an increase in the cost of maintenance, [illegible] 1.5 cents for wages, 1 to 1.25 cents for higher cost of carbons [illegible]

[illegible] A report presented to the French Association for the Advance[illegible] and then deals with the definition of luminous efficiency. The definition as the ratio of the watts within the visible spectrum to the total watts of radiation is considered to be unsatisfactory, since it does not take the physiological effect into consideration. He proposes another definition which takes the varying sensibility of the eye toward different wave lengths into account and gives some notes on the emissivity of various bodies.—*La Revue Electrique*, Aug. 15.

Arc Lamps.—R. Osterburg.—The first part of an illustrated article describing improvements recently made in the mechanism of the suspension of arc lamps.—*Elek. Zeit.*, Aug. 16.

Power.

Feed-Water Heater.—A description of the latest improved form of G. Wilkinson's live-steam feed-water heater, which can be applied to any form of boiler for the purpose of raising the feed water to a temperature approximating that of the steam in the boiler. The apparatus consists of the following parts: A de-aerating chamber fixed at the highest position within the boiler, into which the feed water is delivered; a number of dishes and plates, fixed alternately, over which the feed water gravitates to a receiving chamber. These are built round a vertical hydraulic tube passing through the shell of the boiler. This tube is open at its upper, and closed at its lower, end. A little mercury is poured down the tube to facilitate the transmission of heat to a thermometer which is inserted therein. This thermometer gives the temperature of the feed water at the point where it flows into the water space of the boiler. A tank and dip pipe are fixed below the receiving chamber, and serve to convey the feed water at steam temperature to the bottom of the boiler, near the "blow-off" valve. A small pipe connecting the de-aerating chamber to an air valve



[illegible]

outside the boiler completes the equipment. In Fig. 2 *A* represents the heating and de-aerating box, *B* grid, *C* steam-breathing pipes, *D* final heating plates, *E* testing tank, *F* the thermometer, *G* overflow tank and *H* discharge pipe. The main function of the apparatus is to deliver feed water at the full ebullition temperature at the bottom of the boiler, thereby greatly accelerating circulation and relieving the boiler plates from undue strain. Figures are given on the results of some tests with and without the heater. By the use of the heater a gain was obtained, resulting in increased evaporation per pound of coal, 12.9 per cent, and a saving in coal, making no extra allowance for a continuously clean and efficient boiler, of 11.4 per cent.—Lond. *Elec. Eng'ing*, Aug. 22.

[illegible] An illustrated paper read before the (British) Institution of Mechanical Engineers. The author describes the electric cable ways which are in use at the shipbuilding berths of Palmer's Shipbuilding & Iron Com

pany at Jarrow-on-Tyne. Steel lattice pillars connected by cross girders form the end structures, and between these, in a longitudinal direction, are run the main cables, the ends of which are attached to electrically driven carriages, capable of transverse motion along the end girders. On these cables self-contained trolleys are suspended containing the lifting gear. The transverse motion of the cable, as well as the longitudinal motion of the trolleys on the cables, are controlled by the operator on the lifting trolley, who also controls the lifting and lowering.—Lond. *Elec. Eng'ing*, Aug. 15.

British Station.—An illustrated description of the new power house of the South Metropolitan Electric Light & Power Company. The new station is located next to the company's old plant. The generating plant at present installed consists of two 1500-kw turbo-generators, but the ultimate capacity of the station is to be 32,000 kw. The arrangement of the plant is simple and compact, and full advantage is taken of the proximity to the river bank for coal and condensing water facilities.—Lond. *Elec. Eng'ing*, Aug. 15.

Steam Power.—W. D. Ennis.—A third article in his serial on efficiency in the burning of fuel under the steam boiler. In the present installment the author discusses the practical modifications affecting the theory of the air supply and necessitated by various commercial fuels.—*Eng'ing Magazine*, August.

Turbines.—J. Dalemont.—A continuation of his long-illustrated serial on the wear and tear of turbines. In the present installment the author discusses several special cases of corrosion [illegible], Aug. 24.

Traction.

[illegible] *System.*—G. B. [illegible]—An analysis of the operating costs and revenues of the Interborough Rapid Transit Company for the year ending June 30, 1906. The various items of the operating expenses are reduced to the car-mile basis. The cost of maintenance of way and structures is 0.996 cents per car-mile; the maintenance of equipment, 1.214; the operation of power plant, 1.965; the operation of cars, 3.800; general expenses, 0.997; total expenses, 8.972 cents per car-mile. The maintenance of way and structure represents 11.10 per cent of the total operating expenses; maintenance of equipment, 13.54 per cent; operation of power plant, 21.90 per cent; operation of cars, 42.35 per cent; general expenses, 11.11 per cent. The total operating expenses are 42.69 per cent of the gross earnings. The figure for the total operating expense of 8.97 cents per car-mile is very low. The operating cost on a number of representative electric roads, elevated and surface, averages about 13 cents per car-mile, the higher figures representing urban lines. The Brooklyn Heights Railroad (elevated and surface) and the New York City Railroad (surface) runs up to 14.8 and 18.4 cents, respectively.—*Eng'ing Magazine*, August.

Electrification of Cable Railway.—An article on the inclined cable railway connecting Lyons with a suburb which has recently been converted from steam power to electrical driving. Continuous current at 500 volts is used, and advantage is taken of the presence of a buffer battery to arrange for voltage control during the starting and acceleration of the trains. The safety appliances are well worked out, and figures given show that the electrification has resulted in a saving of over 50 per cent in the power expenses of the railway.—Lond. *Electrical Eng'ing*, Aug. 22.

Electric Traction.—P. Dawson.—A continuation of his illustrated serial giving remarks on the choice of acceleration and motors.—Lond. *Elec.*, Aug. 16.

Installations, Systems and Appliances.

[illegible] and J. Herzog.—A mathematical investigation of high-frequency oscillations which may occur in direct-current cables, with replies to criticisms of Hiecke.—*Elek. Zeit.*, Aug. 15.

The Peak Load in Electricity Supply.—An editorial proposes the obtaining of a uniform load curve by using for electrochem- [illegible] for other purposes. It is stated that a calcium carbide factory is to be erected close to a British central station to use the surplus power of the latter.—Lond. *Elec.*, Aug. 16 and 23.

Tariff.—A description of a method of charging for electrical energy for which a meter has been patented by a German company. It is essentially a combination of a two-rate meter in conjunction with a maximum demand indicator.—Lond. *Eng'ing*, Aug. 22.

Wires, Wiring and Conduits.

Wiring Rules.—Sets of standardization rules for overhead wiring, cables, etc., of the German Association of Electrical Engineers, with an article by H. Jaeger, G. Klingenberg and F. Schrottke, giving explanations of the rules.—*Elek. Zeit.*, Aug. 15.

Fuse.—An illustrated description of a new spring fuse devised by J. W. Turner. The ends of the fuse when broken are rapidly drawn by springs into sand pockets.—Lond. *Elec. Eng'ing*, Aug. 22.

Electrophysics and Magnetism.

Luminosity and Conductivity of Flames.—F. L. Tufts.—An abstract of a Physical Society paper. In the case of the red lithium line and the yellow sodium line the luminosity of a Bunsen flame varies directly as the electric conductivity imparted to the flame by the salt vapors, whether the variation is produced by varying the rate of supply of air, gas or salt spray to the flame, or by the introduction into the flame of chlorine gas or chloroform vapors. Both the luminosity and the ionization imparted to the Bunsen flame by the salts of lithium and sodium are directly connected with the formation in the flame of the oxides of these metals.—*Phys. Review*, July.

Ether.—Lord Kelvin.—A theoretical paper on the motions of ether produced by the collisions of atoms or molecules containing or not containing electrons.—Lond. *Electrician*, Aug. 16.

Electric Waves.—W. B. Cartmel.—A discussion of experiments of Blake and Fountain on the extra transmission of electric waves, with a reply to recent criticisms of Schaefer.—*Phys. Review*, July.

Electrochemistry and Batteries.

Tantalum Rectifier.—G. Schulze.—An account of experiments on the use of tantalum electrodes in electrolytic rectifiers. They are in some respects superior to aluminum electrodes, since they are formed more rapidly and show valve action in all electrolytes examined. The highest valve action may be obtained in the carbonates of the alkalies, sometimes approaching 1000 volts. In all electrolytes the effectiveness is greatly reduced by concentration. The deleterious effect of breaks is greater in tantalum than in aluminum. The deleterious effect of heat is much lower in tantalum. The relation between thickness of the gaseous layer and voltage resisted is different in tantalum and in aluminum, supposing the layers to have the same dielectric constant in both. There is no satisfactory agreement between the potential gradient near an (ineffective) tantalum cathode and the gradient deduced from sparks between electrodes very close together. Disruptive observations made with mercury in place of the electrolyte give the same results as in the case of aluminum. The valve action is also great in vanadium and niobium, as well as aluminum and magnesium, but occurs in other metals also under favorable conditions.—*Ann. d. Physik*, No. 7; translated in abstract in Lond. *Electrician*, Aug. 16.

Edison Accumulator.—F. Foerster.—A long paper on the nature of the chemical reaction in the Edison accumulator. The active mass of nickel at the end of charging is a mixture of Ni_2O_3 and NiO_2. On drying this oxide changes of the sesquioxide Ni_3O_4 and on discharging $Ni(OH)_2$ is produced.—*Zeitschrift fur Elektrochemie*, July 12; from Lond. *Elec. Eng'ing*, Aug. 22.

Units, Measurements and Instruments.

[illegible] *Wave Detector.*—G. W. Pierce.—The first part of an experimental paper on crystal rectifiers for electric currents and electric oscillations. This first part deals with carborundum, which is shown to be unilaterally conducive. With one speci-

men under 10 volts the current in one direction was 100 times the current in the opposite direction. With another specimen platinized on one side the current at 34.5 volts was 527 times as great as the current in the opposite direction under the same voltage. In another case at 30 volts the current in one direction was 4000 times the current in the opposite direction under the same voltage. On account of this unilateral conductivity carborundum may be used for rectifying alternating currents. As the current increases, the efficiency of rectification decreases. A specimen platinized on both sides has a smaller efficiency of rectification, but a much lower resistance than a piece not platinized. Though the efficiency of rectification is

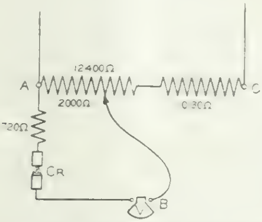


FIG. 3.—ARRANGEMENT OF RE[illegible]

less with the platinized specimen, the excess of one current over the other for a given voltage is much greater with the platinized specimen on account of its low resistance. Carborundum may be used in this way to adapt an ordinary direct-current measuring instrument to the measurement of alternating currents. The utility of these crystals for this purpose will depend upon their permanence and constancy when submitted to long continued use. For this purpose long runs are at present being made. An alternating voltmeter making use of carborundum as the rectifying substance has stood satisfactory tests for several weeks. The crystal is put in a metallic clamp enclosed in a tube containing oil, and is used with a delicate milliammeter, with a scale of 100 divisions, each division being 3.92 x 10.6 amperes. Shunt and series resistances as shown in Fig. 3 are used. When these resistances are properly chosen the scale of the instrument used as an alternating voltmeter will be nearly uniform over a wide range, or if desired the readings for the small voltages may be spread out instead of being compressed as in the ordinary alternating voltmeters. By dispensing with some of the series resistance, or by changing the shunts, it is possible to give the instrument a multiple scale. Calibration curves for the instrument are shown in Fig. 4. Curve I shows the reading of the direct-current instrument for different alternating voltages, the instru-

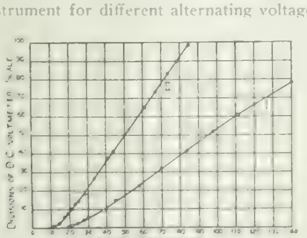


FIG. 4.—CALIBRATION CURVES.

ments being provided with the shunt and series resistances shown in Fig. 3. Curve II is the corresponding calibration curve without the 10,130 ohms series resistance. Both of the curves are nearly straight above 20 volts. When it is desired to measure voltages smaller than those given above, a step-up transformer may be used to raise the voltage of the alternating circuit. On account of the high resistance of the carborundum [illegible] that its introduction into a circuit will not materially modify [illegible] of this kind might quite accurately replace one of the transformers between the talking and listening circuits of the line. Very feeble currents may be measured in this way, and many experiments on resonance in telephone circuits may be performed. An explanation is given of the adaptability of carborundum for electric wave detectors. Besides carborundum a number of other crystals have the same property.—*Phys. Review*, July.

Alternating Current Galvanometer.—A. H. TAYLOR.—The instrument discussed in this paper is really a shunt-circuit dynamometer with a laminated iron core. Or, it is an ordinary D'Arsonval having a laminated iron core separately excited by a current drawn from the same source as the alternating current to be detected. Since the moving coil hangs in an alternating field, it must either not be wound on a copper frame, or else the reaction of the frame (due to eddy currents) must be compensated for after the manner of Stroud and Oates, who used this method of controlling the initial equilibrium position of the moving coil. A more satisfactory method of control is the one devised by Terry. Providing that the suspensions are not too heavy, they have in general but little to do with the initial position of the coil when the field current is on, since the induced currents in the coil react upon the field in such a way as to produce a torque whose direction depends on whether the induced current leads or lags with respect to the induced e. m. f. To use the galvanometer as a detector of alternating current, it must be permanently connected to the circuit. If the coil is too stable in the first position, with its plane parallel to the field, it must be shunted with a capacity whose effect may be regulated by a resistance in series with the same; if the coil turns its plane perpendicular to the field, it must be shunted with a resistance. Hence, on any but a very low-resistance external circuit, the control circuit may be regulated very easily so that the coil is not constrained by its own induced currents. Then the current to be detected is applied to the external circuit, and produces its effect as in any galvanometer. This galvanometer is especially useful as a sensitive instrument for the detection of alternating currents in bridge work, and it has the great advantage of being applicable to commercial circuits of ragged wave form and inconstant frequency.—*Phys. Review*, July.

Capacity and Power Factor of Condensers.—F. W. GROVER.—An abstract of a Physical Society paper. In a condenser having absorption, the angle of phase difference between the current and the electromotive force is less than 90 degrees by a small angle Θ, the power factor being equal to sin Θ. The author describes four methods for simultaneously measuring the capacity and the power factor of a condenser. These methods have been applied for testing a large number of condensers at frequencies between 30 and 1000. For good mica condensers the angles Θ may be as small as 0′ 30″ and as large as 4′. Poorer mica condensers, especially if their capacity is small, may give values of Θ as large as 30′ or even more. Good condensers, with a paraffined paper for a dielectric, have a value of from 5′ to 20′; in poor telephone condensers, angles as large as 10 degrees have been observed. For all the mica condensers examined the angle Θ diminishes slowly as the frequency rises. The same result was observed with all the poorer paper condensers, but with some of the better paper condensers the effect was in the opposite direction. The changes are all greater than in the case of mica condensers. Above 20 degrees the power factor increases with rise of temperature both in mica and in paper condensers, the effect being small for the former and very large for some of the poorer paper condensers. Since the power factor depends primarily on the absorption, the leakage having but a small effect, the value of the power factor gives a relative indication of the magnitude of those effects which depend on absorption, viz., residual charges, change of capacity with the frequency, dependence of the apparent capacity on the time of charge and discharge, etc.—*Phys. Review*, July.

Variations of Standard Resistances.—E. B. ROSA and H. D. [illegible]

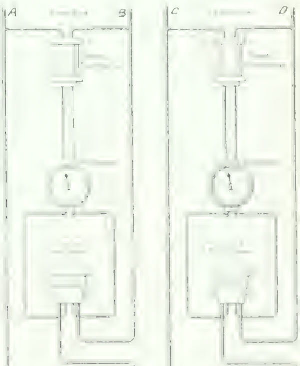
course of an extended investigation on the ratio of the electromagnetic to the electrostatic units carried out at the Bureau of Standards in Washington, it was found that all the resistances employed had a higher value at the same temperature in summer than in winter, the change being a gradual drift upward from early spring to midsummer, followed by a steady drift to the same minimum in the winter. The amplitude of the change was of course small, varying from 15 to 25 parts in 100,000, but far too large to be neglected in precision work. This variation was found to be due to the effect of atmospheric humidity on shellacked coils of manganin wire. The cause of the increase of resistance appears to be the stretching of the wire due to the shellac expanding as it absorbs moisture. On drying out in a dryer atmosphere the shellac and the wire embedded in it contract to their original volume and the resistance fall to its original value. A new form of sealed resistance standards is being developed.—*Phys. Review*, July.

Switchboard Connections of Wattmeters and Watt-Hour Meters for Measuring Power and Energy in Polyphase Circuits.

By [illegible]

A simplified description of the various methods employed in measuring polyphase power and energy by means of switchboard meters and directions for locating errors in connections will be of use to many who are unfamiliar with the practice of the principal electric companies.

It has been the experience of the writer that approximately 90 per cent of the outside troubles which the manufacturer has to deal with, otherwise known as "kicks," have been traced to



[illegible] CONNECTION FOR [illegible] POWER IN A [illegible] [illegible]

errors in connections, the watt-hour meters themselves being at fault approximately in only 10 per cent of the cases reported. Therefore, it follows that it would be well, in all cases where the operation is not satisfactory, to look into the connections before blaming the meters or the meter transformers.

Single-phase measurements being familiar to all, will not be dwelt upon further than to say that if the indications are reversed, either the voltage or the current leads should be reversed.

For polyphase work, it is recommended never to use single-phase meters. If one single-phase meter is used, even with a "Y box," the readings are dependent directly on the balancing of the load equally between the phases, any unbalancing producing an error in proportion. It is futile to assume that any polyphase circuit will be balanced. Even when operating only an induction motor or a synchronous motor, it is possible to have a violent unbalancing, due to a voltage unbalancing of the line. A case came to the writer's notice where a single-phase meter on a Y box connection to a three-phase motor circuit actually reversed, due to a reversal of the flow of energy in only one phase of the induction motor, caused by a lower voltage on that phase than on the others.

When two wattmeters are used to measure power in a polyphase circuit, their readings must be added to obtain the true power, and, moreover, on three-phase, a special set of connections must be used involving three series transformers and a voltage transformer having a mid-voltage secondary loop. Such an arrangement will be found much more expensive than a polyphase meter.

The modern polyphase wattmeter consists of two single-phase wattmeters with a common shaft. When properly connected, registration is correct under all conditions of unbalancing or low power factor. It is equally correct on either single-phase, two-phase, three-phase three-wire, three-phase four-wire, or three-phase six-wire. Thus it may always be calibrated on single-phase for use on any polyphase circuit.

The diagrams in the following explanations are schematic only, and do not show the actual appearance of the instruments. In Figs. 8, 9 and 10 are shown several instruments as they actually appear, without any connection to outside circuit, however. From the diagrams and the actual instruments the exact connection is readily determined for an actual meter.

[illegible]

PHASE WATTMETERS.

Two wattmeters connected as shown in Fig. 1 may be used to measure the power in a two-phase circuit. In making connections care must be exercised to see that the voltage leads are connected to the proper phases. If it is inconvenient to trace the connections, a voltmeter may be used to insure that the voltage is not taken "across phases." By this test the voltage across *a-b* or across *c-d* should be the normal e. m. f. of the system, and the voltage across *a-c*, *b-c*, *a-d* or *b-c* should be zero, if the system is not "inter-connected." If the system under test is interconnected, the voltage across *a-c*, *a-d* or *b-c* should be 70.7 per cent of the normal voltage.

If either meter shows reverse reading, the voltage leads should be reversed; if the meters read incorrectly and show a uniform reading at all times of the day, the probabilities are that the voltage circuits are interchanged. Under these conditions of connections to the wrong phase, its voltage being displaced 90 degs., the meter would only measure the wattless component of the apparent power.

If a polyphase meter is used to measure the power in a two-phase circuit, the above considerations still hold true, the connections being as shown in diagram Fig. 2.

These methods presuppose that no power is taken from across phases. If, however, there exists between the phases a load that is to be measured, a different arrangement is necessary, as the ordinary two-phase connection would not take account of loads between any two lines not having series transformers. To measure the power properly when load is drawn across phases it is necessary to connect a series transformer in each line, as shown in Fig. 3. To prove that this method is correct, the following case is assumed in which the voltage is 100 volts per phase (therefore, 70.7 volts between adjacent leads) and the series transformers are wound for a primary of 1000 amperes and a secondary of 5 amperes. Assuming that the wattmeter series coils are wound for 10 amperes, it will be seen at once that the proper calibration would be 10 amperes × 100 volts (or 1000 watts) in each phase of the wattmeter, for a single-phase [illegible] on the meter's dial.

A load of 1000 amperes at 100 volts and 100 per cent power factor, or 100 kilowatts between wires *A-A'* will act upon the wattmeter as follows:

As one series coil is carrying 10 amperes and one voltage coil, 100 volts and the time-phase displacement between the current and the voltage to which the voltage coils are connected is (assuming 100 per cent power factor) zero, the watts will equal 100 × 10 or 1000, which equals 100 kilowatts on the dial. This

result is in accordance with the calibration and is correct. (Note: Under the above conditions one set of series coils is carrying no current.)

A load of 1000 amperes between wires *A-B*, at 70.7 volts, and 100 per cent power factor, or 70.7 kilowatts, will act upon the wattmeter as follows:

Each series coil will carry 5 amperes, which is displaced in phase 45 electrical time-degrees from the voltage impressed upon the voltage coils, which is 100, thus 5 × 100 × cos. 45 degs. equals 353.5, whence the meter will indicate according to the calibration $\frac{353.5}{1000} \times 200$ equals 70.7 kilowatts, which is correct. Hence, it will be seen that any distribution of the load will be correctly metered by this method.

THREE-WIRE THREE-PHASE CIRCUITS.

Power in the three-wire three-phase system may be correctly measured by means of two single-phase meters connected as shown in Fig. 4.

Assuming a balanced load of 1000 amperes, 100 volts, 100 per cent power factor with 1000/5 series transformers. The total power will be equal to that in three single-phase circuits whose currents are the line currents and whose voltages are the Y voltages of the system, it being noted that at 100 per cent

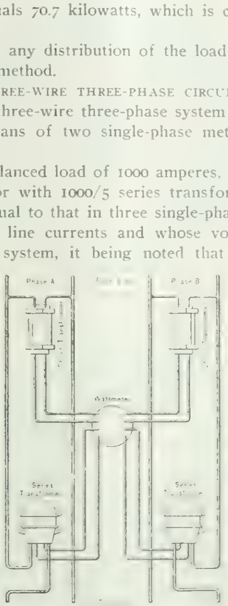


FIG. 2.—CONNECTIONS FOR MEASURING POWER IN A TWO-PHASE CIRCUIT WITH A POLYPHASE WATTMETER.

power factor, the time angle between the line currents and the Δ voltages or voltages between the lines is 30 degs. in a three-phase system and that the Y voltages are 57.7. Hence the power is 1000 × 57.7 × 3 equals 173.2 kilowatts.

The meters are calibrated as for single-phase: that is, 5 amperes, 100 volts, 500 watts on the coils equals 1000 × 100 or 100 kilowatts registered. With 100 per cent power factor, meters A and B will have in their coils 5 amperes × 100 volts × cos. 30 degs., equals 433 watts, which will, of course, indicate $\frac{433}{500} \times 100$ kilowatts or 86.6 kilowatts. Hence, the total reading of the two meters will be 173.2 kilowatts.

It will be noted that if the power factor is less than unity the angle of lag must be taken account of in addition to the 30 electrical time-degrees of normal lag between the current and the voltage. Thus at 50 per cent power factor the total angle of lag (that is, the angle of lag between the Y currents and the Y voltages) is 60 time-degrees. Hence the total power is 1000 × 57.7 × cos. 60 degs. × 3 = 86.6.

In the coils of meter A there will be 5 amperes × 100 volts × cos. 90 degs. = 0, and it will then indicate 0. Meter B will have in its coils 5 amperes × 100 volts × cos. 30 degs. = 433 watts which will, of course, give a reading on the dial of $\frac{433}{500} \times 100$ or 86.6 kilowatts. Hence, the meter shows the correct total.

At a load of 50 per cent power factor meter A registers 0, meter B registers the total power, the sum of the two readings being the correct power as before.

It should be noted that when the power factor becomes less than 50 per cent, meter B registers more than the total power, and meter A registers backward an amount sufficient to make the total power indicated still correct.

It can readily be shown by a specific example that no amount of unbalancing can give any error in the total readings, which will always represent the true power.

It is interesting to note in this connection that on a balanced

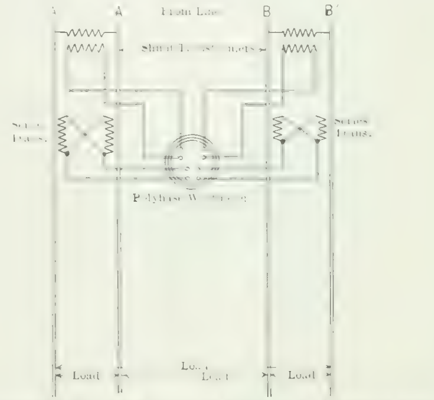


FIG. 3.—CONNECTIONS FOR MEASURING POWER IN AN INTERCONNECTED TWO-PHASE CIRCUIT BY MEANS OF A POLYPHASE WATTMETER.

load, a comparison of the two wattmeter readings gives an indication of the power factor of the system, as shown in the accompanying table:

Ratio.	Power Factor	Ratio.	Power Factor.
[illegible]	[illegible]	[illegible]	80
[illegible]	[illegible]	[illegible]	73
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		

There have been many ways devised to prevent the ratios of the readings varying with the power factor, among which may be noted:

1.—Connecting the series coils of the wattmeters to two series transformers in parallel, the primaries of the transformers being in different phases. The phase of the resultant secondary current in the meter will thus be displaced by 30 time-degrees from its normal time-phase position with reference to the voltage, thus preventing the reversal. The voltage coil of one of the wattmeters is connected from one line to the middle point of a voltage transformer connected across two of the lines, thus shifting the phase of the voltage coil by 30 electrical time degrees.

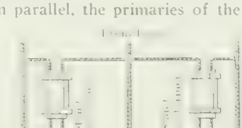


FIG. 4.—CONNECTIONS FOR MEASURING POWER IN A THREE-PHASE CIRCUIT BY MEANS OF TWO SINGLE-PHASE WATTMETERS.

2.—The use of Y boxes to connect the voltage coils from the lines to an artificial neutral point. If one single-phase wattmeter is used for either of the above methods, the readings depend upon the balance of the system, as before explained. If more than one wattmeter is used, two or more readings must be taken, thus increasing the chance of error, in addition to increasing the cost and the inconvenience.

3.—Mechanically connecting the two wattmeter elements and mounting them in the same case, to operate a common dial.

This method, known as the "polyphase wattmeter method," is the only one which has proven thoroughly satisfactory. The

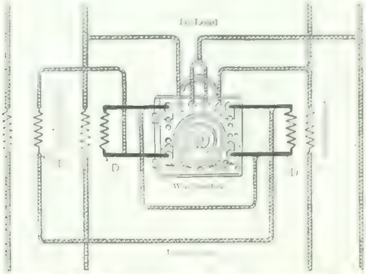


FIG. 6.—POLYPHASE WATTMETER ON THREE-PHASE, FOUR-WIRE CIRCUITS WITH SERIES TRANSFORMERS.

common shaft or other mechanical connection adds the readings of the two wattmeter elements automatically, thus preventing a reverse reading unless the total power actually reverses its sign. The readings of a well-designed polyphase meter are strictly independent of the power factor or the unbalancing of the system, and it will read correctly on either single, two, or three-phase, if properly connected to the circuit. To secure the above results, it is important that the design of the meter be such that one element does not affect the other inductively. Thus the older polyphase meters made with two electromagnets driving a common disk are very much inferior to the designs employing two separate disks or drums on the same shaft.

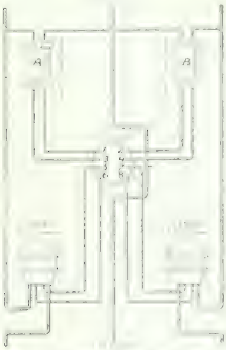


FIG. 5.—THREE-PHASE WATTMETER CONNECTION.

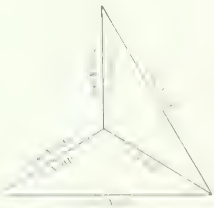


FIG. 7.—VOLTAGE AND CURRENT RELATIONS.

The connections for measuring the power in a three-phase three-wire system by means of a polyphase wattmeter are as shown in Fig. 5.

It is important for the connections to be correctly made. With some makes of meters or of series or voltage transformers it occurs that the leads are not properly brought out, thus necessitating a variation from the diagram of connections furnished. Some manufacturers now mark one primary and one secondary lead with corresponding symbols, indicating similar "polarity." Frequently the leads are threaded through conduits, or they may be hard to trace for other reasons. The following simple test should determine whether the connections have been properly made:

The connections should be tested when the load is on, and the power factor is higher than 50 per cent. First, the voltage at the shunt binding posts 3-4 should be 1.73 times that on 1-3 and 2-4, and the voltage should be zero on 1-2. If voltage 3-4 is equal to 1-3 and 2-4, one of the voltage transformers must be reversed. Second, the series transformer in only the line to which the voltage transformer *B* is connected (not the line common to both voltage transformers) should have both of its leads brought to 7-8, and the series transformer in only line to which voltage transformer *A* is connected should have both of its leads attached to 5-6. Third. One series trans-

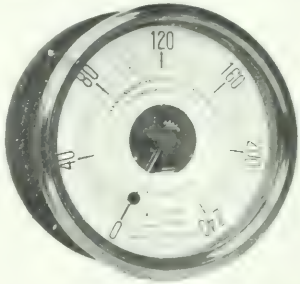


FIG. 8.—POLYPHASE INDICATING WATTMETER, SWITCHBOARD TYPE.

former should be disconnected at a time and the meter should in each case read forward, the power factor being over 50 per cent. If it reads backward, reverse the terminals of the series transformer which causes a backward reading.

FOUR-WIRE THREE-PHASE WATTMETER CONNECTIONS.

When a polyphase wattmeter is to be used on a four-wire three-phase circuit, the connections must be such as to take ac-

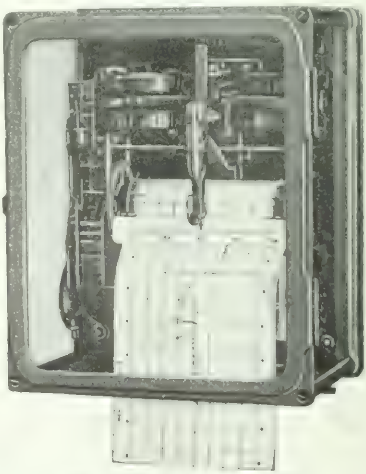


FIG. 9.—RECORDING WATTMETER.

count of power drawn either across phases, or from any phase to the neutral, under all conditions of unbalancing or power factor. This result is obtained by using connections to the voltage coils from two of the lines to the neutral instead of to the third phase as usual in ordinary three-phase circuits, and a third series transformer is connected to take account of the current between the third line and the neutral or "ground." The connections to the extra series transformer are shown in Fig. 6. It is exceedingly important for the connections to be exactly correct, otherwise the meters will not read correctly.

Assume a three-phase four-wire circuit with 100 volts to the neutral, and 1000 5 ampere series transformers. The standard calibration is such that 100 volts, 5 amperes, and 500 watts

(both sets of coils on single-phase) registers as 200 kilowatts. When there is a load of 1000 amperes in each line, a total load of 1000 × 100 × 3, or 300 kilowatts is obtained. In each series coil the resultant of the two 5-ampere currents in the series transformer secondaries, 120 degs. apart in time-phase, is 8.66, which will be 30 degs. out of time-phase with the voltages (assuming 100 per cent power factor). See Fig. 7. Hence, each electromagnet of the wattmeter will be subjected to 8.66 amperes × 100 volts × cos. 30 degs., or 750 watts. Hence the registration will be (from the calibration given) $\frac{750}{500}$ × 200, or 300 kilowatts, which is correct. It can readily be shown by an example that no amount of unbalancing can affect the accuracy of the reading.

In order to test the connections, there should be a load on and the power factor should be higher than 50 per cent. First, the voltage at the shunt binding posts 3-4 should be 1.73 times that at 1-3 and 2-4, and it should be zero at 1-2. If the voltage 3-4 is equal to 1-3 and 2-4, the terminals of one of the voltage transformers must be reversed. Second, the series transformer, in the same line to which voltage lead 4 is connected, should have both of its leads brought to 7-8, and the series transformer in the line to which the voltage lead 3 is connected should have both of its leads attached to 5-6. Third, all three series transformers should be disconnected by opening one lead of each at points *D*, between the transformer and the point where the secondary wire connects to another transformer (not between the junction point of the transformers and the meter). The meter will then read zero. One series transformer at a time should then be reconnected in succession and the meter in each case should indicate forward. If it indicates in the reverse direction (the power factor being over 50) the leads at the series transformer terminals should be reversed. When all three of the phases thus cause the meter to read forward, the connections are correct.

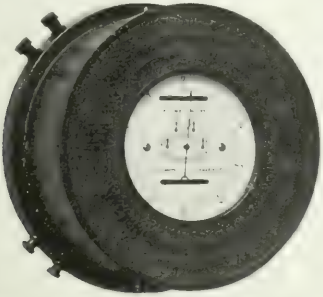


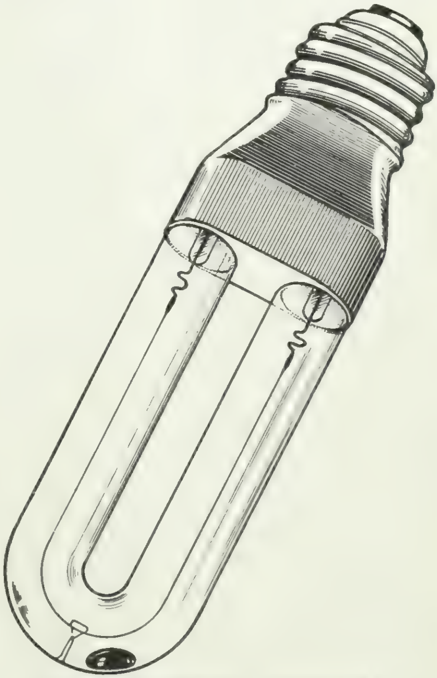
FIG. 10.—POLYPHASE WATT-HOUR METER, SWITCHBOARD TYPE

The above remarks, although applying to wattmeter connections and power measurements, are directly applicable to the connections used with watt-hour meters for measuring the energy transmitted over polyphase circuits.

New Type of Incandescent Lamp.

Since the introduction of the mercury vapor lamp, and its adoption in commercial work generally, various attempts have been made to combine with it the incandescent lamp in such a manner that the color of the vapor light would be corrected to a certain extent, at the same time retaining its economy. What seems, however, to be a distinct new departure is found in the German lamp of which a sketch is herewith shown. The lamp is a U-shaped tube, both ends of the tube entering the brass cap or socket and being held there by plaster of paris. The carbon filament is also of the same shape and one end is carried into each tube, with the regular leading-in wire; and the loop is anchored at the bottom. When cold, a small button of mercury is seen at the bottom of the lamp, but after the filament has been burning long enough, the mercury becomes vaporized and there is thus secured a direct combination of the two methods of illumination at the same time, in what is said by the German inventor to be a very effective manner. Data as to economy, life, etc., are, however, not yet forthcoming.

The lamp is 5 ins. over all in length, with a 2-in. brass cap extending well down over the tube. The lamp is almost exactly 1½ ins. in width, and each leg of the U is about ½ in. in diameter. As will be noted there is considerable space between the glass legs. The lamp is tipless. It will be interesting to see whether this type makes its way into practice.



COMBINATION FILAMENT AND MERCURY VAPOR LAMP

Lectures on Illumination.

Members of the engineering department of the Holophane Company delivered during the past season no less than 98 lectures on illumination. These illustrated lectures have attracted much interest from electric light and gas companies, for the benefit of whose solicitors and customers they are generally given. The lectures treat of the fundamental principles of illumination broadly, combining primary instruction in the practical engineering of light with non-technical expositions of good and bad practice of the art.

Of the lectures given last season, Mr. Lansingh delivered 21, Mr. Lauritzen 8, and Mr. Marshall 69, the latter speaking in all of the principal cities of the Central and Western States, in a tour which lasted over nine months, during which he traveled over 28,000 miles, and addressed approximately 17,000 people. Each lecture was given under the auspices of the local gas or electric company of the city visited, and was widely advertised in the newspapers by write-ups and display advertising, the latter not infrequently running from one-quarter to a full page and continuing several days previous to Mr. Marshall's arrival. Announcements or special invitations also were sent to technical societies, architects, gas and electrical engineers, merchants, window trimmers and others whom the lighting company deemed interested.

[illegible] attention upon the importance of the subject of illumination, and were invariably well attended by people whom it was desirable to interest. The greatest practical result of the lectures, however, lay in the more or less informal after-meetings with the commercial men and solicitors of the several companies, who displayed an eagerness and desire for additional information which was testimony of the deep interest they felt. Not infrequently arrangements were made for a series of private talks with the solicitors, these talks being in the nature of practical lessons in illuminating engineering, continuing several days. On a number of occasions, also, Mr. Marshall was called upon to act in his capacity of consulting illuminating engineer for the lighting company.

This branch of the Holophane Company's activities is a distinct departure in educational work along the lines of illuminating engineering. It is undertaken, not as a source of revenue, but to assist those vitally interested—the lighting companies—in bringing forcibly to the attention of their customers and salesmen the importance and mutual advantage of good illumination. The lecture system will be continued the coming season, and applications from lighting companies interested will receive the attention of the Holophane Company.

The Canadian Electrical Exhibition.

The exhibition held this week in the Drill Hall, at Montreal, is the first of its kind ever held in the Dominion except that given some years ago in Montreal under the auspices of the National Electric Light Association, and reflects great credit upon the men responsible for it, notably Mr. W. McLea Walbank (president of the Exposition Company), Mr. R. S. Kelsch (vice-president), Mr. J. W. Pilcher, of the Canadian General Electric Company (secretary and treasurer); Mr. Henry D. Bayne, of the Canadian Westinghouse Company, and others interested in the enterprise. The Drill Hall is a blaze of light, the interior has been literally transformed by a liberal use of Canadian and American flags, and the decoration scheme of blue and white, coupled with the thousands of electric lamps, makes a picture full of brilliant color. The booths have been attractively arranged and a uniform style is maintained throughout.

The Canadian Westinghouse Company has an especially instructive and well selected exhibit, including meters, motors, controllers, fans, etc. The whole lighting of the Drill Hall was entrusted to this company, and the Westinghouse Nernst lamps are used, which give a soft, mellow light, evenly distributed. One of the chief features of the exhibit is the 1500-hp railway type generator, manufactured for the Montreal Street Railway Company, which will be placed in the new power house at Hochelaga. There are also on view the 4000-hp transformer which will be used on the new development at the Soulanges Canal, and a static sign. The latter has a potential of 45,000 volts, and lights up the letters of the name "Westinghouse" in vivid flashes.

There are a great many exhibits of interest. In contrast to many of the other exhibits that of Allis-Chalmers-Bullock, Limited, is intended more for the engineer and student. The company shows a belted alternator with a direct-connected exciter in operation, two alternators built for driving by water wheel, one unwound and the other partly wound, to show the method of fastening the field poles and windings; an engine-type direct-current generator, which can also be used as an alternating-current generator; a number of polyphase induction motors and single phase self-starting motors; transformers and other apparatus made at their factory in Montreal. On a small scale they reproduce the electric pump which has been in operation for the past two years on McTavish Street. The capacity is only 300,000 gals. daily, as compared with 5,000,000 gals. daily by the city pump, but the unit shows clearly the method of operation.

The electric fountain, with the multi-colored rays, has elicited a universal chorus of admiration. "The man behind the gun" in this case was an Allis-Chalmers-Bullock, Limited, 5-hp induction motor driving a small Worthington centrifugal pump made by the John McDougall Caledonian Iron Works Company, Limited.

The "process of manufacture" is always interesting. Realizing this, Allis-Chalmers-Bullock, Limited, has a number of girls from its factory and shows a regular winding department, where induction motors are built up from the point where the wire is covered until they are ready to operate. This is not only one of the most interesting features, but also one of the most instructive to many of the visitors to the exhibition.

The exhibit of the Northern Electric & Manufacturing Company attracts attention. The company is showing a complete system of fire and police alarms, and the demonstrations which are made at frequent intervals with the fire-alarm bell cause the horses in the fire station located in the Drill Hall to champ their bits and grow restive.

Another interesting exhibit is that of Messrs. Babcock & Wilcox, whose booth is tastefully decorated, and who have a selection of their water-tube boilers and fittings on view. The manager, Mr. H. Wray Weller, is especially proud of a remarkable steel forging which forms part of the exhibit and which excites the interest and admiration of every man who understands the difficulties to be surmounted in making such a piece of metal.

The Packard Electric Company, of St. Catherines, has one of the largest and most attractive exhibits in charge of Mr. George C. Rough, and in connection with this there is a fine display of Jandus interchangeable arc lamps, gyrofans, etc., and the Jandus automatic regulator for alternating-current series-connected arc lamps.

The Crocker-Wheeler Company is well represented in the Packard space by a 65-kw direct-current generator, crane motors and controllers, motors and a large ventilating fan, and the American Instrument Company shows a line of its instruments in the Packard space.

The National Electric Lamp Association is represented by its Canadian member, the Sunbeam Incandescent Lamp Company, which exhibits all kinds of incandescent lamps and Holophane globes. Mr. E. Irving has charge of this exhibit.

Mr. Fred Thomson, of Montreal, keeps a crowd constantly gathered around his booth, where he exhibits a number of interesting experiments, which mystify the public, such as lighting a large incandescent lamp immersed in a bowl of water by placing the bowl upon a sheet of plate glass that rests upon an induction coil. He also exhibits the DeForest wireless telegraph apparatus.

One of the most popular of the exhibits is that of the Canadian General Electric Company, where, in addition to a representative display of its electrical apparatus, it has a space fitted up as "a modern kitchen." Experienced women are busy cooking and distributing little tid-bits, fudge, coffee, etc., and in another corner a young woman is industriously engaged in ironing shirtwaists with an electric iron and explaining the advantages of it over the old-fashioned fire-heated, quickly cooled, heavy flatiron. This exhibit is sending many visitors home with well defined intentions of installing electrical heating and cooking apparatus in their homes. The other part of the Canadian General Electric Company's exhibit consists of magnetite arcs, flaming arcs and enclosed arcs. A mercury arc rectifier, motors, luminous radiators, meters, exide batteries, its own types of Nernst lamps, electric humidifier ejecting a fine spray of water to keep the air moist, a sewing machine run by a motor, automobile coils, etc., all of them interesting to the general public.

The Canadian Fairbanks Company exhibits Fairbanks gas engines belted to one of its generators and one of its pumps, Fairbanks valves, Pratt & Whitney tools, Yale & Towne hoists, Norton emery grinders, etc.

The Canadian Pneumatic Tool Company shows a full line of Duntley electric drills, blowers, grinders and buffers, electric hoists and a "magnetic old-man," a magnetic device for holding

a drill in place, which work has heretofore been done by an old man.

The Vulcan Electric Heating Company, of Chicago, has its soldering and branding irons displayed in the booths of the Sayer Electric Company, R. E. T. Pringle Company and the Montreal Electric Light & Power Company. The irons are shown in actual operation.

The Pringle Company also exhibits D. & W. fuses, boxes and Deltabeston wire, the Hubbard specialties, the Prometheus heating apparatus, the Edison specialties, Moloney transformers, Century Electric Company motors, Adams-Bagnall arc lamps, Beck flaming arcs, and a full line of the Pringle and Ever-Ready specialties.

The Robb Engineering Company shows a 50-kw direct-connected engine and generator and a 25-hp vertical engine.

The Montreal Light, Heat & Power Company occupies a large space in which it exhibits electrically driven coffee grinders, washing machines, meat choppers, heating devices, an electrically-driven vacuum pump and carpet cleaner, Benjamin clusters, D'Olier reflectors, and the Marsh Brothers electric advertising signs of all kinds, many of which are fitted with Hylo Skedoodle lamps. In this space the Shelton vibrator is exhibited and visitors are given a few moments treatment gratis, which serves to keep an interested audience gathered.

Munderloh & Company exhibit Helios arc lamps, Whitney instruments, Gladstone Lalande batteries, Shedrick irons and a line of Munderloh electric fixtures.

A. Roy MacDonald exhibits mica in various forms, including a tube 10 ft. long, 2 ft. in diameter, made of 1½-in. material built up in overlapping sections and consisting of nearly 5,000,000 pieces of (4-in. sq.) mica. It is made for the C. P. R. Company.

The Locke Insulator Company shows a very attractive and interesting line of insulators of all sizes, bus-bars, overhead line material, etc.

American manufacturers are well represented in the John Forman space. This exhibit includes Chase-Shawmut cut-outs and fuses, Trumbull service boxes and combination switches and cut-outs, Alphaduct, the Sangamo meters, American Electric Company heating devices, flatirons and soldering irons; Partrick, Carter & Wilkins annunciators, American transformers, Lima insulators, Gordon batteries, Clayton & Lambert torches and fire pots, Connecticut telephones and switchboards, Crofton storage batteries, Connecticut and Heinz spark coils, Stay-rite spark plugs, etc.

The Montreal Steel Works show a street car equipped with their own make of trucks and Westinghouse motors fitted with the unit switch system of multiple train control.

J. A. Dawson & Company exhibit the Consolidated Car Heating Company appliances; E. W. Bliss gears, pinions and pressing machines; Crouse-Hinds Company headlights; Albert & J. M. Anderson trolley bases; Lord Electric Company and Forest City bonds; Vought-Berger and Stombaugh guy [illegible], Keough cord grips, Mc Allen Company overhead material; Sterling varnish; Couch telephones; Delaware Hard Fiber Company products; Duby brush holders; Duncan rosettes, sockets, lamp guards, etc., and the patented J. A. Dawson Company controllers made with [illegible] parts. Among the other exhibitors are Aluminum Company of America, aluminum cables and joints; American Conduit Company, conduit construction; Bell Telephone Company of Canada, telephone exchange; Canadian Buffalo Forge Company, electric blowers, etc.; Canada Electric Company, electric and gas fixtures; Canadian Rand Company, Limited, motor-driven air compressor; Dominion Electric Manufacturing Company, Limited, electrical specialties, conduit fittings, switches, switchboards, fixtures; Dossert & Company, solderless connectors and terminals for wires and cables; Economical Electric Lamp Company, turn-down lamps; Fibre Conduit Company, fibre conduit; G. M. Gest, conduit construction; Garth Company, fixtures and fittings; Laurie & Lamb, models of [illegible] engines for direct connection; Linde-British Refrigeration Company, Limited, motor driven refrigerating machine; Marconi Wireless Telegraph Company, sending station and in another part of the hall a receiving station; Martel-Stewart Company, Limited, electric signs; Phillips (Eugene F.) Electrical Works, Limited, wires and cables; Sayer Electrical Company, electrical supplies and novelties; Stratton Rotating Engine Company, rotary engine connected to dynamo; Wire & Cable Company, electrical wires and cables.

One of the features of the exhibition is the large sign with the dancing skeleton and Jupiter outlined in white and red incandescent lamps operated by a Dull flasher.

Tuesday night was press night, and there was a special car at the Windsor Hotel at 8 o'clock to convey the members of the fourth estate to the Drill Hall. While the numbers were sparse when the car left the Windsor, a number of the representatives of the city press were at the hall during the evening and were shown the various exhibits by Mr. W. McLea Walbank, the president, and Mr. Kelsch, the vice-president, of the Exhibition Company, ably assisted by Mr. H. D. Bayne, the Montreal manager of the Canadian Westinghouse Company. Later the party were entertained at an informal supper, the piece de resistance being a turkey cooked by electricity and done to a turn, which was announced by Mr. J. W. Pilcher, of the General Electric Company, to be "the first time this bird had been cooked by electricity in the Dominion." A number of speeches were made and an enjoyable evening spent by the various men present. The Electrical World had the distinction of being the one electrical paper represented at this function.

The booth of the Electrical World is the first booth on the left hand side, near the entrance, and our friends are invited to make it their headquarters during their visit to the exposition and convention.

Commutator Truing Device.

The accompanying illustration represents a commutator truing device which is being placed upon the market by The Patterson Tool & Supply Company, Dayton, Ohio. The picture shows it to be a simple and substantial device, and it is stated to be very effective in trimming down uneven commutator surfaces,

DEVICE FOR TRUING COMMUTATORS.

which constitute a source of much trouble with dynamos through sparking, etc. The machine is especially adapted to use on large direct-connected generators. A few of its dimensions are given herewith: Size of base, 7 ins. x 12 ins. x 1 in. thick; diameter of split column, 5 ins.; diameter of swivel stem, 3¾ ins.; length of same, 7 ins.; distance from floor to cross feed handle when down, [illegible] ins.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The volume of business was satisfactory, exceeding, in many sections, the activity of last year. The outlook for fall is bright, there being a demand for goods at leading jobbing markets as a result of more favorable crop conditions, which are reported, especially from Northwestern and Southwestern centers. Collections show improvement in different localities, but on the whole they are still slow. Cotton reports range from good on the Atlantic Coast to poor in Texas, the latter because of drought. Foreign commerce at the port of New York for the week showed gains of $2,564,654 in imports and $245,789 in exports. In some of the leading industries the conditions were irregular. Cotton goods manufacturing is active and the stocks are all sold ahead. Iron and steel mills are actively engaged in filling old orders, but report new business light with easier prices. A reduction of 4 cents per pound in "official" copper prices did not cause much new buying. Producers proclaimed that the price at which large sales would be made was 18 cents for Lake, but the market went a good bit below that and the quoted range for spot lake Friday was 17¼ to 17¾ cents as quoted by the Metal Exchange, and the American Metal Company quoted lake at 17½ to 18 cents, but "weak" at that. The closing quotations were 17½ cents for lake; 17¼ cents for electrolytic, and 17⅛ cents for casting copper. Failure returns show some effect of the money stress, but the total for August is, next to August, 1906, the smallest recorded in that month since 1893. The number of commercial failures in the United States in August this year was 850 and the amount of defaulted indebtedness $15,197,740. In the corresponding month last year the corresponding figures were 788 and $8,821,154. The increase in amount of liabilities occurred in the class embracing manufacturing insolvencies, where 217 failures for $11,047,249, compared with 194 failures last year, when the amount of indebtedness was $3,089,172. Trading failures were 621 in number and $3,740,828 in amount, against 573 failures last year when the amount involved was $3,552,039. Distinct improvement occurred in the third class, which embraces brokerage, insurance, real estate and similar concerns, there being only 12 failures, for $409,672, against 21 last year, when the amount involved was $2,179,943. There were only three failures of banks, trust companies and other fiduciary institutions with debts of $2,662,696, which compares with eight similar failures last year, when the amount involved was $7,619,768. *Bradstreet's* reports 130 failures during the week ending Sept. 5, against 167 in the week previous and 121 in the corresponding week last year.

THE COPPER SITUATION.—In their monthly circular, D. Houston & Co. say: "The United States production of copper for the year 1906, as per government figures, was 906,591,947 lbs., and on the basis of present quotations of 18 cents this product could be purchased for $65,727,916 less than at the market price of 25¼ a few months ago. The difference in copper values as above noted leaves an immense amount of capital available for other purposes. The price of electrolytic copper has been reduced to 18 cents by leading producers, and it is to be hoped that the widely irregular features which have characterized market quotations lately may gradually disappear along with the unsettling effect they create. Moderate sales are reported. The market has passed through a protracted period of dullness, and values have consequently been adjusted to a basis more in harmony with existing conditions. The situation is waiting for demand to become a stimulating factor, and while recent buying has not measured up to anything like the normal level, nevertheless, the consumption of copper is bound to start up again eventually on a heavy scale. Meanwhile when conditions are quiet and trading slack urgent sellers have to accept the best they can get, but the low prices on occasional sales do not represent the market for the bulk of supplies. It would take much time for a strong and persistent demand to absorb the floating copper seeking a market, and with that out of the way the tone would show immediate improvement. Many important enterprises are held up until the money market becomes easier, and included in these are a number of electrical projects. No matter what vicissitudes the market for copper may pass through there is one thing that can be safely predicted, it will not remain permanently dull."

RAILWAY TURBO-GENERATOR.—Following the tests recently made on the 1000-kw Allis-Chalmers turbo-alternator now in operation for some months past at the power house of the Kokomo, Marion & Western Traction Company, Kokomo, Ind., this company has placed an order for a duplicate unit comprising a 1000-kw turbine driving a 1000-kw alternator, with turbo jet condensing system complete. The unit is wound for 50 cycles, two-phase, 2300 volts. This unit, like the one already in service, will operate normally with steam pressure of 140 lbs. per sq. in. gauge pressure at the turbine throttle, dry saturated, and a vacuum of 28 ins. of mercury, referred to a 30-in. barometer at the exhaust nozzle. The unit is calculated to carry an overload of 50 per cent when operated under the above steam conditions and at 100 per cent power factor. In the test of the first unit referred to above, the entire load placed upon the machine aggregated only a little over half its normal capacity or approximately 554 kilowatts on the average. Not only did the machines meet the guaranteed consumption and other conditions of the test satisfactorily, but lowered the steam consumption guarantee at one-half load by 2.1 lbs. The test was conducted by Mr. Paul Diserens, of Purdue University, working in consultation with Mr. Phil H. Palmer, superintendent, who represented the traction company's interest, and by Mr. F. C. Purcell, of the Allis-Chalmers Company, Milwaukee. The second unit just ordered will be placed beside the first one in the power house at Kokomo, and will furnish power for lighting and railway service.

DOUGLAS & COMPANY, of Cedar Rapids, Iowa, are large manufacturers of corn products, including corn oil, cake, germ oil, meal, gluten feed and starch for laundry, domestic and manufacturing purposes. The company's plant has been provided with the best equipment obtainable and is operated throughout by means of electric motors, group and individual, drive. The latest addition to the equipment of the Douglas Mills comprises approximately 650 horse-power in Allis-Chalmers induction motors, some of which are of the vertical type especially adapted to the operation of corn product mills. These machines are to operate at standard speeds for driving individual and grouped machines, according to the character of the work.

LARGE ORDER FROM UTAH.—Another silent testimony of the confidence remaining in the country's continued prosperity is the large order for railway equipment just contracted for with the General Electric Company by the Utah Light & Railway Company, of Salt Lake City. The Utah Company is planning large extensions to its present 90 miles of track and will install 50 new cars. The contract calls for 50 complete quadruple equipments consisting of 200 GE-80 40-hp motors with K—28 controllers. In addition the company has ordered 74 GE-80 motors, with extra controllers, circuit breakers, rheostats, etc., for the re-equipment of old cars.

DODGE & DAY, engineers and constructors, of Philadelphia, have submitted a betterment report covering the entire factory of Fayette R. Plumb, Inc., of Frankford, Pa., and are now engaged in making extensive alterations to the forge shops. When this work is finished other departments will be taken up, and ultimately the entire plant will be remodelled.

PRICES FOR VENEZUELA.—We are in receipt of a letter from Messrs. Angarita & Co., Empresarios Luz Electrico, San Crestobal, Venezuela, S. A., stating that they would like to receive from American manufacturers catalogues and price lists of electrical machinery.

THE UTAH COPPER COMPANY has installed in the Garfield plant, at Garfield, Utah, two cranes built by the Northern Engineering Works, Detroit, Mich. One is of 15 tons capacity, three-motor electric type, and the other of six tons capacity hand type.

MINNEAPOLIS TROLLEY POWER.—The Twin City Rapid Transit Company, Minneapolis, operates two power stations, one a hydro-electric plant with an output of 10,000 hp, and operated in parallel with it in a station approximately 1000 ft. distant, a steam-driven electrical generating plant of 35,000 hp normal rated capacity. These two plants furnish electrical energy to ten electric sub-stations in St. Paul, Minneapolis and adjacent towns, the maximum transmission distance being 25 miles, over which alternating current, three-phase, is carried at 13,200 volts, to be converted at the sub-stations into 600 volts direct current. The steam-driven power plant, located on the east bank of the Mississippi River, stands just below the flour mills in the center of the city, in a brick building 155 ft. x 225 ft., and 93 ft. high. The engine room, 67 ft. wide and extending through the length of the building, contains, among other units, four reciprocating engines direct connected to engine type generators. These machines, which comprised the original installation, are Allis-Chalmers vertical cross compound condensing engines 46" and 94" by 60" stroke. They have a normal capacity of 5000 ihp hour, steam at 175 lbs. gauge pressure and 75 deg. F. superheat and engines exhausting into 26" vacuum. The engines, which operate at a speed of 74½ r. p. m., are equipped with Reynolds Corliss valve gear having an automatic weighted governor operating with the high and low pressure sides. The steam supply and exhaust valves are operated by separate eccentric; the speed control is operated by a motor controlled from the switchboards. Each of these engines occupies a floor space of 17' x 36' and is approximately 36' in height. One of the four engines, the last to be installed, is equipped with an Allis-Chalmers barometric condenser with the condenser chamber attached to the engine cylinder. This condenser has two barometric columns, one 16" in diameter for the removal of both air and water and one 20" for an overflow. Cooling water is supplied by a 20" centrifugal pump. Aside from its city lines a portion of the Twin City Rapid Transit Company's output is utilized for the operation of the double track electric line to Excelsior on the southern shore of Lake Minnetonka, 19 miles west of Minneapolis.

THE STANDARD ROLLER BEARING COMPANY, of Philadelphia, Pa., has recently made many large additions to its plant, which is claimed to be now the largest works of its kind in the world. The buildings extend over one-half mile of ground from end to end, with a floor space of over 500,000 square feet. The concern now employs over 1500 men. The business has grown to such proportions as to necessitate the establishing of a thoroughly organized department of publicity. The new department will be conducted by Mr. C. Dickens Sternfels, who has been identified in a similar capacity with the Arthur Koppel Company, Pittsburg, Pa., for the past three years. Mr. Sternfels assumes charge of the Standard Roller Bearing Company's publicity department on Sept. 16, and will be located at Philadelphia.

AMERICAN CONCRETE POLE COMPANY.—The American Concrete Pole Company, of Richmond, Ind., has taken over the patents of William M. Bailey for the manufacture of concrete poles at its works, and also accord the right to construct to other companies, on a royalty basis, or sell the right for a certain territory. The officers and directors of the company are as follows: A. C. Lindemuth, Richmond, Ind., president; W. M. Bailey, Richmond, Ind., vice-president and general manager; L. E. Browne, Richmond, Ind., secretary and treasurer; James S. Brailey, Jr., Toledo, Ohio; Col. W. P. Orr., Piqua, Ohio; L. M. Flesh, Piqua, Ohio; S. K. Statler, Piqua, Ohio; J. L. Boyer, Piqua, Ohio; John M. Lontz, Richmond, Ind.; Edwin H. Cates, Richmond, Ind.; Perry J. Freeman, Richmond, Ind.

CONTRACTS FOR ELECTRIFICATION OF SOUTHERN PACIFIC LINES IN OAKLAND, CAL.—Contracts were let last week at the New York offices of the Southern Pacific Railroad Company for the electrical equipment of its electrical line in Oakland, Cal., and vicinity. Eighty motor cars will be equipped each week with four 125-hp motors, the contract for which has been awarded to the General Electric Company. The power station will [illegible] 25-cycle, 13,200 volt, three-phase units, the contract for which [illegible] Parker boilers have been ordered with Worthington condensers and auxiliaries.

ELECTRICAL SUPPLIES.—Manufacturers of electrical supplies, plant fittings and measuring instruments are invited to send their latest catalogues to the Comptroller of Government Stores, Colombo, Ceylon, for the use of the Government.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market showed a continued disposition to take a more favorable view of the financial and speculative situation. There was no increase in public participation in the market, but for the first time in many weeks London was a buyer of American securities. The easing of money rates was the most important factor bearing upon the action of the stock market, and more or less attention continues to be given to the prospect for the success of the New York City $40,000,000 4½ per cent bond issue. There was some renewal of bearish activity in certain securities, but the declines were moderate and no large amount of stocks seemed to be forced out. Later on the underlying strength was exhibited in face of the announcement of the failure of a large stock and grain house, and the passing of the dividend upon Interborough-Metropolitan preferred. The reduction of copper prices by the leading producers to 18 cents failed to have an unfavorable effect on Amalgamated Copper. At the latter end of the week the market was very strong. Electric and traction stocks were comparatively steady on moderate trading, and all closed the week at slightly advanced quotations. Metropolitan Street Railway, which last week suffered a heavy slump, rose to 44, the opening price being 37. The curb market experienced a slow recovery during the week, following the lead of the Stock Exchange list. But little public interest developed, and speculative trading was trifling. The closing stock quotations of Sept. 10 are given below.

NEW YORK.

	Sept. 3	Sept. 10		Sept. 3	Sept. 10
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	[illegible]	[illegible]
Allis-Chalmers Co. pfd.	[illegible]	[illegible]	Hudson River Tel.	[illegible]	[illegible]
Am. Dist. Tel.	—	20	Interborough Met.	[illegible]	[illegible]
American Locomotive	[illegible]	[illegible]	Interborough-Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	[illegible]	[illegible]	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable	[illegible]	[illegible]	Mackay Cos. Pfd.	[illegible]	[illegible]
American Tel. & Tel.	—	166	Marconi Tel.	—	—
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	[illegible]	[illegible]
Electric Boat	[illegible]	[illegible]	N. Y. & N. J. Tel.	[illegible]	[illegible]
Electric Boat pfd.	[illegible]	[illegible]	Western Union Tel.	[illegible]	[illegible]
Electric Vehicle	[illegible]	—	Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd.	—	—	Westinghouse pfd.	—	165*

BOSTON.

	Sept. 3	Sept. 10		Sept. 3	Sept. 10
American Tel. & Tel.	[illegible]	[illegible]	Mass. Elec. Ry. pfd.	[illegible]	[illegible]
Cumberland Telephone	—	[illegible]	Mexican Tel. Phone	[illegible]	[illegible]
Edison Elec. Illum.	[illegible]	[illegible]	New England Telep.	[illegible]	[illegible]
General Electric	[illegible]	[illegible]	Western Tel. & Tel.	[illegible]	[illegible]
Mass. Elec. Ry.	[illegible]	[illegible]	West. Tel. & Tel. pfd.	[illegible]	[illegible]

PHILADELPHIA.

	Sept. 3	Sept. 10		Sept. 3	Sept. 10
American Railways	[illegible]	[illegible]	Phila. Elect.	[illegible]	[illegible]
Elec. Co. of America	[illegible]	[illegible]	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery	[illegible]	[illegible]	Phila. Traction	[illegible]	[illegible]
Elec. Stor. Battery pfd.	[illegible]	[illegible]			

CHICAGO.

	Sept. 3	Sept. 10		Sept. 3	Sept.
Chicago City Ry.	[illegible]	[illegible]	National Carbon	[illegible]	[illegible]
Chicago Edison	[illegible]	[illegible]	National Carbon pfd.	[illegible]	[illegible]
Chicago Subway	[illegible]	[illegible]	Union Traction	[illegible]	[illegible]
Chicago Tel. Co.	08	—	Union Traction pfd.	[illegible]	[illegible]
Metropolitan Elec. com.	[illegible]	[illegible]			

*Asked.

DIVIDENDS.—The trustees of the Massachusetts Lighting Companies have declared a quarterly dividend of 1½ per cent, payable Oct. 15 to stock of record Oct. 1. This places the shares on a 6 per cent basis, which compares with 4 per cent paid in 1904-5 and 5 per cent since January, 1906. Directors of Safety Car Heating & Lighting Company have declared the regular quarterly dividend of 2 per cent, payable Oct. 1. General Electric Company has declared a dividend of $2 per share, payable Oct. 15. The J. G. White Company, Inc., has declared its eighteenth quarterly dividend of 1½ per cent on the preferred stock, payable Oct. 1.

CHICAGO TELEPHONE.—General Counsel Payne, of the Chicago Telephone Company, says: "The American Bell Company has paid for every dollar's worth of stock it holds. The Chicago Telephone Company has paid the Bell 4½ per cent royalty and this is the only return made to the parent company for its rights. We paid 10 per cent dividends and earned surplus, although our rates are reduced 15 to 25 per cent. Ex[illegible] under the proposed ordinance, and we estimate less than 6 per cent. We do not refuse long distance interchange with any concern having standard equipment."

GENERAL NEWS

Construction News.

[illegible] establishment of an electric light and water works plant in this town, and also an electric railway between Montevallo and Columbiana.

[illegible] struct an electric power plant in Dothan, writes that about $150,000 will be expended. No engineer has yet been selected. The plant will be located about 17 miles from Dothan and will be run by water power.

FLORENCE, ALA.—Improvements are being made to the plant of the Cherry Cotton Mills in this place. The old machinery is being replaced by modern machinery, and electricity is to be substituted for steam power.

HARTSELLE, ALA.—It is reported that local electricians are making estimates on the establishment of an electric light plant in this place.

FORT SMITH, ARK.—Owing to the rapid increase in business the Fort Smith Light & Traction Company is making arrangements to increase the capacity of its plant. New boilers, dynamos and other machinery will be installed. J. Walter Gillette is general manager.

HOT SPRINGS, ARK.—According to an announcement just made a new electric power plant and system to cost more than $135,000 is to be commenced within sixty days by Atwood Benton. Mr. Benton states that the price of electricity will be reduced from 12 to 7 cents per kilowatt hour. A franchise compelling the plant to be in operation by April next and fixing the prices as stated has been granted by the City Council.

OZARK, ARK.—An electric light company has been organized at this place with A. Bueglar as president.

ALAMEDA, CAL.—The Southern Pacific Railroad Company has applied to the City Council for an electric franchise covering not only the present broad-gauge and narrow-gauge roads but several branch lines, along the streets as yet untouched by railroads. The application is for an overhead electric railway system for 50 years.

BAKERSFIELD, CAL.—Work has commenced on the construction of a large telephone system, which will practically connect all points in the reserve in Kern County Mountains.

EUREKA, CAL.—Application has been made to the City Council by E. C. Sharp for a franchise to erect and maintain a telephone and telegraph system for a term of 50 years, bids for which will be received by the city clerk until Sept. 24.

FRESNO, CAL.—The board of directors of the Fresno Home Light & Power Company will soon meet and organize. An application for a franchise to erect and operate an electric light and power plant has been prepared and will be presented to the Board of City Trustees in a short time. Plans are now being made for the plant, work on which will begin as soon as the franchise is granted. H. H. Hart, of San Francisco, will be president of the company, and Charles McCardle, secretary.

KENNETT, CAL.—The two furnaces now being added to the copper smelter near this point will have a greater capacity than the three now in operation. A large addition will be built to the power house and the capacity of the plant largely increased. The power house contains three blowers of 15,000 cubic feet capacity, driven by three electric motors of 200-hp each, and two 100-hp motor generators. To these will be added four blowers driven by four electric motors of 250-hp each. The engine operating the converter blower will be driven by a 750-hp motor.

LOS ANGELES, CAL.—A trust deed for $20,000,000 has been executed by the Los Angeles-Pacific Railway Company in favor of the Southern Trust Company, of this city, to secure the payment of a bond issue of that amount. The new bond issue has been ordered for retiring or refunding the old bonds, and to provide funds for the extensive improvements which are to be made to the system. After retiring the old bonds the company will have about $8,000,000 to spend in improvements.

MARTINEZ, CAL.—Z. A. W. Maltby is planning to construct an electric railway from Antioch to Oakland.

NAPA, CAL.—The Snow Mountain Power Company will enter the local electric field and also that of Vallejo and Oakland in addition to supplying Marin, Sonoma, Mendocino, Glenn and Colusa counties. Dr. G. F. Conners, of Calistoga, secretary of the St. Helena Gas & Electric Company, announces that by Dec. 1 the lines of the company would be strung through the entire Napa Valley.

SACRAMENTO, CAL.—The Vallejo & Northern Railway, which is building an electric railway from this city to Vallejo, passing through Woodland and Winters, has procured a franchise to run on Second Street, [illegible]

SACRAMENTO, CAL.—Announcement has been made that the Northern Electric Railway Company will build an electric railway to Woodland, and also along the towns on the west side of the Sacramento Valley. The company will soon ask the Trustees of Woodland for a franchise over certain streets in the city. It is understood that Colusa, Willows, Arbuckle and Winters will be reached by the new line.

[illegible] has applied for a franchise in Calistoga, and, if granted, will extend the lines of the St. Helena Gas & Electric Company to that place. Surveys are now being made for locating the line between Napa and St. Helena. The electrical power will be distributed by the St. Helena Gas & Electric Company, which will be reorganized and reincorporated for that purpose. The plant will be taken over by the new company, and the power house now in use will be used as a sub-station. Transformers will be installed in the present station at a cost of about $5,000. The Snow Mountain Company is erecting a power plant on the Eel River in Mendocino County. The main line has been built to Ukiah, and from there a branch line will be built to Lakeport. The main line will traverse Mendocino and Sonoma counties, with Oakland as its objective point. The company has secured many contracts to furnish electricity to operate pumping plants to secure water for irrigation. Dr. G. F. Conners, of Calistoga, is secretary.

SAN DIEGO, CAL.—Plans are being made to electrify the Corando Railroad (steam line) between the ferry and Tent City. William Clayton, vice-president and managing director of the John D. Spreckles interests has charge of the work.

SAN FRANCISCO, CAL.—[illegible] awarded the contract for furnishing light to the municipality to the San Francisco Gas & Electric Company. The appropriation is $275,000.

SANTA ROSA, CAL.—The Pacific Gas & Electric Company has awarded a contract to the Globe Construction Company to erect a substation on First Street for $2,175.

TURLOCK, CAL.—C. H. Weed, promoter of the electric and water systems, states that actual work on the construction of the electric light plant will commence at once. The Board of Supervisors has ordered a franchise to be granted to the Turlock Electric & Water Company giving it the privilege to erect poles and wires for furnishing electricity for lighting and power in and about Turlock. It is understood that options have been taken on several blocks of land, as a site for the plant.

DENVER, COL.—Final surveys of the Interurban Construction Company's electric line from Denver to Greeley will soon be started, preparatory to beginning work on actual construction of the road. Rights of way and franchises have been secured by the company in Denver, Adams and Weld counties. The system will cost about $1,500,000 to build and equip. It is the purpose of the company to have the railway completed and in operation by next spring.

DENVER, COL.—It is announced that the main plant of the Northern Colorado Power Company at Lafayette is almost completed, and that a test of the transmission lines over the lines of the entire northern district will soon be made. The plant has a capacity of 12,600 horse-power, and sub-stations have been constructed at Longmont, Boulder, Fort Collins, Greeley, Berthoud and Loveland, and another sub-station is now being built at Niwot. The company will furnish electricity to all of these towns and also to the Fort Collins Tramway Company and to the Denver & Interurban Railway, which the Colorado & Southern Railway is constructing from Denver to the northern part of the state. A sub-station will be erected in Denver to furnish electricity for this road. The equipment is now being installed in the sub-station for the Denver & Interurban, which consists of two 1000-kw, single-phase, turbo-generator sets. Westinghouse, Church, Kerr & Company have the contracts for construction of the plant.

GLENWOOD SPRINGS, COL.—The Central Colorado Power Company is planning the construction of a tunnel 12 miles long at the Shoshone plant near Glenwood Springs. Two miles of the tunnel will be constructed first and will generate 10,000 horse-power, but ultimately an additional ten miles will be built, which when completed will treble the capacity of the plant. There are now three plants under way, and it is understood that additional plants are being considered by the company.

HARTFORD, CONN.—Westinghouse, Church, Kerr & Company have secured the contract to erect an addition to the boiler house extension of the power plant of the Hartford Electric Light Company at Dutch Point.

NEW LONDON, CONN.—Bids will be received until Sept. 30 by Major Harry Taylor, Corps Engineers, U. S. A., New London, for furnishing 40 or more 25-kw electric generating sets, each consisting of a gasoline-driven, multiple-cylinder, vertical engine, directly connected to a direct-current generator.

NORWICH, CONN.—[illegible] London, has been awarded the contract for the installation of the high-tension transmission line, 22,000 volts, from Scotland station on the Shetucket River to the present municipal plant in this city, for $25,000.

THOMPSONVILLE, CONN.—The electric lighting system is now being operated by electricity furnished from the power plant of the North [illegible] commenced on dismantling of the Enfield electric light station. The large [illegible]

station, which give that station three engines besides a water wheel to operate the plant. E. H. Farr, superintendent of the Enfield Electric Company, will be retained as manager of the local supply company.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Sept. 17, to furnish at the navy yards and naval stations the following supplies: New York, N. Y., schedule 270—electrical supplies, cut-outs, fuse wire, switches, Portland and linoleum cement, electric drills, copper wire, etc.; schedule 280—steel conduit, Portland cement, etc. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster General, U. S. N.

JACKSONVILLE, FLA.—George W. Clark has given a bond to the Board of County Commissioners for $10,000 to guarantee the building of a railroad from the city limits to Panama Park within a year.

BLUE RIDGE, GA.—The Council has decided to call an election to vote on the question of issuing $30,000 in bonds for water works and electric lighting.

CANTON, GA.—An election is to be held Sept. 21 to vote on the proposition to issue $29,500 in bonds for water works and electric lighting.

MILLEN, GA.—An election is to be held Sept. 16, to vote on the proposition of issuing $30,000 in electric light and water works bonds.

BOISE, IDA.—Rights of way have been secured by the Boise Electric Railway for extending its line to Barber Dam and to Table Rock, where it proposes to build a large hotel, and plans a summer resort.

EDWARDSVILLE, ILL.—The Illinois Traction system will install a new turbo-generator set of 9500 horse-power capacity at the Riverton power house.

MT. PULASKI, ILL.—The capital stock of the Independent Farmers' Telephone system has been increased from $8,000 to $25,000.

QUINCY, ILL.—The City Council has granted a franchise to the St. Louis, Terre Haute & Quincy Railway to operate its lines on several streets in the city.

COLUMBUS, IND.—The Grammar Telephone Exchange, together with the telephone lines in the Burnesville district, have been purchased by the Citizens' Telephone Company of this city. The local company recently purchased the Elizabethtown exchange and is after other lines in the county to connect up into a large system.

EVANSVILLE, IND.—Strouse & Brother are securing estimates for installing an extensive electric power plant.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a duplicate of the 1000-kw turbine and alternator now installed, with turbo jet condensing system complete. The unit is wound for 60 cycles, two phase, 2300 volts. The second unit will furnish electricity for lighting and railway service.

LOGANSPORT, IND.—The local telephone company is contemplating installing an automatic telephone plant here.

CHICKASHA, I. T.—The City Council has granted a franchise to the Chickasha Water Power Company for a term of 25 years. The franchise carries with it a contract with the city to furnish 50 street lamps at the rate of $5.25 per lamp per month. The city is now paying $8 per month for each lamp. Work has commenced on the construction of its plant to be built on the Washita River, about three miles from the city. A steam plant will also be installed to use in case of emergency. Local men are at the head of the enterprise.

DENISON, IA.—The capital stock of the Crawford County Telephone Company has been increased to $120,000.

OSKALOOSA, IA.—The Oskaloosa Traction & Light Company has [illegible]

CHANUTE, KAN.—The power plant of the Brunswick Oil & Gas Company is reported to have been completely destroyed by fire recently.

LEAVENWORTH, KAN.—[illegible] franchise of the Leavenworth Light & Heating Company in its revised form.

PARSONS, KAN.—A company has been formed at Kansas City to take over the projected railway of R. G. Rawlins, of Chanute, who promoted an interurban line from Chanute to Parsons, Cherryvale, Coffeyville and Independence. W. B. Henderson, of Kansas City, who is interested in the new company, states that construction will be commenced at once at [illegible] supply electricity for all the lines.

SALINA, KAN.—[illegible] the People's Light, Heat & Power Company has been let to W. H. Ringle.

COVINGTON, KY.—Owing to the refusal of the committee on light [illegible] proposition to the Union Light, Heat & Power Company to furnish arc [illegible] Council to have the Mayor approve the contract to cover five years.

JEFFERSONVILLE, KY.—The Jeffersonville Home Telephone Company, through James W. Fortune, secretary, has applied to the Board of Public Works [illegible] system in opposition to the Cumberland Telephone & Telegraph Company.

LAKE CHARLES, LA.—The Lake Charles Street Railway Company is installing a 300-kw rotary converter in its power station and is rebuilding its car barns, recently destroyed by fire.

BALTIMORE, MD.—The question of installing arc lamps on Baltimore Street to replace the incandescent lamps now in use is being considered. Bids for incandescent lamps were asked for recently, and the contract is being held pending the decision on arc lamps.

BERLIN, MD.—The Mayor and City Council will receive bids until Sept. 20 for franchise to furnish electricity for lighting and water for the town.

OXFORD, MD.—The R. H. Pollard Company, of Baltimore, has placed a contract with the Oxford Ice & Electric Light Company to construct an electric plant to furnish electricity for lighting purposes in Oxford, also a plant for the manufacture of ice.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has petitioned the Selectmen at Deerfield for rights to extend its line to Old Deerfield.

LOWELL, MASS.—The Boston & Northern Street Railway Company will soon place contracts for the construction of a single-track electric railway from Lowell to Lawrence, via West Andover, a distance of nine miles.

MALDEN, MASS.—The Malden Electric Company has applied to the Commissioner of Gas and Electricity for authority to issue $275,000 additional capital stock, the proceeds to be used to pay the floating debt and for additions to the plant.

NORTH ADAMS, MASS.—The Board of Selectmen has granted the petition of the Williamstown Gas Company for the right to erect and maintain a line of poles on the Bridges Road on the north side of the Hoosac River, which will enable the company to extend its transmission line from the Henderson Road to Sand Springs, where electricity will be furnished to light the sanitarium, bath houses and grounds of the Sand Springs. Dr. S. L. Lloyd is owner of the Sand Springs.

STOCKBRIDGE, MASS.—The Stockbridge Light & Power Company has nearly completed its conduit system and many residences have been connected with its lines. The switchboard has been placed at the new station and temporary connections have been made and electricity will be furnished as soon as the conduits are completed.

WINCHENDON, MASS.—A new engine is being installed in the power plant of the Winchendon Electric Light & Power Company.

ESCANABA, MICH.—The Escanaba Electric Power & Pulp Company is making plans to erect a plant on the site of the old Flat Rock Mill on the Escanaba River.

ESCANABA, MICH.—F. E. Hatch, of Pellston, is interested in a company which proposes to utilize Boney Falls on Escanaba River in Delta County. Application has been made to the Board of Public Works by Mr. Hatch to furnish electricity to operate the municipal electric light plant.

GRAND RAPIDS, MICH.—The franchise voted by the City Council to the Grand Rapids-Muskegon Power Company will be submitted to the people for ratification, the required 12 per cent of the voters having signed a petition for such action.

GRAND RAPIDS, MICH.—Low water in the Grand River has put many power dams out of commission temporarily. The feed wires for the Ionia street lamps have been connected with the Commonwealth Power Company's line to Jackson and electricity is being taken from the company's steam plant at that city, its dams on the Kalamazoo River being out of business because of the low water.

HOLLAND, MICH.—This city is considering the proposition of giving a trial this winter to the Grand Rapids-Muskegon Power Company's water electric power service or to repair and operate its lighting plant. Should a trial be given and prove successful, the city will contract with the company for electricity for a term of years. Repairs to the lighting plant would cost $30,000.

MUSKEGON, MICH.—Plans are being made by the Grand Rapids-Muskegon Power Company to erect four more power dams between the Rogers dam and Newaygo, making six dams in all which will develop a total of 60,000 horse-power. George L. Erwin is secretary.

WYANDOTTE, MICH.—Bids will be received until Sept. 17 by the Board of Public Works for the following electrical machinery: A 300-hp boiler, a 240-kw generating unit complete, generator panel, feeder panel, series enclosed alternating-current lamp system. James G. Pinson is secretary of the board.

ALBERT LEA, MINN.—The Hartland Telephone Company is making arrangements for the extension of its telephone lines from the terminus northwest of Freeborn into Matawan and from there west.

AURORA, MINN.—The City Council is reported to be considering the question of installing an electric lighting system.

BEMIDJI, MINN.—[illegible] leading out of the city.

DAWSON, MINN.—Contracts for the electric light plant and water works [illegible] W. D. Lowell & Company, Minneapolis; construction of building to J. W. Carson, Dawson; Muenzel gas producer engine of 80-hp capacity to the Minneapolis Steel & Machinery Company, Minneapolis; dynamos, switch [illegible] nt of the contracts will aggregate $25,000

[illegible] be rebuilt at once. It is reported that the city is contemplating the building of a municipal electric lighting plant in connection with the water works. The electric plant at the University also supplied electricity for lighting the town.

JEFFERSON, MO.—The Worth Mutual Telephone Company has in- [illegible]

MEADVILLE, MO.—There is a project on foot to establish an electric light plant in this place. For further information apply to J. H. Dunn.

ST. LOUIS, MO.—The St. Louis, Lakewood & Grant Park Railway will place contracts for construction of about six miles of additional track next month, for which franchises have just been granted. J. G. Hughes is chief engineer.

ST. LOUIS, MO.—Bids will be received until Sept. 20 by the Board of Public Improvement for furnishing and installing the following equipment in the Quarantine Hospital: Two engines; two generators; steam-heating system, together with certain steam fixtures and appliances; boilers, boiler furnaces, smoke connections, chimney, etc. Andrew J. O'Reilly is president of the board.

SPRINGFIELD, MO.—The promoters and stockholders of the new north side lighting and heating company, which was recently granted a franchise by the municipality, have decided to incorporate with a capital stock of $50,000. A. J. Eisenmayer is acting chairman of the company. It has been practically decided that the name chosen for the company will be either the Mutual Lighting Company or the People's Lighting Company.

WINDSOR, MO.—The plant and franchise of the Windsor Electric Light & Power Company have been sold to Messrs. Carver and Roberts, of Neosho, Mo., and Canyon City, Tex., respectively. The consideration was $7,200.

BILLINGS, MONT.—The power plant owned by the Yergen Brothers has been completed and has been in operation since Aug. 1. The City Council has granted Yergen Brothers a franchise to operate a street railway in the city, which will be voted upon by the people Sept. 14. As soon as the franchise is granted a new company will be organized under the name of the Yellowstone River Power Company. J. E. Brayton is manager of the Yergen Brothers power plant.

FLORENCE, NEB.—The Independent Telephone Company is contemplating the erection of a three-story exchange building in this place.

LOVELOCKS, NEV.—J. W. Gemkroger, secretary and treasurer of the Lovelock Light & Power Company, writes that the company has been incorporated with a capital stock of $25,000. The company is doing its own construction work.

RENO, NEV.—Henry W. Esden, formerly owner of the Wadsworth Light & Power Company, has organized a company composed of several San Francisco capitalists and is at present constructing a large power plant on the banks of the Truckee River, about seven miles east of this city. The plant will be one of the largest on the Truckee River, and besides furnishing electricity to Olinghouse, Fallon, Fairview and Wonder, will extend its lines to this city and enter into competition with the Reno Light, Power & Water Company.

BETHLEHEM, N. H.—Dr. G. H. Morrison, of Manchester, N. H., has purchased a controlling interest in the Bethlehem Electric Light Company, and will become its treasurer and general manager.

LINWOOD, N. J.—The Borough Council has voted in favor of lighting the streets of the borough by electricity. The Pleasantville Electric Light Company has submitted a proposition to furnish arc lamps of 1200 candle-power at $50 per lamp per year to burn until midnight.

NEWARK, N. J.—The contract for installing the municipal electric lighting plant in the city hall has been awarded to E. M. Waldron & Company, of this city, for $28,904.

PHILLIPSBURG, N. J.—A company is being organized by Phillipsburg capitalists to build an electric railway from Phillipsburg to Clinton, N. J. The road will be 30 miles in length.

TRENTON, N. J.—It is said that the Chamber of Commerce has taken up the old project of erecting a dam on the Delaware River above this city for the purpose of supplying electricity for lighting and power purposes in the city.

AMSTERDAM, N. Y.—The Eastern New York Railroad Company has been granted a franchise for a route into Amsterdam from Hagaman.

NEW YORK, N. Y.—McKesson & Robbins, of New York, N. Y., have contracted with Dodge & Day, engineers and contractors, of Philadelphia, Pa., to make additions to their present power plant. The additions will include a new engine, generator and the necessary changes in piping and wiring, etc.

ONEIDA, N. Y.—Surveys are now being made for the extension of [illegible]

OWEGO, N. Y.—The Ithaca & Owego Traction Company has applied to the Board of Trustees for a franchise to construct and operate an elec- [illegible]

ROCHESTER, N. Y.—Bids will be received until Sept. 30 by the Commissioners of Public Buildings of Monroe County for furnishing and installing an electric lighting plant in the basement of the court house. G. L. Meade is chairman.

[illegible] is now constructing an electric power plant on the Hoosick River in this place, has filed in the country clerk's office an amended certificate of incorporation extending the field of its operations to Schenectady and Mont- [illegible] George E. Greene is president.

ASHEVILLE, N. C.—The Asheville Rapid Transit Company will soon place contracts for the construction of two and one-half miles of track in the city.

[illegible] F. L. Carpenter, town clerk, for $50,000 water, light and improvement bonds.

RALEIGH, N. C.—The Raleigh Electric Company is now building a new power station and coal storing pockets, and has recently placed contracts for the following equipments: One 500-kw, General Electric turbo-generator; Alberger condenser; cooling tower; one 500-hp Stirling boiler; a 150-kw motor generator set, and also three new semi-convertible cars from the Southern Car Company.

CLEVELAND, OHIO.—The street lighting service will be extended by the installation of 125 arc lamps immediately. Charles Kibbie is superintendent of lighting.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company is contemplating the construction of a generating plant on the Lake Shore. Involved in the scheme is said to be the construction of a tunnel into the lake to supply the plant with water. C. W. Schultz, chief engineer of the Water Department, will prepare plans for the plant.

NORWALK, OHIO.—J. Y. Boyd, of Toledo, financial agent of the new interurban road from Cleveland to Indianapolis via Norwalk and Bluffton, Ind., has signed a contract with Western capitalists, who will supply funds to build the road at once.

TOLEDO, OHIO.—The council committee on gas and light has approved the ordinance granting the People's Heating & Lighting Company the privilege to use the streets of the city.

YOUNGSTOWN, OHIO.—The Lake Erie & Youngstown Electric Railway has completed plans for the road to enter Youngstown, connecting with the Youngstown & Southern Railway Company. The right of way has been secured to Conneaut and work will soon be started. A. W. Jones and John H. Puhlman are interested in the project.

YOUNGSTOWN, OHIO.—G. L. Wells, chief engineer of the construction force of the Youngstown & Ohio Interurban Electric Company, states that $1,000,000 will be invested in building and equipping the new road. The Cleveland Construction will construct the road, which is expected to be in operation by Sept. 1, 1908. A power house is now under construction at West Point, and a reserve plant will be maintained at Leetonia for emergency purposes. The main office of the company will be at Leetonia.

DAYTON, ORE.—The City Council is securing estimates for the cost of a water turbine and dynamo with the view of establishing an electric light plant in this city.

PORTLAND, ORE.—Contracts will soon be let for the construction of an electric plant at Katolla, Alaska, to generate 1500 horse-power. The Guggenheim interests are behind the work.

PRINEVILLE, ORE.—The Prineville Light & Power Company is contemplating installing a power plant on the Matoles next year to supply the whole county with electricity.

SALEM, ORE.—A. Welch, of Portland, has applied to the City Council for a franchise over several streets of the city from the northern to the southern limits with outlet to the Willamette River for an entirely new electric railway system.

DONORA, PA.—C. A. Richter and George W. Moore, of Pittsburg, said to represent Pittsburg capital, have been in the town in the interest of a project to build an electric railway to connect Donora with the Pittsburg-Charleroi line at Eldora. Surveys have been made for the road to cut across the country to Eldora by the way of South Donora.

[illegible] is contemplating building three miles of track, and is also in the market for a 250-hp gas engine.

LANCASTER, PA.—Surveys are being made for the Conestoga Traction Company for an electric railway from Gap to Parkersburg, which will connect the electric railway system of Lancaster County with a line running to Philadelphia. The Philadelphia & Western Company is also preparing to extend its line through to Parkersburg.

PHILADELPHIA, PA.—Bids have been asked by George R. Stearns, director of public works, for additional pumps and dynamos for the Torresdale plant as follows: One 1,000,000 and one 2,500,000-gallon centrifugal pumps, at an estimated cost of $60,000; three generators for electric lighting and driving the air blowers for the preliminary filters, the cost of which is estimated at $25,000.

PINE GROVE, PA.—It is reported that the farmers of Pine Valley are considering a project of building an electric railway through that section, connecting Tremont and Pottsville.

POTTSVILLE, PA.—The Pottsville Union Traction Company is contemplating the construction of a new electric railway from Minersville, [illegible]

READING, PA.—The Board of Park [illegible] is [illegible] installing electric cables in conduits in the City Park, and to have the lamps suspended from ornamental iron poles.

WATERFORD, PA.—Articles of incorporation will soon be filed for the Waterford Electric Light Company by Betram E. Waltz, Allyne C. Hovey and Charles Himrod. The company proposes to supply electricity for lighting, heating and power purposes in the borough of Waterford.

PHILLIPSDALE, R. I.—The Washburn Wire Company has awarded the contract for the construction of its manufacturing plant, estimated to cost $300,000, to the E. K. Watson Company, of Warren, R. I. The plant includes wire mill, annealing building, rod mill, boiler house and engine house. Leon H. Allen, of the American Electric Works, of Phillipsdale, is the architect.

AIKEN, S. C.—A. Ludlow, manager of the Carolina Light & Power Company, writes that no contracts will be let in connection with the development of the Anderson Shoals for electrical purposes. All work will be done by day labor. The cost of the work is estimated at $40,000.

CHARLESTON, S. C.—Bids will be received at the office of Ion Simons, city electrician, until Nov. 15 for lighting the streets and public buildings of the city for a term of one, two and four years from June 30, 1908, with electricity, gas or some other illuminating system. Bids will also be received for lighting both by gas and electricity.

YORKVILLE, S. C.—Work has commenced on the construction of the plant for the Lockmore Cotton Mills in this place. The building will be 75x300 feet. It will have a capacity of 6500 spindles and will be operated by electricity. Thomas F. Moore is president of the company.

ABERDEEN, S. D.—The City Council has granted a franchise to C. F. Freehauf, of Creston, Iowa.

YANKTON, S. D.—The City Council has granted a franchise to build a single-track railway along First Street and Broadway to the Yankton & Southern Railroad, which is being promoted by Fremont Hill.

GLEASON, TENN.—W. H. Williams, general manager of the Gleason Water & Light Company, writes that probably nothing will be done this year on the construction of the electric light plant.

MEMPHIS, TENN.—The question of constructing a municipal electric lighting plant is now under consideration.

NASHVILLE, TENN.—The Southern Electric Company of this city has contracted to install a complete electric lighting plant at Ruskin, near Charlotte.

BROWNSVILLE, TEX.—The City Council has awarded the contract for the construction of the electric light plant and water works system to the American Light & Water Company for $65,940.

CALVERT, TEX.—James J. Henry, of Denver, Col., is promoting a project to build a power plant at this place to furnish electricity for light and power purposes.

EL PASO, TEX.—The County Commissioners have granted a franchise to J. E. Gibbs to construct and operate an interurban street railway between El Paso and San Elizario.

HOUSTON, TEX.—E. C. Lamb is organizing a company with a capital stock of $50,000 to build a plant to manufacture electric dry kilns.

TERRELL, TEX.—A. M. Woolley, city secretary, writes that no engineer has been employed as yet to prepare plans for the electric light plant, which is to be constructed at a cost of $15,000.

WACO, TEX.—It is reported that the money needed for the establishment of the electric power plant in Milam County, about 60 miles south of Waco, has been subscribed by Texas and Eastern capitalists. The company has been granted a franchise by the City Council to erect and maintain transmission lines to furnish electricity in this city. It also proposes to supply electricity in the city of Houston and electrical power to operate an interurban railway in Central Texas. Joseph J. Henry is [illegible]

MONTPELIER, VT.—The City Council has granted a franchise to Frank M. Corry, E. H. Deavitt and I. M. Frost to erect poles and wires in the streets of the city for the transmission of electricity from their proposed plant on the Winooski River near the towns of Barre, Berlin and [illegible]

PITTSFORD, VT.—[illegible] Brook for the Vermont Marble Company. The company proposes to develop the water power of this stream and build a power house on the site east of the Pittsford Mills. The plan is to use steel tubing between the reservoir and the power house.

[illegible] WASH.—[illegible] have been completed for the road, which will pass through Cherry Valley.

EVERETT, WASH.—The street railway system, which was taken [illegible] Harbor. At present the Everett street railway system is operated by [illegible] at the falls of Noosack River in Whatcom County, which is now being installed by Stone & Webster. The Whatcom County power plant will [illegible] Electron and a new plant will be built on the upper White River. Steam auxiliary plants at Seattle, Georgetown and Tacoma will be used with the main system as reserve stations.

SEATTLE, WASH.—The lamp and lighting committee of the City Council has granted the Seattle-Tacoma Power Company an extension of three years in time to place its wires underground in the downtown section of the city. The underground system will cost the company $400,000 and is to be completed by Jan. 1, 1912.

SEATTLE, WASH.—The Board of Public Works on Aug. 24 approved the plans and specifications for the cluster lamps that have been ordered installed by the City Council in the downtown district. It is reported that bids for the installation will be received by the Board of Public Works in about three weeks, the cost of which is estimated at about $175,000.

TOPPENISH, WASH.—The Council is considering granting a water and light franchise to T. H. Noble, of North Yakima.

ELKINS, W. VA.—Bids will be received by the county court (Lee Crouch, clerk) until Sept. 23, for electric and gas fixtures for the court house now being erected.

MANNINGTON, VA.—Albert M. Schenck, of Wheeling, has purchased the plant and holdings of the Mannington Light & Power Company. The line will be extended and made a link in a proposed traction system from Fairmont to Wheeling by the way of Mannington, Clarksburg and Moundsville.

MORGANTOWN, W. VA.—George C. Sturgess, president of the Sabraton Street Railway Company, is promoting a plan to build a traction system from the Fairmont region in West Virginia to the Connellsville coal region in Pennsylvania by the way of the Monongahela River to Point Marion and thence to Connellsville. Work on the line to Point Marion will commence at once.

ANTIGO, WIS.—Henry Sherry, of Neenah, is contemplating developing a water power on Wolf River.

EAU CLAIRE, WIS.—The Chippewa Valley Railway, Light & Power Company is in the market for a 225-kw, 600-volt railway generator, either new or second hand, and two interurban cars.

LA CROSSE, WIS.—The La Crosse Water Power Company, which is building a large hydro-electric power plant at Hatfield, is making arrangements to furnish electricity for lighting and power purposes to towns and villages in southern Minnesota, including Caledonia, Spring Grove, Preston, Houston, Hokah and other places in Fillmore and Houston counties. Franchises will soon be asked of the village boards and town councils.

SUPERIOR, WIS.—The City Council has decided to make a contract with the Superior Water, Light & Power Company for street lighting. The contract is for one year, with an option to lengthen it to five years. The question of building a municipal electric light plant has been abandoned for the present.

WALWORTH, WIS.—The sale of the Chicago, Harvard & Geneva Lake Electric Railway to the Elgin, Belvidere & Rockford Electric Road interests has been consummated, and it is said that the latter company will extend the line of the Chicago, Harvard & Geneva Railway from Harvard to Marengo, and will also soon begin surveying for an extension of the road to Elkhorn, Wis., touching Delavan Lake at its eastern end. It is expected to have the entire line equipped for service by early spring. The new deal will involve an expenditure of about $600,000 in addition to the power plant at Walworth, making it a central station for the entire line.

CALGARY, ALB.—The Alberta Portland Cement Company has applied to the City Council for concessions for the development of electric power at Radnor.

REVELSTOKE, B. C.—The date for receiving tenders on the hydro electric plant for this city has been extended until Sept. 30. Address Mayor Brown.

VANCOUVER, B. C.—Orders will soon be placed in the near future by the British Columbia Electric Railway Company for material needed in the overhead work for the proposed electric railway between New Westminster and Eburne. Work has commenced on the line between New Westminster and Chilliwack, which will be 62 miles in length and will cost about $2,500,000.

MINNEDOSA, MAN.—Water for the proposed power plant to be erected here will be obtained from Clear Lake, 30 miles north, where a dam will be constructed. For further information address E. O. Denison.

WINNIPEG, MAN.—The civic power committee has decided to extend the time for receiving tenders for its $3,500,000 power development until Oct. 1, in order that European firms may submit tenders. Plans and specifications may be seen at the office of Cecil B. Smith, civic power expert, Winnipeg, Man.

[illegible] considering the question of transmitting electricity to Kingston. The [illegible]

MILBROOK, ONT.—J. Davidson, of this town, has purchased the local electric lighting plant and has seccured a contract for lighting the town.

OTTAWA, ONT.—The Municipal Electric Commission has made a [illegible]

[illegible] 25,000 horse-power, be purchased by the city for the sum of \$200,000, and that in addition the city agrees to build, within ten years, a dam across the entire river capable of establishing an 80-foot head at the water power.

[illegible] city, has sent out a fourth surveying party to locate the transmission line from Hamilton to Guelph, Berlin, St. Mary's and Stratford.

Company Elections.

[illegible] Light & Power Company, held recently, the following directors were elected: A. Sbarbaro, P. C. Rossi, A. E. Sbarbaro. A. Sbarbaro is president of the company and A. E. Sbarbaro is secretary.

ROCKVILLE, IND.—At the recent annual meeting of the directors of the Parke County Telephone Company the following officers were elected: A. M. Adams, president; L. N. Whitney, vice-president; C. L. McNaughton, secretary-treasurer, and M. R. Ufriehard, auditor. The question of [illegible]

New Industrial Companies.

THE SECOND HAND MACHINERY COMPANY has been formed at Kansas City, Mo., by Edward R. Royer, Ralph B. Coleman and George B. Wandling. It will make a specialty of the purchase and sale of new and second-hand electrical and steam machinery for power stations and power applications. The company's office is in the Sheidley Building, suite 448-50.

THE TELHARMONIC SECURITY COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of \$125,000. The company will deal in securities, etc. The incorporators are: John C. Lowe, Oliver C. Reynolds and John R. Turner.

New Incorporations.

CITRONELLE, ALA.—The Citronelle Light & Power Company has been incorporated with a capital stock of \$25,000 by J. A. Shannon, E. E. Shannon and H. H. Orr. The company has been granted a franchise to manufacture and distribute electricity for lighting and power purposes and also to manufacture ice. J. A. Shannon is president.

SAN FRANCISCO, CAL.—Articles of incorporation of the Stockton Gas & Electric Company were recently filed with the county clerk, together with a certificate of bonded indebtedness. The capital stock is placed at \$1,500,000, and the bonded indebtedness is for a like amount. The directors are: A. H. Winn, Paul McDonald, R. T. Hooper, H. F. Allen and J. T. Handy.

MONTEZUMA, COL.—The Montezuma Power & Light Company has been incorporated with a capital stock of \$50,000 by Geo. L. Nye, B. B. [illegible]

DOVER, DEL.—Incorporation papers have been filed for the Van Buren Fuel & Light Company by the Corporation Trust Company of America. The company is capitalized at \$25,000, and the directors are James S. Cummings, R. T. Graf and R. A. Wortman, all of Chicago, Ill.

AMERICUS, GA.—A charter has been granted by the Secretary of State to the Americus Railway & Power Company. The company is capitalized at \$250,000 and proposes to construct four miles of street railway, to install an up-to-date electric lighting plant, and in addition will pump water for the city for the next 20 years.

EMMETSBURG, IA.—The Spirit Lake, Emmetsburg & Fort Dodge Railway Company has filed articles of incorporation with a capital stock of \$20,000. The company proposes to construct an interurban railway from Fort Dodge to Spirit Lake. Plans are being made to erect a large dam across the Des Moines River about seven miles north of Fort Dodge and build a hydro-electric plant at this point, which with a steam auxiliary plant at the north end of the line is expected to furnish sufficient power to operate the cars.

ST. ANSGAR, IA.—The St. Ansgar Light & Power Company has been incorporated with a capital stock of \$10,000 by A. N. Lund and others.

ELLSWORTH, MAINE.—The Monterey Hydro-Electric Power Company has been incorporated with a capital stock of \$5,000,000 by William E. Whiting, Perry Langley, R. H. Whiting, H. F. Drunemey, E. B. Doyle, M. F. Doyle and E. K. Whiting, Ellsworth.

LIMERICK, MAINE.—The Limerick Water & Electric Company has been incorporated with a capital stock of \$500,000 by Charles G. Moulton, Ralph Clark, Charles H. Adams, of Limerick; J. Merrill Lord, of Parsonsfield; John F. Moore and Ira H. Moore, of Newfield. The company has a legislative charter granting it the right of eminent domain in the towns of Limerick, Newfield and Waterboro.

EXCELSIOR SPRINGS, MO.—Articles of incorporation have been filed for the St. Joseph, Excelsior Springs & Lexington Railway Company by Dr. G. P. Lingenfetter, Charles Dyer, of Denver; C. D. Wade, A. M. Bates, S. S. McIntire, of Excelsior Springs; W. J. Bates, of Hibbard, and D. C. Finley, of Kansas City. The company is capitalized at \$200,000.

[illegible] ated to construct and operate an electric railway in Bath, N. Y. The [illegible] Leber and Frederick M. Dayton, of Buffalo, and Arthur Lozier.

[illegible] filed articles of incorporation with the Secretary of State with a capital stock of \$100,000. The directors are Austin McCausland, William J. Bagnell, of New York, and James E. Rock, of Niagara Falls.

FERRIS, TEX.—The Ferris Light & Power Company has been incorporated with a capital stock of \$4,000 by W. W. Batchelor and others.

Legal.

[illegible] Sept. 5, argument was made on the motion to set aside the purchase by Abraham White, of the John A. McCall country seat on Norwood Avenue, before Judge William M. Lanning in the United States Circuit Court. The motion was made in the suit of Walter Althouse against the De Forest Wireless Telegraph Company and the Abraham White Realty & Improvement Corporation. Mr. Althouse is a stockholder in these companies, and he seeks to have the purchase of the McCall property adjudicated, asserting that White bought it with money of the company. The property is one of the finest in the State and cost upward of \$1,000,000. White was supposed to have purchased the property at a sacrifice, with one day's earnings on a bull market in Wall Street, from a syndicate headed by Myron H. Oppenheim, which bought the property when Mr. McCall was pressed for funds during the insurance investigation. Oppenheim, it is said, paid a trifle over \$200,000 for it. White was reported to have given \$500,000 for the place, but the exact figures were never made public.

TAXATION OF TELEGRAPH WIRES UNDER THE STATUTES OF IOWA.—The Chicago, Burlington & Quincy Railroad Company owns approximately 800 miles of telegraph lines and equipment in the State of Iowa, situated on the company's right of way between Burlington and Council Bluffs, Iowa. In addition to using their lines for railroad purposes they were leased to the Western Union Telegraph Company. The statutes of Iowa provide that no telegraph line shall be assessed which is owned and operated by any railroad company exclusively for the transaction of its business, and duly reported in the railroad's annual report for taxation. The railroad company erroneously included its telegraph line in its return of taxable property as a part of its railroad property, under the Iowa statute which provided for the taxation of railroad property and the company voluntarily paid the tax assessed. In an action by the company against the country treasurer to recover back the tax which it had paid, it was held that although the property was not taxable under the section of the statute referred to, it should have been taxed under another provision of the statute for the taxation of telegraph companies, and that the railroad company was not entitled to a refund of the tax. Chicago, Burlington & Quincy Railroad Company vs. Rhein, Supreme Court of Iowa, 112 N. W. Rep. 823.

RIGHT OF INTERURBAN ELECTRIC RAILWAY TO CONDEMN LAND FOR RIGHT OF WAY IN WISCONSIN.—The Milwaukee Light, Heat & Traction Company, having commenced a proceeding to condemn land for right of way for an electric railway in the County of Milwaukee, Wis., its right to do so was denied by the Milwaukee Northern Railway Company, operating a steam railroad, the latter company claiming that it had already acquired option contracts covering eight of the nine miles of the disputed right of way, together with the necessary franchises, and that the former company had not in any event the right to take land by condemnation. The facts show a contest between two corporations, one a steam railroad and the other an electric railway, each attempting to acquire the same strip of land for its right of way, the electric railway by condemnation and the steam railroad by purchase. After indulging in a lengthy investigation of the condemnation statutes, the court concluded that, under them, interurban electric railways were authorized to exercise the power of eminent domain. The steam railroad advanced a further argument that it was first on the ground and had acquired a prior right to the land in question by being secured by option contracts. It was shown that the stockholders of the steam railroad company had advanced money for the purpose of laying the proposed right of way, and that resolutions had been adopted by the directors authorizing the acquirement and all necessary rights and franchises and appropriating money to pay for the right of way on which options had been secured. And it was held that these acts constituted a complete location, and, hence, that the electric company could not later come in and seize the same property for its right of way. In re Milwaukee Light, Heat & Traction Company, Sup. Ct. of [illegible]

SALE OF TELEPHONE LINE [illegible] arising in the Supreme Court of Iowa it appeared that the plaintiff had [illegible] and instruments on hand, or used in connection with the system, for a [illegible] phone poles, lines, rights of way, and the right to maintain the lines and poles as originally erected. The appraisers found that the fair value of the property to be transferred under the contract was \$7,500. The bill of sale which was subsequently made provided for the transfer of "a line of telephone poles and wires, and rights of way for the mainten- [illegible]

and lawful authority to sell and convey the same. After paying $7,000 the defendant held up the balance due on the ground that it had not received all that it had bargained for. Evidence was introduced which tended to show that, over certain farms through which plaintiff's line passed, the plaintiff, instead of owning absolutely a right of way, had only a permissive right to erect poles and run telephone wires, subject to be revoked at the pleasure of the owners, and that the plaintiff did not have a right of way which would entitle him to maintain his lines through these farms, and to enter the farms for the purpose of making repairs as against the objection of such owners. The defendant contended that this was inconsistent with the plaintiff's warranty that the property was free from all encumbrances. The court decided that the contract did not contemplate the conveyance of an absolute right of perpetual maintenance of the lines where constructed, but only the right which seller was enjoying at the time of the transfer. As far as this contention was concerned, then, the plaintiff was entitled to recover the balance due, but it appeared that the contract also provided for delivery of certain materials and instruments, and the plaintiff offered no proof that the materials and instruments had ever been delivered. For this reason, it was held that the court would not be justified in directing a verdict for the plaintiff. Lattner vs. Interstate Telephone Company, 112 N. W. R. [illegible]

Obituary.

MR. FRANKLIN H. SPIESE, of Tamaqua, Pa., died suddenly Aug. 30, while conversing with friends in the Elks' Club. Mr. Spiese was one of the most prominent business men of that part of the state. He was president of the Tamaqua National Bank, originator of the Edison Electric Illuminating Company and the Tamaqua & Lansford Street Railway Company, now merged into the Eastern Pennsylvania Railway Company, and was a director in the Cumberland Valley Telephone, the American Subway and the Schuylkill Subway companies, and was also vice-president of the United Haiti Improvement Company.

MR. W. J. PHELPS.—It is with deep regret that we have received news of the death, after a brief illness, of Mr. W. J. Phelps, on Sept. 3, at the Grace Hospital, Detroit, of inflammation of the brain. He underwent a mastoid operation on Aug. 28. Mr. William Joshua Phelps was born in Elmwood, Ill., Nov. 19, 1866. He was a graduate of Knox College, Galesburg, Ill., and was a member of the Illinois Delta of Phi Delta Theta fraternity. He was an electrical engineer and inventor. The most well-known and useful of his inventions was the "Hylo" lamp, which he manufactured in its various forms. He is credited with being the originator of the turn-down lamp art, which has proven to be an extensive business. He was also the inventor of the Phelps motorless flasher, which has proven to be of great use in the electrical advertising field. He was a member of the American Institute of Electrical Engineers, the American Society for the Advancement of Science, the Society of Illuminating Engineers and the Detroit Engineering Society. He leaves a widow and two children, his father, Mr. W. E. Phelps, mother, brother and sister. He was well known in the electrical trades.

MR. J. L. GAYLORD.—Mr. James L. Gaylord, 37 years old, was found dead in a rear room of the apartment on Sept. 8 in New York City by a colored porter. Coroner Harburger was called, and after an examination, it was found that death was due to acute kidney trouble. Mr. Gaylord, who is a nephew of James W. Paul, Jr., of the banking firm of Drexel & Company, of Philadelphia, has been an electrical engineer with headquarters in New York for the last sixteen years, and was very well known, both here and in Philadelphia in business and social circles. He was dining on Saturday night with a companion, Mr. Schultz, also an electrical engineer, who has an apartment at the same number as Mr. Gaylord, at the Café Martin, when Mr. Gaylord complained of a slight illness. His companion advised him to go home and rest, which he did. At about 10.30 o'clock on Saturday night Mr. Schultz called at Mr. Gaylord's apartment on his way home, but after continued knocking got no response, from which the police judge that he probably was dead at that time. Mr. Gaylord had given up several years to pushing the Arnold monophase patents, of European origin, and more lately was deeply interested in new processes of electroplating.

Personal.

PROF. M. DEHN, associate professor of electrical engineering at the Stuttgart, Germany, Polytechnicum, is making a tour of the principal electrical centres of this country.

MR. CALVIN W. RICE, secretary of the American Society of Mechanical Engineers, has just returned from the Continent of Europe with his wife, who was ordered abroad to take the waters at one of the German spas. Mrs. Rice is thoroughly restored in health.

MR. THEODORE H. BAILEY, who was assistant general manager of the General Electric Company for 20 years, has been appointed general manager of the Kobusch Automobile Company, St. Louis. Mr. Bailey has arrived in St. Louis from Chicago and has taken charge of the plant.

MR. WM. W. MERRILL has resigned as president of the Appleton Electric Company, of Chicago, and disposed of his entire stock holdings to Mr. Albert I. Appleton and Mr. John V. Painter. Mr. Appleton assumes the presidency of the company, of which he is also treasurer, and Mr. Painter becomes secretary.

MR. W. E. HARRINGTON, president and general manager of the Eastern Pennsylvania Railways Company, of Pottsville, Pa., has resigned the latter position and will retain his position as president of the board of directors only, relinquishing the management to Mr. L. C. Bradley, who has been associated with the company since last June. Mr. Bradley will fill the office of general superintendent and general manager.

Business Notes.

THE MAPLE LEAF AUTOMOBILE & ELECTRICAL MANUFACTURING COMPANY, of Galt, Ont., has changed its name to the Galt Electrical Manufacturing Company, Ltd.

BOSSERT ELECTRIC CONSTRUCTION COMPANY, of Utica, N. Y., has disposed of the switchboard and panelboard department of its business to the N. Y. Electric Switchboard Company, of Twenty-eighth Street and First Avenue, New York City, which has acquired the sole right to manufacture the Bossert type of switches and panelboards. The former superintendent of the department will be in charge of the new factory, which will be represented by R. B. Corey & Company, of 39-41 Cortlandt Street, as sales agents.

THE PITTSBURG GAGE & SUPPLY COMPANY, Pittsburg, Pa., has installed White Star continuous oiling systems in the engine rooms of the Fitchburg Yarn Company, Fitchburg, Mass.; Indianapolis & L. Traction Company, Scottsburg, Ind.; Berwind-White Coal Mining Company, Windber, Pa.; Tennessee Coal & Iron & R. R. Company, Ensley, Ala.; Seconnet Mills, Fall River, Mass.; American Sheet & Tin Plate Company, Vandergrift, Pa.; American Bottle Company, Newark, Ohio; Bethlehem Steel Company, South Bethlehem, Pa., and Diamond Rubber Company, Akron, Ohio. The great saving in lubricating oil, requiring but one handling (from barrel to system) by human means, its constant use, being cleaned by the White Star filter after passing through the bearings, and thence used over and over again until actually worn out, render the use of an oiling system an actual necessity in every up-to-date power plant.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 3, 1907.

[illegible] SAFETY HANGER [illegible] clip with lapped ends which receive a flexible strap surrounding the [illegible]

[illegible] and other fixtures. Covers details of construction.

[illegible] filed Aug. 7, 1905. A drum or barrel open at one end is revolved on an inclined axis which can be varied by reason of the bevel gear ar- [illegible]

[illegible] metal work in general. Has an electrode and a graphite holder for [illegible]

[illegible] tion, as, for example, to provide for the suitable draw of a paper or web through a paper-making machine.

864,858. AUTOMATIC CIRCUIT CLOSER; Hermann G. Pape, New York, N. Y. App. filed June 16, 1904. The combination with a receiver, of a circuit closer, and a head band for the receiver constituting operating means for moving the switch to closed position upon the positioning of the head band and receiver upon an operator.

864,866. AUTOMATIC TRAIN STOP; Hiram G. Sedgwick, Mill Valley, Cal. App. filed Nov. 28, 1906. The track rails are constructed with long and with intermediate short insulated sections, and special contact plates are also employed engaged by a brush or shoe on the train. This arrangement closes the circuits for operating the train-stop relay magnets.

[illegible] iam W. Dean, Chicago, Ill. App. filed Jan. 25, 1904. Relates to cord [illegible]

864,888. TROLLEY-WIRE CROSSOVER; David H. Doak, Morgan Park, [illegible] overhead trolley systems used on electric railways. Is designed to insulate the trolley wires from one another and at the same time permit high-speed passage of cars in both directions. Has normally de- [illegible] one of the trolley wires and constituting a continuation of the other [illegible]

with relation to each other, and engaging devices on the levers whereby they are in operative connection only during a portion of the movement of one of the levers in one direction.

864,909. SOUND-PRODUCING DEVICE; John P. Northey, Toronto, [illegible] orifices and a reciprocating cushioned [illegible] n an enlargement of the cylinder and having tranverse orifices.

864,912. JOINTED TROLLEY POLE; Harry Padley, Elyria, Ohio. App. filed June 1, 1906. A trolley pole having a hinge substantially at its middle and the hinged members constructed each with an abutting face at an inclination to a right angle whereby the trolley pole will buckle or bend when the car backs against an obstruction, thereby avoiding breakage.

864,915. ELEVATOR SIGNALING APPARATUS; Charles A. Reiners, Hoboken, N. J. App. filed April 9, 1907. Relates to an elevator signaling apparatus, and provides a construction by which an attendant may control the movement of the elevator cars in order to have them make their trips with regularity.

864,928. ELECTROLYTIC PRODUCTION OF EARTH-ALKALI METALS; George O. Seward and Franz von Kugelgen, Holcombs Rock, Va. App. filed April 25, 1906. Maintaining the current density at a submerged cathode so high that the metal is formed in a molten state, and cooling the metal which separates from the cathode while it is passing through the electrolyte.

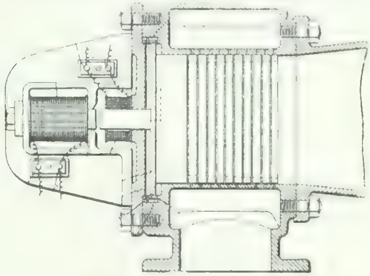
864,947. CLAMP FOR ELECTRIC WIRES; Elisha W. Buffington, Fall River, Mass. App. filed May 1, 1907. A cylindrical insulator pin having two portions with parallel grooves which cooperate to receive conductors between them. The surfaces of the grooves are roughened so as to clamp the conductors more tightly.

864,950. TELEGRAPH TRANSMITTER; Josiah A. Carter, Jr., Atlanta, Ga. App. filed March 4, 1907. Has a vibrator extending beyond the pivotal point of the key lever, speed adjusting screw weights, and an auxiliary lever or bar contacting with the vibrator and with the key lever, a movable stop, and a key lever controlling the action of the [illegible]

864,957. PORTABLE SEARCHLIGHT; John Dickens, Passaic, N. J. App. filed Oct. 8, 1904. A portable electric lamp of the type having a plurality of dry batteries in a cylindrical casing and a miniature incandescent lamp at one end. Relates to features of switch plug by which the circuits are controlled.

864,959. TANK ALARM; Glen F. Elliott, Delmar, Del. App. filed April 20, 1907. A carriage slides vertically between suitable ways, being controlled by a float in the tank. At the limits of its movement it completes alarm circuits.

864,961. AUTOMATIC ELECTRIC GONG-RINGING DEVICE FOR STREET CARS; Nathan Fallek and George F. Wolfe, Denver, Col. App. filed April 22, 1907. An automatic electrical gong-ringing device



864,909.—Sound-Producing Device.

for street cars. Provides means for automatically and continuously ringing the gong when a car is standing still unless the motorman holds the crank handle against the stop post of the controller.

864,968. MULTIPLE NEEDLE HOLDER FOR ELECTROLYSIS; Edward W. Johnson, Chicago, Ill. App. filed June 28, 1907. An apparatus in which a considerable number of depilatory needles are supported on independent bracket arms so that they can be used simultaneously.

864,971. ELECTRIC SIGNALING DEVICE; Alfred Larsson, Buffalo, N. Y. App. filed June 9, 1906. Construction of electric vibrator bell having a magnet, the yoke of which supports the bell, forming a housing for the magnet. The armature is angularly disposed within the bell [illegible]

864,995. JUNCTION BOX COVER ROSETTE; Frank J. Russell, New York, N. Y. App. filed Oct. 20, 1906. A junction box comprising two independent insulating blocks which telescope together through a suitable opening in a supporting plate. The screws which constitute the fastening means also serve as electric terminals to make the connections.

865,011. CONNECTION SYSTEM FOR DIRECT-CURRENT ELECTRIC MOTORS; Raoul Brun, Havre, France. App. filed Feb. 28, 1906. A system in which a compound motor has a flywheel and booster mechanically coupled to the motor and having its armatures so connected to the supply circuit in series with the shunt winding of the motor as to reduce the shunt excitation with increasing loads.

865,013. RAILWAY BLOCK-SIGNAL SYSTEM; Winthrop M. Chapman, Needham, Mass. App. filed Jan. 24, 1906. Provides a signal system in which the signals cannot be improperly actuated under abnormal conditions, but which will be actuated with certainty under the usual traffic conditions.

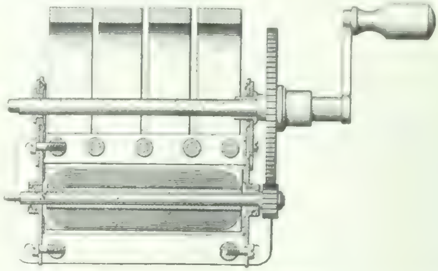
865,016. ELECTRIC FURNACE; Walter G. Clark, New York, N. Y. App. filed Dec. 17, 1906. An electric furnace having its walls of conducting material of relatively low resistance, and an internal heater or electrode arranged to contact at its lower end with the furnace walls, and being of less resistance at its end portions than at its intermediate portions and means for elevating the electrode.

865,027. APPARATUS FOR EXTRACTING MINERALS FROM ORE; Oscar A. Ellis, San Francisco, Cal. App. filed March 24, 1903. An [illegible] nder provided with riffles and a precipitating box and [illegible]

865,038. WATER-TIGHT ELECTRIC BELL; Walter C. Hill, London, England. App. filed May 19, 1906. Relates to electrically actuated bells of alarms wherein the electric striking mechanism is enclosed within a water-tight metallic casing which forms the sounder or bell.

865,059. MEANS FOR ATTACHING PIGTAILS TO CARBON BRUSHES; Maxwell W. Robertson, New York, N. Y. App. filed April 29, 1907. The pigtail is clamped to the carbon brush by a pair of metallic plates which are disposed on opposite sides of the brush and rightly riveted together through the body thereof.

865,068. ELECTRIC GENERATOR; Klas Weman and Alfred Larsson, Buffalo, N. Y. App. filed May 21, 1906. An electric generator having two-pole pieces and supporting brackets for one of said pole pieces



865,068.—El[illegible]

formed integrally therewith, each bracket having arms projecting laterally from the pole piece on opposite sides of its longitudinal center.

[illegible]5,093. CURRENT TRANSFORMER; Oswaldo de Faris, Paris, France. App. filed Feb. 4, 1905. In an electrolytic transformer, a cell comprising a vessel of insulating material, a hollow carbon electrode within said vessel provided at its top and bottom only with horizontal series of perforations, a metallic electrode within said hollow electrode, and an electrolytic liquid contained in said vessel, the circula- [illegible] being identical with that which is produced in a thermo-siphon.

[illegible]5,108. PRINTING TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed June 29, 1907. A feeding apparatus for the record sheet of a printing telegraph. Has a magnet actuating an escapement and which is energized by a polarized relay.

[illegible]5,169. SIGNAL; Charles R. Dowler, Denver, Col. App. filed Sept. 12, 1906. A system for indicating dangerous conditions on a railroad comprising a weight buried in an embankment and connected to a semaphore apparatus, whereby the semaphore will be displayed when the embankment is washed away and the weight allowed to fall.

[illegible]5,211. BINDING POST; Earl H. Rollinson, Albany, N. Y. App. filed Nov. 12, 1906. Binding post having a washer with laterally projecting ears which is clamped between the usual thumb nuts. The ears engage the wire to be clamped and prevent it from falling out in case the nuts loosen slightly.

[illegible]5,215. ART OF TELEPHONY; Daniel M. Therrell, Charleston, S. C. App. filed July 23, 1904. In the art of the electrical transmission and reproduction of sound, means for producing resonance in the transmitter circuit, substantially as set forth.

[illegible] NETS OF ALTERNATE-CURRENT GENERATORS; Miles Walker, Hale, Altrinchham, England. App. filed July 13, 1907. Relates to features of construction of supporting three collector rings and making connections with terminals of winding.

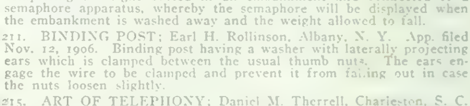
865,271. LONG BURNING ARC LAMP; Josef Rosemeyer, Lindenthal, Germany, and Gustave Dive, Bressoux, Belgium. App. filed March 7, 1905. Relates to long burning arc lamps and includes features of the clutch and feeding mechanism for the upper or positive carbon.

[illegible]5,285. ELECTRIC SMELTING APPARATUS; James C. Young, Jersey City, N. J. App. filed Jan. 16, 1907. In an electric smelting apparatus, a carbon forming one pole and a series of spaced receptacles mounted for rotation in a vertical plane and forming the other pole, whereby an arc is adapted to be established or interrupted between said receptacles, one at a time, and the carbon, substantially as described.

[illegible]5,291. LIGHTNING ARRESTER; William J. Bell, Deerfield, Wis. App. filed Sept. 26, 1906. Has an insulating base from which projects upward a carbon rod forming a ground connection. A metallic casing is supported by the base and extends closely alongside the carbon so as to establish a spark gap in connection therewith.

[illegible]5,323. TROLLEY; Leslie S. Wilder, Northampton, Mass. App. filed Jan. 10, 1906. The trolley harp has a U-shaped frame hinged thereto to which are pivoted spring fingers. The arrangement is such that the fingers are yieldable downward and laterally in passing hangers, etc.

[illegible] THERMOSTAT; James M. Harrison, New York, N. Y. App. filed [illegible] Has a plurality of carbon disks provided with



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NEW YORK, SATURDAY, SEPTEMBER 21, 1907.

CONTENTS.

STANDARDS OF LIGHT.

We note in the Digest some of the results reached by the International Photometric Commission, which met in Zurich a couple of months since. While the action taken was rather tentative in its nature and can hardly be expected to establish an international ruling, it will certainly be of service in clarifying the issues and in helping to bring about a general convention regarding luminous standards, which is at present much needed. There have been numerous attempts to settle *ex cathedra* upon luminous standards, usually by bodies which, like the congress that established the Violle standard, had real authority to speak for nothing save itself. The whole matter is so complex that it will take many preliminary conferences to pave the way for concerted action, and the present one is valuable especially in that it has brought up to date the facts regarding the concrete primary standards which are now in use. The commission certainly represents a high degree of experimental skill and the results presented will carry no inconsiderable weight. At the present moment the three standards of sufficient importance to be considered are the hefner, the pentane standard and the carcel. Of these the last-named derives more importance from its still considerable use than from its intrinsic excellence. In uniformity and reproducibility it leaves considerable to be desired, although its color and magnitude make it convenient for the comparison of flame sources. We doubt whether, as a primary standard, it can fairly be considered eligible for final choice so that in lack of anything better the hefner and the 10-cp pentane standards have the field to themselves.

Yet even these are far from ideal, the former by reason of its small power and inconvenient color, the latter on account of its relative complication and relatively large variations with atmospheric conditions. Leaving the carcel out of consideration, the values adopted by the commission make the Harcourt standard equal to 10.95 hefners; or the hefner equals 0.913 pentane candle. Previously the hefner has been generally held to equal 0.88 Parliamentary-candle, so that there is an outstanding discrepancy of about 3 per cent between the two definitions. The value 0.88 is the one adopted by the American Institute of Electrical Engineers and by the Bureau of Standards, so that practically the American standard "candle" varies from the present canonical value of the British "candle" by the amount just given. If this were the whole story the issue would be simple enough. But in an admirable paper by Dr Hyde, of the Bureau of Standards, it appears from direct comparison between the Harcourt and the standard incandescent lamps of the bureau, and between these and the hefner, that the relation between the Harcourt and the hefner is not 10.95, [illegible]. This gives the hefner equal to 0.894 pentane candle, a value about half way between the new and the old ratios. In fact, various direct comparisons give this ratio all the way from 0.88 to 0.913. The fact remains that there is [illegible] discrepancy of 3 per cent to be accounted for [illegible]

It must be admitted that the situation is a difficult one. In some respects the values obtained via incandescent lamps should be more reliable even than direct comparisons since each flame standard can then be worked in its home laboratory, while the incandescents seem to be reliable between themselves to a highly satisfactory degree. Still, there must be taken into account the well-known advantage of comparing flame standards with each other under identical atmospheric conditions as against applying the full value of the atmospheric corrections when checking incandescent lamps. This is one reason for the hesitancy of gas photometrists in using the otherwise extremely convenient incandescent standards. It seems to us that there is much room for improvement still in flame standards when variations as large as those noted appear in the careful work of skilled investigators. Certainly it would seem possible to devise a lamp while burning, like the hefner, an entirely definite chemical compound, should yet give a better magnitude and a color nearer to that of modern illuminants.

The carcel and the recent kerosene lamp of Dr. Elliott show the results that can be reached by methods comparatively crude as regards the material burned, while the hefner is a good example of what can be done with a constant fuel in spite of small dimensions, naked flame and inconvenient color. There is, of course, a comparatively unexplored field in the metallic filament incandescents, but the failure with platinum, which is relatively easy to obtain in pure condition and to manipulate, is somewhat discouraging. The investigation leading to a satisfactory primary standard of light will be a long one since not only has the thing itself to be found, but the inertia of long usage must be overcome. As a preliminary step, however, it should be possible to establish an international "candle" or other unit of intensity to which each country could attach its value in terms of its own pet primary source. The unit in terms of incandescent lamps is amply easy to manage and would at least give photometrists the advantage now denied them of working in terms of the same thing with the same name everywhere. When the concrete primary standard comes it can be adjusted in magnitude to a simple ratio with the unit.

Telephonic Distortion.

Elsewhere we print an interesting contribution by Mr. Louis Cohen calling attention to the apparent neglect by investigators in the past of the influence of skin resistance on telephonic transmission; that is, of the increase of the resistance of a conductor with increase of frequency caused by unequal flow through the cross section of a conductor by the action of self-inductance which crowds the current toward the surface, whereby the conductive medium is unequally utilized. The practical bearing of this consideration depends largely upon the telephonic speech value of the current components of higher frequency, for at the lower and predominant frequencies the skin effect may be negligible. We note that in the present case, as in the case of other writers on the subject of telephonic distortion, the term distortion is connected only with the effect of attenuation. This use appears to ignore the fact that the effect of reactance not only attenuates differently the values of current components, but also changes their phase relations—in the first case affecting the tone value, and in the second case the word form.

What Constitutes Good Street Lighting.

The paper by Mr. W. H. Blood, Jr., on "What Constitutes Good Street Lighting," which was read before the convention of the Illuminating Engineering Society and summarized in our issue of Aug. 10, well represents the views of a great many central station men and illuminating experts on what should be sought in street lighting. Mr. Blood took the position that smaller units than are now common are desirable; or, in other words, that incandescent lamps of high efficiency located at frequent intervals enable one to see the way along a street much better than large arc lamps at less frequent intervals, as there is less variation between the maximum and minimum illumination on the street, and, hence, for purpose of pathfinding the street is better illuminated. Any observer who has ever walked or driven on shaded streets at night, illuminated by frequent incandescent lamps, and on streets lighted by arc lamps at infrequent intervals can testify to the truth of these statements. As a matter of fact, much of our street lighting is not beyond the stage of pathfinding, and whatever system makes it easiest to see the path at a given expenditure per mile of street is logically the most desirable. There are, nevertheless, a number, even among illuminating engineers, who point to the brilliant effect produced by arc lamps which is impossible with incandescents, and claim that the high maximum intensity near the lamp is not altogether a drawback, as it helps make a well-lighted effect whether the street is actually well lighted for purposes of finding one's way or not. There appears to be a place for both systems of lighting. In the numerous towns where arc lamps are placed every second corner in the residence districts, there is no question at all but that an equal amount of energy in incandescent lamps would enable citizens to see their way around the streets much better. The arc lamp at such infrequent intervals is simply barbarous, because of the violent contrasts and deep shadows which result. On the other hand, on business streets where arc lamps can be placed on every corner or even closer, the blinding effect and contrasts are not pronounced enough to cause trouble, although even in such places opal diffusing globes might well be used to lessen the glare.

Incandescent Lamp Specifications.

The extent to which the U. S. Government proposes to employ incandescent lighting during the forthcoming fiscal year is indicated by the fact that proposals have recently been invited for 270,000 incandescent lamps, as detailed in our issue of August 3. These proposals are noteworthy, since they are the first of their kind to employ mean spherical candle-power as a basis of comparison. This distinctly marks a step in advance. The rating of the lamps called for remains on the mean horizontal candle-power basis, as is customary, but the initial specific consumption called for is 3.76 watts per mean spherical candle, corresponding to 3.1 watts per mean horizontal candle, when the spherical reduction factor is 82.5 per cent. Not only is the mean spherical candle-power basis the most nearly accurate from a technical standpoint, but it is also the only safe standard of valuation in comparing lamps of different types and manufacture. There are many conditions in which increased candle-power in some particular direction is preferable to nearly uniform distribution, as, for example,

case of a single incandescent lamp, without globe or reflector, suspended above a reading desk. In this case a type of lamp with powerful end-on candle-power with weakened horizontal intensity is preferable to a lamp of the usual type. No proper comparison of the two types of lamp would be possible on the basis either of end-on candle-power or of mean horizontal candle-power. The true comparison would, however, always be available on the basis of mean spherical candle-power. The government engineers who formulated the department specifications have performed an excellent service to electric lighting in requiring the commercial recognition of the spherical candle-power which had so long been denied.

Color Photometry

The very interesting letter on this topic from Dr. Lummer which appears elsewhere in our columns, raises anew some important practical questions. It has certainly been far from our purpose to criticize the admirable Lummer-Brodhun screen for failing to do what it was never expected to accomplish. The fact is, however, that some writers on photometry have been, by the very care of setting which characterizes the instrument, misled into thinking that it is particularly adapted for the very thing which Dr. Lummer himself vigorously disclaims. Hence it seems desirable to set them right. Exact results in the comparison of fields varying widely in color are certainly not yet attainable; however, consistent readings can be obtained by an observer at a particular time. One of the hardest lessons for the experimenter to learn is that consistency does not imply precision in the final result. As Dr. Lummer suggests, there may be some doubt as to the real value of comparisons between very different colored fields. The difficulties of color photometry, however, are very seriously involved in the comparison of our present commercial illuminants, and hence cannot be laid aside even if the results are known to lack in precision. It is a case where one must do the best he can even with unsatisfactory methods and instruments.

For instance, it has become necessary to compare lamps differing in color as much as the flaming arc and the enclosed arc, the incandescent lamp and the mercury vapor tube. Not only do these vary immensely among themselves, but they all differ conspicuously from the scale of color values found in average daylight. These, in turn, range from a light redder than the hefner to one bluer than the enclosed arc. It is a case then of making the best of a bad proposition, and of trying to devise a fair method of approximation rather than a satisfactory method of exact measurement. It may very likely turn out that one must, in color photometry, be satisfied with methods which would be quite inappropriate for the comparison of fields approximately alike in color. Facing the problem as one finds it, one of the exasperating preliminary troubles is that there is no general agreement upon a definition of what shall conventionally be called white. The Welsbach, acetylene, metallic filament incandescents, Nernst lamps, and even the Moore tube and the enclosed arc, have been exploited vociferously as white. And lately the magnetic arc has been added to the list of aspirants. It would seem desirable to establish some uniformity in color nomenclature before trying to compare a "white" enclosed arc with a "white" Welsbach. This matter aside, there remains a practical color difference between these various sources so great as to defy proper evaluation in spite of the fact that the lamps concerned are really in commercial competition.

It seems to us that the work which Dr. Lummer has in progress regarding the sensibility of the eye to various spectral colors is much to the point. Previous work on this point has hardly been carried far enough to serve as a basis for anything like a commercial criterion. One of the possible methods of dodging the color difficulty is to assign, by obtaining the average results from a very large number of normal eyes, conventional standard values for the luminosity of each spectral region, so that light sources may be compared by a relatively simple spectro-photometric method. Another plan is that of Crova, many years since—using a colored screen permeable only to the colors of high luminosity, and, therefore, reducing the lights to be compared to approximately the same color. We fear this scheme, fair as it undoubtedly is for most sources, would cause a riot when applied to some of the illuminants at present employed. Again, one might find it possible to use some sort of reading-comparison photometer which should give a fair approximation to the practical value of the sources compared for seeing purposes. It is not without the bounds of possibility, too, that a constant might be found to connect the luminosity values for the average eye with the effect of the beam upon a selenium cell. In fact, the whole range of photometric appliances must be gone over before the question is finally settled. And, first of all, it is well worth while for a thorough investigation to be made of the actual errors committed in balancing lights of different colors with the usual screens.

It is true, of course, that the Purkinje phenomenon is extremely troublesome in such work, but it is not so clear that its effect cannot be allowed for, if one were using a standard, conventional method of working. If one could connect the actual relative luminosities of the lamps as determined by the spectro photometer, with the settings made under standard conditions, it might turn out that reasonable precision would be attainable. The amount of personal equation in setting a photometer screen on colored lights, aside from Purkinje's phenomenon, has never been sufficiently studied, nor is the constancy of the personal equation satisfactorily known. There is pretty good reason to expect that it may be subject to large variations in the same person, and it is not yet clear whether these are or are not controllable. The real fact is that, as Dr. Lummer very truly says, we are quite at sea in color photometry. There is a prodigious amount of work to be done merely in gathering the data necessary to the formation of an intelligent judgment on many of the points involved, the more since it looks very much as if the reactions of the average eye to color would have sooner or later to be determined. The study of the color sense is so laborious that most investigators have been per force content with a few "subjects." Yet when it was possible to chance upon, as did one experimenter, two cases of an altogether exceptional aberrant color sense in the same laboratory, it is clear that safety lies in considerable numbers. It is a case for carefully laid-out co-operative research, if results are to be obtained in a reasonably short time. The Illuminating Engineering Society and allied bodies have plenty of work ahead of them along these lines, and they will do well to start [illegible] lest they be overwhelmed by still more illuminants.

The Exhibits and the Awards Jury at the Jamestown Exposition.

Last week, under the presidency of Dr. Albert Shaw and the vice-presidency of Mr. Ambrose Swasey, the jury of awards of the Jamestown Exposition took up its work. The jury in this instance has been limited to about 75 members, chiefly university officials, government experts and men prominent in technical bodies. From this body and its departmental groups no appeal is permitted by the rules of award, but a superior jury has been constituted to take care of various difficult points that arise in such work. The whole week was devoted by the jury of awards to its task, and the present week will probably see the close of the work of its jury of review. It is understood that the awards will be announced early in October. While the exposition is relatively small, it is in some respects very select, and the rules have aimed to limit the award of only one medal to any exhibitor in any given department. Hence the work of the jury has been of an unusually critical nature.

In the general group of machinery, electricity and transportation, Mr. J. M. Dodge was made chairman of the machinery and transportation section, and Dr. Carl Hering chairman of the electrical section; both having great familiarity and experience with the work. The department group for electricity comprised Dr. Carl Hering, Prof. B. V. Swenson, secretary of the American Street and Interurban Railway Association; T. C. Martin, editor, ELECTRICAL WORLD, and C. T. Malcolmson, expert, U. S. Fuel Testing Plant. Prof. Swenson was also a juror in the transportation section. The electrical jury considered exhibitors in Class 79, telegraphy and telephony; 80, electro chemistry; 81, electric lighting; 82, various applications of electricity; 143, working of mines electrically, and 146, electrometallurgy. The exhibits in these classes were chiefly in the Machinery Building, but were scattered also throughout the various departments, owing to the fact that electricity is now so pervasive in its influence and effects, it is hard to name any branch of human effort or experiment in which electrical energy is not employed.

During the week the officers of the jury, with the support of the whole body, adopted resolutions commending the exposition to the people of the United States as worthy of visitation and cordial support. In view of the nature of the productions of the Southern States, emphasis is everywhere laid on the agricultural and mineral productions of the various commonwealths, but the machinery section is altogether of an excellent character; and it is probable that no previous exposition has seen so many industrial and domestic applications of electric light, heat and power. Moreover, the lighting of the exposition is admirably done, and Mr. W. M. Dixon, assistant director-general and electrical chief of installation, has achieved notable success in spite of the obstacles in his way. About 75,000 lamps of 8 candle-power have been used in outlining the main buildings, and there are eight searchlights on the Administration Building employed to throw broad beams of light seaward over the water gate, after the manner of a streaming aurora borealis. These lamps are supplemented by at least as many incandescents on the Warpath, and by other searchlights. The buildings make free use of a dull red brick that absorbs light, but the general accentuation of outline is admirably carried out. In addition there is, on Raleigh Square, south of the Grand Basin, an electric fountain, of the concealed chamber type, with colored screens passing in front of the arc lamps, whose beams are projected upward through the jets of water. The manner in which the exposition is supplied, by a large sub-station, from the system of the local traction and lighting company was described in these pages some months ago. It is needless to add that this system has been very heavily taxed this summer; now that the exposition has "found itself," now that cool days are coming with leisure for the Southener, and now that the beautiful spectacle on the historic Hampton Roads is fully set, the burden of travel is reaching its peak, and the whole plant is working to the limit.

[illegible] the transportation [illegible] members [illegible] arduous week, viz., Prof. B. V. Swenson, Prof. G. Lanza, of the Massachusetts Institute of Technology, and Mr. C. T. Malcolmson. The electrical exhibits in this group were also considered by the electrical jury. All possible courtesies and help were extended by Mr. T. S. Southgate, governor of exhibits; Mr. J. L. Farmer, secretary of the jury of awards, and Capt. J. F. Reinburg, chief of the departments of machinery and marine. The jury lunched daily at the Swiss Alps Village to discuss work and details, and the Army and Navy Club also threw open the hospitable doors of its cozy home on the outskirts by the water, near Machinery Building. During the week a most interesting trip was made over the electric division of the Norfolk & Southern Railroad to Virginia Beach and Cape Henry, at which place the United States navy has a fine wireless station, where considerable testing and experimental work is being carried on and where some most valuable data have already been accumulated.

The Trend of Invention and Improvement in the Electric Field.

The August issue of the *General Electric Review* contains an interesting article by Prof. Elihu Thomson discussing the trend of invention and improvement in the electric field. This article is reprinted, practically in full, below.

The electric industry did not reach any considerable development until the beginning of the decade between 1880 and 1890, when numerous discoveries and inventions were made, following each other in quick succession. Upon these the industry was founded, although some of the early work was not applied in actual commercial form until quite recently.

For a long time the open-type carbon-arc lamp alone served in arc lighting. Some 10 or 12 years ago the movement towards restricting the access of air to the carbons and thereby saving expense in renewals of carbons and trimming the lamps took place, and resulted in the enclosed-type of arc lamp. A few years later, however the superior efficiency of the so-called luminous arc drew attention to new types of arc lamps, in some of which the carbon in the electrode served only to confer conductivity, while the light was no longer due to the bright positive carbon crater, but to the presence in the arc flame of vapors and fine particles of refractory substances. The com[illegible] with those of the enclosed arc gave again the disadvantages of the open arc in frequent renewals and trimming.

The present trend of invention is towards securing not only the superior efficiency of the luminous arc, but by a selection and combination of suitable substances, a long life of the electrodes. The inventor has the task of finding the best combination, and constructing a lamp mechanism which will properly take care of the arc adjustment. Work in this field will doubtless continue actively for some years as the possibilities are not yet exhausted in the experiments hitherto made.

While formerly the constant-current arc dynamo with series circuits was universally used, we find its place taken by the constant alternating-current transformer, and this may eventually be used in combination with rectifying apparatus, such as the mercury arc, and a return to direct-current arcs may thus take place. Invention in this field has been quite active, and will probably continue until practical perfection of construction and operation is assured. The tendency in stations is to unify the supply, so that instead of arc machines, constant potential low-tension dynamos, railway generators and alternators being found, large generating units of the alternating-current type are alone installed, the current from which by transformers, rotary [illegible] adapted [illegible] varied kinds of load. Practically to-day the station supply is alternating except in railway work not involving transmissions at high voltage and transformation.

The various new conditions of regulation and distribution will doubtless continue to furnish a field for the exercise of inventive genius as has been the case in the past.

In the incandescent lamp, carbon, which for so long held its own as the best material for filaments, is likely to be eventually replaced by metals possessing high melting point, and, what is of the utmost consequence in this connection, a low or negligible vapor tension when near melting. Carbon, while quite infusible, fails in being too volatile at such temperatures as are necessary to be attained in the incandescent lamp if it is to be efficient. While improved greatly by "metallizing" it cannot be expected to possess a reasonable life of run at a specific consumption of only one-half of that which can be attained in the latest lamps with metallic filaments, notably in the tungsten lamp.

Beginning with the rare metal, osmium, as the first substitute for carbon, we have seen in succession tantalums and tungstens. We may rest assured that the refractory metals which are not too rare or costly will be scrutinized very carefully in the effort to find whether they are possessed of the properties needed for use in a lamp filament. These are briefly, high fusing point, low vapor tension, when near melting, high specific resistance, and capability of being formed into pieces of the lengths and sections desired in the lamps. A new era of incandescent lighting has begun, although much work yet remains to be done, which will involve great skill in manipulation and perhaps discovery. The advent of a lamp requiring about one watt per candle cannot fail to profoundly affect the progress of electric lighting, and tend, when small units are available, to render electric lighting far more general than is now the case. Existing mains will serve for a much larger output in light, and, with the high economy lamp, day current may be with advantage employed to charge batteries on the customers' premises, which are discharged for lighting at night; thus tending to a relief of the load peak. In a station supplying electric energy for motors and lamps, any gain in efficiency of the lamps will make the peak less pronounced.

In the application of electric motors, as in railway or stationary work, the improvements or inventions will naturally relate more and more to details. It is probable that no radical departures from present constructions can be economically made.

The recent revival of the inter-pole for assisting commutation has already had a very important effect on dynamos and motors, leading to increased voltage and output rating, and giving to the continuous machine an added value. The alternating-current generators and motors, both single and polyphase, are at present highly developed machines, and the improvement is not likely to involve any radical departures. Lessened cost, saving of material, ease of maintenance will continue to be sought by the designer or inventor.

The endeavor to secure variations of speed in motors has led to some ingenious modifications of the machine. In like manner the demand for railway car lighting has led to the invention of generators having a nearly constant output notwithstanding great variations of speed, as when the driving is from the car axle. This kind of specialization of machines will doubtless continue to afford in the future a field for the exercise of inventive talent.

The future progress will probably depend as much upon refined engineering and construction as upon invention, except in special instances similar in character to the examples mentioned. We can see no reason to expect great revolutions in methods or apparatus as a result of new inventions yet to be made. The art is old enough to permit standardization and there is much less danger than formerly that portions of the plant will soon become obsolete.

In the comparatively new field of wireless telegraphy there is still considerable room for invention and improvement, but it is remarkable what progress has hitherto been made. It is hardly likely, however, that this art will be developed to such an extent that it will replace for communications of intelligence existing wire circuits. It will rather tend to supplement such service and occupy fields peculiarly its own, which it does already in furnishing means of communication with vessels at sea.

Fixation of Nitrogen.

A patent issued Sept. 10, to Dr. C. P. Steinmetz, describes a method for the fixation of nitrogen from the atmosphere by submitting air to the action of an electric arc of minimum volume and the greatest practicable length. The former process in which short arcs have been used is criticized on the ground that it requires a great number of electric arcs and high tension currents, is expensive and troublesome and the apparatus employed is liable to get out of order, while owing to the multiplicity of the arcs readjustments and repairs are troublesome and time consuming. It is claimed that by the process described these difficulties are overcome by the employment of a single electric arc maintained by direct current, which arc is magnetically deflected or drawn laterally to a distance within which it can be safely maintained, and also magnetically rotated within its sphere of action so as to sweep through the air which is to be converted into nitrous compounds. As illustrated, the arc is established between electrodes entering a cylindrically enclosed chamber, and an electric motor rotates about the cylinder two opposing electrical magnates, the legs of which project inwardly toward the air chamber so that the magnetic flux passes substantially at right angles with the axis of the arc. In this manner the arc is both deflected and rotated, the latter motion serving the double purpose of extending the sphere of action of the arc and of limiting the time within which the arc acts upon any portion of the air which passes through the converting chamber.

Making Nickel and Cobalt Films.

Two patents were issued Sept. 10, to Mr. Thomas A. Edison on a process of making metallic films or flakes, particularly of cobalt or nickel or of cobalt and nickel combined, such as are used in the Edison storage battery. In making, for example, cobalt films, the cathode, consisting of a copper cylinder having a polished, nickel-plated surface, is first immersed in a cobalt plating bath and rotated, whereupon an extremely thin film of cobalt is deposited, the thickness being .0001 of an inch or less. The cathode, after being washed, is then immersed in a solution of copper sulphate which causes the cobalt to go into solution and copper to be deposited as "cement copper" in a granular but slightly adhesive form. The cathode is then introduced into a copper plating bath and a thin film of copper plated on the chemically deposited film of "copper cement," during which process the cathode is rotated. The cathode is then finally introduced into a cobalt bath in which a film of cobalt of about .0002 of an inch is deposited. The operations described are repeated, alternate layers of copper and cobalt being deposited on the cathode until a composite sheet of the desired thickness is secured. The sheets are then cut into long strips and introduced into a bath into which the copper is dissolved without affecting the cobalt. After washing the films thus obtained they are annealed in hydrogen prior to being used in storage battery plates.

Variable-Speed Induction Motor.

A solution of the problem of obtaining good running characteristics in an induction motor having a high starting torque is given in a United States patent recently issued to Mr. F. M. Lewis, of Brighton, England. Each primary phase winding is divided into two parts, one of which can be electrically reversed with reference to the other when desired by means of a throw-over switch. There are two electrically-distinct and separately-insulated secondary windings, one of high resistance and the other of low resistance. The high-resistance wind-

ing is of the squirrel-cage type, while the low-resistance winding consists of a succession of wave or continuous windings of the same polar pitch as the primary.

Assuming an eight-pole machine, under running conditions the primary connections would be such as to make the relative polarities *N, S, N, S, N, S, N, S*. Normal current traverses the low resistance wave windings, but very little current flows through the high-resistance winding. Under starting conditions the primary connections are so arranged as to make the relative polarities *N, S, N, S, S, N, S, N*, so that no current flows through the low-resistance winding because the e. m. f. in one-half of it opposes that in the other half, but current flows in the high-resistance winding and gives a large starting torque [illegible]

New Incandescent Lamps.

In a paper read by Mr. Leon Gaster at the recent meeting of the British Association for the Advancement of Science, entitled "Developments in Electric Incandescent Lamps," the subjects of the tungsten and helion lamp were treated in some detail.

Credit is given to Dr. H. Kuzel, of Vienna, for being one of the first workers on the tungsten lamp. By his process the metal is obtained in the colloidal state by means of an arc under water. The resulting paste of extremely fine metal is squirted into filaments, and afterwards heated in order to make them better conductors. The lamps are manufactured in Vienna by Kremenetsky. From such tests as have been made it is ascertained that the lamps consume a little over one watt per candle-power, with a useful life of about 1000 hours, with a loss of only 10 to 15 per cent of the initial candle-power.

Another method of manufacturing tungsten filaments is the joint invention of Dr. Alexander Yust and Franz Hannaman, of Vienna. According to their process the carbon filament is electrically raised to a high temperature in an atmosphere of gaseous tungsten or molybdenum compounds. The carbon then becomes coated with metal, and after burning out the carbon, the filament appears quite homogeneous even under the microscope. By another method the metallic powder is prepared by chemical means mixed with an agglutinant, and squirted into the form of filaments, which are then freed from carbon as [illegible]

Various other processes have been devised for preparing a paste of the oxide of tungsten, which can be squirted in filaments and afterwards reduced. According to the British patent 4814 of 1907, Messrs. Siemens & Halske have devised a process of stamping tungsten powder, sometimes mixed with another metallic powder, but without an agglutinant, in a tube of some metal, which is easily drawn or rolled, such as tantalum or iron. Then, after electrically sealing the ends, they subject the tube to drawing or rolling processes. After the completion of the drawing process the outer skin can, if desired, be removed. This method obviates the necessity for the great care and treatment involved in the ordinary fusing process, but it was not stated whether the method is actually in use. The diameter of some of these metal filaments is very small, lying between 0.05 mm and 0.03 mm. A filament yielding 60 candle-power at 110 volts requires to be over 600 mm long.

Experiments which attempt the manufacture of filaments of smaller diameters, such as permit the production of lamps of 110 volts and of about 20 candle-power, are in progress, and some lamps of such small candle-power and even of high voltages have already been made on a laboratory scale, one of these being made at the Robertson Lamp Works, in London. The average life of these tungsten lamps for the present can be reckoned to lie between 600 and 700 hours; some lamps have been burning as long as over 2000 hours.

The next lamp using tungsten, and which is already used commercially, is the "osram" lamp, and it is the invention of Dr. Aeur von Welsbach. The lamps are for the present manu- [illegible] imported by the London General Electric Company, who have decided to begin the manufacture of the same in England. The lamps are made in various sizes up to 100 candle-power, and for varying voltages, but the common type which is expected to be used in the near future will be intended for voltages lying between 100 and 130, and of 35, 50 and 100 candle-power. The lamps burn with a consumption of 1.2 watts per candle-power, having a useful life, on an average, of over 600 hours. The candle-power is well maintained over the whole useful life of the lamp. The lamps are recommended to be burnt for the present with the filament in a vertical plane, and can be equally well used on direct or alternating current circuits.

The Berlin A. E. G. Company is also manufacturing some type of tungsten lamps, the process for the manufacture of which has not been divulged. The lamps are made for various voltages, one being of 50 hefners at 100 volts. The Zircon Wolfram lamp has been much improved during the last few months, and certainly represents a great advance over the lamps previously mentioned. It is the first metal filament lamp of a voltage above 100 which burns satisfactorily in any position in the chandelier. The filaments are mounted on spring hooks made out of tungstenized carbon, the hooks having the effect of maintaining the filament rigid and in shape, while in service, and of preventing the loops from touching, and also allow of a greater number of filaments in the bulb, and, consequently, reducing their length and that of the lamp. The lamps can be burned in any position, and the breakage of filaments is considerably reduced. On account of the elasticity of the spring hooks, the breakage of filament has been reduced in transit and in service.

Another improvement over the old type of lamp is the adoption of electrical soldering of the filament to the leading-in wires, thus doing away with the inconveniences caused by the use of graphite paste, which was a partial cause of the blackening, the giving off gases, and the defective contacts met with in the previous lamps. The improvement also avoids much extra labor, and also the danger of oxidation of the filament, if the paste is not very carefully burned away. The electrical soldering process takes place in the open, and an experienced operator can carry out the soldering of about 500 lamps daily. The firm of La Carriere, in Paris, are the inventors of this spring hook, and the filaments can now be mechanically mounted in such a manner that the operators do not have to touch them with their fingers, thus reducing thereby the number of breakages in mounting the filaments. One operator can mount about 500 lamps of 110 volts daily. The latest type of 110-volt lamp contains only four filaments, of 0.025 mm diameter, giving 24 hefner candles; or for 220-volt 48 hefner candles necessitating the use of only eight filaments. Lamps can also be made of 150 to 200 candle-power to compete with small arc lamps for shop and street lighting. The progress made in England with the use of this lamp has not been great, but arrangements have been made for a factory to be established in London for the manufacture of filaments, and the subsequent sale to lamp makers.

The helion lamp invented by Prof. Parker, of Columbia University, and Mr. W. G. Clark looks like an ordinary carbon incandescent lamp [illegible] volt lamp, consuming 35 watts, and gives out 30 candle-power. In the manufacture of the filament silicon is reduced from a gaseous form in combination with carbonaceous gases on the surface of a high resistance carbon core. The inventors claim that this lamp operates at a high temperature without the carbon and silicon uniting to form carborundum as might be supposed. The silicon shows no tendency of becoming molten or fluid at the temperature attained. The filament starts with a negative temperature coefficient less than carbon, but at about a red heat the coefficient changes distinctly to positive, and remains so as the temperature is further increased. The consumption of the lamp [illegible] candle, or it can run even at less. Although a useful life between

600 and 1000 hours is claimed, a proper series of life tests could not be made, as there seems to be a difficulty in keeping the joints between the filament and the leading-in wires in good condition. For the proper working of the lamp, it is essential that mercury vapor pumps must be used for obtaining the vacuum, and great care must be taken in selecting the carbon core, so as to obtain homogeneity and purity, otherwise the results are considerably affected. Experiments are now being conducted by the inventors, using as a core the graphitized carbon filament. The inventors are also experimenting with a special cement for the use of making the joints, and, it is said, that the results are promising. One of the characteristic features of the lamp is that the length of the filament need not be increased over the ordinary carbon lamp. The filament is very pliable, and there will be no difficulty (if the present defects, which are chiefly of a mechanical character, have been overcome) in making lamps of low and high voltages and of reasonable candle-power. The lamp easily stands transport, and will be just as safe to handle as the ordinary carbon filament lamp of to-day. This is rather an important point, because one of the troubles common to all metal filament lamps at the present is their liability to breakage in transport and in handling, particularly so at the hands of the uninitiated consumer. The advantage to be derived from the use of metal filament lamps may often more than be counterbalanced by the expenditure for renewals of lamps, on account of the breakage of the filament.

Iridium has also been used for the manufacture of lamp filaments. According to Gulcher's process, amorphous iridium is made up into a paste by the aid of an organic binding material. The filaments are squeezed from this paste, and are made to glow in the air, and not in a receiver containing air in the diminished pressure or indifferent gases. The lamp is only produced for low voltages, up to 24, and consumes between 1 and 1.5 watts per candle. Other metals, like vanadium, niobium, molybdenum, etc., may also be used in the future, but not much has been made public as yet regarding their use for filaments.

In speaking of the economies which can be derived by the use of those new metal-filament lamps, one naturally has to bear in mind the fact that the economy to be derived depends on the price at which the lamps could be sold, the rate of charge for the current used, and the useful life of the lamp, and this is a matter which requires proper calculation, and which one must not overlook when tempted to adopt these new metal-filament lamps for the sake of economy only. The question of breakage in transport and in handling by dusting or fixing the lamps is a very serious drawback, and to mitigate this evil the lamp makers will have to work out an arrangement with the consumer so as to reduce this expense to a minimum. The price of the lamp of 100 volt, 50 cp., is 4 shillings, but there is no doubt that this high price, with an increased output and growing demand, will be greatly reduced in the near future.

Although we have seen that the metal-filament lamps can be made of relatively small candle-power at voltages above 100, and of high voltage up to 240, it is stated that it is not the intention of most of the manufacturers sell for the present other lamps than those of high candle-power above 30 cp. and intended for voltages varying between 100 and 130. This decision has a distinct commercial value, making the change from the carbon filament to the use of metal filament gradual, so as to be properly appreciated and benefited to the consumer, manufacturers and energy suppliers alike. The fact that the high cp. lamps [illegible] only [illegible] one-third or even less energy than generally the present carbon lamps, will, to a very large extent, [illegible] of the consumer, who, in adopting the lamps, will obtain increased illumination at the same or less energy expenditure than hitherto. It is well known that the carbon incandescent lamps are at present in many [illegible] positions often situated in the direct angle of vision, and, therefore, detrimental to sight. The reason may be [illegible] on account of the expense at which energy is supplied to the consumer, he could not well afford to enclose the lamps in proper diffusing globes, or to remove them a good distance away from the objects he wishes to be illuminated. With the advent of the new metal-filament lamps of relatively high candle-power, the lamp could easily be removed to above the level of the eyes, or enclosed in properly diffusing globes. We should thus obtain good illumination without additional increase of expenditure.

German Railway Engineers on a Tour of Inspection.

The decision of the Prussian Government to electrify the Berlin Stadt-und-Ringbahn, has led to the appointment of a government commission to study the application of electricity to heavy electric traction conditions in this country. This commission reached this country Aug. 27 and has already visited the New York Central, New Haven and Long Island installations in New York, the Boston subway and elevated system, Schenectady, the Erie electrification, Rochester, Niagara Falls, and Pittsburg. It left Sept. 11 for Indianapolis, Fort Wayne, Chicago, Toledo, Helena and Spokane, where it will investigate the high-tension distribution system in operation there. After leaving the Pacific Coast it expects to go to Mexico and inspect the Necaxa and other high-tension transmission lines.

The chairman of the commission is Herr Geheimer Baurat Wittfeld, of the Ministry of Railways, Highways and Bridges. Associated with Mr. Wittfeld and accompanying him on the trip are Dr. Ing. Walter Reichel, professor of the Berlin Polytechnic University and formerly chief engineer of the railway department of the Siemens & Halske Company; Mr. Frederick Jordan, general manager of the Felten Guillaume-Lahmeyer works of Frankfurt; Herr Emmerich Frischmuth, engineering director of the Siemens-Schuckert Works, of Berlin, and Baumeister Phillip Pforr, manager and chief engineer of the railway department of the Allgemeine Elektricitäts Gesellschaft, of Berlin. It is proposed to divide the Prussian system to be electrified, comprising 366 miles, into two sections, one to be electrified by 1913, the other by 1920. The single-phase system with 10,000 volts on the trolley wire will probably be used.

New York Electrical Show.

The electrical show to be held in Madison Square Garden Sept. 30 to Oct. 9, inclusive, promises to be a decided success from present indications. It is announced that all of the space in the arena has been disposed of and not only will electrical manufacturing and supply companies be represented, but the New York and Brooklyn Edison Companies have also reserved space, the New York Edison Company having the largest space in the exhibit, and the Edison Electric Illuminating Company of Brooklyn the second largest.

It is the intention of the Edison Electric Illuminating Company of Brooklyn to build a five-room apartment across the Fourth Avenue end of the arena. The apartment will be furnished lavishly by a local department store company and will be modern in the extreme. Every known electrical device will be shown in operation. The apartment will comprise a kitchen, dining-room, bed room, corridor, parlor and library. Motor-driven, labor-saving devices and the usual arrangement of cooking utensils will be shown in operation in the kitchen, and the bed room will contain all the electrical devices and conveniences known. The other rooms will likewise contain electrical devices of the latest design.

The music during the show will be furnished by the Eastern [illegible] Company, supplemented by a brass band.

A feature of the show that will doubtless appeal to the public will be the [illegible] of the National Dairy Supply [illegible]

This company has reserved four spaces in the arena and will show a new electric milking device in operation on a herd of Jersey cows.

In the three booths on the Twenty-Seventh Street side of the main entrance a Marconi wireless telegraph station will be shown in operation. In the center aisle, facing the main entrance, will be the space of the New York Telephone Company comprising seven booths. Here will be shown a modern telephone system and, as on previous occasions, numerous telephones will be connected with the various theaters in the city, so that the performance may be heard in the Garden.

The Electric Testing Laboratories will show methods for testing lamps, cables, etc. The National Lamp Association will occupy five booths, in the main aisle, facing the entrance, where various lamps made by the companies represented in the association will be exhibited.

The General Electric Company will occupy eight booths along the main aisle, as will also the Westinghouse Electrical & Manufacturing Company. The other exhibitors are as follows: G. M. Gest, conduits; Mongul Paint Company, insulating paints; Tel-electrical Music Company, electric piano playing attachment; Lord Electric Company, lightning arresters; Federal Sign Company, electric signs; Monaton Construction Company, electric signs; Driver-Harris Wire Company, various devices showing the application of the company's resistance wire: Safety Car Heating & Lighting Company, car heating and lighting devices; India Rubber & Gutta Percha Insulating Company, insulated wires; the New York Beck Lamp Company, flaming arc lamps; Metropolitan Engineering Company, electric signs; American Wire Brush Company, electrical cleaning devices for floors, walls, etc.; the F. Alexander Manufacturing Company and Henry Fallek.

CURRENT NEWS AND NOTES.

A. I. E. E. MEETING.—The next New York City meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineering Societies' Building, on Friday, Oct. 11, at 8:15 p. m. The subject for discussion has not yet been announced.

CHEAPER WIRELESS.—A special despatch from Liverpool states that Mr. Marconi, who sailed on the steamer *Virginian*, Sept. 14, for Montreal, said before sailing that when he arrived in Canada he would install constant cheap commercial service between Canada and Great Britain. The rate from Canada to Great Britain on ordinary commercial messages would be 10 cents a word. The press charge would be 5 cents a word. The present rates are 25 and 10 cents a word respectively.

REPORTS OF RAILWAY ACCIDENTS.—The Public Service Commissioners for the State of New York not included in Greater New York have issued a circular containing regulations governing the reporting of railway accidents. Certain classes of accidents are required to be immediately reported by telegraph, including those resulting in loss of life, and accidents at grade crossings resulting in death or serious injury. Classes of accident not thus enumerated are required to be promptly reported by mail.

OHIO TELEPHONE RATES.—The advisability of legislation to fix telephone rates has become a public question in [illegible] Ellis, this has been brought about largely by the fact that the long-distance companies recently increased their night-toll rates. Mr. Ellis says that he has for some time felt that the Legislature ought to take some steps toward the regulation of telephone rates, as it has the authority to do so. At present most other public service corporations are subjected to supervision in this respect, and he can see no reason why telephone companies should be [illegible]

TELEGRAPH STRIKE.—The telegraph strike still drags along but gives many evidences of early cessation, so far as any real effectiveness is concerned. A number of the operators have endeavored to get back their old positions, and the support from the labor unions has proved very small. The Government has refused absolutely to have anything to do with the matter, the New York Public Service Commission has declared any interference to be beyond its jurisdiction and powers, and the New York aldermen have passed a resolution favoring some kind of conciliation. President S. J. Small of the Commercial Telegraphers' Union has issued from Washington another appeal for funds from organized labor.

EDISON CONVENTION.—The annual convention of the Association of Edison Illuminating Companies was held at Hot Springs, Va., last week, when the programme already printed in these pages was carried out very successfully. There was an excellent attendance, and although as usual business was attended to very strictly, the scenery and natural attractions of the spot were also greatly enjoyed. Mr. A. Dow, of Detroit, was reelected president, Gen. G. H. Harries, of Washington, was made vice-president, and Mr. W. W. Freeman, of Brooklyn, was elected secretary. A large number of the party traveled by special car, which, after the meeting, was run to Old Point Comfort, where two days were spent with the object of seeing the Jamestown Exposition, now wearing its best aspect.

INDEPENDENT TELEPHONY IN CINCINNATI.—Mr. Phillip Fitzsimmons, of Cincinnati, is reported to have secured the necessary financial aid to construct an independent telephone system in Cincinnati, Ohio, in competition with the Cincinnati & Suburban, or Bell, Company. Recently when applying for a permit to make repairs to his present lines, permission was granted upon the condition of giving a bond for payment of a wire tax under an ordinance passed 13 years ago, the amount of the tax being $342. The charge was then made that the Bell Telephone Company had never been required to pay this tax, and that its arrearages aggregate about $500,000. This charge has been denied by the attorney of that company, who furthermore has said that since the Bell Company has placed its wires underground another company cannot legally operate an overhead system, even should it have been granted a franchise for such a system.

NEW JERSEY UTILITIES.—A bill has been introduced in the New Jersey Legislature of a public utilities commission. The measure provides for a commission of three members to be appointed by the Governor at an annual salary of $5,000 each. The commission is to have supervision over all gas, electric, light, heat, power, water, sewer, telephone, telegraph and street railway companies operating in the state, together with their plans and equipment. It will not have supervision over the railroads, this jurisdiction being held by the Railroad Commission appointed under an act of last winter. Specific authority is given to the commission to inquire into the condition and method of operating all corporations coming within the class mentioned and to investigate companies touching alleged rebates, rates, charges or demands for services rendered, and all discriminations in service rendered in the transportation of personal property or otherwise. It is authorized to make recommendations in writing to any corporation touching the improvement of its service or the betterment of its conditions and affairs. The commission is to make an annual report to the Legislature and is also to report to the Interstate Commerce Commission upon such subjects as the commission may request. The total expenses of the commission must not exceed $30,000 a year.

NEW YORK-HAVANA CABLE.—A dispatch from London states that the cable steamer, *Silvertown*, with over 1300 miles of submarine cable on board, sailed from there Sept. 12. The cable is to be laid between New York and Havana for the Commercial Cable Company. The direct cable will save much time in transmission between the two points, and will avoid the troubles to which the land lines are subject.

RADIUM CURE FOR CANCER.—In an address on "The Specific Action of Radium as a Unique Force in Therapeutics," delivered before the International Dermatological Congress, held in New York last week, Dr. Robert Abbe stated he believes that radium has solved many problems connected with the treatment of cancerous growths and other lesions. "It is possible to say positively," he said, "that cancer at a certain stage can be cured by radium. Thick, animal-like skin, covered with mouse-like hair, can be reduced by radium to a normal condition. But just how these cures are effected is a matter of conjecture."

TELEGRAPHS IN INDIA.—U. S. Consul-General W. H. Michael, of Calcutta, reports the following in regard to telegraphic messages in India: Drafts of telegrams or cablegrams filed in the Indian Telegraph Company's offices will be preserved for reference for three months. The director-general of telegraphs has addressed a letter to various chambers of commerce stating that it is under consideration to add to the number of abbreviations which can be accepted as one word, and he asked the various chambers to supply him with a list of abbreviations most commonly used to enable him to judge if any of them can be admitted. This is being done.

WORLD'S LARGEST MICA MINE.—What is claimed to be the largest mica mine in the world is located at Sydenham, Ont., 16 miles from Kingston, according to reports from Consul Van Sant. The product is mostly amber mica, with some silver amber, the highest quality mined. The mine is one mile from the upper end of Sydenham Lake, and the mica is transported in bulk from the mine by barge to the railroad at Sydenham, where it is shipped to Ottawa for trimming for the market. From Ottawa it is exported to the United States and other points. This valuable mine is owned and worked by Americans, and the output is almost entirely taken by one of the largest American electric companies.

ENGINEERING COURSES FOR EXTENSION STUDENTS.—The College of Arts and Engineering of the Polytechnic Institute of Brooklyn has arranged for the season of 1907-1908 a series of evening and Saturday courses in engineering, chemistry, physics, mathematics, drawing and languages especially designed to afford men in active practice opportunities for professional study. The term of study begins on Monday, Sept. 30. No formal examinations for entrance will be required of those not seeking a degree, although secondary school preparation will be assumed. The courses will be conducted by means of lectures, discussions, reports, problems and examinations. No charge is made for matriculation and examination, but a reasonable charge for laboratory use and breakage is necessary in the laboratory courses.

CONTROLLING SUBMARINE MINES.—A special telegraphic dispatch from Newport of Sept. 6 says: "Tests have been made at the torpedo station for several weeks of an invention by Henri Stenffieben, a Frenchman, of a device to render useless submarine mines planted by an enemy. The device, the nature of which has been kept secret, is understood to consist of a mechanism operated by magnetic power. The tests have been so secretly carried on that their location in the bay has not been disclosed. The inventor, who has supervised the tests, will not talk about the apparatus and the tests, but it is understood that the mines have been invariably destroyed or rendered powerless long before the vessel equipped with the apparatus has come within the zone of the explosives. The report will be sent to Washington.

MUNICIPAL FIGURING.—In his casual notes in the *M. O. Bulletin*, Mr. John Kendrick Bangs remarks: "The municipally owned electric light plant at Crawfordsville, Ind., having shown a so-called profit last year of $6,727, the trustees have just made a 10 per cent advance in the charge for street lighting. The probable reason for this is a desire on the trustees' part to increase this year's profits to an even $6,800, round figures being so much more satisfactory than angular ones." In another item he says: "One of the pleasing features of municipal ownership, as shown in New Zealand and Australia, is the luscious, juicy fatness it gives to the public debt. That of the United—sometimes called the Benighted—States is less than $12 per capita, but in New Zealand it is $335, in New South Wales, $267, and in Australia's six states it averages $291 per capita. It takes genuine prosperity to increase a nation's credit—or debit—all the way from 2200 to 2800 per cent."

INSULATING MATERIAL.—A patent issued recently to Mr. Charles L. Norton describes a method for making a new insulating material for use in the insulation of electrical apparatus. A material such as asbestiform fiber is bonded with magnesium hydrate and impregnated with an oxidizable liquid hydrocarbon such as ozocerite or mineral wax. It appears that the magnesium hydroxide combines with the hydrocarbon in such a way as to make the resulting material much harder than by other processes. The porous and refractory material employed as a base is, after ordinary drying by heat, submitted to heating in a partial vacuum and is then immersed in the liquid hydrocarbon. After drying for some days at a temperature of about 80 deg. C., the product is found to have its electric resistance, dielectric and mechanical strength many times increased, while its diminished porosity renders it non-hydroscopic; the material is also capable of a high polish and of being worked with tools.

ELECTRIC SLEEP FOR SURGICAL OPERATIONS.—A despatch from Paris states that Professor Leduc, of the School of Medicine at Nantes, has discovered a method of producing electric sleep which, it is declared, will take the place of the usual anæsthetics in surgical operations. For a human being a current with a pressure of 35 volts is applied intermittently in its full strength for minute fractions of a second. Two electrodes are applied to the skull in a special manner, the points of application being first carefully shaved. During the electric sleep the patient is perfectly quiet and the awakening occurs as soon as the electrodes are withdrawn. The sensations after the operation, it is stated, are quite agreeable. The mind appears to work more clearly and more rapidly and there is a sense of increased physical vigor. Professor Leduc incidentally asserts that the application in a certain manner of his special current will electrocute a subject, in an absolutely painless manner, gentle sleep being followed by gradual death.

FLUORESCENT ELECTRIC LAMP.—Following the discovery of the Roentgen rays, in 1896, Mr. Thomas A. Edison made a thorough study of the phenomena connected therewith, and at the time it was announced that he had invented a fluorescent electric lamp based upon the use of these rays. A patent for such a lamp has just been issued to Mr. Edison, the date of application being May 19, 1896. The lamp consists of a vacuum tube of a shape similar to that usually employed in the generation of Roentgen rays, containing two opposing electrodes with their surface at an angle with each other; crystals of tungstate of calcium are fused to the inner glass surface of the vacuum tube. When the tube is properly excited by electric current the effect of the bombardment of the molecules of the residual gas causes the tungstate to fluoresce brilliantly with pure white light. It is stated that a single bulb of moderate size can by this means be made to give several candle-power with a very small expenditure of energy.

[illegible] that the one year up to the end of July showed a net gain of 1,000,000 16-cp equivalents, for all kinds of service. It is also noted that the suburb of Yonkers showed a gain in the year [illegible]

[illegible] from New England, "fan baths" are the latest remedy used by the Boston City Hospital physicians in the treatment of typhoid fever. Heretofore the ice plunge was used, and a patient whose temperature had reached the danger point was soused in a bathtub filled with broken ice until his teeth rattled. This treatment after a time was found to be too heroic, as the shock was too severe and pneumonia sometimes developed. Then ice water sponge baths were substituted, but the fan baths, the doctors declare, are just the thing. The patient is sponged off with ice water first, then a sheet that has been soaked in ice water is wrapped about the body and more ice water sprinkled on the sheet. The air from an electric fan is then turned on him so that he is chilled by the rapid evaporation caused by the breeze. The method has proved highly successful.

NIGHT TELEPHONE RATES.—An order has been issued making day and night rates the same over long distance telephone lines. This change is necessary, it is stated, on account of the practice which has grown up of making, through the day, appointment calls for 6 p. m., when the reduced rates were in effect. As people do not realize that hundreds of others are doing the same thing, they cannot understand why their service is delayed, in many cases for one or two hours beyond the appointment time, thus interfering with many engagements. It is believed that this change will take a severe and unnecessary strain off the operating force by cutting out the rush hours and distributing the traffic more evenly, and for the same reason will greatly improve the efficiency of the service to the general public. It will add something to the cost of service of some large business houses, which have built up this appointment message practice to such an extent as to make the present action absolutely necessary.

CANADIAN WIRELESS.—U. S. Consul A. F. Dickson, of Gaspé, in Quebec, makes the following report on the new wireless telegraph service between the British Isles and Canada: "The Marconi company announces that it will be prepared for wireless telegraph service between the United Kingdom and Canada in September. The messages will be transmitted between Clifton, Ireland, and Glace Bay, Nova Scotia. The regular rates will be 5 cents per word and the Government and press rates 2½ cents. Great improvements have been made lately to the station at Glace Bay, which has been moved to a more favorable situation and much enlarged. The station at Clifton has also been improved in order to meet the situation. The first stations erected were found to be too small. For some time past the Marconi company has had communication across the Atlantic and exhaustive tests have been carried on. The company has been transmitting messages from this side to England for some time, but it is only recently that the communication from England to Canada was thoroughly successful, and now that the tests have proved satisfactory the company intends entering the commercial field at once."

SAXONY WATER POWERS.—U. S. Consul J. St. John Gaffney, of Dresden, states that water power is not used to any great extent in Saxony, being entirely limited to small saw and corn mills in outlying mountainous districts. He adds: The laws relating to the development and use of water power give the right of concession to the ministry of public works. Before any concession is granted the applicant must file plans of the system proposed, buildings, etc., and power required. These plans are laid before the local technical commission, who report to the ministry. [illegible] the last decade. The government has no water-power station in operation at present. Formerly a few turbines were in use for milling purposes on the Upper Elbe, but have been discontinued. All water-power plants at present in operation are in private hands, controlled by the government. As far as can be ascertained, there are only a few plants established, all of which develop only enough power for the needs of the mills which own them. In the absence of any figures as to water power it is impossible to make any comparison with steam power, but the former is absolutely negligible.

MUNICIPAL BONDS.—The Boston *Transcript* in a brief comment on the financial situation, after the tenor of our own recent remarks, says: "The raising of the interest rate of New York city bonds to four and a half per cent, is accepted as the inevitable sequence of new financial adjustments in the business world and as having no bearing, direct or otherwise, upon municipal credit. A similar tendency is observable, not only in Boston and other American cities, but in the leading money centers of Europe as well. But attention is called to another aspect of the situation, its probable effect upon the municipal ownership movement. One of the pivotal points in the arguments of the advocates of municipal ownership has been the cheapness with which cities could borrow money. Two years ago, one of the leading spellbinders made this assumption practically fundamental. The existing companies, gas, electric, transportation or what not, were to be bought out or forced to compete with rival plants, built with municipal funds, which, it was contended, could be obtained in any amounts at a rate not exceeding three and a half per cent at the utmost. That was only two years ago. Yet for some months we have seen four per cent suppliants on the market with few takers, and the additional half per cent was inevitable. But this will compel the municipal ownership people to revise their line of reasoning. Their old figures are no longer of service. On the basis of their own former claims they are now put on the defensive by hard and stubborn facts. Sentiment does not govern in the issue of city bonds. They must conform to the same economic [illegible]

TELEGRAPHS IN CANADA.—[illegible] graph strike in the United States, it is pointed out that such wanton interruption of service is not possible in Canada. By the general Dominion Act incorporating telegraph companies, they are required to dispatch messages in the order in which they are received without delay. A telegraph company that should detain messages a week before forwarding them would scarcely be held to have fulfilled the law because in finally sending them it adhered to the sequence in which the messages had been presented to it. Irrespective of the force of relevant conditions in its special Act, the company would doubtless be found to have violated the section of the general Act relating to the order in which messages are to be transmitted. But the will of Parliament that the telegraphic service must be maintained as far as possible without interruption is expressed in a more recent statute passed last session known as the Lemieux Act. This measure takes from employees engaged in certain occupations the liberty of striking and deprives the corresponding employers of the right to lock out their men. Before a labor dispute can produce a cessation of work the differing parties are bound to ask for the mediation of a board of conciliators. Only after the board has failed to restore a good understanding between employees and employers is it allowable for a strike or a lockout to be resorted to. Telegraphy is one of the departments of activity covered by some of the prohibitions of the Act. If telegraphers strike before steps are taken to have their grievance submitted to a Board of Conciliation, each striker is liable to a fine of not less than $10 and not more than $50 for each day he is out on strike. If any employer of telegraphers locks them out he shall be liable to a fine of not less than [illegible] nor more than [illegible] for each day of the lock-out.

The Plans of the Bar Harbor and Union River Power Company.

An important hydro-electric equipment is now being installed at Ellsworth, Me., by the Bar Harbor & Union River Power Company, headed by John R. Graham, Esq., of Bangor, president and general manager of the Bangor Railway, Light & Power Company. The fall of the Union River at Ellsworth is unusually favorable for an extended development for hydro-electric transmission, and the accompanying photographs, together with the power house drawings reproduced herewith, show clearly the general scope of the work. Messrs. Sellers and Rippey, of Philadelphia, are the consulting engineers for the undertaking, which is supervised by Mr. J. A. Leonard, resident engineer of the Bar Harbor & Union River Power Company.

Electricity is to be transmitted to the electric railway and lighting system of Bangor from Ellsworth by a 25-mile, 33,000-volt transmission line connecting the Ellsworth power house with the Bangor Railway & Electric Company's hydro-electric plant on the Penobscot River in the town of Veazie, near Bangor. The line will, at first, consist of a three-phase circuit equivalent in conductivity to No. 3 copper. It has not been decided

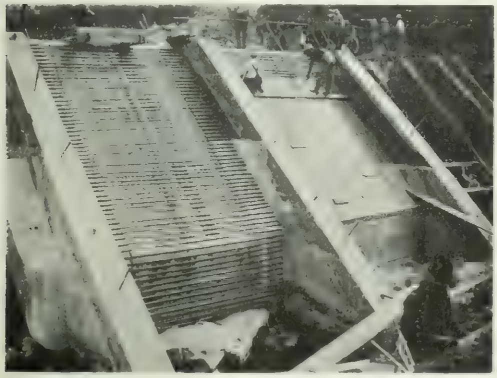


FIG. 1.—REINFORCING STEEL FOR DECK IN PLACE.

FIG. 2.—WEST SIDE OF RIVER, LOOKING UP STREAM.

whether to use copper, aluminum or steel conductors for this service. The company has been experimenting with both iron and steel wire in view of the present high price of copper, but so far the results secured have simply been extensive enough to debar the use of iron. Electricity will also be transmitted to Mt. Desert Island for central-station service and Mt. Desert Transit Company, a railway being built between Ellsworth and Bar Harbor, Maine, and delivered locally at about 33,000 volts to a lighting station in Bar Harbor. The length of the line from Ellsworth to Bar Harbor will be 24 miles. The pole lines will be arranged for two circuits each with Locke insulators. At Bar Harbor there is now a 1000-h.p. steam plant which will be held as a reserve.

To pass from the mainland to Mt. Desert Island across the narrow channel between the two, two spans 850 ft. long will be required in order to give the clearance above the water demanded by the War Department. These spans will be supported by steel towers 140 ft. in height. There will also be a span of 850 ft. between steel towers across the Penobscot River between Eddington and Veazie on the Bangor line. The Bar Harbor station will at first be equipped with three 400-kw, 19,600-34,000-volt primary star connected, 2490-1920-volt, secondary water-cooled General Electric single-phase transformers with controlling switchboards. At Veazie there will be three 200-kw. single-phase transformers of the same make with secondaries wound for 7000 or [illegible] volts. Step-up transformers at Ellsworth will consist of three [illegible] three-phase units [illegible] primaries and [illegible] 33,000-volt secondaries.

The switchboard here will have capacity to control two 1500-kw outgoing, three-phase lines.

The power house at Ellsworth will be a concrete block structure with red Spanish tile roof. It will be supplied with water through a canal 75 ft. wide, 20 ft. deep and 180 ft. long leading to a forebay 95 ft. long, 76 ft. wide and 20 ft. deep above the power house on its west side. The river is now being damned at the power house site by a reinforced concrete dam 71 ft. high, 100 ft. wide at the base, 8 ft. wide at the top and with a 300-ft. length spillway. The dam is to be hollow inside and is of the familiar type built by the Ambursen Hydraulic Construction Company, of Boston, Mass., who is the contractor for this part of the work. The plans provide for the construction of a future storage reservoir 1.5 miles above Ellsworth, which will be 20 miles long and 3 miles wide, with a 300-ft. dam, 60 ft. high. The total flow of the river with the storage developed is figured at 825 cu. ft. per second, giving an ultimate power of 6000 horse-power for 24 hours, or 12,000 horse-power for 12 hours. The present development provides for about 2500 horse-power.

The dimensions of the power house at first will be 50 ft. x 70 ft. Coarse racks will be provided at the forebay entrance, and above these will be a foot and cable bridge which will connect the power house with a transformer building about 20 ft. x 80 ft. At the south end of the transformer house will be a tower for high tension lines, which will provide for the issuance of the overhead circuits at a height of about 35 ft. above the ground. At the south end of the forebay will be a temporary spillway and on the east side a gate house which will control the water in the penstocks leading downward into the power plant. Additional racks will be installed at the penstock entrance. The head at the water wheels will be 60 ft. The first installation provides for a 1000-kw generator and one of 500 kilowatt rating, both being General Electric, revolving-field 2300-volt, three-phase, 60-cycle alternators. Sixty cycles is the frequency adopted for the entire system because the old plants at Veazie and Bar Harbor operate at this frequency. The speeds are 277 and 400 r. p. m. respectively. The turbines are to be of S. Morgan Smith make, rated at 1700 horse-power and 850 horse-power respectively. The intention is later to substitute a 1000 kilowatt unit for the 500-kw machine, and to reduce the cost of reconstruction. The 850 horse-power outfit will be provided with a wheel casing and draft tube for 1700 horse-power. Two 75-kw, 125-volt exciters will also be installed.

Each of the main generating units will be supplied with water through a penstock 8 ft. in diameter, which will connect the wheel casings and the forebay by a straight run with two 45-degree bends at the top and bottom. As indicated, each turbine will be provided with a draft tube. The penstocks will be 21 ft. apart on centers. The exciters will be served by a penstock 3 ft. in diameter, with provision for a second of the same [illegible] on centers when the expansion of the

plant warrants it. Four governors will be provided by the Ludlow Valve Manufacturing Company. The switchboard of the plant will be mounted on a gallery commanding a view of the entire generating room. All the units will be direct-coupled to their prime movers. Local lighting service in Ellsworth will be handled by constant-current transformers and regulators located on the gallery. The turbine room will be served by a 15-ton Niles electric crane with hand attachment. The exciter turbines will consist of 125-hp machines making 550 r. p. m., The 2300-volt current from the generator will be carried across the forebay bridge to the transformer house by a cable duct, thus freeing the power house from high-tension line current. An interesting feature of the power house and dam construction is the utilization of the space between the buttresses nearest the power house for machine shop, storage, heating and toilet rooms. The hollow character of the dam permits free passage through it and stairways are provided at each end of the dam to facilitate this. Three sluice pipes are also carried under the dam between buttresses with controlling valves at the foot of the stairways. The power house can be extended indefinitely toward the south by removing the temporary spillway at the end of the station and excavating further in the direction of the town. The columns, roof trusses and rock supports were supplied by the Berlin Construction Company, of Berlin, Conn.

The Veazie power plant has a total capacity of about 2200 horse-power, and is one of the oldest hydro-electric plants in the country There is also at this plant an auxiliary steam equipment aggregating 1800 horse-power. Upwards of 40,000 incandescent lamps are now on the circuits of the Bangor company, or more than one 16 candle-power unit per inhabitant. For manufacturing purposes about 600 horse-power for motors is supplied to 140 consumers, the motors ranging from 1/4-hp to 30-hp in size. The company operates 60 miles of trolley lines, and last year handled 4,114,715 revenue passengers with a total car mileage of 990,000. Municipal lighting in Bangor is supplied by the city itself from a power plant located at the water works dam within the city limits. The Penobscot River drains about 8000 square miles of territory.

Local distribution in Bangor is effected at a new sub-station on Park Street, near the center of the business district. The railway load is handled by two 500-kw, 60-cycle, 360-600-volt rotaries of General Electric make supplied by two banks of transformers of 185 kilowatts, each unit being of the oil-cooled type. The electric supply from Veazie is transmitted over five

FIG. 4.—NORTH FOUNDATION WALL OF POWER HOUSE.

three-phase No. 0 circuits, 4.5 miles long. An auxiliary to the railway service is a battery of 270 cells of the Electric Storage Battery Company's make, which is floated on the direct-current sub-station bus-bars without the use of a booster. The substation contains 480 kilowatts of lighting transformers with star-connected secondaries, 6050-volt, primaries and 2110-volt low-tension sides. Separate bus-bars for lighting and railway service are in use at Veazie. In Bangor the lighting distribution is four-wire, the neutral of the star being brought out. Each service transformer (normally 2080 volts) is connected between the neutral and one of the three-phase legs. The lighting switchboard contains seven marble panels. Motor service is handled by 240 kilowatts of transformer capacity, distributing at 575-volt, three-phase around Bangor.

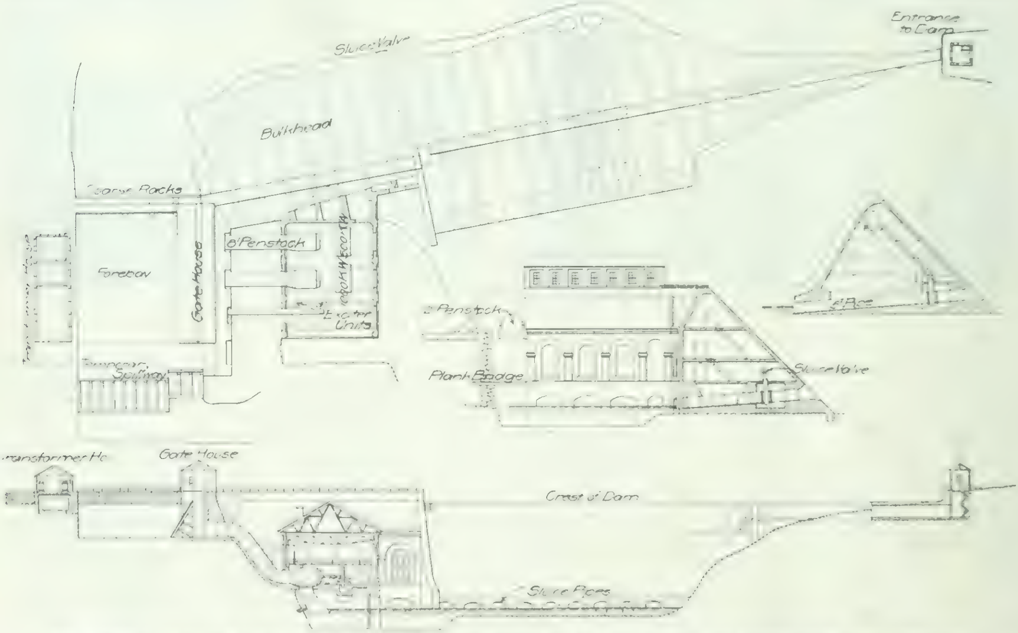


FIG. 3.—PLAN VIEW AND ELEVATIONS OF DAM AND POWER HOUSE OF THE BAR HARBOR AND UNION RIVER POWER COMPANY.

The Design of Plunger Magnets.

By C. P. Nachod

In an iron-clad stopped plunger magnet of the type of Fig. 1, having specified external dimensions and stroke, and in which the coil is to operate under a specified temperature rise, the proportion of copper and iron in the coil and core may be varied between the limits from all copper and no iron to no copper and all iron, at both of which extremes the pull between the iron plunger and magnetic core will be zero. It is evident, therefore, that there is some intermediate proportion where the pull is a maximum. It is the object of this article to show the relation between the pull and the diameter of the plunger under the above-mentioned conditions, and incidentally to show also such other properties of the magnets as number of layers, resistance, current, ampere-turns, and volts, corresponding to the various diameters of plungers.

In the symbols below capital letters refer to the constants imposed by the above-mentioned conditions, and small letters to variable quantities.

Let W, r, i, be the watts, resistance and current, respectively, in the coil. Then

$$i^2 = \frac{W}{r} = \frac{56.25}{r} \qquad (1)$$

Since the coils have the same outside diameter and length, and, therefore, present the same exterior radiating surface, if the heat conducted away by the core is neglected, the condition of constant temperature is that of constant watts absorbed. The value of 56.25 watts has been taken for a coil of 2¾ ins. outside diameter, 2 1/16 ins. long, or .317 sq. in. per watt, which figure has been found safe under the conditions of oil cooling used.

The resistance of the coil is proportional to its mean diameter and to the number of layers. Let r = hot resistance of coil, d_m = mean diameter of winding in inches, s = number of layers. Then

$$r = k d_m s = 2.235 d_m s \qquad (2)$$

where k = constant of proportionality, equal to 2.235, as found by experiment with No. 28 single cotton-covered wire, which is assumed for all the coils.

By inspection of Fig. 1

$$d_m = d + 2C + As = d + \frac{1}{4} + .01562 s \qquad (3)$$

where d = diameter of plunger, C = ⅛ in. radial clearance between outside of iron plunger and inside of winding. A = thickness of a layer as measured on a radius of the coil = .01562 in. as found by experiment with No. 28 s. c. c. wire, or about 95 per cent of the nominal insulated diameter of the wire. This is probably due to the bedding of the wire.

The outside diameter D, 2¾ ins., is seen by inspection of Fig. 1 to be

$$D = 2As + 2C + d \text{ or } 2\tfrac{3}{4} = .03124 s + \frac{1}{4} + d \qquad (4)$$

$$n = Ts = 114 s \qquad (5)$$

n being the total turns, and T = 114, the turns per layer.

In the c. g. s. system, the fundamental formulas for magnetic pull p, and magnetizing force H, are

$$p = \frac{B^2 A}{8\pi} \text{ and } HL = \frac{4\pi n i}{10}$$

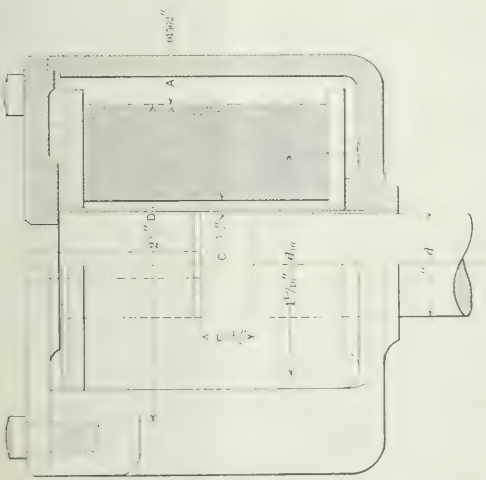


FIG. 1.—IRON CLAD STOPPED PLUNGER MAGNET.

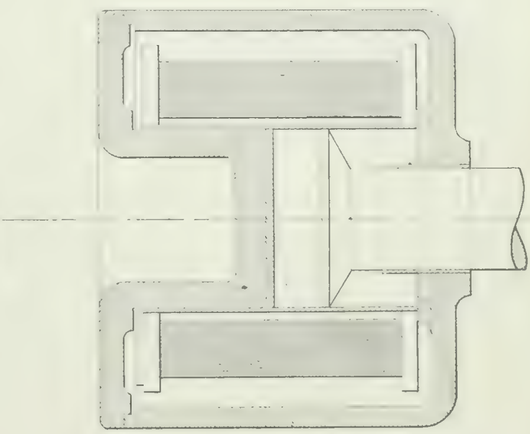


FIG. 2.—MAGNET WITH 1.5 IN. PLUNGER.

In the air-gap $B = H$, and the area A for the cylindrical plunger is $\frac{\pi}{4} d^2$. Making these substitutions and converting to pounds and inches, there results for the initial pull

$$p = \left(\frac{ni}{2660 L}\right)^2 \frac{\pi d^2}{4} = \left(\frac{ni}{1330}\right)^2 .7854 d^2 \qquad (6)$$

where ni is the ampere-turns and L the length of air-gap, ½ in.

From equations 1 to 6 inclusive, it is now possible to express the pull in terms of the foregoing constants, and the diameter of plunger as the independent variable. Performing these eliminations there results

$$p = \frac{M d^2 (Q - d)}{N + d} = \frac{9.3 d^2 (2.5 - d)}{3 + d} \qquad (7)$$

where M, Q, N, are compound constants used for abbreviation, and have the following values:

$$M = \left(\frac{T}{2660 L}\right)^2 \frac{\pi W}{4 k A} = \left(\frac{114}{2660 \times .5}\right)^2 \frac{.7854 \times 56.25}{2.235 \times .01562} = 9.3 \qquad (8)$$

$$N = D + 2C = 2\tfrac{3}{4} + \tfrac{1}{4} = 3 \qquad (9)$$

$$Q = D - 2C = 2\tfrac{3}{4} - \tfrac{1}{4} = 2.5 \qquad (10)$$

To find the diameter which gives the maximum pull, the first

derivative of p with respect to d had been formed and equated to zero, the solution of the resulting quadratic yielding

$$d = \frac{[illegible]}{4} \pm \sqrt{\left(\frac{[illegible]}{4}\right)^2 + [illegible]} \qquad (11)$$

$$[illegible] = 1.56 \text{ in.} \qquad (12)$$

From the form of d in equation (12) it will be seen that the diameter of plunger for maximum pull is independent of all other constants except the outside diameter of coil, and the clearance between plunger and coil. If this clearance C equals zero, an impractical but ideal condition, there results

$$d = \frac{\sqrt{5}-1}{2} D = .618\, D = 1.697 \text{ in.} \qquad (13)$$

In the interpretation of equation (7) the diameter of the plunger is conceived increasing from zero as the pull is observed, the iron plunger swelling at the expense of the copper until it reaches the outside diameter of the latter, the current

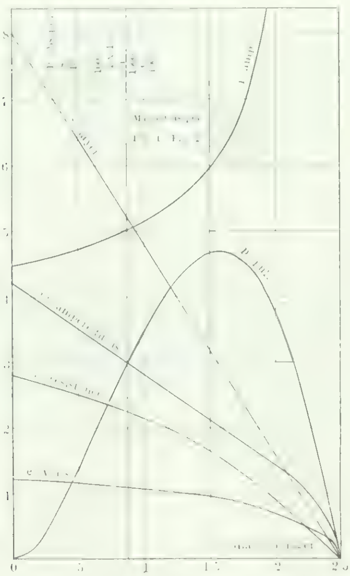


FIG. 3.—CURVES OF MAGNET DESIGN.

and resistance meanwhile changing so as to keep the watts and consequently, the temperature, constant.

The form of the curve p in Fig. 3 shows that for each value of the initial pull there are two magnets conforming to the conditions named that will produce it.

The other properties of the coils are given below in the equations (14-18), derived from equations (1-5) inclusive—both in their general and specific forms. Equations (14-18) are plotted in Fig. 3 against the common abscissa, diameter of plunger d.

$$n = \frac{D - 2C - d}{2A} = \frac{2.5 - d}{.03124} \qquad (14)$$

$$r = [illegible] \qquad (15)$$

$$I = \sqrt{\frac{W}{[illegible]}} = [illegible]\sqrt{\frac{1}{15 - d - 2d^2}} \qquad (16)$$

$$at = I\sqrt{\frac{W(D - 2C - d)}{.1R_s(D + 2C + d)}} = 4570\sqrt{\frac{2.5 - d}{2.5 + d}} \qquad (17)$$

$$e = \sqrt{Wr} = 31.7\sqrt{15 - d - 2d^2} \qquad (18)$$

e being the volts on the coil.

Of these curves the resistance, ampere-turns, volts and layers have their greatest values, and the current the least, for $d = 0$; while for $d = 2.5$ all these quantities are zero except the current, which is infinite. The maximum pull occurs with a plunger 56.7 per cent of the outside diameter of the coil under the particular conditions assumed.

Figs. 1 and 2, drawn to scale, show a comparison between the magnet actually constructed and the one producing the maximum pull. By reading from the curves it may be seen that the former, having a plunger .875 in. diameter, has 52 layers, .5 ampere, 225 ohms, 112.5 volts, 2960 ampere-turns, and produces a pull of 2.96 lbs.; and that the latter, having a plunger diameter of 1½ ins., has 32 layers, .591 ampere, 161 ohms, 95 volts, 2155 ampere-turns, and produces a maximum pull of 4.64 lbs. That is, an increase from ⅞ in. to 1½ in. plunger diameter increases the pull 57 per cent, decreases the ampere turns 27 per cent, and the resistance or the weight of copper, 40 per cent.

Other things than the maximum pull, however, enter into practical consideration; and the magnet of Fig. 1, besides being of the simpler mechanical design, has smaller inertia, which will facilitate rapid action. The magnetic leakage is less in Fig. 1 than Fig. 2, as the m. m. f. is greater, and the return iron path further from the core.

The reluctance of the invariable air-gap has not been considered in the above discussion. It is, however, relatively small on account of its greater area and shorter length, though great enough to be taken into consideration.

Equation 6 is based on the assumption that the reluctance of the iron is negligible in comparison with that of the air-gap, but as only low densities are employed at the beginning of the stroke, this amount is insensible, though the error increases as the plunger diameter decreases.

It is not necessary that the pull increase greatly, as the plunger moves to the stop and this explains the cutting away of superfluous iron in Fig. 2.

Distortion in Telephonic Transmission.

By Louis Cohen.

THE most important factor to be considered in telephonic transmission is distortion; every telephone engineer appreciates this fact, especially so when it is a question of long-distance telephony. The cause of the distortion arises from the fact that an electric wave in its passage along a conductor is attenuated, and the attenuation is a function of the frequency, so that every harmonic is attenuated to a different degree and the speech wave is distorted. The distortion, of course, becomes more pronounced as the length of circuit increases.

This subject, which is of great importance in telephony, has been investigated by a number of scientists and engineers, notably among them Mr. Oliver Heaviside and Prof. M. I. Pupin, yet there is one vital point in connection with this subject which, to my knowledge, was entirely overlooked by the preceding investigators.

If we denote the inductance per unit length of line by L, its capacity by C, and its resistance by R, then the attenuation constant β will be as follows:*

$$\beta = \sqrt{\frac{1}{2}}\sqrt{\omega C\left\{\sqrt{R^2 + L^2\omega^2} - L\omega\right\}}$$

Now all previous investigators assumed, at least by inference, that the constants of the line are the same for all frequencies

*For the derivation of this expression [illegible]

and the only variable in the expression of β is ω. If this is so, then in the case of a long line, say, the line from New York to Chicago, the constants of the line are approximately as follows:

a (radius of wire) $= 0.2$ cm
$L = .004$ henry per mile
$R = 2$ ohms per mile
$C = .01$ microfarads per mile.

Using these constants in the above expression of β, the values of β for various frequencies will be given in the following table:

$\omega = 2\pi \times$ frequency.	β	$\epsilon^{-\beta l}$ [illegible]
[illegible]	[illegible]	[illegible]
3,000	15.76 [illegible]	[illegible]
6,000	15.80×10^{-4}	0.4540
9,000	15.806 [illegible]	[illegible]
12,000	15.808×10^{-4}	0.4538

Now the column under $\epsilon^{-\beta l}$ gives the fraction of the sending current that reaches the end of the line, and from this table it will be seen that difference in the attenuation for these frequencies, which are about the range of telephonic frequencies, is not so large as to introduce any distortion; the difference in the attenuation for a frequency of 500 and 2000 is only about one-fifth of a per cent, which is hardly appreciable, and it thus seems reasonable to conclude that on the assumption that the constants of the line are independent of frequency we ought not to have any distortion. Since, however, we know that distortion does take place in telephonic transmission, the question naturally suggests itself: What is the cause of distortion? And I submit the following explanation: In passing an alternating current through a conductor the resistance will vary with the frequency, increasing as the frequency increases. The resistance of a straight cylindrical conductor for alternating currents is given by the following formula:

$$R = R_0\left(1 + \frac{1}{12}\,\frac{\omega^2\mu^2\pi^2a^4}{\sigma^2} - \ldots\ldots\right)$$

where

R_0 denotes the resistance of conductor for direct current
ω " 2π. frequency
μ " permeability
a " radius of conductor.
σ " specific resistance.

Calculating the resistance of the line by the above formula, the values of the resistance for various frequencies will be as follows:

$\omega = 2\pi \times$ frequency	[illegible]
1,000	2.00096
3,000	[illegible]
6,000	2.03456
9,000	[illegible]
12,000	2.13824

[illegible] the above values of R in the expression for β, [illegible]

ω	β	$\epsilon^{-\beta l}$
[illegible]	[illegible]	[illegible]
3,000	[illegible]	[illegible]
6,000	[illegible]	[illegible]
9,000	[illegible]	[illegible]
12,000	[illegible]	[illegible]

From this table it will be seen that the difference in the extent to which the different components were attenuated is decidedly more pronounced than in the previous case when the change of resistance was neglected. In fact, in this case the difference in attenuation between a frequency of 500 and 2000 will be about 7 per cent, which may cause considerable trouble. It is to be noticed also that the [illegible] somewhat with the frequency, but it is so slight that it may be neglected. The above consideration would naturally suggest the use of stranded wire for [illegible], for the change in resistance varies as the fourth power of the radius, and consequently by diminishing the radius we diminish the change in resistance, which according to the theory developed here is the cause of nearly all the trouble.

It may be of some interest in connection with this subject to consider the Heaviside distortionless circuit. Mr. Heaviside [illegible] that if a certain relation, which we will give presently, obtains between the constants of the line then all distortion will be eliminated. If we take into consideration the leakage constant of the line, and follow the same method of deduction as that given in my paper referred to above, we shall obtain the following value for the attenuation constant:

$$\beta = \sqrt{\frac{1}{2}}\sqrt{-(CL\omega^2 - KR) + \sqrt{(CL\omega^2 - KR)^2 + \omega^2(RC + KL)^2}}$$

where K denotes the coefficient of leakage.

If we adjust the constants of the line so that $\frac{R}{L} = \frac{K}{C}$, then the above expression of β will become

$$\beta = \sqrt{KR}$$

which is independent of the frequency. Mr. Heaviside deduced his results in an entirely different manner, but the result obtained is the same, and he repeatedly calls attention to the fact that when the constants of the line are so arranged that $\frac{R}{L} = \frac{K}{C}$ then we shall have a distortionless circuit. Now, this would be perfectly true if the resistance of the line were independent of the frequency, but I maintain that the resistance is different for the different frequencies; in fact, this is the cause of nearly all the trouble, and therefore even if it were possible to realize in practice the above relation between the constants, we shall still have distortion, since β is a function of R. and R varies with the frequency.

Canadian Electrical Association Convention.

The seventeenth annual convention of the Canadian Electrical Association was called to order at the Canadian Society of Civil Engineers' building, in Montreal, at 10:45 a. m., Sept. 11, with President R. G. Block in the chair. The minutes of the previous meeting were first read, after which the president's address was delivered. This consisted of a résumé of the last year's progress in energy transmission from Niagara Falls, the place of the 1906 meeting, and running comments on the general bearing of high-tension commercial distribution and the needs of the central-station industry with reference to future conditions. Attacks on vested rights have been very severe during the past year, but it is believed that saner counsels are prevailing in the public mind and that the duplication by the government of existing private investment is less of a danger than a short time ago. On the part of certain unthinking persons there arose a cry that Niagara power should be as free as air, but there is no more reason why it should be freer than ice or gold, which anyone is at liberty to harvest or dig for himself and order brought at his door in unlimited amounts free of charge! If rates are to be lower the entire existing investment in power-plant equipment must be utilized.

Transmission lines of the very high potential type do not lend themselves readily to distribution in scattered areas, small towns and sparsely populated centers. It is possible that the Thury direct-current system may be pressed into service for this work, giving plants and towns far away from Niagara the benefits of cheap energy. President Block urged the need of studying winter and summer load curves in small centers, and stated that a flat rate based on the maximum demand would probably be the best solution of the cost of supply question. Care must be taken not to increase the capital expenditure for the sake of handling peak loads. Underground distribution is almost certain to become more general, and a single system [illegible]. The use of more efficient lamps is liable to cut down the revenue of the companies by one-third to two-thirds, and new uses of electric motors, extension of heating loads, sign lighting, general lighting, and even increasing the distribution voltage will have to be considered

as offsets to customers' equipment economies, high cost of copper and high operating expenses. The report of the secretary and treasurer, Mr. T. S. Young, was then read and a total membership of 320 chronicled, an increase of ninety over the preceding year.

Mr. A. B. Lambe, of the Canadian General Electric Company, then read a paper on "Electric Heating and Cooking Devices." He discussed the peculiar physical characteristics of heating apparatus, described the salient construction features of representative equipment and outlined the best methods of attacking the commercial problem of placing heating apparatus in customers' homes. The flat-iron is the best device to introduce first by actual demonstration and free trial in the residence. A report from a commercial laundry using electric irons stated that 20 per cent more work can be done by electric heat and all the work is of one lustre and finish. In another instance 30 per cent more work per operator could be performed. Convenience and cleanliness outweigh the cost of operation, including the greater safety of the electric heater.

A fair average of the energy consumption for cooking a complete electric meal per person is 300 watt-hours, amounting to $10.80 per month at an 8-cent rate per kw-hour, or $6.75 per month on a 5-cent rate. To compete in heating with coal at $7 per ton the rate must be 5 or 6 cents per kw-hour, and to compete with gas at $1 per 1000 cu. ft. the rate must be 3 cents. Lighting companies should exploit heating devices, leaving the regular sales later to the supply house. The cost of flat-irons is medium and the consumption of energy reasonable. Small heating devices are usually charged on lighting rates, but larger units can be given lower rates on a separate meter; heating rates, for example, are 5 cents in Jackson, Mich.; 3 cents in Hartford, Conn.; 5 cents in Schenectady and Montreal, and 2 cents in Sault Ste. Marie, where the distribution is close to the generating plant. In 1906 the central station company in Cleveland put in 1200 heating devices; it now installs 120 per month and demonstrates only on complete electric cooking outfits. Montpelier, Vt.; Massillon, Ohio, and Rochester, N. Y., peculiarly a gas city, with only some 700 houses wired, have been particularly good flat-iron and electric-heating fields. Los Angeles has 10,000 irons, and Spokane gave an electric flat-iron as a bonus for getting newspaper subscriptions. The increase of the day load is a special advantage to the companies.

In the discussion it was emphasized that more revenue should be obtained from that portion of the plant which is idle a considerable part of the time. The defects of electric heater practice were outlined as high maintenance charges unless used with skill, liability to burn out, as in the case of a motor heater used to heat thick and heavy liquids, like wax, and the failure of many companies to advise their customers how to select and use the apparatus to best advantage. The luminous type of heater is being used to great advantage in England, and there is no question that the light adds to the selling power of the device. It is important to show the public that on heavy goods a heavy iron must be used, and a light iron on light goods.

In the afternoon session two papers were read. The first was by Mr. M. A. Sammett, of the Montreal Light, Heat & Power Company, on "Trials of the Operating Man." Mr. Sammett emphasized the need of additional work in lightning protection, and urged liberality in plant design. There is no need of installing units which will carry continuously 50 per cent overload at moderate temperatures. What is essential is that the apparatus should be capable, under emergency conditions, [illegible] per cent overload for a specified interval. The problem of maximum permissible units to be most advantageous under given conditions of operation is becoming prominent in power-house economy. This results usually in larger capacity units and involves artificial cooling. The operating man should be fully aware of the time at his disposal for safe [illegible] machine under overload conditions or under conditions of no artificial cooling. A curve of temperature at overloads should be used as a gauge in emergencies.

To improve the receiving voltage it is only necessary to increase the voltage of the generator, but increased voltage means increased iron loss in the armature laminations, a larger field current and higher temperatures. In transformers an increased voltage means higher temperatures. The safety of increasing the voltage by 10 or 15 per cent to compensate for increased line drop can only be determined after the study of each particular machine. In the case of a 3750-kw generator the core-loss curve showed that an increase of 10 per cent in the generator voltage is equivalent to an additional loss of 18 [illegible] armature, and the corresponding temperature increase resulted in 55 deg. C., giving a maximum of 41.5 deg. C. No difficulty should be anticipated from the above increase in voltage on the ground of increased potential between turns and layers of winding or from increased strain to ground.

With proper adjustment of prime movers the generator will divide the load proportionally. In this respect they are more under control than some of the less complicated apparatus, like transformers. Over and under excitation of the generators will cause a flow of circulating currents between them. The adjustment of the field currents remedies this, and the use of power-factor meters on each machine is of considerable assistance. To prevent unequal loading of transformers the primary and secondary voltages must be the same and the impedances equal. The characteristics determining the division of load must be known under actual conditions of operation. In one case when a bank of transformers was connected in service during the pressure of a heavy Christmas load, the bank burned out on account of overload in a few days after installation. Time could not be spared to test transformers for impedance. They were connected in parallel on high and low tension windings on the strength of the manufacturer's guarantee. A test subsequently made on two spare transformers supplied on the same order as those that burned out revealed the fact that the new transformers had an impedance of 3.58 ohms,* while the old transformers had 4.4 per cent, and so the new bank carried an overload of 19 per cent. With transformers the suitability for proper parallel operation must be verified, and if they will not divide the load proportionately to their capacities, corrective reactances must be added to equalize them in this respect.

Air-blast transformers accumulate dust readily, which is objectionable on moderate voltages between 15,000 and 22,000. The temperature of the upper portions of the coils is often much in excess of the average winding temperature. Whenever transformer coils are connected on top, the air passages are frequently blocked and the temperatures reach a danger point. Unless compressed air is perfectly dry it may damage the insulation in blowing out and cause a burnout. Another trial is to the ease with which flames are carried from one transformer to the other through the air-chamber. With the oil-insulated, water-cooled transformer many of these defects are absent. Less insulation thickness enables larger ducts to be used and the temperature of the coils with ample oil insulation are more uniform. The main argument in favor of oil-insulated, water-cooled transformers is their ability to withstand excessive overloads, and their immunity from breaking down at temperatures even as high as 200 deg. C. In a case of this character the temperature was reached under abnormal conditions of phase transformation. One unit ran at 72 deg. C. and the other at 200 deg. C., the room being 42 deg. C. The trouble was discovered when an inspection of the transformer installation was made. A thermometer of 150 deg. C. range was found with a broken bulb when left in the oil, and a long-range instrument showed 200 deg. C. When brought into the testing department the transformer was given an insulation test of 10,000 volts from primary to secondary and ground; also from secondary to ground of 500 volts, which it stood successfully. Double voltage was applied across transformer terminals and the insulation stood the test. The rating of the unit was 24 kilowatt, 60 cycle, 2000-550 volts. A great advantage of the oil-insulated transformer is the higher effectiveness of

insulation to resist induced high voltages, either through switching or through lightning disturbances. The fear of oil in the transformer as a fire risk is a matter of the past. Instances of stations destroyed by fire when oil-insulated apparatus such as transformers and regulators were the only machines saved. show the fallacy of opposing oil-insulated apparatus. Oil will also extinguish the arc resulting from a short circuit in the transformer and prevent the burning of the insulating fabrics, thus doing away with smoke filling the station, which is always the case with air-blast apparatus. The two main drawbacks of oil-insulated, water-cooled transformers are the possibility of water getting into the winding and the breaking up of the oil, forming a thick non-conducting mass.

A water coil capable of withstanding 200 lbs. hydrostatic pressure and proper connection of the coil to outside piping will guard against the former difficulty, while care exercised to remove the water from the coils by an air-pump or by filling it with oil under pressure will guard against freezing. The breaking up of the oil takes place only at high temperatures. In one case a sample of oil subjected to a temperature of 90 deg. C. formed a heavy deposit in two weeks. It is inadvisable to allow transformers to reach a temperature in excess of 70 deg. C.

It sometimes happens that through no apparent reason the temperatures begin to rise. The cause may be due to either the iron ageing, with higher iron loss, to breaking up of the oil, or clogging of the water-cooling coils. In one instance where water was carried to the brass cooling coils through an iron pipe the acidulated water passing through the iron pipe attacked the iron and then going through the brass tubes deposited the iron in the form of a sediment which reduced the coil opening to one-third its normal size; hence the rise in temperature.

A brief discussion followed Mr. Sammett's paper. It was pointed out that many transformers are injured by careless handling after they have been in service, and there was general agreement that the oil-insulated transformer is a good fire risk. Current transformers with split cores are desirable for testing. The importance of bunching transformers close together on the same load was illustrated by a case in which four 25-kw transformers were located on two poles 50 ft. apart outside a building, one pair being that much nearer the load. The nearer pair ran at 100 per cent overload and the farther pair at 80 per cent load. The trouble was remedied by adding two more units and locating all six close together.

The next paper was by Mr. B. T. McCormick, of the Allis-Chalmers-Bullock Company, on "Three Wire Questions." The paper dealt mainly with the general electrical principles involved. Probably the most efficient three-wire outfits consist of a generator provided with a two-phase combination of balancing transformers, in which the center laps are tied together and the neutral wire joined to the point of connection. Two pairs of slip rings are used, connected to taps in the armature winding, situated 90 electrical degrees apart. Such a combination results in a more even current distribution in the armature than can be secured by the use of a single transformer. The cost of the balancing transformer is a very small portion of the total cost of the apparatus. Ordinarily an allowance of 25 per cent unbalancing is sufficient, which would mean a 22-kw transformer of the two-phase combination of coils for a 100-kw, 250-volt machine. If shunt-wound, the generator differs from standard generators only by the addition of slip rings, while if compound wound the alternate poles are so connected that half the poles receive their series excitation from each of the main leads. In this way the corresponding characteristics are retained even if one side of the system is completely unloaded.

The discussion hinged on the feasibility of operating three-wire generators in multiple with one another or with two-wire generators. It is perfectly practicable to do this, though all three-wire generators give fluctuating e. m. f. at low loads, say, 10 per cent of full rating. It is often convenient to operate a 120-volt machine in multiple across one side of a 240-volt, three-wire system to maintain a better balance, in case that side is unloaded. The two-wire generator with rotating balancers as a competitor of the three-wire generator, has many good points, but the cheapness, simplicity and compactness of the three-wire generator are important advantages.

The morning session Sept. 12 opened with a paper by Mr. C. E. Delafield, of the Ohio Brass Company, on "High-Tension Insulators." Mr. Delafield pointed out that to-day we are face to face with the problem of transmitting power at 100,000 volts or over. In California power is transmitted more than 200 miles at 60,000 volts, but great line losses are suffered and the investment in copper is heavy. An increase in voltage from 60,000 to 150,000 would make it possible to deliver this power with much lower losses and in much greater quantity. Niagara power could be economically delivered to Boston, New York or Philadelphia if it were not for the insulator problem. The design of an insulator for high voltages should involve a consideration of all the effects of electrical tension on the dielectrics in the vicinity of the conductors. Mr. Delafield then outlined the fundamental principles of insulator designs as discussed and investigated by Gerry, Steinmetz, Perrine and Ryan.

In all the various branches of transmission, with the exception of the line insulators, it is now possible to handle potentials in excess of 75,000 volts, there being no difficulty in designing transformers and switchboard apparatus for these high potentials. In the future designing of transmission lines the possibility of increasing the voltage to a value much higher than is now in use must be considered, and energy may be economically distributed over long distances. Energy successfully generated can be distributed over long distances economically only by the use of high voltages.

Wood can be safely accepted for insulator pins up to 25,000 or 30,000 volts. Beyond that, for mechanical reasons, it is advisable to use malleable iron; but the so-called pin type of insulator has reached such dimensions in the endeavor to obtain higher voltages that it is the general opinion that this type of insulator has exceeded the limit of good line construction. Not only is it a difficult matter, from a mechanical standpoint, to find a pin that will take the necessary stress, but the problem of manufacture from the standpoint of the pottery is exceedingly difficult. It is probable that in future work a suspended type of insulator will be used, it being a comparatively simple matter mechanically, and it seems possible to design an insulator that will be both mechanically strong and possess good insulating qualities.

The suspended type of insulator would have the advantage that ample arcing distances could be provided without making the insulator topheavy and difficult to manufacture. It should not permit arcing to occur until the potential is sufficient to rupture the air and cause the current to arc from end to end, this feature being of great importance in steel tower work. On high-voltage lines where steel towers are used the pin type of insulator for 100,000 volts or higher would seem to be almost an impossibility, owing to the size necessary to take care of the wires, and to line disturbances, and owing to the fact that the earth potential is carried into the insulator by the steel pin and through the metal towers.

An ideal insulator would take care of all climatic conditions and have few still air spaces. It should expose a large part of its surface to the wind and have a long leakage distance of small area. Cemented parts, if any, should be under compression and not tension on account of expansion and contraction strains. There should be nothing but porcelain between the points of opposite potential. It is only a question of time before insulators designed along these lines will be evolved. On the insulator alone should be the reliance of the engineer for his insulation, and all insulators, whether porcelain or glass, should be tested with approximately three times the full line voltage brought to the inside of the insulator head. The cost of the insulator is not a matter of paramount importance.

In the discussion there was general agreement that lightning troubles and sometimes resonance are the more serious prob-

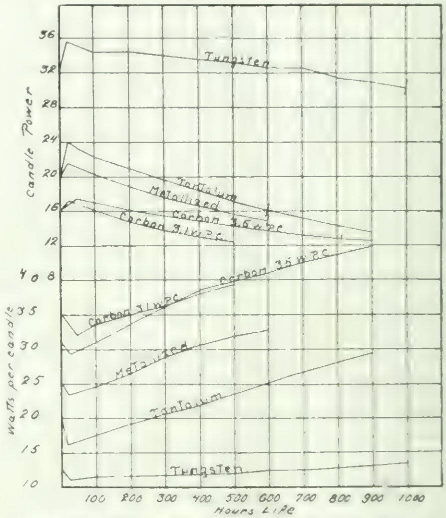
lems in insulator work. The Toronto-Niagara line has been remarkably successful except for lightning, which has shut down the line a few times by arcing over from the insulator to ground. The line originally had multi-gap arresters only, at the ends of the line, but the horn-gap type have since been installed, the horns being grounded 3 ft. above the transmission line on each tower. The new type of electrolytic arrester will also be installed. In one case an insulator broke and the wire struck the tower; a surge resulted, but the arc was broken by the horn gap.

The next paper was by Mr. A. E. Fleming, of the Canadian Nernst Lamp Department, on "The Value of the Nernst Lamp to the Central Station." Within the last three or four years more new types of lamps have been brought out than at any time in the 30 years' existence of the incandescent lamp. With the introduction of these new types has come a remarkable change in the sales policy of central stations. The most progressive have not only taken advantage of high efficiency lamps, but have also been more liberal and broad-minded in their dealings with consumers. Mr. Fleming emphasized the value of the Nernst lamp in meeting gas and gasoline competition and quoted at length from Mr. T. C. Martin's progress committee report to the National Electric Light Association in 1906 illustrating the success of this lamp in displacing the ordinary four-burner gas-arc lamp. He then described the different styles of Nernst lamp now on the market and discussed its color value. The latter feature was one of the strongest points in leading the Pennsylvania Railroad Terminal in New York to adopt the Nernst lamp. The illuminating engineers in charge of this work had one of the most difficult propositions to consider that has ever come before the lighting world. From the lighting of the main waiting room, which is about 300 ft. long, 100 ft. wide and 167 ft. high, to an office 16 ft. x 20 ft. x 12 ft. was the range, and 15,000 Nernst glowers were selected for the work. Marshall Field & Company, of Chicago, have replaced 40,000 incandescents by 12,000 glower units in their 38 acres of floor space.

The objection of high initial cost of the Nernst system is often raised, but the objectors do not stop to consider the low power factor of the arc lamp, which means additional outlay in secondary distribution, transformers and station equipment. Under such cases the Nernst lamp costs very nearly 50 per cent less per unit. Experienced, but not expert labor is required for maintenance, which, at the prevailing prices and guarantees on Nernst lamp repair parts in Canada, should not exceed 0.6 cents per kw-hour, and some stations claim 0.3 cents. Over 20,000 glowers have been installed in Canada, and in the United States over a million glower units are in operation. The Nernst lamp should aid the change from flat to meter rates, assist in meeting gas competition, create new advertising business, and broaden the peak by obtaining a large number of small customers whose connected load very nearly equals their daily peak consumption.

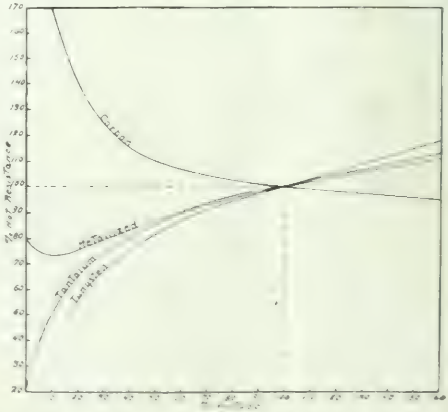
In discussion it was stated that poor regulation will shorten the life of the glower faster than variable frequency. One company reporting 618 glowers noticed a depreciation in candle-power of 30 per cent after 400 hours' burning. The cost of maintenance was 3 or 4 cents per glower, of which 10 per cent was for the maintenance of heaters. The life of glowers seems to be somewhat uncertain. To avoid the bad effects of vibration, the lamps can be hung from springs. Another company fixed the depreciation as 20 per cent in candle-power in 600 hours. Six or eight weeks ago a direct-current Nernst lamp was placed on the market, with heavier terminal and an average life of 500 hours per glower.

Mr. J. M. Robertson, of the Montreal Light, Heat & Power Company, then read a paper upon the "Present Status of Carbon and Metallic Filament Incandescent Lamps." He touched upon the history of recent high-efficiency developments and described the essential features of the types now on the market. Summing these up, the carbon filament's lowest consumption is 3.1 watts per candle-power, with short life on variable voltage; the metallized filament has a positive temperature coefficient and increase in candle-power of 80 per cent of that on increasing voltage of the carbon lamp, and a life of 560 hours on good regulation; the tantalum lamp has about double the efficiency of the carbon filament, and lamps in the 10 to 16 candle-power size, with a life of from 500 to 1000 hours, may be soon obtainable, and the life on alternating current is about 60 per cent of that on direct-current circuits; the tungsten lamp has a life of 1000 hours on a well-regulated circuit and a consumption of 1.3 w. p. c. Very careful handling of the tantalum lamp is required where short, sharp vibrations are present. Mr. Robertson then discussed a curve sheet which he had prepared, showing the relative ratings, consumptions, and candle-powers in terms of life and voltage, with tabulated costs as printed below:



[illegible]

The discussion hinged mainly upon the influence of high-efficiency lamps, particularly the new helion lamp, which is not yet on the market, upon central-station revenue. The general



[illegible]

opinion was that the industry would not be harmed for any length of time because of the time required to change-over established methods of manufacturing and the stimulus to en-

ergy sale and extensions of loads which improved lamps would bring about.

The afternoon session was opened by Mr. John Murphy's paper on "A Remedy for Frazil and Anchor Ice." Mr. Murphy exhaustively discussed the physical phenomena associated

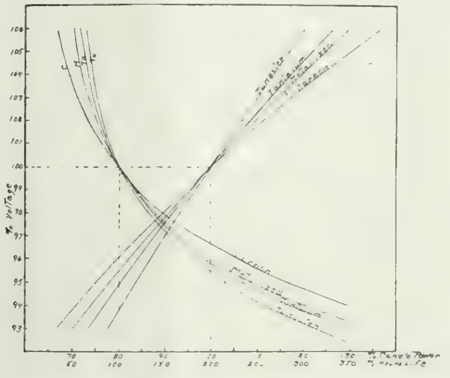


FIG. 3.—VARIATION OF LIFE AND ILLUMINATION WITH CHANGE IN THE OPERATING E. M. F.

with freezing, and showed the absolute impossibility of attempting to prevent the forming of ice in the river approaches to hydroelectric plants by the application of heat on a large scale. The surface formed ice or frazil is the chief offender, sticking to the packs, gates and wheel parts. The ice difficulties at

TABLE SHOWING THE COST OF ELECTRICITY AND RENEWALS FOR VARIOUS TYPES OF LAMPS

Kind of Lamp	Candle Power	Amperes	Watts	[illegible]	Cost of Power per K. W. HR. — Cost of Power and Lamp Renewals per 1000 Hours	[illegible]
Carbon Street Series	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Carbon Street Series	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tungsten Street Series	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tantalum [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Ottawa in the past winter were reviewed as illustrative. Shortage of water is another difficulty in hydroelectric plants in the cold winters of northern latitudes. Many hydraulic engineers in estimating the area drained lose sight of the fact that little or no drainage occurs during a great part of each winter in northern latitudes.

The first trouble which frazil usually causes at a hydraulic plant is to clog up the openings in the rock or screen. This may to a great extent be obviated by the use of a motor-driven rake which is more effective than hand raking in continuous service. Then the racks are kept open by raking the frazil, which passes in and forms like adhesive plaster around the gates and mechanism, thus preventing speed regulation, and finally shutting down the wheels altogether.

When the sun is shining anchor ice rises from the bottom of the stream, bringing with it loose rocks, etc., and is carried by the current into the forebay. Here the pressure of the water holds it against the rack, and while it is not adhesive or very cohesive at such times, it will stop the flow of water if it is not broken up by raking and passed through.

It was found in one case that waterwheels which had their tail races enclosed so that the cold air could not sweep in were more slowly affected by [illegible] protected

Waterwheels set in wooden penstocks fared better than those in exposed concrete chambers. Mr. Murphy applied a moderate amount of heat to the racks and other parts of the hydraulic equipment, and succeeded in obviating the frazil difficulties. With the aid of an old boiler which had been operating a couple of steam drills, a 3000-hp station was kept in operation throughout sieges of frazil which shut down or tied up every other waterwheel in the Ottawa district. Some experiments were carried out upon the racks at a temperature of 15 degs. F. It was only necessary to expend 180 watts upon an iron bar in a rack made up of strips 3.5 in. wide and 0.25 in. thick in order to detach solid ice which otherwise could be removed with great difficulty and with a chisel or axe. The section of the rack warmed was 5 ft. long. Waterwheels are successfully warmed by steam, also. In one station five sets of wheels are supplied by a boiler which is unable to consume more than a ton and a quarter of coal in 24 hours, and steam is not applied to the wheels continuously—though such is the proper plan when frazil is running—but it is only injected when the gates are inclined to get stiff or when the wheels show signs of dropping their loads.

An illustrated lecture on illumination was then given by Mr. V. R. Lansingh, of New York. A large number of slides of typical installations were shown, with comments upon the principles and methods involved. Illumination, both as a science and as an art, was broadly discussed.

The session of Friday included the papers of Mr. G. P. Cole, Allis-Chalmers-Bullock Company, on "Modern Lighting Transformers," and Mr. Geo. H. Montgomery, of the Montreal Light, Heat & Power Company, on "The Responsibility of Electrical Companies for Accidents." Mr. Cole's paper reviewed in detail the latest progress in core-type transformer designs and construction, with special reference to special alloyed sheet steel of low watts loss. Insulation, regulation, efficiency, small core loss, low rise of temperature and lessened cost of manufacture all depend upon sheet steel of favorable qualities, which can be had in the market; with a low watts loss iron there can be used a higher density for the same core loss, resulting in fewer turns of coils and a greater allowable coil cross-section. Efficiency and regulation are both better for this reason. Close regulation is important since the power recorded is almost in direct proportion to the voltage at the meter. Poor regulation decreases the revenue and also gives the customer poor service.

In lighting transformers of the present day no trouble need be feared from ageing, as the core plates are not clamped too tightly and the operating temperatures are comparatively low. Ageing is only due to an excessive operating temperature, and has been shown in even the worst samples of sheet iron to occur hardly ever below 80 degs. C. Such operating temperature is rarely met in lighting transformers. The rules of the German Electro-technical Society define ageing as the percentage variation of the figure of loss (which is the watts loss per kilogram at a density of 10,000 lines per sq. cm. and 50 cycles per second) caused by keeping the sample at 100 degs. C. for over 600 hours. The paper concluded with a description of modern impregnating methods.

Mr. Montgomery pointed out that electricity is in a class almost by itself as regards the difficulty of the task imposed upon those engaged in its production and distribution. The failure of appliances, the carelessness of employees, and more frequently, the reckless imprudence and gross negligence of the public afford very easy channels for the arrival of accidents. The paper reviewed a considerable number of cases against Canadian companies, and emphasized the legal bearings of reasonable care in the prevention of accidents on the part of the public and the [illegible] station.

A feature of the convention was the publication of its annual question box under the editorship of Mr. A. A. Dion, of Ottawa. This was printed in pamphlet form, and it contains a large number of practical operating points of general interest, which cannot be outlined in these paragraphs for lack of space at this time.

New Telephone Patents.

With two-wire multiple common-battery systems the necessity of devising a non-interfering busy test was at once apparent. The obvious way was the use of a high retardation relay operating upon a minute current and controlling the larger busy test current through its contacts. If such a relay be permanently connected to the cord circuits, it is evident that a leak in any one will defeat the test of a whole position. Because of this keys are arranged to connect the busy test relay to any cord during only the actual period of testing. W. W. Dean has associated his busy test and listening keys so that they are operated by different positions of a common lever. Besides this he provides an electrically operated locking device which prevents operation of the test key on any cord, if the plug be in a jack. Mr. Dean has patented this arrangement and assigned it to the Kellogg Company.

In Fig. 1, is shown a repeater circuit invented by N. A. Warth, of Columbus, Ohio. It will be noted that there is a short circuit across the line conductors at H. Now this divides the receiving and forwarding lines so that there can be practically no direct effect of either upon the other. It will be noted that the repeating induction coil has four sections,

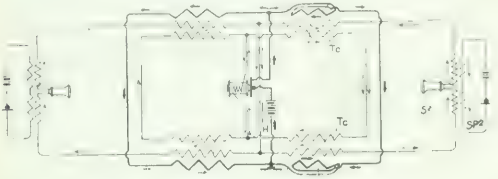


FIG. 1.—WARTH TELEPHONE REPEATER.

each of three windings. All three have corresponding bridges. In the bridge of one local circuit is the receiving part of the repeater and in the other the transmitter and battery. Now an impulse arriving from S^2 cannot pass beyond H. It induces currents in both locals at T_c, T_c. Those of the primaries practically all pass through the transmitter bridge without effect. Those of the tertiary affect the receiver and transmitter. The new impulses from the transmitter divide between the two primary coil circuits, with two effects; the one is a repeating of the reinforced current into the main line, while the other is a set of four potentials set up in the tertiary circuit. If these latter be of equal values and properly poled, the receiver part will be virtually connected between equipotential points as far as this reinduced effect is concerned, and thus we have traced our repeated current through without having produced any secondary excitation of the receiving part.

Fig. 2 shows two forms of bridle rings for conveniently supporting wires along walls and fences. The cut is self-explanatory. The patentee is W. J. Hiss, Jr., of New York City.

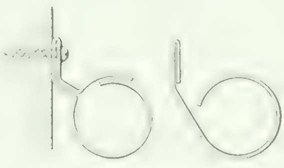


FIG. 2.—HISS BRIDLE RINGS.

With farmer stations there is often a considerable waste of battery due to the listening in on the line of those stations not wanted. Again there is apt to be introduced upon the line various disturbing noises picked up by the transmitters of these stations. To avoid this, A. S. Perry, of Yukon, Okla., has patented a wall set with a push switch to control the primary circuit. This switch locks in, if pushed while the receiver is off the hook, and it is released by the return of the receiver. The primary circuit is only made when the push is depressed.

R. P. Ludlow, of Philadelphia, is the inventor of a combined transmitter and receiver. A diaphragm is mounted in the usual way before the poles of a receiver magnet, and a linkage connects the diaphragm with the front electrode of a transmitter contained in the same case. The two elements are connected in series. It is expected that the received impulse will affect the diaphragm and transmitter simultaneously and that the effect of the latter upon the current will augment the original effect.

LETTERS TO THE EDITORS.

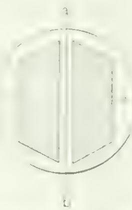
Color Photometry.

To the Editors of Electrical World:

SIRS:—All who have an interest in the subject of photometry and are acquainted with the new theories of vision as set forth in a paper by the writer, reprinted in the Smithsonian Report for 1904, will not be surprised at the results obtained by Lauriol, upon which you commented editorially in your issue of April 27.

In the first place, it is necessary to distinguish strictly between photometers for the comparison of sources of light of the same and of different color.

Both Dr. Brodhun and myself have always emphasized that our photometer (working for equality as well as contrast), was devised with a view to utilizing as fully as possible the sensitiveness of the eye to illumination differences in the comparison of sources of light of identical color. Both Dr. Brodhun (who is color-blind, and who discovered the traveling of the neutral point with decreasing brightness of the colored fields under comparison) and the writer knew very well that the ratio of the intensities of two fields of different colors depends on the size of the fields, on the absolute value of the illumination, and on the "color" of the source of light for comparison. For this reason our photometer is intended only for comparison of light of the same color. Beyond that—ultra posse nemo



PHOTOMETER DISK.

tenetur—no one is justified in using our photometer beyond its limits of application, nor in condemning it if he does so.

In the incandescent lamp industry, and in the illuminating practice where the object is always to make relative measurements, absolutely identical color can be obtained. To connect with the unit of light, however, fundamental measurements are necessary on sources of light which are not of absolutely uniform spectral quality. In reducing the paraffine candle to the hefner unit a slight inaccuracy is not of much importance. In determining the relation between incandescent lamps as standard lamps and the hefner lamp it is easy to obtain an accuracy of 1 per cent. In the case of a comparative test with a color-blind observer and the writer, the same adjustment sufficed, especially in the case of the contrast photometer, where the adjustment is made such that the two somewhat differently colored trapezoids *c* and *d* in the accompanying sketch appear with the same sharpness. This method is essentially based on the criterion of "sharpness" of vision, which alone is a correct principle for comparing differently colored sources of light, and should be further developed.

We also gave attention to the disappearance of the line *a b* in the sketch, which vanishes when the trapezoids *c* and *d* become equally sharp. The reason is that the sharp image of

a b on the retina always so strikes a retinal element that the sensation of mixed color is produced.

For comparing very differently colored fields the Lummer-Brodhun photometer fails, and must fail. Possibly the comparison of very differently colored fields has no real value. Experiments are now being made under my direction on spectral light with the flicker photometer of Rood, and determinations are being made of the "brightness-sensibility curve," which indicates how much the sensibility of the eye differs for different wave lengths. In the photometry of colored fields we are still at sea. Certainly all methods should be avoided in which, as in the comparison of brightness, the Purkinje and similar phenomena play a rôle. Unfortunately these limitations are little known.

The delay in sending this communication is due to my recent trip in the United States, and to much urgent work which had

BRESLAU, GERMANY. OTTO LUMMER.
Königl. Universität.

Iron Bridges and Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—It is popularly supposed that large, elevated masses of metal, either in the form of iron buildings or bridges, are inimical to wireless communication in their immediate neighborhood, owing to absorption or shadow effects. That this is not necessarily true was recently brought to the attention of the writer by Mr. Benjamin Dolbear.

Mr. Dolbear, then in charge of the wireless installation on the *Horatio Hall*, of the Maine Steamship Company, plying between New York and Portland, Maine, observed a very marked increase in the intensity of received signals while passing under the East River Williamsburg bridge, and a similar, although not so strongly marked effect, under the partially completed bridge at Blackwell's Island. This increase in intensity appeared to be confined to relatively short wave lengths, of the order of 500 meters or less, and was either absent or reversed in the case of long waves, as was shown by the 1800-meter waves from the Marconi station at South Wellfleet, Mass., which decreased in intensity beneath the bridges.

The writer, wishing personally to observe this effect, recently made a trip to New York on the *Horatio Hall*, and was fortunate enough to have the involuntary cooperation of a number of more or less distant stations while passing under the bridges. When within a few hundred yards north of the Williamsburg Bridge, the steamer *Priscilla*, of the Fall River Line, then about two hours out of New York, and probably some 25 miles up the Sound, commenced to send, and continued until the *Horatio Hall* passed under the bridge, and arrived at her dock on the other side. When within about a hundred yards of the bridge, the intensity of the sound in the telephone receivers began slowly to increase, reaching a maximum of about three times normal when the antenna was directly under the bridge, and then, almost immediately after leaving the bridge, falling back very sharply to normal intensity.

On the return trip, similar observations were made with the stations at Galilee, N. J., and 42 Broadway, New York, these being on the south side of the bridge. In each case the effect was the same; a slow increase in the strength of the signals as the bridge was approached from the sending station side, and a very rapid falling back to normal when the bridge was passed.

The writer would be inclined to lay this effect to a "wave chute" action of the bridge, gliding electrical waves being concentrated along the conducting structure, were it not for the fact that the stations heard were nearly at right angles to the bridge, so that the wave front must have been nearly parallel to the bridge. He trusts that this communication will lead others to make further observations in the East River, as wirelessly equipped vessels pass under the bridges daily, and sending stations are numerous.

AMESBURY, MASS. GREENLEAF W. PICKARD.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors, and Transformers.

Winding Alternator Coils.—An illustrated description of the new method of the Oerlikon Company, which has been noticed in the Digest, for constructing the coils used on armatures with open slots. The coils are formed complete and fully insulated before mounting in the slots, in which they are held, as usual, by wedges. Instead of winding them with ordinary round or rectangular cotton-covered wires, bare, flat copper strip is used. This strip is bent on formers into its final shape and arranged so as to lie flat in the slot; that is, the width of the strip takes up the whole width of the slot and the depth of the slot is occupied by a number of layers of the strips. The separate strips are next covered throughout with tape or paper, or in special cases, with micanite, and finally the completed coil is covered, at the parts which lie in the slots, with a jointless coating of micanite. It is claimed that in this way the slot space is utilized to the best advantage by reducing the necessary insulation since the turns only touch at the flat sides and the voltage difference of only a single turn occurs from layer to layer. Since the insulation is put on after the bending is completed there is no risk of breakdown during formation, and the absence of air spaces between the turns reduces the likelihood of any chemical action occurring at high pressure.—Lond. *Elec. Rev.*, Aug. 30.

Direct-Current Dynamo.—[illegible].—A correction of his former mathematical study of a direct-current dynamo.—*L'Industrie Electrique*, Aug. 15.

Testing Transformers.—C. F. Guilbert.—An article illustrated by diagrams on a method of testing transformers which is a modification of the old method of Sumpner.—*L'Eclairage Electrique*, Aug. 24.

Lamps and Lighting.

Direct-Current Metallic Arcs.—C. E. GUYE AND L. ZEBRIKOFF.—An abstract of a French Academy paper. Mrs. Ayrton has shown that the power P consumed in a carbon arc with different currents i may be represented by a straight line according to the equation

$$P = A + Bi$$

where A and B are constants, and the length of the arc is assumed to be constant. On the other hand, if the current is held constant and the length l of the arc is varied, the relation is again a straight line according to the equation

$$P = C + Dl$$

From these two equations she has found a formula which represents very well the potential difference e at the electrodes as a function of arc length and current. This formula is

$$e = a + bl + \frac{c + dl}{i}$$

where a, b, c, and d are constants which depend on the nature of the electrodes and the conditions of the atmosphere in which the arc burns. The present authors have made experiments with arcs between metals and have found that the above formula applies very well to them. Care was taken to have stable arcs. The results are given in the following table, the figures for a, b, c and d, being the coefficients in the above formula. The figures on carbon are those of Mrs. Ayrton; those for the other metals are the results of the present authors.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cobalt	20.71	2.05	2.07	10.12
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Iron	15.73	2.52	9.44	15.02

The above formula, with the above numerical coefficients, is said to represent very well the potential difference at the electrodes for short and stable arcs.—*L'Industrie Elec.*, Aug. 25.

[illegible] *Lamp with Thermo-Element.*—[illegible]—At the recent annual meeting of the German Society of Gas and Water Engineers, the author gave a demonstration of the new Lucas compressed-gas lamp with a thermo-element. The disadvantage of ordinary compressed-gas lamps (which, on account of their intense light, are believed to be in the best position to compete with electric arc lamps) is the necessity of providing compressors which need attendance, the use of special pipes and special fittings, etc. Lucas avoids all this by providing a small thermo-element to each lamp. It consists of two different alloys, one an alloy of copper and aluminum and the other an alloy of copper and nickel. Each of the alloys is quite refractory and since the waste gases contain sufficient heat there is no necessity of using a highly efficient thermo-element. This thermo-element supplies current to a small motor, which drives a ventilator for compressing the gas. The operation is as follows: The lamp is first lighted and the flame, with comparatively small candle-power, heats the thermo-element, which now generates a voltage. After about half a minute the ventilator begins to move and sucks air in, revolving at a speed of 2000 r. p. m. The air is mixed within the box with the entering illuminating gas and the mixture of gas and air is supplied under the required higher pressure into the incandescent mantle. In the first construction of the thermo-element, its life was found to be a year, but by some modifications the life is believed to have been lengthened now a great deal beyond this period.—*Jour. f. Gasbeleucht.*, Aug. 24.

Mercury-Vapor Lamps.—A note on a new form of the Bastian mercury-vapor lamp, which is illustrated in Fig. 1. The lamp takes about 500 watts at 200 or 220 volts. The lamp tube

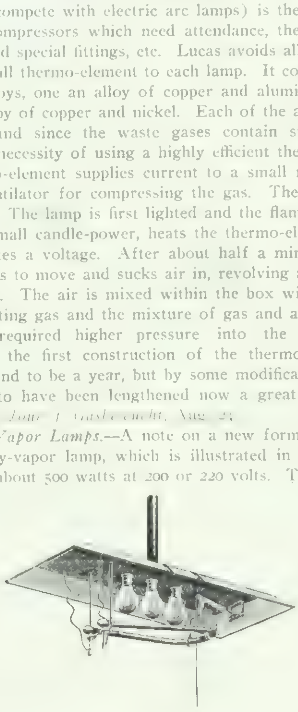


FIG. 1.—MERCURY-VAPOR LAMP.

[illegible] so that the light emitting surface is of large area. In former types the incandescent lamps were connected in parallel with a mercury-vapor lamp, thus increasing the current required. In the new type, however, the lamp is started by pulling the cord to tilt the tube, a small external resistance being in series with it. The external resistance is then cut out and replaced by the incandescent lamps. The light is stated to be remarkably free from shadows, "and effectively lights a large area, the candle-power, so far as it is practicable to measure it, being greater than that of an arc lamp of equivalent watts, while no trimming or other attention is required during its life. The quality of the light with the incandescent lamps in circuit is very nearly white, the ghastly effects of the pure mercury-vapor lamp being absent."—Lond. *Electrical Review*, Aug. 23.

[illegible] he described the Carbone arc lamp, which has been repeatedly noticed in the Digest. The author also describes the latest lamp made by the same company, which is called the "Radiante" direct-current lamp. In principle the system of regulation of these lamps is the same as in lamps with inclined carbons, but in the new lamp the carbons are placed one above the other. The "radiants" burn 20 to 30 hours and are made for any desired current up to 12 amperes at an e. m. f. of 80 volts per lamp.—*Elek. Zeit.*, Aug. 29.

New Lamps.—A second article on recent advances in artificial lighting. The present installment deals with arc and vacuum-tube electric lamps under the following headings: Light from gases and vapors; direct and alternating-current arcs; luminous arcs; flame arcs; metallic arc lamps; use of metallic arc lamps as rectifiers; Cooper-Hewitt mercury-vapor lamps, and Moore vacuum-tube lamps.—*Eng'ing News*, Sept. 12.

Power.

Water Power.—J. SMYTH.—A paper read before the British Association in which the author states that many falls of water are not utilized because they are considered too small and the flow of water too irregular. The author claims that such falls may be made valuable by using a source of variable auxiliary power to supplement the water supply. The following instance is given: On the upper Bann River, in the North of Ireland, there are a number of these small falls. On one of these the head is 8 ft. 2½ ins., but as there is a loss from a long and somewhat narrow race in part of its course, only 7 ft. 6 ins. is reckoned on. Two Achilles turbines, one 48 ins. in diameter and one 36 ins., have been erected at this fall. They are capable of developing 126 horse-power with a discharge of 11,095 cu. ft. per minute at full gate of sluice. As it is an advantage to work with something less than full gate with such turbines, they are never required to do more than about 112 horse-power. There are reservoirs provided for the river by a public company to keep up the normal supply in summer and in scarce times to 4500 cu. ft. per minute or 54 horse-power. At these and intermediate times the necessary power for the machinery is kept up by a steam engine, so that it is estimated that an average of 83 horse-power is obtained. Had a turbine, or turbines in this case, been erected for only the normal supply, a loss would have resulted of 3.8 horse-power throughout the year (or $95 per annum if steam were used for 10 hours' drive per day). A steam engine is used as the supplemental motor in this case, as the works are used for bleaching, where the steam is passed through a high-pressure engine at 65 lbs. per sq. in. and leaves it at about 4 lbs. passing into another boiler, thence to do the boiling and heating required in such works, and thereby great economy is secured. In other works the supplemental power might be obtained from an oil or gas engine.—Lond. *Elec. Review*, Aug. 23.

[illegible] the cost of the water-power plant which supplies the electrolytic chlorate factory at Vallorbe, in Switzerland. The height of fall is 70 m., the power utilized amounts to 3000 horse-power, and the output of the works is from 900 to 1000 tons of chlorates per year, calculated at the round figure of one ton per hp-day. The expenditure was as follows:

[illegible]	[illegible]
Dam	[illegible]
[illegible]	[illegible]
Pipe line...	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	60,000
[illegible]	8,000
	[illegible]

Thus the cost per horse-power was $40. Interest and depreciation at 10 per cent make $4 per hp-year. These results are exceptionally favorable; more usually, it is stated, the cost of installation would average $80 per horse-power and the annual charges $8.—Lond. [illegible]

[illegible] the electrical drive in the Peiner rolling mills, which obtain 4000 kilowatts from the metallurgical works of Ilsede, 4½ miles away. This is partly generated in an old three-phase steam station at 500 volts, the e. m. f. being increased to 10,000 volts for transmission. In parallel with this is a second sta-

tion in which three-phase currents are generated at 10,000 volts by gas engines operated with blast-furnace gas. The transmission lines, which are in duplicate, consist of six silicon-bronze wires 0.075-in. in section. At full load the voltage drop is 6 per cent, and the total loss is 4 per cent. In the rolling mills there are three synchronous-motor-generators each of 800 kilowatt capacity, which convert the three-phase currents into continuous current at 500 volts. There are also three 500-kw stationary transformers, which reduce the e. m. f. to 500 volts. The e. m. f. is further reduced to 110 volts for lighting purposes. There is a 289-cell battery with a rating of 2000 ampere-hours. The load in the rolling mills, which averages in the mean 1540, varies between 600 kilowatts and 1800 kilowatts. The transmission line also feeds a phosphorus factory, and an induction motor-converter supplies direct current to the slack conveyor. The total horse-power of the motors installed is 5772.—Lond. *Electrician*, Aug. 23.

Turbo Alternator.—An illustrated description of a large three-phase turbo-alternator built by a German company. It has a capacity of 2500 k. v. a.—*L'Industrie Electrique*, Aug. 25.

Traction.

Alternating Current Traction.—J. Sahulka.—A paper read before the last meeting of the German Association of Electrical Engineers on two new systems of alternating-current traction. Single-phase or polyphase currents may be used. Since no regulating resistances are required which are operated by the main current, the efficiency is claimed to be high. With the first system direct current may also be used. The first system is shown diagrammatically in Fig. 2. The motor *M* is

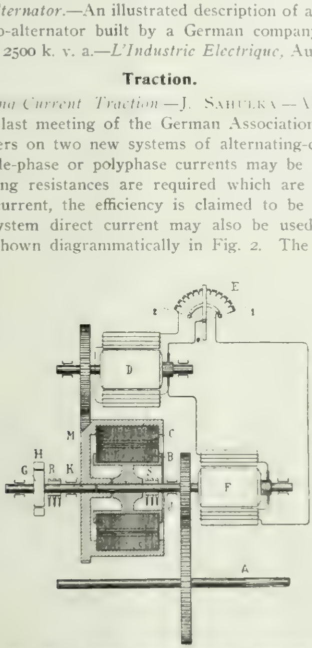


Fig. 2.—Alternating-Current Traction.

the main motor, and both its parts are movable. It acts on the driving axle *A* and on a direct-current shunt-wound generator *D*, which supplies energy to the motor *F*, which also acts on the axle *A*. In the illustration the motor *M* is assumed to be a three-phase induction machine which is operated directly by high-tension three-phase currents, but *M* could also be any other type of motor, either direct-current or alternating-current. The inner part *B* of the motor is mounted on the axle *J*; the outer part *C* is mounted on the concentric axle *K*. The operating currents are supplied to *C* by means of the slip-rings *R*. On the axle *J* slip-rings *S* may also be provided in order to use resistors during the starting of the motor *M*. These resistors may have a very small resistance, since the motor *M* is started unloaded. The member *B* acts on the axle *A*. In the same way the member *C* drives the shunt dynamo *D*, which supplies current to the motor *F*, which is mounted on the same axle *A* as the member *B* of the main motor *M*. The regulation of speed of the axle *A* is accomplished by the field rheostat *E* of the dynamo *D*. In starting, the motor *M* is first started unloaded, the circuit between *D* and *F* being broken. The lever of the resistance *E* is, therefore, in the position 1. If the motor *M* is started in the usual way the outer member *C* begins to run, and it reaches a certain maximum speed. In order to start the axle *A*, the circuit between *D* and *F* is closed by moving the lever of *E* to the left. The excitation of *D* is thus gradually increased. The motor *F*, therefore, receives current of gradually increasing intensity and drives the axle *A*. This is simultaneously driven by the main motor *M*. The dynamo *D* counteracts the motion of *C* so that the rotor *B* exerts a torque on the axle *K* and, therefore, also on the axle *A*. The greater excitation of the dynamo *D*, the greater is the driving effect of the motors *M* and *F* on the axle *A*. The regulation of speed of *A* is accomplished by the regulating rheostat *E* which may have a great number of steps. When the axle *A* is driven as described above the motor *M* gives half of its power directly to the axle *A*, while the other half is supplied to the dynamo *D*, which furnishes the current for the motor *F*. The motor *M* must therefore be sufficiently large to develop the whole power necessary for driving the axle *A*, while either of the two machines *D* and *F* needs to be of only half this rating. At any speed of the axle *A* the efficiency is high since the main motor *M* always runs at high speed and there are no losses in main-current rheostat. If *M* is an induction motor, the slip is very small at any speed of the axle *A*. The speed of the axle *A* may be increased beyond the value obtainable by diminishing the resistance *E*, by interrupting the circuit between *D* and *F* and turning on the brake *G* and *H* so as to bring the member *C* of the motor *M* to rest. The speed of the member *B* and of the axle *A* is thereby raised to a maximum and the axle *A* is driven only by the main motor *M*. The dynamo *D* is at rest and the motor *F* runs together with the motor *M*, but without current. This system enables the recuperation of energy when running down grades. In this case the main motor *M* must be an induction motor or a direct-current shunt motor. As soon as the member *C* of the motor *M* is brought to rest by breaking and the speed of the axle *A* rises beyond a certain value, the motor *M* returns energy to the network. Even at a lower speed of the axle (as long as the member *C* is not yet brought to rest) energy may be given back from the motor to the network by separately exciting the field magnet of the motor *F*. In this case, up to a certain speed of the axle *A*, the machine *F* acts as a generator supplying energy to the machine *D*, which now acts as a motor and raises the speed of the main motor *M* above synchronism so that again energy is returned

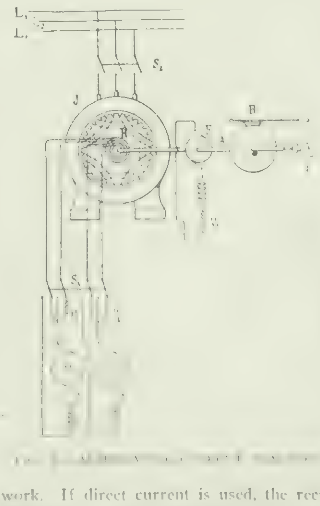


Fig. 3.—Alternating-Current Traction.

to the network. If direct current is used, the recuperation of energy requires that all three machines *M*, *D* and *F* be shunt wound. The system is claimed to have certain advantages over the Ward-Leonard system. The second system described in the paper employs single-phase commutator motors or three-phase induction motors. During starting they are supplied

with [illegible] e. m. f. from an induction motor acting as frequency changer. The arrangement is shown in Fig. 3. Three-phase currents are supplied to the induction motor J. Its rotor has a two-phase winding, the induced currents being taken off by means of the slip-rings R. The motor J is started unloaded; for this purpose the rotor windings are closed through the resistances P_1 and P_2. The two motors M_1 and M_2, which act on the driving axles are shown in the illustration as single-phase commutator motors with series windings. In order to start the motors the windings of the rotor of J are first connected by means of the switch S_3 with the motors M_1 and M_2 without the use of starting resistances. The motors M_1 and M_2 do not yet start, since J runs almost synchronously so that only a very small e. m. f. is induced in the windings of its rotor. By braking the rotor of J by means of the mechanical brake B, the frequency and voltage of the currents supplied to the motors M_1 and M_2 increase and the speed of these motors therefore begins to increase. By means of the brake B the speed of J may be varied so that the voltage and the frequency of the current supplied to M_1 and M_2 is simultaneously changed. At the end of the starting period, the motor J can be completely brought to rest by means of the brake B and acts then simply as stationary transformer. Since in the beginning of the starting period the frequency of the current supplied to M_1 and M_2 is very small, the disadvantages in starting single-phase commutator motors are avoided. The illustration also shows a braking dynamo E, which also acts on the axle of the induction motor J. Both B and E should be used for starting, while when running at medium speed E alone should be used. When M_1 and M_2 are to be brought to maximum speed the motor J is brought to rest by means of B.—*Elek. Zeit.*, Aug. 29.

Liverpool.—An abstract of the last report of the Municipal Tramways of Liverpool. The number of kw-hours used per car-mile increased from 1.448 in 1903 to 1.566 in 1904, 1.677 in 1905 and to 1.730 in 1906. The percentage increase in 1906 over the preceding year was three. On the other hand, the number of passengers carried increased 2.5 per cent, and the mileage 0.4 per cent. The cost per car-mile was 5.890 cents for traffic expenses, 3.262 cents for general repairs and maintenance, 3.960 cents for energy, 2.158 for general expenses, hence total expenses, excluding capital charges, 15.270 cents, and if the capital charges are included this figure becomes 22.022 cents. On the other hand, the income from all sources per car-mile was 23.114 cents.—Lond. *Electrician*, Aug. 23.

Installations, Systems and Appliances.

Manchester.—In the early nineties when the battle between continuous and alternating-current systems was at its height, Manchester was looked upon as the most powerful stronghold of the former and was recorded as an efficient example of what could be done with multi-wire distribution. In spite of this experience, this municipality has established within the past six years one of the largest alternating-current stations in England and is now supplying polyphase power direct to consumers' premises. At the present time the large Stuart Street station contains 27,000 horse-power of equipment comprising slow-speed vertical engines and flywheel alternators, but a 6000-kw steam turbine is being added and will shortly be put in service. Approximately 10,000 horse-power of this equipment is at the disposal of the motor supply, the remaining and greater portion taking the traction and lamp loads. The high-tension feeders are run in a cable tunnel, the feeders being three-core, paper-insulated and armored with steel wires. Beyond the tunnel the cables are laid in the ground in iron troughs filled with bitumen compound. The consumers' sub-station equipment is, in the case of new installations, arranged for polyphase supply entirely. When private plants have already continuous current in use and the motors are too numerous to be replaced by alternating-current machines, provision is made in the sub-station for a suitable converting equipment. In the present installment the sub-station equipment is described in detail with many [illegible]—Lond. *Electrician*, Aug. 23.

[illegible] P. MacGahan and H. W. [illegible]—An illustrated article in which the authors first discuss visual or indicating devices for synchronizing alternators, namely, the use of synchronizing lamps and the use of synchroscopes either of the inductor or of the Lincoln type. In the second part of the article an automatic synchronizer is described which is primarily intended for use in stations operating large machines and where it is essential that synchronizing be done rapidly and safely. In an editorial note by P. N. Lincoln the difference between machine operation and hand operation in this case is said to be that the machine uses no judgment and makes no mistakes, while a man may use judgment, but is prone to make mistakes. The experience already gained in practice has shown that personal judgment can be dispensed with in synchronizing, and that manual mistakes are more frequent than machine derangement.—*Electric Journal*, September.

Notation for Polyphase Circuits.—C. H. Porter.—In working out the current and voltage relations in complex cases of polyphase circuits the particular notation employed must be clearly defined. The author uses clock-face diagrams, and his notation is based essentially on lettering every junction and terminal on the diagram of connections and on the use of two subscripts with every symbol of current, or e. m. f., or a vector representing them. The vector diagram must be carefully distinguished from the diagram of connections, although there is a certain similarity between them in the simpler cases. The method of applying this notation is explained and illustrated by several problems.—*Electric Journal*, September.

Regulation of the Use of Electric Energy.—The regulations proposed to be made by the (British) Home Secretary for the generation, transformation, distribution and use of electrical energy in premises under the factory and workshop act of 1901. —Lond. *Electrician*, Aug. 23.

Wires, Wiring and Conduits.

Soldering.—A. Lippman.—Concerning joints made by soldering, the regulation of the German Association of Electrical Engineers is that the solder shall not contain anything which attacks the metal. Weber adds for explanation that colophony (common rosin) is suitable, but that in no instance should any acid be used. The present author discusses the different solders and their specific effects, and points out that any objection which might be raised against the content of acid in a solder cannot be based on the effect of the acid in the soldering process itself (since here it is advantageous), but only on after-effects, the metal being attacked by the acid after the joint has been made. But such after-effects are possible only when the workman is careless. The author shows that it is impracticable not to use any acid if one desires to omit previous careful cleaning of the metallic surfaces either by mechanical or chemical means. Further, the author's researches have shown that so-called absolutely acid-free solders may contain no acid when they are bought, but are liable to cause the formation of an acid later on; finally, common rosin contains some free organic acid. The article is to be continued.—*Elek. Zeit.*, Aug. 29.

Records and Drawings of Electric Mains.—W. M. Milnes.—An account of the methods adopted by the electricity works of Burnley for keeping records and drawings of their mains. As long as the supply amounted to only a small output over a small area the mains were simply plotted on ordnance survey maps of the supply area, but when the supply increased this method was no longer satisfactory and a new system was devised. The new system is described and illustrated.—Lond. *Electrical Review*, Aug. 16.

Electrophysics and Magnetism.

Resonance.—G. Benischke.—If in an [illegible] circuit a condenser and an inductance coil are connected in series, resonance occurs when the inductive and the condensive reactances are equal. The resonance phenomenon is, however changed with respect to the point of its occurrence and the am

plitude of the condenser is not a perfect one, but has a certain conductance, or if the self-inductance of the inductance coil is complicated by eddy currents or magnetic hysteresis. The author formerly investigated the effect of the conductivity of a condenser and in the present article he outlines the effects of eddy currents and hysteresis. He finds that the point at which resonance occurs is changed, and takes place at a lower condensive reactance. The maximum of the current is also smaller. Both of these effects are the stronger the stronger the eddy currents and hysteresis and the higher the frequency.—*Elek. u. Masch.*, Aug. 18.

Direction of Induced Currents.—H. L. KIRKER.—In an article illustrated by diagrams, the author describes an easy method for remembering the relation between the direction of induced current and motion of a conductor in a magnetic field. One must remember that a current-carrying circuit is encircled by circular lines of force and that the relation of the direction of the magnetic lines to the direction of the current in the wire is that of right-hand rotation, and the forward-travel of a corkscrew. He then assumes the encircling magnetism to be a magnetic whirl or vortex. If such encircling magnetic lines come into the neighborhood of another wire they are held back from jumping across the wire, thus forming a bend or dent in the vortex. This dent becomes an incipient vortex around the neighboring wire and this gives an immediate indication of the current produced.—*Electric Journal,* September.

Electrochemistry and Batteries.

Storage Battery Development.—L. H. FLANDERS.—An article in which the author discusses the trend of the development of the lead storage battery. For the positive plate of the Plante type the principal object of design is now to confine the buckling effect to the individual sections and not to let it develop in the plate as a whole; also to make all parts of the active mass equally accessible to the current and to the electrolyte. The trouble in the negative plate of the Plante type is the loss of capacity due to the shrinkage of the negative material, on account of cohesion and welding together of particles of the porous mass. This has recently been overcome by the introduction of inert material into the pores of the spongy mass, which prevents the collapsing and sticking together of the walls of the pores. There is little probability of any development being made in the electrolyte beyond increasing and maintaining its purity. With respect to containers, efforts are now being made to manufacture glazed earthenware tanks. If successful, they will prove absolutely permanent and while their first cost will probably be somewhat higher than lead-lined wooden tanks, the reduced maintenance charge will more than compensate for this increase. The greatest care is necessary in the installation of batteries, since proper installation is a large factor in reducing the maintenance expense. In charging, the author recommends the determination of the end of the charge by the measurements of specific gravity rather than by voltage measurements. The persistent use of the auxiliary cadmium electrode to determine whether trouble is caused by the positive or negative plates should be encouraged. The use of distilled water for replenishing the loss in the solution due to the evaporation and care in preventing impurities from getting into the cells must be insisted upon.—*Electric Journal,* September.

Electric Hardening Furnace.—L. M. COHN.—A paper read before the Vienna Electrical Society on an electric furnace for hardening steel. The advantages are that the temperature can be quickly raised to any desired point and can be very carefully regulated and maintained. The furnace is essentially a crucible, which is carefully insulated to prevent loss of heat. Current is introduced into the crucible through two terminal plates of wrought iron. The crucible is filled with a metallic salt which is a non-conductor at ordinary temperatures, but a conductor at higher temperatures. In order to fuse the salt a piece of carbon is first inserted between the two iron terminal plates so that the current can pass through it and heat the surrounding particles of the salt. Comparisons are made concerning the cost of hardening steel in a gas furnace and in an electric furnace. The results of tests have shown that with the electric furnace it is possible to reduce the time required very considerably so that the cost of attendance and wages is also reduced. The total cost for doing the same work, in the case in question, with the electric furnace was found to be only about one-third of that with the gas furnace.—*Elek. u. Masch.*, Aug. 18 and 25.

Electric Iron Ore Reduction.—A. E. GREEN AND F. S. MACGREGOR.—An account of an experimental investigation of reduction of iron ore in an electric furnace rated at about 30 kilowatts. The construction of the furnace and the methods of measurements are described, and the results of some runs with the amount of energy consumed are given.—*Electrochem. and Met. Ind.*, September.

Units, Measurements and Instruments.

Photometry.—A conference of the International Commission for Photometry was held in Zurich from July 16 to 18. Fifteen delegates were present, France being represented by five, Germany by four, England by two, and Italy, Austria, Holland and Switzerland each by one. On the basis of reports presented by the (German) Reichsanstalt, by the (British) National Physical Laboratory, by the Central Laboratory of Electricity in Paris and by the Testing Laboratory of the Conservatoire des Arts et Metiers in Paris, the conference adopted the following relations between the fundamental units of light:

$$1 \text{ carcel} = 10.7_8 \text{ hefner}$$
$$1 \text{ harcourt} = 10.9_5 \text{ hefner}$$
$$1 \text{ harcourt} = 1.02_0 \text{ carcel.}$$

These figures are considered to be correct within 1 per cent.. The last digit, which is printed in small type, is uncertain. The carcel and the harcourt are assumed to burn in air containing 10 liters of steam per cubic meter, the hefner in air containing 8.8 liters of steam per cubic meter. In order to prevent confusion the conference recommends the following notation:

I_h horizontal candle-power (intensity)
I_{α_s} candle-power at the angle α above the horizontal
I_{α_i} candle-power at the angle α below the horizontal
I_o mean spherical candle-power
$I \frown$ mean upper hemispherical candle-power
$I \smile$ mean lower hemispherical candle-power
$I_{m\alpha_s}$ maximum candle-power at the angle α above the horizontal
$I_{m\alpha_i}$ maximum candle-power at the angle α below the horizontal.

(The United States seems not to have been represented at the conference.)—*L'Industrie Elec.*, Aug. 10.

Universal Instrument for High-Frequency Currents.—E. NESPER.—The first part of a description of a universal measuring instrument for high-frequency currents and oscillations. It may be used as a calibrated resonator for measuring frequencies and wave lengths, for plotting resonance curves or for the production of oscillations of certain frequencies, etc. It is essentially a closed oscillation circuit in which a condenser of variable capacity is made use of. Indicating and exciting devices may be connected to the instrument in various ways.—*Elek. Zeit.*, Aug. 29.

High-Temperature Measurements with the Nernst Glower.—C. E. MENDENHALL and L. R. INGERSOLL.—By a graphical extrapolation of the empirical isochromatic radiation formula the authors determined the working temperature of the Nernst glower. For an 0.8-ampere, 110-volt glower, 1.04 mm. in diameter, the temperature may be perhaps placed at 2120 or 2200 degrees C. (according to the value accepted for the platinum melting point, which is either 1745 deg. C., or 1780 degrees C.); for one, 1.30 mm. in diameter, the temperature is some 200 degrees lower. The maximum temperature attainable with the Nernst glower is about 2380 degrees C., or 2490 degrees C. The authors have also used the glower as a species of optical meldometer, which, for the determination of high temperature melting points, seems to have certain decided advantages, namely, simplicity of method, great temperature-range and, at least for certain classes of metals, freedom from contamination and alloying of metals used. In this way a number of melting points have been determined. For each melting point two figures are given according to the uncertainty

[illegible]
[illegible]
melting point of palladium 1548 or 1576, that or rhodium 1907
[illegible]
[illegible]

Units and Standards.—The report of the (British) Association Committee on practical standards for electrical measurements. The chief points of the report have already been noticed in the Digest. Three appendices are reprinted in full, all emanating from the (British) National Physical Laboratory. The first gives notes on the present condition of the work on electrical units at that laboratory; the second gives the specification for the practical application of the definition of the international ampere, and the third exact rules as to the preparation of the Weston cadmium standard cell.—Lond. [illegible], Aug. 16.

Standard Cells.—G. A. Hulett.—An account of an experimental investigation of the chemistry of mercurous sulphate, cadmium sulphate and the cadmium cell, with observations on the ageing of standard cells.—*Phys. Review,* July.

Inductance.—An abstract of a Physical Society paper, by L. Cohen, on an exact formula for the mutual inductance of coaxial solenoids, and an abstract of a paper by E. P. Rosa on a new method for the absolute measurement of inductance.—*Phys. Review,* July.

Meter.—An official announcement of the Reichsanstalt admitting for calibration an alternating-current induction meter of the Siemens-Schuckert Company and describing its action and construction.—*Elek. Zeit.,* Aug. 29.

Testing Switchboard.—An illustrated description of the general arrangement of a board for testing direct-current motors and dynamos with little trouble.—Lond. *Elec. Review,* Aug. 30.

Telegraphy, Telephony and Signals.

Railway Signals.—J. B. Struble.—In a continuation of the illustrated serial on railway signals, automatic block signaling by means of alternating currents is discussed. There are two schemes of using alternating current, the signal-rail return system and the double-rail return system. In the former, one rail of each track is insulated into block sections for signaling purposes, the other rail serving as a continuous return for the power current and as one side of the alternating-current track circuit. In the latter, both are insulated into block sections and both are used for the power current. This is accomplished by the use of balanced inductive bonds and is used in preference to the single-rail system under certain conditions. In the present article the single-rail scheme and various features of its application are discussed and illustrated. The remarkable record of performance of the single-rail system in the New York subway is noted. The failures due to all causes, many of which are not directly chargeable to the signal apparatus, are about one to every 400,000 signal operations. Some months it is not so good, while in others it is better. Finally some notes are given on alternating-current signals on steam roads.—*Electric Journal,* September.

Perforator.—Many attempts have been made in recent years to devise a Wheatstone perforator actuated by a typewriter keyboard. The machines hitherto designed have involved the entire replacement of the perforators previously in use, but the most recent invention avoids the necessity for scrapping existing plant by applying a keyboard to manipulate the levers of the existing apparatus. The apparatus which is described and illustrated in this article is invented by M. Kotyra and consists of two essential parts, namely, three electromagnets and a keyboard. The combination can be used in conjunction either with an ordinary perforator or with a pneumatic puncher, the electromagnets being so applied to the plungers that, when actuated by the keyboard, they perform the work known as punching [illegible] by hand or by air pressure.—Lond. [illegible], Aug. 16.

[illegible] A paper read before the [illegible] wireless telegraphy. The author deals with the characteristics of a "tuned arc" station as distinct from a "spark" station.—Lond. *Electrician,* Aug. 23.

[illegible] with a brief summary of those systems which have been proposed.—*[illegible]*, Aug. 23.

[illegible] a new type of [illegible].—[illegible], Aug. 29.

Miscellaneous.

Removal of Limitations of Electricity.—C. F. Scott.—An address delivered at the Worcester Polytechnic Institute discussing the various limitations which have been removed by the application of electricity. By removing the mechanical difficulties and limitations in the distribution of power the electric system has completely revolutionized the methods of generating power, has concentrated the generation of power and has made the large steam turbine and the large gas engine possible. The waste gases of blast furnaces are now becoming the sole source of power in some plants. Electricity has also brought into service water power. The natural result is cheap energy. With respect to the applications of electricity the facility of transforming electrical energy into other forms of energy is pointed out. The principal substitution of the steam locomotive by electricity have been radical ones, for not only the steam, but the locomotives themselves have been eliminated. The method of distributing power in workshops has been revolutionized. In ordinary life the telephone has removed the limitation of the range of the human voice.—*Electric Journal,* September.

Sales Contracts.—B. A. Brennan.—The third article of his serial. The author deals with bailments or lease contracts, consignments, contracts by post, statutes of fraud, promises and agreements not contained in contracts, sellers' remedies and buyers' remedies, warranties.—*Electric Journal,* September.

Electromedical Equipment in English Hospital.—An account of the equipment of the Royal Devon and Exeter Hospital. The apparatus in use includes a Finsen ultra-violet lamp equipment and a large induction coil with mercury break for X-ray work, which is used in conjunction with a valve tube and has one secondary terminal permanently earthed. The same induction coil can be used in conjunction with a resonator for high-frequency treatment. A special machine is used for giving sinusoidal currents, and apparatus is provided for applying continuous or interrupted currents. Special precautions are taken in the case of the bath for electrical treatment to prevent excessive currents being transmitted to the patient from leakage or other accidental causes.—Lond. *Electrical Engineering,* Aug. 15.

Magnetic Character of Ships.—W. [illegible].—A paper in which the author discusses the development of the magnetic character of a steel ship and the improvement of the compass position by the use of non-magnetic material.—Lond. *Electrician,* Aug. 16.

Lightning Rods.—A note on the work done by the Paris Academy of Science with respect to the construction of lightning rods. As early as 1784 a set of instructions on the erection of lightning rods was presented to the Academy by Franklin, LeRoy, Coulomb, De Leplace and Rochon. This is here reprinted.—*Elek. Zeit.,* Aug. 15.

Electrical Inspectors' Convention.

The third annual meeting of the Western Association of Electrical Inspectors will be held at Hotel Ryan, St. Paul, Minn., Oct. 22, 23 and 24, 1907. Tuesday, Oct. 22, will be taken up by business sessions and by reports of committees on "Uniformity in Rulings," "National Electrical Code," "Outside Wiring," "Theater Wiring" and "Show Equipment." Wednesday, Oct. 23, a number of addresses will be given as follows: "Approved Electrical Fittings," by Mr. Dana Pierce, electrical engineer, Underwriters' Laboratories, Chicago; "Joint Construction Pole Lines," by Mr. H. B. Gear, general inspector, Chicago Edison

Company; "Electrical Inspection from the Viewpoint of the Central Station," by Mr. Paul Doty, manager, St. Paul Gas & Electric Company; "Electrical Inspection from the Viewpoint of the Telephone Exchange," by Mr. Chas. M. Mauseau, general manager, Northwestern telephone exchange, Minneapolis; "Flexible Cords for Pendants," by Mr. H. T. Wreaks, secretary, Wire Extension Bureau, New York. The evening session, Oct. 23, is to be devoted to discussion of "Difficulties Arising in Electrical Inspection Work," by members.

Thursday, Oct. 24, is to be given to reports of the following committees: "Grounding of Conductors for Safety," "Construction and Installation of Electric Signs," "Show Window and Display Lighting," "Instructions to the Public Concerning Safe Operation and Maintenance of Electrical Wiring and Apparatus," "Underground Systems," "Installation and Operation of Induction Motors," "Wiring for Electric Cranes," "Laws and Ordinances," "Architects' Specifications." Tours of inspection are to be arranged for those desiring to see up-to-date installations of wiring, to include knob and tube work, exposed wiring, conduit work, high-tension motor installation, theater wiring installation, and an underground tunnel system for electrical conductors. The secretary of the association is Mr William S. Boyd, 382 Ohio Street, Chicago.

Incandescent Lamp Exhibit at Montreal.

In our issue for Sept 14 an account was given of the exhibits and other attractions at the Canadian Electrical Exhibition which was held in Montreal last week. The accompanying illustrations give a general idea of the appearance of the hall and show the tasty arrangement of the exhibits and the attractive decorations of the room.

Following are a few additional notes of the exhibits, referring particularly to the display of incandescent lamps. The exhibit of the Sunbeam Incandescent Lamp Company of Canada, Limited, and the Holophane Company, co-operated through the engineering department of the National Electric Lamp Association of Cleveland, Ohio, was very attractive.

At the corners of the booth [illegible] tungsten lamps. Between the pillars was an iron framework from which were suspended 20-cp, 40-watt tantalum meridian lamps, 40-cp, 27-volt tungsten lamps, and Gem graphitized filament 50-watt lamps, as well as 40 and 80-watt regular tantalum lamps. Each of these lamps was equipped with some form of Holophane reflector, which protects the eye from the glare of the bare filament and added materially to the lighting effect.

Fig. 2.—View from the Gallery.

From an arched iron framework supported by the pillars were suspended 63 40-cp tungsten street series lamps. These gave a white light very similar to that of daylight. The lamps were operated nine in series on a 110-volt circuit. In the center of the booth were three holophane reflecting arcs or clusters consisting of six lamps each.

On the back wall was a case of miniature tantalum lamps ranging from 1.4 volts to 20 volts. A test board arranged for showing the relative power consumption of tungsten and carbon street series lamps demonstrated the vast superiority of the former in current consumption. A clever device was also in operation for showing the manner in which the high-efficiency tantalum lamps are less affected by a variation in voltage than the old style carbon-filament lamp.

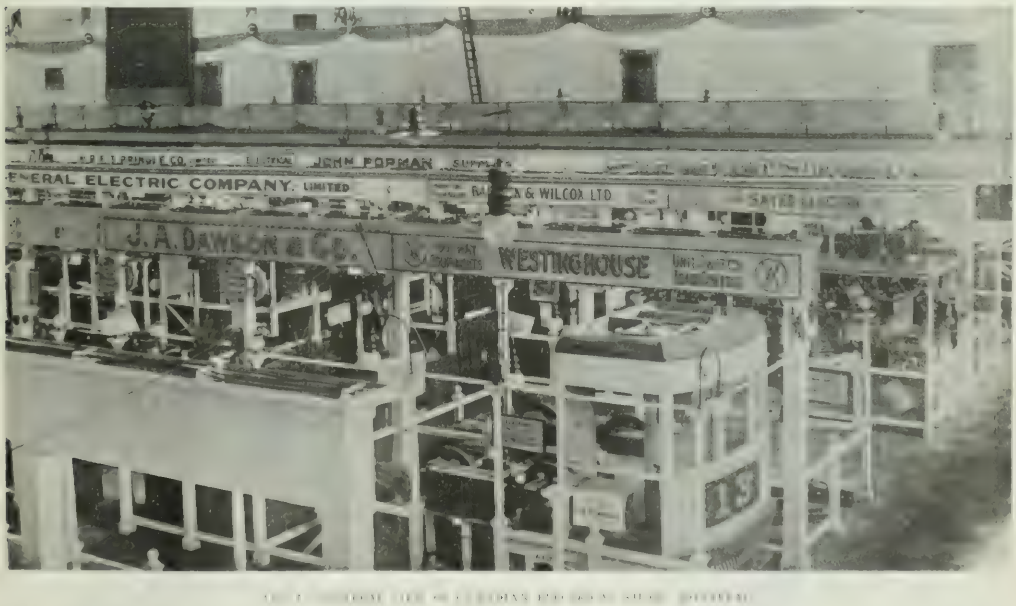


Fig. 1.—[illegible]

A large number of holophane globes and reflectors of various shapes and sizes arranged with lamps underneath, attracted considerable attention. In a darkened room especially constructed for the purpose, the increased downward light obtained by the use of holophane globes and reflectors was readily demonstrated.

One very interesting point brought out at this exhibit was the adaptability of the tantalum lamp for alternating circuit. All of the lamps were operated several hours per day on 110-volt, 60-cycle circuits without injury to the lamps.

Bulletins issued by the engineering department of the National

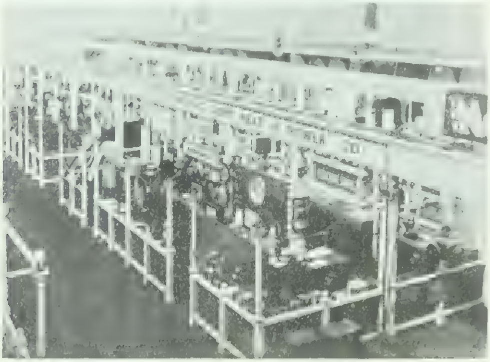


FIG. 3.—EXHIBIT OF MONTREAL LIGHT, HEAT & POWER COMPANY.

Electric Lamp Association, and dealing with progress on new lamps and modern illumination were placed in large quantities on tables and distributed to visitors.

Among the men to be seen around the booth were: Mr. B. T. Tremaine, of the National Association; Mr. S. E. Doane, chief engineer of the association; Mr. E. Irving, of the Canadian Sunbeam Company; Mr. V. R. Lansingh, of the Holophane Company; Mr. Geo. Loring, of the engineering department, besides several representatives of the engineering department of the Holophane and Sunbeam companies. The booth was in charge of Mr. Wm. Skiff, of the engineering department.

Fort Wayne Portable Wattmeter Calibrator.

The usual method of calibrating wattmeters by means of standard indicating instruments has the disadvantage of requiring the use of a stop watch and is, moreover, a time con

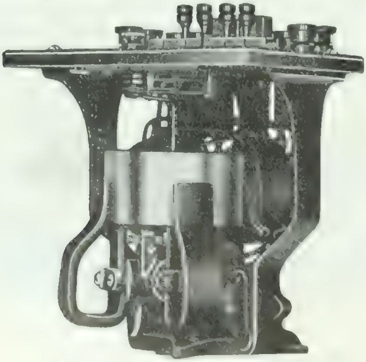


FIG. 1.—VIEW OF CALIBRATOR MECHANISM

suming process which becomes unduly expensive where a large number of meters are in use. To meet the situation created by the present more systematic calibration of consumers' meters, the Fort Wayne Electric Works have placed on the market a portable wattmeter calibrator with which no stop watch is required except in standardizing the instrument itself, nor is it essential that the load be constant. It is only necessary to observe the revolutions of the meter under test and the pointer indications of the calibrator before and after test, from which, by the use of the proper constants, the watt-hours registered by the meter under test and the calibrator may be determined. The calibrator is so designed that it covers the range of most meters in service from light to full load, for either 110 or 220 volts, two or three-wire circuits. This is a desirable feature in that it saves carrying more than one standard.

As will be seen in the accompanying illustration, the calibrator is enclosed in a mahogany carrying case provided with a carrying strap for use in transportation. The register is located on the top of the calibrator so that the pointer indications can be read by the operator, at a distance if necessary, as

FIG. 2.—CALIBRATOR IN CASE.

in checking a meter installed close to the ceiling with the calibrator resting on the floor. The dial is $2\frac{3}{4}$ ins. in diameter and provided with three pointers, the larger of which reads directly in revolutions, being connected directly to the shaft, and which in turn drives the units and tens pointers. The periphery of the entire dial constitutes the tenths circle and is divided into ten large divisions, which in turn are subdivided into ten smaller divisions so that the pointer indications may be easily read to one-hundredths of a revolution. The units and tens circles are within the large circle, the former reading one revolution per division and the latter reading ten revolutions per division.

Directly in front of the dial is located a small knurled thumb screw by means of which the rotating element may be raised from the jewel and locked firmly in transportation. The rear section of the top of the calibrator constitutes the terminal plate to which all connections are made. On this plate are located four current binding posts to which the current coils of the calibrator are connected. On this plate are also located plug switches by means of which the current capacities of the calibrator may be changed. The current coils (two in number) are wound in sections which may be connected in series or series-parallel with the plug switches and in parallel on the plug switches in conjunction with the cable connectors on the current leads. Directly behind the plug switches are located the

potential receptacles, one for use on 110 volts and the other for use on 220 volts. These receptacles are provided with caps to prevent dust entering the interior of the calibrator when not in use. On this plate are also two, one-ampere fuses to protect the one-ampere winding from possible injury due to improper connections.

The entire calibrator may be lifted out of the case by removing the screw under the strap in the bottom of the case. The top plate is made of hard rubber in two sections, all of the connections being made on the rear section. This feature permits the removal of the register and rotating element without interfering with the connections.

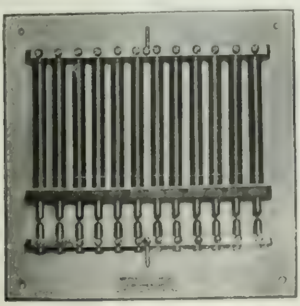
The windings selected as most suitable for meter testing are 1, 2, 5, 10 and 20 amperes and 110 and 220 volts. With these windings meters up to and including 25 amperes, two-wire, either 110 or 220 volts, and up to and including 12½ amperes, three-wire, 220 volts, may be tested. The ampere turns of all the windings are equal, therefore the torque is constant when the meter is operating on a given percentage of full load for any of the different windings.

In operation the calibrator is placed in a level position and the rotor lowered by means of a knurled thumb screw on the top. The rotor should always be raised in transportation. The current lead terminals should be connected to correspond with the stamped binding posts on the calibrator, these connections to remain the same for all circuits. The other terminals of the current leads are connected to the meter under test and the line, according to instructions furnished with each calibrator and pasted on the inside of the lid. Different current capacities are obtained by plug switches, which are fully explained in the instructions which go with the instrument.

After making the proper connections for calibrator and meter under test, a reading of the dial should be taken. The calibrator should then be started simultaneously with the counting of the revolutions of the meter under test and stopped after the desired number have been taken. A pendant snap switch connected to the potential leads is provided for this purpose. The difference between the first and last reading of the calibrator gives the total number of revolutions. The watt-hours registered by both meters is the product of the revolutions and their respective calibrating constants. These constants being the watt-hours registered per revolution, the relative accuracy of the meter under test is shown by the ratio of the watt-hours registered by the two meters. After the test has once been started it need not be stopped until the desired number of revolutions have been taken, as any change in the external circuit affects both the meter and the calibrator the same.

Lightning Arresters.

A new lightning arrester made by Campbell Brothers, of Traverse City, Mich., was exhibited at the Michigan convention.



MULTIPLE-DISCHARGE NON-ARCING LIGHTNING ARRESTER.

This arrester, known as the Gifford, is shown in the accompanying illustration. It consists simply of a number of multiple air-gaps in series with graphite rod resistances. The lower bus-bar, to which the lower discharge points are connected, is grounded. The line is connected to the upper discharge points and graphite rods. The theory of the arrester is that the resistance in series with the discharge points is sufficient to allow static discharges to pass over but not sufficient to cause an arc to follow after such a discharge has passed. The multiplicity of gaps is to provide two paths to earth to relieve the static discharge. It is claimed that it can be adjusted to discharge at a very small per cent above the line voltage.

New Instruments of D'Arsonval Type.

A new line of ammeters and voltmeters for direct-current switchboard use has just been placed on the market by the General Electric Company. These instruments, which are to be known as "Type D," are constructed on the D'Arsonval principle. A small coil of wire mounted on a light cylindrical aluminum frame is pivoted in jeweled bearings so as to move freely in a small annular space between a soft iron core and the pole pieces of a permanent magnet. These instruments are

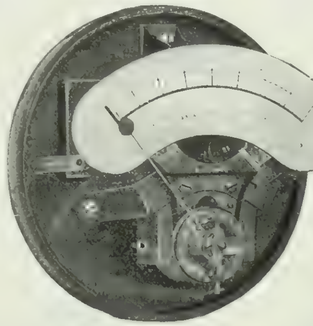


FIG. 1.—VIEW OF INSTRUMENT WITH CASE REMOVED.

rendered dead beat by the Foucault currents generated in the aluminum frame as it passes through the field of the permanent magnet. This damping quality prevents injury to the pointer from violent load fluctuations and permits rapid and accurate readings as the pointer comes quickly to rest after each change in current value.

Accuracy is assured by the unusually high torque, light moving elements and the very small air-gap between magnet pole

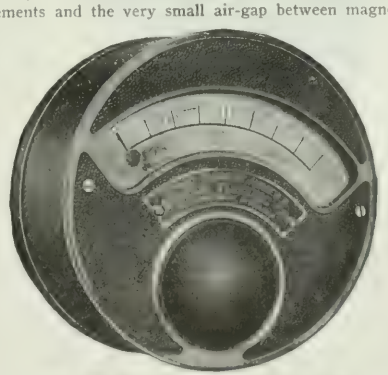


FIG. 2.—VIEW OF INSTRUMENT COMPLETE.

faces and the iron core, combined with the permanency of the magnets which are made from the best obtainable grade of magnet steel and subjected to special processes of hardening and aging which fixes its magnetic characteristics. The round cast iron case which encloses the instruments protects it from the effects of stray fields and makes it dust-proof.

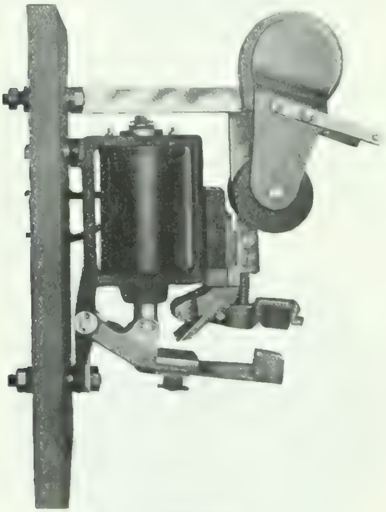
Inspection or repairs of these instruments is easily made.

[illegible] ports are assembled within the soft steel shell constituting the pole pieces. By removing the screws which hold the shell to the magnet pole faces, the entire mechanism may be removed. The scales are uniform throughout their entire range and very legible. The standard finish is dull black with raised portions polished copper, making a very pleasing and durable surface.

Type D voltmeters are made self-contained in capacities up to and including 750 volts. The ammeters are self-contained up to 60 amperes capacity. Larger capacities are furnished with external shunts which are made of a special alloy having practically a zero temperature coefficient. All instrument shunts above 1000 ampere capacity are now provided with a thermo-electric attachment. This attachment consists of a metal strip having one end electrically connected with one end of the shunt, with the other end in close thermal contact with the other end of the shunt, but insulated from it electrically. The ammeter leads are connected to the shunt and to the metal strip at the two insulated points. This prevents the superimposing of secondary thermoelectric currents upon the primary current, which is due to the fall of potential in the shunt and the amount of which fixes the value of the indication of the instrument. Ammeter shunts with this attachment are found free from temperature errors due to the generation of thermoelectric current.

Improved Contactor.

The Cutler-Hammer Mfg. Co., of Milwaukee, [illegible] type of contactor, shown in the accompanying illustration. These contactors are used for handling main-line currents where the nature of the service is severe. In such cases controllers employing sliding contacts cannot be relied upon to handle the main-line current, and it is customary to employ a controlling panel consisting of a number of contactors, this panel in turn being controlled by a



[illegible]

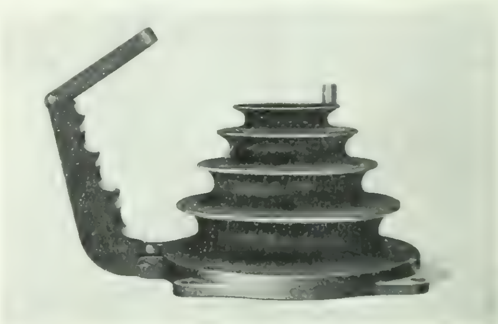
[illegible] controller designed to regulate the secondary [illegible] which energizes the solenoids of the contactors.

The contactor illustrated is a compact and strongly constructed piece of apparatus, and is provided with an exceptionally powerful blow-out magnet. The main-line circuit is closed by the solenoid raising a pivoted arm carrying a thick copper plate, to a point where contact is made with a pair of stationary, laminated copper brushes. Arcing on this contact is prevented by providing an auxiliary copper and carbon contact in the field of a powerful blow-out magnet, which instantly extinguishes the arc incident to the breaking of the circuit. This auxiliary contact closes before the main contact is made and opens after the main contact is broken, thus effectually preventing any sparking on the main contact.

A noteworthy improvement is the pivoting of the blow-out shields, permitting these to be raised (as shown in illustration) so as to expose the auxiliary carbon and copper contact. In earlier types of contactors, these shields were rigidly fastened to their normal position, completely covering the copper and carbon contacts and rendering access to them difficult. The present construction makes renewal of either contact, or of the coiled spring (visible just above the carbon contact) a matter of a few moments only. The makers state that at a recent test at one of the largest Pittsburg steel mills a 220-volt circuit was opened and closed by a contactor of this type 88,000 times before renewal of the copper and carbon contacts became necessary, and—on a test to determine time required for repairs—the old contacts were removed and new ones inserted in less than two minutes.

Conduit Bender.

A conduit bender of extreme simplicity and of wide application is shown in the accompanying illustrations. As indicated in Fig. 1 it may be opened to receive the conduit, and hence no



[illegible]

time is wasted in pushing the conduit through a tight-fitting hole. Its construction allows it to be used with the maximum of ease; being bolted on the top of the work-bench as seen in Fig. 2, the workman stands in a [illegible] and can ac-

[illegible]

complish the maximum of work. It is solidly built, and is [illegible] ins. may be used in the bender.

This bender has been placed on the market by the Glaze-[illegible]

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Among the favorable developments of the week were the increasing shipments of grain and flour for export. Further evidence of the increasing demand for our cereals was found in the weakening of foreign exchange and the reports that commercial bills against grain and cotton are appearing in larger volume. The crop outlook, as compared with recent years, is, on the whole, only fair. As the staple crops are secured and marketed there comes improvement in mercantile collections throughout the agricultural districts, and the decline in prices was especially helpful in stimulating export trade. In the several leading industries there were more irregular features, the most notable of which was the sharp break in copper prices. At the close of the week the United Metals Selling Company, which disposes of the product of the Amalgamated Copper Company, quoted electrolytic at 16½ cents. This is a reduction of 1½ cents from the price that was made ten days previous, when the cut from 22 to 18 cents was made. On July 9 the price was reduced from 25 cents to 22 cents. In spite of the latest cut there were no signs that the consumers were preparing to buy in quantity, and they were reported to be waiting for a further reduction of a cent or more. The closing prices were 16¼c. for Lake; 15¾c. for electrolytic and 15½c. for casting stock. In the iron industry there were reports of further shading of prices of pig iron at leading markets. Steel billets and sheet bars are scarcer and prices have hardened. Specifications on all finished material were heavy and the demand for structural material was fair. Building material is slow, despite increased buying of lumber at the West, and prices tend to ease. Building in August showed increased expenditures at a majority of cities, but losses at large cities result in a net decline from August, 1906, and July, 1907. August railway earnings point to a gain of at least 9 per cent over the same month a year ago. Reports by the Agricultural Department as to leading crops show lower conditions and smaller probable yields than in 1906. All cereal crops are below the ten-year average and the output of cereals this year is 14.4 per cent below that of 1906. Wheat yields promise to be 14 per cent smaller, corn 13 per cent and oats 18 per cent less than in 1906. Cotton conditions are below the ten-year average and are nearly equal to those of 1905 at this date. There are, however, 5,000,000 more acres in cotton this year than at that time. *Bradstreet's* reports 172 business failures during the week ending Sept. 12, against 130 in the previous week and 164 in the corresponding week last year.

ELECTRIC POWER IN COTTON MILLS.—The development of hydro-electric power along the Catawba River in South Carolina has already reached the point at which 67 cotton mills are operated by electricity generated at two power plants on this stream. These two plants have a capacity of 42,000 horse-power. Extensions will be added within a year to bring that up to 150,000 horse-power. An outlay of $1[illegible] 000,000 is already planned. The lines now radiating from these power [illegible] 250 miles in length. The cost of construction of these lines ranges from $6,000 to $7,000 a mile. On the North Carolina side of the line, on the Yadkin River, $5,000,000 are being spent on another plant, with an initial capacity of 5000 horse-power and [illegible] 70,000 horse-power. [illegible] several Southern States, each using a thousand horse-power or more. One of these [illegible] a horse-power a year.

ELECTRICAL IMPORTS AND EXPORTS.—[illegible] May [illegible] months the electrical export trade will reach a new high level. During May the exports of [illegible] $[illegible], as compared with [illegible] months the total is $7,92[illegible] $7,229,576 and $6,661,676 in 1905. The export of electrical instruments has shown a gratifying increase for the whole period, although May itself fell off somewhat. The exports of this class in May reached $619,393, while in 1906 they were $709,875. But for the eleven months they were $7,508,364, as compared with $6,115,254 and $4,490,818 in the periods corresponding of 1906 and 1905. For the eleven months, therefore, the total exports of electrical apparatus has attained the respectable figure of not less than $15,483,170, and it bids fair for the whole fiscal year to reach about $17,000,000.

THE COLUMBIAN ROPE COMPANY, Auburn, N. Y., will install an extensive new electric generating and motor equipment recently ordered from Allis-Chalmers Company, Milwaukee. The generator is to be a 940-kw, 60-cycle, three-phase machine, designed to operate at 120 r. p. m. Two 30-kw exciters are provided, one engine and the other motor-driven. The motors, all of which are standard Allis-Chalmers type, with bearings having sealed end boxes so designed as to exclude dust and flying particles of metal will be suspended from the ceiling. They include four 150-hp for 600 r. p. m., two 100-hp machines of the same speed, and a 20-hp motor with a speed of 900 r. p. m. This equipment includes three 40-kw transformers for use on the lighting system. A five-panel switchboard, built of Vermont blue marble, comprises three feeder panels, a generator and an exciter panel.

STEAM TURBINE FOR COTTON MILL.—The Cherry Cotton Mills, of Florence, Ala., have recently placed a contract with Allis-Chalmers Company, Milwaukee, covering a 500-kw steam turbine and alternator unit, together with turbo jet condenser and engine-driven exciter complete. The cotton mill industry of the South, which has known such phenomenal growth in the past decade, owes no small portion of its success to the use of electricity to drive its looms and spindles. The advantage of this method over the older line-shaft and belting are well known, resulting in saving of first cost of shafting, lower frictional losses, saving of power, labor and oil, and the possibility of easily securing a clean, well lighted mill, which insures the better health of operatives.

THE "LINOLITE" SYSTEM OF LIGHTING.—In our issue of June 1 appeared a description of the "Linolite" System of Show Window Lighting. This is an arrangement by which windows, show cases, etc., may be lighted with a continuous "line o' light" in the form of long tubular glow lamps with single filaments, placed behind a continuous reflector. We are now advised that the H. W. Johns-Manville Company, of New York, has recently secured the exclusive sales agency from the "Linolite" Company of America for the sale of this system in the United States and its possessions.

VERTICAL OIL ENGINE.—The De La Vergne Machine Company, East 138th Street, New York, is placing on the market a vertical type of oil engine. The company will continue the manufacture of the Hornsby-Akroyd, four-cycle horizontal oil engine, in size from 13 to 215 horse-power, and the new, or De La Vergne two-cycle engine is designed especially for the use of cheap oils, kerosene or fuel oil, and not for gas or gasoline. No carburetor or valve motion is used, the engine thus being one of the simplest ever devised.

NAVY PURCHASES.—The Bureau of Supplies and Accounts, Navy Department, Washington, will open bids Sept. 24 and Oct. 1 for electrical supplies, comprised in a number of classes, and including 4300 ft. of conduit, 200 dry cells, 500 Leyden jars, 241 bells, 10,000 carbons, 50,000 fuses, 4005 globes and shades, 11,700 incandescent lamps, 4240 switches and 1700 lbs. insulating tape. Applications for schedules of classes should be addressed to the above-mentioned Bureau.

COPPER.—A Boston [illegible] Consumers of copper are meeting the great falling off in new orders by restricting production. One [illegible] pounds of copper per month when running to full capacity is restricting production by running the plant but five days per week. Six months ago these mills were running nights.

CATALOGUES WANTED.—The Edgecombe Company, Cuyahoga Falls, Ohio, mechanical and electrical engineers, has [illegible] and desire [illegible] of electrical appliances and supplies.

Financial Intelligence.

THE WEEK IN WALL STREET.—Various influences depressed the general stock list. Among these were the further decline in copper prices and reports that the mines of the Amalgamated Copper Company might be closed down. Heavy liquidation and short selling with severe breaks in [illegible] copper stocks [illegible] had a [illegible] effect. Favorable developments were not lacking, however, embracing as they did the success of New York City bond subscription and the decision of the lower court in Pennsylvania against the constitutionality of the two-cent fare bill. Considerable activity developed in the New York City 4½ per cent bonds, which sold up to 103½ in the market after the allotment was announced. One of the features in later transactions was the renewal of bearish activity in the United States Steel shares. The argument in this connection was that the decline in copper and other metals might extend to the iron and steel industries. Some attention was paid to the position of the Philadelphia market which in the latter half of the week became decidedly demoralized with heavy liquidation and declines in local stocks, such as Philadelphia Rapid Transit and United Gas Improvement. Philadelphia Rapid Transit broke badly, losing 4½; Union Traction lost 7½ points and U. G. I. 2½. Toward the close of the week the New York market experienced a further bearish manipulation with renewed weakness followed, however, by a sharp rally at the end. The electric and traction stocks are all lower, with the exception of Metropolitan Street Railway, which recovered some of its recent losses to the extent of 3⅛ points net. No heavy declines are noted in the other stocks of these classes, the weakness being probably sympathetic. Following are the closing quotation of Sept. 17:

NEW YORK.

	Sept. 10	Sept. 17		Sept. 10	Sept. 17
Allis-Chalmers Co.	6	6¾	General Electric	127	[illegible]
Allis-Chalmers Co. pfd.	16	[illegible]	Hudson River Tel.	—	—
Am. Dist. Tel.	20	—	Interborough Met. com.	[illegible]	9
American Locomotive	53	[illegible]	Interborough Met. pfd.	25	[illegible]
Amer. Locomotive pfd.	[illegible]	101	Mackay Cos.	64	63
American Tel. & Cable	[illegible]	75	Mackay Cos. pfd.	64	62½
American Tel. & Tel.	106	[illegible]	Marconi Tel.	—	—
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	37	[illegible]
Electric Boat	33	33	N. Y. & N. J. Tel.	100	—
Electric Boat pfd.	80	80	Western Union Tel.	76	[illegible]
Electric Vehicle	—	—	Westinghouse com.	133	*136⅛
Electric Vehicle pfd.	—	—	Westinghouse pfd.	[illegible]*	—

BOSTON.

	Sept. 10	Sept. 17		Sept. 10	Sept. 17
American Tel. & Tel.	[illegible]	[illegible]	Mass. Elec. Ry. pfd.	50	[illegible]
Cumberland Telephone	102	102½	Mexican Telephone	—	2
Edison Elec. Illum.	[illegible]	—	New England Telep.	—	108
General Electric	[illegible]	—	Western Tel. & Tel.	[illegible]	5½
Mass. Elec. Ry.	13	13	West. Tel. & Tel. pfd.	—	[illegible]

PHILADELPHIA.

	Sept. 10	Sept. 17		Sept. 10	Sept. 17
American Railways	[illegible]	[illegible]	Phila. Electric	[illegible]	[illegible]
Elec. Co. of America	9	8⅞	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery	45	*45	Phila. Traction	[illegible]	88
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Sept. 10	Sept. 17		Sept. 10	Sept. 17
Chicago City Ry.	[illegible]	—	National Carbon	—	—
Chicago Edison	—	—	National Carbon pfd.	—	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.	—	—	Union Traction pfd.	—	—
Metropolitan Elec. com.	—	—			

*Asked.

UNITED STATES TELEPHONE.—The increase in gross earnings of the United States Telephone Company for July is small and the amount is more than taken up in the increased expenses. It is believed that the action of the company in dispensing with night rates will result in increasing the earnings materially and that the report for September and the months following will make a much better showing. The figures, as compared with those of July, 1906, are as follows:

	July, 1907.	July, 1906.	Increase.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	12,883.74	1,516.69
[illegible]	[illegible]	$21,039.04	$58.77
Fixed charges:			
[illegible]	[illegible]	$8,983.33	
[illegible]	[illegible]	1,816.00	
[illegible]	[illegible]	[illegible]	$616.86
[illegible] depreciation, etc.	2,058.56	2,104.12	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Surplus	$7,233.49	[illegible]	[illegible]
[illegible]	[illegible]	5,000.00	
Net surplus	[illegible]	[illegible]	[illegible]

*Decrease.

DIVIDENDS.—Otis Elevator directors have declared the regular quarterly dividend of 1½ per cent on the preferred stock, and the regular semi-annual dividend of 1½ per cent on the common stock, both payable Oct. 15. The board of directors of the St. Joe Railway, Light, Heat & Power Company declared a regular quarterly dividend of 1¼ per cent on preferred stock, payable Oct. 1. The directors of the Cumberland Telephone & Telegraph Company have declared the regular quarterly dividend of 1¾ per cent, payable Oct. 1. The directors of the Western Union Telegraph Company have declared the usual quarterly dividend of 1¼ per cent. The directors of the Nebraska Telephone Company have declared the regular quarterly dividend of 1½ per cent, payable Oct. 10. The directors of the Manila Electric Railroad & Lighting Corporation have declared a dividend of 1 per cent, payable Oct. 1.

BOSTON EDISON.—The annual report of the Edison Electric Illuminating Company, of Boston, for the year ended June 30, 1907, compares as follows:

	[illegible]	[illegible]
Gross [illegible]	[illegible]	[illegible]
Expenses	2,591,823	2,443,286
Net [illegible]	[illegible]	[illegible]
Other inc.	41,340	49,256
Total net [illegible]	[illegible]	[illegible]
Interest	176,451	92,170
Balance [illegible]	[illegible]	[illegible]
Dividend	[illegible]	[illegible]
Surplus def.	$10,597	$145,901
Previous surplus	213,409	67,508

HYDE PARK ELECTRIC LIGHT COMPANY.—The Hyde Park Electric Light Company, owned by the Massachusetts Electric Companies, has filed its annual report with the Massachusetts Gas Commissioners for the year ending June 30, 1907, which compares as follows:

	1907	1906
Gross income	[illegible]	[illegible]
Expenses	[illegible]	66,025
Net	$27,925	$42,240
Dividends	[illegible]	23,000
Surplus	$7,810	$19,240

NORTHEASTERN TELEPHONE COMPANY.—A despatch from Portland, Maine, states that the Northeastern Telephone Company, one of the largest independent companies in New England, is defendant in an equity action brought in the Supreme Court Sept. 9, with a view to securing a receivership. The petition was filed by the Portland Trust Company in behalf of the bondholders. It is stated that the company has twice defaulted its semi-annual payment of interest on its $600,000 bonds. The company has 7000 subscribers and operates about 10,000 miles of wire, including 300 miles of long distance lines in Cumberland, Sagadahoc, Androscoggin, Oxford, Franklin and Kennebec counties.

NORTH GEORGIA ELECTRIC COMPANY.—According to a despatch from Atlanta, Ga., Sept. 11, two suits have been filed in the United States Court there against the North Georgia Electric Company, one for a receiver and the other that the company be adjudged bankrupt. The suit for a receiver was brought by John A. Nesbit, of Zenia, Ohio, who alleges that the defendant owes him $5,000 on a promissory note. The company has secured franchises to enter Atlanta, but has not availed itself of that right.

LONG ACRE LIGHT & POWER COMPANY.—The Department of Water Supply, Gas and Electricity, New York City, has issued permits to the Long Acre Electric Light & Power Company for the distribution of its wires throughout the borough of Manhattan. The company will immediately begin construction work and expects to be able to supply light and power to the Long Acre Square district within sixty days.

WORCESTER ELECTRIC LIGHT COMPANY.—The annual report of the Worcester Electric Light Company filed with the Massachusetts gas and electric light commission shows a dividend of 8 per cent last year. The gross earnings for the year are given as $307,532, against $306,019 in 1906, a gain of $1,513. The gross receipts in 1905 were $294,459, showing a gain in 1907 from two years ago of $13,073.

U. S. INDEPENDENT TELEPHONE.—The reorganization committee of the United States Independent Telephone Company has issued a statement from Rochester, N. Y., to the effect that that all of the heaviest bondholders have assented to the proposed reorganization plans.

GENERAL NEWS

Construction News.

DOTHAN, ALA.—It is reported that R. Tillis, of Montgomery, is interested in a project to build an electric railway from Geneva to Dothan via Hartford and Slocomb.

MAGNOLIA, ARK.—The plant of the Magnolia Ice & Electric Company was recently destroyed by fire, causing a loss of $20,000.

OLA, ARK.—The Ola Lumber Company is considering the question of installing an electric plant to furnish electricity for lighting the town.

BISHOP, CAL.—Work on the power plants and dam of the Nevada-California Company on Bishop Creek is progressing rapidly. The additions to the old power house have been completed, increasing the capacity of the plant one-third. The company is constructing a new power house two miles below the present plant and will soon commence work on another, two miles above the old plant. Machinery and material for the plant has been ordered. The present plant has a capacity of 6000 horse-power, and the combined capacity of the new plants will be 8000 horse-power. The company will soon furnish electricity to operate the mine trolley system for handling ore at the mine of the Pittsburg Silver Peak Company, of Blair.

FRESNO, CAL.—The San Joaquin Power Company is making arrangements to increase the capacity of power plant No. 1 from 2500 to 12,500 horse-power.

HANFORD, CAL.—Application has been made to the Board of Trustees by S. F. Granger for a street railway franchise.

OAKLAND, CAL.—A. W. Maltby, of Concord, is interested in a project to construct an electric railway from the terminus of the Key Route at Claremont through the Berkeley Hills to Lafayette, Walnut Creek, Concord and Byron.

OAKLAND, CAL.—Plans have been completed by the Western Power Company for the erection of its power plant in this city, which is to be the main auxiliary to the company's power plant on the Feather River. The plans adopted contemplate a building 250 feet long and 100 feet wide. It is proposed to install turbine generators of 5000 horse-power, besides the necessary steam generating plant. In eight months the plant will supply 50,000 horse-power, and by Oct. 1 50,000 horse-power will be transmitted from the plant at Great Bend on the Feather River, a distance of 140 miles. Contracts have been placed for turbines, generators, boilers and all other machinery required. The cost of the auxiliary plant is estimated at $2,500,000.

SAN JOSE, CAL.—The National Park Electric Company has practically completed surveys for the development of 50,000 horse-power on the Toulomne River. The company contemplates an expenditure of between $4,000,000 and $5,000,000 in construction of power plants and transmission lines. A. C. Kuhn, Charles J. Kuhn, Ralph Hersey, Charles Quilty, of San José, and B. P. Oliver, of San Francisco, are interested in the enterprise.

SISSON, CAL.—The Southern Pacific Railroad Company, through Assistant Chief Engineer Wood, has announced that it would build a large dam on the Klamath River, near Chase's place, and install an electrical power plant to operate its trains over the Siskiyou Mountains by electricity.

VISALIA, CAL.—The Mount Whitney Company, which operates in the Visalia, Tulare and Porterville district, is planning to increase the capacity of its 1200-hp plant to 3200 horse-power.

BUENA VISTA, COL.—It is reported that Charles A. Reiss, of New York, N. Y., is interested in a project to build an electric railway to reach the rich mineral district across the continental divide west of Buena Vista, known as Taylor Park.

NEW HAVEN, CONN.—Work has commenced on the construction of the Shore Line Electric Railway, which is to run from Stony Creek to Saybrook. The road is 28 miles long and will make a continuous route from New Haven to Saybrook. W. C. Jones and Leonard T. Sanders, of New [illegible] and A. W. [illegible] of New Haven, are interested in the enterprise.

NORWICH, CONN.—The incorporators of the Norwich, Colchester & Hartford Traction Company have organized with Costello Lippitt as president; Lucium Brown, secretary, and Henry W. Tibbitts, treasurer, of Norwich. The company has a charter to construct a street railway between Norwich and Hartford and [illegible] The length of the proposed line is 38 miles.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., [illegible] to furnish at the navy yards and naval stations the following supplies: Boston, Mass., schedule 300—induction motor, etc. Charleston, S. C., schedule 300—motor drive; schedule 302—copper wire, electrical supplies, etc. New York, N. Y., schedule 296—electrical conductor, leyden jars, dry cells, receiver sets and insulators; schedule 299—junction boxes, electrical conductor; schedule 30[illegible] [illegible] conduit, interior fittings. Washington, D. C., schedule 299—armature coils, electrical supplies, etc.; schedule [illegible] speed steel. Applications for proposals should designate the schedule desired by number. E. B. Rogers, Paymaster General, U. S. N.

ST. AUGUSTINE, FLA.—The special committee appointed by the City Council to investigate the two bids submitted for lighting the city is said to favor the bid of the St. Johns Light & Power Company to light the city by electricity.

GAINESVILLE, GA.—Samuel C. Dunlap, of Gainesville, has been appointed temporary receiver of the North Georgia Electric Company. The company has just completed a 50,000-hp plant on the Chattahoochee River at Gainesville and a steel tower transmission line to Atlanta, Ga. It is said that the company owes more than $1,000,000, and that it has practically ceased all efforts to develop its water power. It is stated that $650,000 in bonds are outstanding.

MACON, GA.—The Bibb Power Company will soon begin construction work for the development of various water power properties. The company plans to develop 20,000 horse-power. It is understood that plans and specifications have been completed for building the dam on the Ocmulgee River. Charles F. Howe is chief engineer, and W. J. Massel, president.

SAVANNAH, GA.—Bids will be received until Oct. 15 by the Commissioners on Streets and Lanes (Harry Willink, director) for the illumination of the streets of the city by electric arc and incandescent lamps, and also to supply the city with electricity to be used for illumination, heat or power purposes.

BOISE, IDAHO.—At a meeting of the stockholders of the Boise & Idaho Interurban Railway Company held recently the old board of directors was elected. The company has decided to double track its road as far as Pierce Park, a distance of about four miles.

HAILEY, IDAHO.—The Cramer Electric Light Company is making arrangements to improve and increase the capacity of its plant to meet the increasing demands for electricity.

ALTON, ILL.—W. Rudsill, of Bunker Hill, has applied to the Village Board of East Alton for a franchise to build a street railway through that place. The line will run from Bunker Hill through Bethalto, Oil City and East Alton to Alton, a distance of 20 miles.

EARLVILLE, ILL.—It is reported that extensive improvements are to be made to the local electric light plant.

JACKSONVILLE, ILL.—The city is advertising for bids for a 200-kw generator and engine, 200 arc lamps, four transformers and arc regulators. Charles W. Brown is engineer in charge.

PINCKNEYVILLE, ILL.—A petition requesting the dissolution of the Pinckneyville Electric Light Company has been forwarded to the Secretary of State. The company has lighted the streets of Pinckneyville for more than ten years, but after the destruction of its power house by fire it decided not to rebuild. H. P. Huntsinger and H. E. Bincke were secretary and president, respectively.

CLAY CITY, IND.—A franchise and contract for lighting the city has been granted to B. M. Guirl, of Clay City.

CRAWFORDSVILLE, IND.—The County Commissioners will receive bids until Oct. 5 for installing a lighting plant at the county asylum. B. F. Corwin is county auditor.

EVANSVILLE, IND.—The County Board has ordered estimates to be prepared for lighting the county infirmary with electricity.

HARTFORD CITY, IND.—The United Telephone Company has decided to make improvements to its system in this city and county that will entail the expenditure of thousands of dollars for material and equipment. Several additional rural lines are to be erected.

PERU, IND.—A proposition is now before the City Council to sell the municipal electric light plant to a private corporation. If sold the pur[illegible]

PLYMOUTH, IND.—The Commissioners of Marshall County have ordered an election to be held Oct. 5 to vote on a subsidy proposition of $56,000 in aid of the construction of an electric railway through the county. The proposed road will run from Logansport to South Bend.

SEELYVILLE, IND.—[illegible] that Frank Fauvre, of Indianapolis, is to establish an electrical power plant near Seelyville.

SEYMOUR, IND.—Bids will be received until Nov. 1 for furnishing electricity for street and residential lighting and for power purposes; also for furnishing artificial gas for light and fuel. For further information address Frederick Everback, city clerk.

SUMMITVILLE, IND.—The Town Board is experiencing trouble with the municipal light plant. The plant was erected in 1902 and sold to the town for $55,000. The town has operated it since at a loss. The board has decided to separate it from the water works operation to determine the actual earning capacity of the plant. There is some senti[illegible] plant.

SYRACUSE, IND.—[illegible] considered [illegible] Power, Light & Supply Company.

[illegible]

COALGATE, I. T.—The plant of the Coalgate, Lehigh & Phillips Elec- [illegible]

DAVENPORT, IOWA.—Plans are being made to construct a large [illegible]

[illegible] ing a street lighting system in the town.

CLAY CENTER, KAN.—The municipal electric lighting plant has been completed and is in operation. The plant will be in charge of the City Commission, which also has charge of the water works system.

PADUCAH, KY.—The Fairbanks, Morse & Company, of Louisville, have submitted a proposition to the fiscal court to install apparatus for a lighting and heating plant in the county court house and jail for $3,000.

COVINGTON, [illegible] is making extensive additions and improvements to its power station which, when completed, will greatly increase the capacity of the plant. E. J. [illegible]

AUGUSTA, MAINE.—[illegible] Augusta & Waterville Electric Railway Company has been effected, and [illegible]

HOULTON, MAINE.—The stockholders of the Independent Telephone Company have voted to sell all the lines of the company to the Aroostook Telephone Company, a corporation controlled by the New England Telephone & Telegraph Company.

KEZAR FALLS, MAINE.—The Cornish & Kezar Falls Light & Power Company is installing an additional water wheel in its power station to increase the capacity of the plant.

CHESTER, MASS.—At a meeting of the citizens held recently a committee was chosen to present the present electric light conditions to the State Board of Electric Light and Gas Commissioners. The committee has asked the commissioners to authorize the fire district to install its own plant if terms cannot be made with E. Leroy Gardiner, owner of the local electric plant. Estimates are being secured to install a 50 or 100-light plant in the Riverside Inn. Mr. Packard states that he will not install a plant if the present plant can be secured or if the fire district installs another plant.

FALL RIVER, MASS.—[illegible] ize the Mayor to enter into a contract with the Fall River Electric Light Company for lighting the streets of the city for a term of five years. By the terms of the contract the city secures a reduction from 30 cents to 25 cents per night for arc lamps, which amounts to a saving of about $15,000 a year over the contract now in force. The company will replace the present arc lighting system with new magnetite arc lamps.

FRANKLIN, MASS.—The Woonsocket Electric Machine & Power Company has submitted a contract to the Board of Selectmen for lighting the streets of the town. The company asks for a five-year contract and agrees to run transmission lines from its station in Woonsocket to Franklin, and to give 24-hour service, the work of the equipment of the same to be completed by July 1, 1908. The new contract is to be at practically the same rates as now paid by the town for lighting. The local electric plant will be discarded.

HOPEDALE, MASS.—The Milford Electric Light & Power Company is building a new transformer station in Hopedale and will install two 100-light self-regulating transformers. The street light service is to be increased by the installation of 42 additional incandescent lamps. W. C. Tewksbury is superintendent of the company.

ORANGE, MASS.—It is reported that a leading manufacturing concern of this town has secured an option on the water privilege at Eagleville, about two and one-half miles distant, and plans to install an electric power plant at that place to operate its shops.

PEABODY, MASS.—The A. C. Lawrence Leather Company is planning to erect a large power station at its Waters River plant.

MARSHALL, MINN.—The contract for the construction of the municipal electric lighting plant has been awarded to J. G. Robertson & Company, of St. Paul, Minn. Work on the construction of the plant will commence at once. The equipment of the plant will consist of two 200-kw, 3-phase, 60-cycle, 2300-volt, alternating-current generators, made by the Fort Wayne Electric Works; Ideal and Lane & Bodley engines having a [illegible] superintendent.

MINNEAPOLIS, MINN.—Bids will be received until Sept. 24 by the Board of Charities and Correction (Richard Tattersfield, secretary), for the installation of electric wiring for the city workhouse. L. A. Lamoreau is the architect.

CAMPBELL, MO.—A. C. Morse, proprietor of the Campbell electric [illegible] for street and general lighting purposes.

[illegible] There was no insurance.

JOPLIN, MO.—[illegible] contracts for machinery and equipment in connection with the electric [illegible] miles. The company is also planning to build two substations, one at Chitwood and the other at Asburg, Mo., and also a car barn at Joplin

MARYVILLE, MO.—The citizens at an election held recently, voted in favor of granting the Maryville Electric Light & Power Company a fran- [illegible] contract with the company for lighting the streets of the city for five years.

ST. JAMES, MO.—The temporary power house at the Soldiers' Home was recently destroyed by fire, causing a loss of $10,000.

ST. JOSEPH, MO.—The St. Joseph Railway, Light & Power Company is contemplating the construction of an interurban railway to Savannah, plans for which have been completed.

ST. LOUIS, MO.—[illegible] mittee to consider specifications for the city lighting contract to be let soon, has agreed to separate the lighting contract from the proposition to grant a franchise for commercial lighting.

HARVARD, NEB.—E. V. Revell, of Giltner, is installing an electric lighting plant in this place. The equipment will consist of two 50-hp Olds gas producer engines and one 60-kw, 60-cycle, 2200-volt alternator made by the Lincoln Electric Company.

PENDER, NEB.—M. M. Newman is planning to put in a new electric plant in this place.

TABLE ROCK, NEB.—The capital stock of the Table Rock Telephone Company has been increased to $20,000.

CARSON, NEV.—Work will soon commence on the transmission lines of the California-Nevada Electric Power Company, which will extend from Pickle Meadows, near Bridgeport, Cal., to Tonapah and Manhattan, a distance of 220 miles. This extension will include transmission lines into Masonic, Bodie and Aurora. The company expects to be operating its lines into Reno and Yerrington within a year.

ATLANTIC CITY, N. J.—The City Council has granted the petition of the business men of Atlantic Avenue to light the streets with an incandescent lighting system from New Jersey to Florida Avenue, the cost of which is estimated at $12,000.

LINWOOD, N. J.—James Farish, borough clerk, writes that the ordinance passed recently by the Borough Council contains an agreement with the Pleasantville Electric Company to light the borough for a term of five years for $1,500 per year. The contract has not yet been signed

MORRISTOWN, N. J.—The Morris & Somerset Electric Company has been granted permission to lay rails and erect poles and wires along the county roads through Morristown.

CANASTOTA, N. Y.—The Central New York Power Company has completed its plant and is now furnishing electricity for lighting the streets of Canastota and the public buildings, and will extend its commercial power business as soon as warranted. The headquarters of the company are at Utica. Byron E. White is secretary and treasurer.

FREEPORT, N. Y.—The Village Board of Trustees has decided to install an all-night electric light service, which was voted upon by the taxpayers at the spring election.

NEW YORK, N. Y.—Bids will be received by James Stevenson, Commissioner of Bridges, until Sept. 26, for the construction and electrical equipment of the subway station tracks, and the electrical equipment of the elevated railway tracks of the Williamsburg Bridge, over the East River, between the borough of Manhattan and Brooklyn.

KERNSVILLE, N. C.—The Crews Manufacturing Company is contemplating installing machinery to generate electricity for lighting its mill.

LONG ISLAND, N. C.—The Long Island Cotton Mills, of which Osborne Brown is president, is planning to construct a dam at Buffalo Shoals in the Catawba River and to erect a power plant to transmit electricity to this place to operate its mills. The plant will cost about $30,000; 500 horse-power will be developed at first, which can be doubled when required.

NORTH WILKESBORO, N. C.—[illegible] being rebuilt and otherwise improved.

STATESVILLE, N. C.—The Turner Mills Company has awarded a contract to Ordway & Sons Company, of Winston-Salem, N. C., for the construction of a concrete dam at East Monbo, to develop power for the transmission of electricity.

McARTHUR, OHIO.—The citizens are contemplating enlarging the municipal electric lighting plant.

RAWSON, OHIO.—[illegible] lighting plant is now being considered.

TROY, OHIO.—[illegible] tric lighting bonds. Charles F. Rannalls is city auditor.

PORTLAND, ORE.—[illegible]

LANCASTER, PA.—The Lancaster, Oxford & Southern Railway Company has decided to convert its line from steam to electricity. Power for operating the road will be obtained from the plant at McCall Ferry. W. M. Franklin is president of the company.

STEWARTSTOWN, PA.—The new electrical plant at Ebaugh's mill on the east branch of Deer Creek, near Stewartstown, is about completed and will be ready to be put into operation [illegible] time. The plant will furnish electricity to the residents of Stewartstown, New Freedom, Railroad and New Market, Md. Warren E. Fastnacht is electrician.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company is making arrangements to extend its lines to Franklin, Mass., to supply the town with electricity for street lighting and for general lighting and power purposes. It is said that the company is planning to enlarge its plant to almost double its present size. George Batchelor is president of the company.

FLORENCE, S. C.—The city is considering the question of holding an election to vote on the proposition of issuing $25,000 in bonds for the construction of an electric light plant.

WARE SHOALS, S. C.—C. R. Willard & Company, of Spartanburg, S. C., have been awarded the contract to build two dams for hydro-electric power development, one at Ware Shoals and the other at Brown's Mills, seven miles from Ware Shoals, the first to cost approximately [illegible]

CLARKSVILLE, TENN.—Mayor Northington has issued orders to City Engineer S. R. Alexander to remove from the business part of the city the poles and wires of the Cumberland Telephone & Telegraph Company, in accordance with the ordinance passed by the City Council last December. The company has refused to comply with the ordinance, intimating that the order would be fought out in the courts.

HENDERSON, TENN.—The local electric light plant, which has not been in use for some time, has been purchased by S. C. Rush. Improvements will be made to the plant and a 50 to 60-kw alternator, transformers and other machinery will be installed.

DALLAS, TEX.—The Dallas Traction Company is advertising for bids for the construction of the four substations to be built along the line of the electric interurban railway now under construction between Sherman and Dallas. The substations are to be located at Dallas, Plano, Van [illegible] and Sherman.

GROVETON, TEX.—The Groveton Light & Ice Company is planning to install an electric light plant in connection with its ice plant. John R. Collins is president and general manager.

ORANGE, TEX.—The City Council has entered into a contract with the Orange Ice, Light & Water Company to operate the city water works system for a term of 20 years. The company agrees to erect a standpipe not less than 90 feet in height and make other improvements. All extensions to the system are to be made at the expense of the company and paid for by the city at the termination of the contract. The Mayor was also authorized to make a contract with the company for ten additional arc lamps to be placed on the streets of the city.

PALESTINE, TEX.—W. B. Johnson and George R. Cooke will soon apply to the City Council for a franchise to erect a new electric light [illegible] in this city.

MURRAY, UTAH.—The Progress Company of this place has filed a petition with the state engineer for 60 feet of water to be diverted from the Big Cottonwood. It is expected to develop 350 horse-power, which will be used to operate the Murray electrical system.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has decided to relinquish all its restrictions of the city's use of the power deeded to the city by the company in Big Cottonwood Creek by the 1905 franchise, provided the Council will pass its extension franchise and also validate the 1905 franchise and make it run for a period of 50 years.

BRISTOL, VA.-TENN.—Both municipalities of Bristol have granted a franchise to a new electric distributing company as a means of putting into effect the proposition of New York capitalists to spend $600,000 in developing the Holston River water power in order to supply Bristol with electricity for lighting and manufacturing purposes.

TACOMA, WASH.—The City Council has rejected the bid of George Milton Savage for the building of the Upper Nisqually River power plant at a cost of $1,750,000. The engineers recommend that the city immediately acquire land and water rights necessary for the installation of the power plant on the Upper Nisqually. They recommend the building of [illegible] half through the rock on the west side of the river, in preference to a flume line without a reservoir.

[illegible] Appleton, engineer, for the development of the water power at Gardiner on the Wolf River. It is said that from 3000 to 5000 horse-power is [illegible]

Company Elections.

[illegible]

QUITMAN, GA.—At a meeting of the stockholders of the Quitman, Valdosta & Thomasville Electric Railway Company held recently the following directors were elected: A. C. McLeod, O. K. Jelks, Frank Spain, L. W. Branch, S. S. Bennett, J. D. Wilson, H. L. Young, R. B. Young and E. C. Bridges. The directors elected officers as follows: A. C. McLeod, president; H. L. Young, vice-president, and J. J. Jelks, secretary and treasurer.

New Industrial Companies.

THE MILLER ELECTRIC COMPANY, of Terre Haute, Ind., has incorporated to establish and equip a plant for the manufacture of electrical machinery and electrical supplies. Frank B. Miller is president and J. W. Miller, secretary.

THE NATIONAL TRADE TAPPER COMPANY, of Bangor, Maine, has been organized for the purpose of manufacturing and dealing in electrical appliances of all kinds. The company is capitalized at $10,000 and the officers are: Charles L. Snow, president, and Arthur J. Waterman, treasurer.

THE POWER MACHINERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $2,500. The directors are M. E. Berger, R. J. Walsh and J. H. Crawford.

New Incorporations.

DOUBLE SPRINGS, ALA.—The Winston County Telephone Company has been organized with a capital stock of $5,000. Dr. C. A. Olivett, of Addison, is president.

CLAYTON, ILL.—The Clayton Farmers' Union Telephone Company has been incorporated with a capital stock of $1,000 by John W. Wallace and others.

EL PASO, ILL.—The Panola Independent Telephone Company has been incorporated with a capital stock of $525 by Joseph Haas, James Bailey and others.

INDIANAPOLIS, IND.—The A. P. Fox Specialty Company has filed articles of incorporation for the purpose of manufacturing special supplies, etc. The capital is $100,000, and the directors are A. P. Fox, V. A. Smith and Henry Reitz. The company proposes to erect and equip a plant with engines, electric appliances, machinery, etc.

TERRE HAUTE, IND.—The Miller Electric Company has been chartered with a capital stock of $10,000 by Frank Miller and others.

SVEA CITY, IA.—The Farmers' Central Telephone Company has been incorporated with a capital stock of $420 by C. H. Giles and others.

EDMOND, KAN.—The Edmond Southwestern Telephone Company has been incorporated with a capital stock of $1,800 by E. M. Pettegrew and others.

JERSEY CITY, N. J.—The Frontenac Gas Company has been incorporated with a capital stock of $10,000 for the purpose of doing gas and electric lighting business. The incorporators are C. N. Jelliffe, C. R. Barlett and Edward Ostrom, Jr.

RICEVILLE, N. Y.—The People's Mutual Telephone Company has been incorporated with a capital stock of $10 000 by Jesse Martin and others.

HICKORY, N. C.—[illegible] with a capital stock of $125,000. A. A. Shuford is interested in the company.

WINSTON-SALEM, N. C.—A charter has been issued to the Midway Telephone Company for the construction and operation of a telephone line from Midway to Winston-Salem. C. E. Snider is one of the incorporators.

TOLEDO, OHIO.—The Citizens' Lighting & Heating Company has been incorporated with a capital stock of $200,000 by Charles S. Ashley, William S. Walbridge, J. W. Schaufelberger, J. W. McMahon and G. W. [illegible]

LOGAN, OKLA.—The Logan Telephone Company [illegible] k Wents [illegible] J. Thompson and Samuel Smith, all of Logan.

DU BOIS, PA.—A new company has been organized under the name of the United Traction Street Railroad Company, of which Austin Blakeslee is president and M. I. McCreight secretary and treasurer. The electric railway system is to be extended to Big Run. Steps will be taken at once to secure the charter, and the directors have been directed to purchase rails and supplies. As the road is now planned it will not be necessary to construct but about three miles of the road, as it is the intention of the company to use the old B. R. & P. tracks for the greater part of the distance.

LEXINGTON, TENN.—[illegible] Oct. 1.

ROANOKE, VA.—The Rural Power Company has been chartered with [illegible]

[illegible]

EVERETT, WASH.—The Everett & Cherry Valley Traction Company has been organized with a capital stock of $1,500,000 by J. T. Mc- [illegible]

WHEELING, W. VA.—The Interurban Railway Company has been [illegible] from Wheeling to Bethany.

ONTARIO, WIS.—The Brush Creek Farmers' Telephone Company, Ontario, Vernon County, has been incorporated with a capital of $3,000 by I. O. Hoff and others.

PRAIRIE DU SAC, WIS.—The Legislature at Madison has granted articles of incorporation to a company which proposes to construct a dam across the Wisconsin River at Pounds Landing, about 1 mile north of this village. Magnus Swanson, of Madison; J. S. Tripp, of Prairie du Sac, and M. A. De Vitt, of Chicago, Ill., are interested. The dam is to be constructed in connection with the power plant at Kilbourne, and is to furnish electric energy for nearby cities and towns extending as far as Madison, Janesville and Beloit. The plant will have a capacity [illegible]

PRENTICE, WIS.—The Prentice Light, Power & Water Company has been incorporated with a capital stock of $3,000 by A. F. Zeigler and others.

UNITY, WIS.—Articles of incorporation have been filed for the Strum Telephone Company by S. B. Anderson and others. The company is capitalized at $8,000.

Legal.

ACTION FOR DAMAGES FOR DEATH BY CONTACT WITH LIVE WIRE.—In an action against the Western Union Telegraph Company to recover damages for the death of a trimmer in the employ of the Northern Electric Light Company the following facts were shown: An unused telegraph wire, which it was alleged belonged to the defendant or was under its control, fell across an electric light feed wire of the Northern Electric Light Company. The telegraph wire had been connected with a call box which had been removed some months before the accident. The wire had fallen three or four weeks before. One end of it extended down so near the pavement that children reached and played with it. The other end was wrapped around an iron pole. The deceased was a trimmer in the employ of the electric light company and was killed by an electric shock while engaged in placing carbons in a lamp attached to the pole. It was held that the plaintiff was entitled to recover and that a judgment in his favor would not be reversed. Mannenhower vs. Western Union Telegraph Company, Supreme Court of Pennsylvania, 67 Atl. Rep. [illegible]

ARMATURE CORE PATENT LITIGATION.—The United States Circuit Court for the District of New Jersey has filed an opinion in the suit of the Westinghouse Electric & Mfg. Company against the Prudential Insurance Company of America, on Nolan patent No. 582,481, granted May 11, 1897. This opinion is the outcome, after the hearing of testimony of both sides and argument at final hearing, of a suit brought by the Westinghouse Company against the Prudential Company, charging the latter with infringement of Nolan patent No. 582,481, in a generator manufactured by the Bullock Electric Manufacturing Company, of Cinnati, Ohio. The Nolan patent in suit relates to a means for fastening the laminæ of the cores of electrical machines together and to the casting by which they are supported, and whereby the armature can be readily taken apart and put together. The laminæ are clamped between a cylindrical flange at one end of the casting and a ring fitting over the other end of the casting. This ring is held in place by a small fastening ring interposed between it and a small shoulder on the casting. A shoulder is provided upon the outer face of the clamping ring for holding the small ring from flying outward. This is generally termed the spring-ring method of clamping armature laminæ. Judge Lanning in this opinion holds that claims 2 and 4 of the Nolan patent are valid and cover the construction found in the Bullock generator used by the Prudential Company.

CONTRACT TO GIVE TELEPHONE COMPANY EXCLUSIVE RIGHT TO MAINTAIN TELEPHONE EXCHANGE IN HOTEL HELD INVALID BECAUSE IN RESTRAINT OF TRADE.—The Central New York Telephone & Telegraph Company entered into a contract with the proprietors of the Yates Hotel in Syracuse, N. Y., by which it agreed to install a telephone exchange in the hotel with its appropriate switchboards, wires and tubing. In consideration of this agreement the hotel proprietors were to furnish certain space and accommodation for the booths and appliances of the telephone company, were to pay a certain compensation and were to give the company exclusive right to place telephones in the hotel. The proprietors threatening to violate this contract by removing the system and by installing therein the system of a rival corporation, an action was brought and a temporary injunction was obtained. The matter presented for consideration was the validity of the agreement to allow one telephone company an exclusive right to maintain its instruments in the hotel and the only ground upon which the contract was attacked was that it was void because in restraint of trade. It was held that the contract in question was void and that the proprietors of the hotel might disregard it to the extent of negotiating with any other telephone company as they should see fit. Central New York Telephone & Telegraph Company vs. Averill, New York Supreme Court, [illegible]

[illegible] plaintiff had been employed by the defendant as a cable splicer or electric plumber. He was taken from his work, which was done mainly in underground conduits, and directed to assist in the removal of an iron pole, which had rusted near the base and become unfit for use. This was work with which he was not familiar. The pole had been inspected and condemned as unsafe, but of this fact he had no knowledge. The defects were not apparent nor discernible except by inspection. He supposed the pole was safe, as it appeared to be, and from information received from the foreman believed that it was to be replaced by one of a different kind. While he was at the top of the pole assisting in the removal of a mast arm the pole broke a few inches from the ground because it was too weak to sustain the extra weight. This testimony, although flatly contradicted, made out a case that entitled the plaintiff to go to the jury, since it tended to show that there was a special risk in the work which was not patent and was not known to him, but was known to his employer. But it was held that it was improper for the trial judge to direct the jury to find for the plaintiff and a verdict brought in on such a direction was reversed. Crothers vs. Philadelphia Electric Company, [illegible]

RIGHT OF FOREIGN TELEPHONE COMPANY TO EXERCISE THE RIGHT OF EMINENT DOMAIN IN THE STATE OF MISSISSIPPI.—Section 925 of the 1906 Mississippi Code provides that all companies or associations of persons incorporated or organized for the purpose of constructing telegraph or telephone lines shall be authorized to construct the same along and across any of the public highways, railroads, and section 929 empowers them, for the purpose of constructing new lines, to exercise the power of eminent domain as provided in the statutes on that subject. But section 1876, in the chapter on eminent domain, provides that telephone companies "chartered under the laws of this state" may acquire a right of way "across" railroads and does not mention foreign companies. Counsel for the Yazoo & Mississippi Valley Railroad Company, along which the Cumberland Telephone & Telegraph Company desired to lay out a right of way, argued that, as section 1876 provided for domestic corporations only, the Cumberland company, being the creation of the state of Kentucky, had no power to proceed by eminent domain. The court concluded, adversely to this contention, that the first two sections mentioned must be given effect, as well as section 1876, and that as those sections did not discriminate between domestic and foreign companies, the Cumberland company had the right to erect its line along right of way of the Yazoo Railroad. Cumberland Telephone & Telegraph Company vs. Yazoo, etc., Railroad Company, 44 So. Rep. 166.

ACTION FOR DAMAGES BY MOTORMAN INJURED BY EXPLOSION OF THE CONTROLLER ON A STREET CAR.—A motorman who is injured by an explosion in the controller cannot establish a right to damages against the company by showing merely that such an explosion occurred. He must further show in order to entitle himself to damages that the company was in some way guilty of negligence. The evidence showed that plaintiff, David W. Sills, was a motorman on one of defendant's street cars; that while in the discharge of his duty on the front platform of the car there occurred an explosion of the controller which was so violent that Sills was thereby blown or thrown entirely off the car and he fell upon the pavement or sidewalk on the bridge over which the car was passing at the time. He was unconscious when picked up and was found to have suffered painful injuries. Testimony was given that the controller was one of the best on the market and an expert testified that the makers of such machinery have been unable to make it absolutely perfect and that accidents and derangements take place from time to time in spite of all they can do. It was held that the company was not required to furnish its servant absolutely safe appliances or machinery with which to work, but had discharged the full measure of duty toward the servant when ordinary and reasonable care had been exercised to supply and maintain safe machinery, tools and appliances with which to do the work. Beebe vs. St. Louis Transit Company, [illegible]

ACTION FOR DEATH BY CONTACT WITH TELEPHONE COMPANY GUY WIRE.—In the case of Snyder against Mutual Telephone Company, the usual order of parties is reversed, and we find the ad- [illegible] against a telephone company to recover damages for the employee's death, alleging that the same resulted from contact with a guy wire attached to one of the telephone company's poles. As a general rule, the action is against the electric light company for the benefit of the estate of the telephone company's employee, who has been killed as a result of coming in contact with a high-voltage wire belonging to the electric light or power company. The theory upon which the liability of the defendant telephone company was predicated, was that the telephone company was negligent in having an uninsulated guy wire connecting the light company's pole with the defendant's own pole across the street, with which the foot of the deceased came in contact while he was handling the live wire extending from the converter to the fuse box, thus grounding the light company's circuit of a high voltage and causing instant death. The chief contention of the defense with reference to the lineman's contributory [illegible] voltage. The testimony for the plaintiff tended to show a custom among [illegible]

as proper to work without gloves, unless they were working on a "bad pole." The court concluded that it would not be justified in saying under the evidence that it was conclusively negligent on the part of the lineman to work where he was at the time of the accident, depending on the insulation afforded by the dry pole without wearing rubber gloves. And so far as the telephone company was concerned, it was wholly immaterial what were the rules of the light company, or whether such rules had been observed. The telephone company offered as a further defense that the administrator had settled with the light company, and, therefore, had no cause of action against the defendant. It was shown that the light company had paid $1,200 to the administrator, and the plaintiff admitted the receipt of that sum of money, but averred the same to have been a gift or gratuity voluntarily paid, without solicitation, and without any demand or claim. The document which he signed purported to accept the $1,200 in full of all claims against the electric light company. The rule is that where two persons are jointly liable for the same negligent act, a settlement with one of them operates as a release to the other. It was immaterial whether the plaintiff had made a claim against the light company on account of the death, or whether the manager of that company first approached him, and suggested the payment of the money. The question was whether the plaintiff had received from the light company by voluntary settlement full compensation of any demand which he could have made against the light company for the death of the lineman. This he was held to have done, and for that reason could not later bring suit against the other negligent party upon the same cause of action. Snyder vs. Mutual Telephone Company, Supreme Court of Iowa, 112 N. W. Rep. [illegible]

Obituary.

MR. I. F. BLACKMER, electrical engineer for the Des Moines [illegible] Electric Light Company, died recently from injuries received Aug. 27. Mr. Blackmer had been with the above-named company about 10 years.

PROF. GEORGE W. PLYMPTON, professor of physical sciences at the Polytechnic Institute in Brooklyn, died on Wednesday, Sept. 11, at his summer home in Tyson, Vt., in his eightieth year. He was born in Waltham, Mass., and graduated as a civil engineer from the Troy Polytechnic Institute in 1847. He was in the service of the Government as an engineer during the Civil War. In 1851 he became a professor of mathematics in the New York State Normal School, and in 1860 held the same position in the New Jersey Normal School. His connection with the Brooklyn Polytechnic Institute began in 1863. He was professor of chemistry and toxicology for several years in the Long Island College Hospital, and from 1870 till 1886 was editor of Van Nostrand's *Engineering Magazine.* He had been director of schools in the Cooper Union for thirty-eight years. He was president of the Board of Electrical Subways in Brooklyn during Mayor Low's administration and was a member of the Society of Civil Engineers. He leaves a son, Dr. [illegible] Plympton, a Brooklyn physician, and two daughters. The interment was at Troy, N. Y.

Personal.

MR. [illegible] P. JOHNSTON has resigned [illegible] of the [illegible] boiler department of the Atlas Engine Works, Indianapolis. Mr. Johnston's present address is Engineers' Club, New York.

MR. CHARLES N. BLACK has been appointed [illegible] of the [illegible] Railways of San Francisco, and has resigned his position as [illegible] of the Metropolitan Street Railway of Kansas City.

MR. FRANK B. BATCHELDER has been appointed [illegible] of motive power of the United Railways & Electric Company, of Baltimore, Md., having charge of the operation of the power plants [illegible]

MR. [illegible] GIBBS has been appointed [illegible] of the Baltimore & Ohio Railroad, succeeding Mr. W. D. Young [illegible] Mr. Gibbs [illegible] of Mr. George Gibbs [illegible] of motive power of the Pennsylvania Railroad.

MR. JAMES L. RICHARDS, president of the [illegible] companies of the Massachusetts gas companies, has been elected president of the [illegible] companies of the Boston Suburban Electric Companies [illegible] Mr. Samuel L. Powers, who resigned [illegible] the practice of law.

MR. [illegible] NICHOLSON, superintendent of the electrical department of the [illegible] Water, Light & Railroad Company of [illegible] N. Y., has been appointed superintendent of the Oswego Electric Lighting Company at Oswego, N. Y. Mr. [illegible] Cunningham succeeds Mr. Nicholson and has already assumed his duties.

MR. L. J. B. WALL, of Perth, West Australia, [illegible] interested in [illegible] development in West Australia. The firm of which he is the [illegible] member, Splatt, Wall & Company, [illegible] about [illegible] miles from the coast, and [illegible] for their operations [illegible] the exclusive use of electrical [illegible] Mr. Wall [illegible] of the A. I. E. E.

DR. WALTER REICHEL, formerly chief engineer of the railway [illegible] of the Siemens & Halske Company, [illegible] professor at the Berlin Polytechnic University [illegible] of a Prussian Government commission [illegible] subject of [illegible] electric traction as applied [illegible] Dr. Reichel [illegible] in connection [illegible] Zossen high-speed [illegible] railway tests.

MR. LEROY P. SAWYER, manager of the Buckeye Electric Company, will shortly become a benedict, his engagement to Miss Jessamine Pike having recently been announced. The prospective bride is well known in Cleveland, having been the leading singer at the Unity Church there for some years. Mr. Sawyer is a graduate in electrical engineering from the University of Nebraska, and in view of the executive ability he has shown in the management of the Buckeye Electric Company, has been placed upon a number of the governing committees of the National Electric Lamp Association.

Trade Publications.

DIRECT CURRENT GENERATORS of the belted type are fully discussed in Bulletin No. 1094 of the Fort Wayne Electric Works, Fort Wayne, Ind.

ELECTRIC HOISTS.—The Lidgerwood Manufacturing Company, 96 Liberty Street, New York, has issued an illustrated bulletin dealing with electric hoisting equipments for 250 and 500 volts.

TURBO-GENERATORS FOR TRAIN LIGHTING.—Bulletin No 4509 of the General Electric Company deals with Curtis turbo-generators designed for mounting either upon the locomotive or in the baggage car. The bulletin contains a list showing 57 trains upon which 15-kw, 80-volt and 25-kw, 125-volt Curtis turbine sets are now used.

PLUNGER PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has issued an attractively illustrated booklet dealing with triplex pumps for heavy duty driven by electric motors. The booklet contains illustrations of the many services to which the pumps are applied, and shows many buildings equipped with Goulds pumps.

ARC LAMPS.—Circular No. 1102A, of the Westinghouse Electric & Mfg. Company, is devoted to direct-current multiple-circuit arc lamps designed for either 110 or 220. The lamps are of the direct-lift type, the pull of the magnets being directed upward; and the mechanism is so arranged as to secure a uniform and even action during the entire lift.

BLOWERS AND EXHAUST FANS.—Direct connected electric forge blowers are discussed fully in bulletin No. 3304 of the Emerson Electric Manufacturing Company, St. Louis, Mo. The motors are of either the direct-current or alternating-current type. Exhaust fans direct connected to alternating-current or direct-current motors are treated in bulletin No. 3503 of the same company.

ELECTRICAL HEATING DEVICES.—The Lowe Electrical Company, 54 Vesey Street, New York, in a 12-page pamphlet, describes its line of Conqueror electric heating devices. These are of the iron-clad type and interchangeable, and are claimed to be indestructible. Among the apparatus illustrated are laundry irons, disk stoves and circuit attachments for electric heating apparatus.

PORTABLE TESTING INSTRUMENTS.—Circular No. 1104 of the Westinghouse Electric & Manufacturing Company deals with portable voltmeters, milli-ammeters, lamp testers, volt-wattmeters, ammeters, single-phase wattmeters, polyphase wattmeters, single-phase power-factor meters, polyphase power-factor meters and portable series and shunt transformers for use with measuring instruments.

MILLWORK.—Under the title of "Some Mill Engineering Work," Mr. Frank Sutton, E. E., of 91 Wall Street, New York City, has issued a neat pamphlet addressed to mill owners and giving a list of the various mills, factories and other places for which he has undertaken the design and equipment of their power plant, sprinkler system, etc. The list is very long and comprehensive in its range.

SPECIAL-SERVICE, DIRECT-CURRENT MOTORS.—Constant-speed motors of the four-pole type rated at from 2-hp to 10-hp and two-pole motors rated at from .16-hp to 1.5-hp are discussed fully in circular No. 1099 of the Westinghouse Electric & Mfg. Company. Motors rated at from 25-hp to 150-hp and intended for heavy mill service are treated at length in bulletin No. 1144 of the same company.

ELECTRICAL MACHINERY. [illegible] of the Gregory Electric Company, Chicago, Ill., contains a list of the largest stock ever carried by this company, including generators, motors, transformers, meters, arc lamps, instruments and repair parts. This stock is ready for immediate delivery. [illegible] copy of the [illegible]

GOODWIN & KINTZ COMPANY, [illegible] Winsted, Conn., announces that its new catalogue No. 31 is now ready. The catalogue contains [illegible] shades, and the manufacture of dining-room domes is a new departure with it. Several of these are shown in the new catalogue.

PREPAYMENT WATT-HOUR METERS. [illegible] of the Westinghouse Electric & Manufacturing Company, which deals with prepayment watt-hour meters, contains valuable hints in the form of two tables showing for what length of time certain numbers of 16-cp lamps can be operated for 25 cents with energy at 10, 12.5 and 15 cents per kw-hour [illegible]

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY has issued its catalogue No. 19, covering open and enclosed fuses of all the kinds which it manufactures. It begins with enclosed fuses and fuse blocks [illegible]

[illegible]

NOVI [illegible] art. The cover design and particularly the illuminated initials would be creditable to a professed art publication. The text is devoted to a "preachment" in the interest of the Novi lamp, in which the prospective purchaser is taken energetically in hand and told plain truths in homely terms he cannot misunderstand.

STROMBERG-CARLSON TELEPHONE EXCHANGES.—The Stromberg-Carlson Telephone Manufacturing Company of Rochester N. Y., has issued a thirty-two page pamphlet entitled "Lost Time," describing various branch exchanges and equipments of its system. The cover is printed from a special design in four colors and bronze; the inside pages are printed in three colors, the illustrations being in two colors. Headings and initial letters are mostly of special design made for the publication.

DOUBLEDAY-HILL CATALOGUE.—The Doubleday-Hill Electric Company, 919 Liberty Street, Pittsburg, Pa., is sending out to the trade its new catalogue. It comprises seven hundred and twenty-five pages, 10x6½ inches, of a complete, comprehensive and up-to-date line of electrical material. All obsolete matter has been entirely eliminated, so that nothing but the latest and most approved material can be found. Apparatus from 100 to 5000 volts is illustrated; even the tantalum lamp [illegible]

SMALL SINGLE-PHASE MOTORS.—Bulletin No. 3 of the Electric Supply Company, St. Louis, Mo., describes a line of small motors which has been designed to meet the demand for a small alternating motor which can be operated from single-phase lighting circuits, which will give the same service as direct current motor of equal capacity and which will require a minimum of attention and cause no disturbance of lamps in starting. The design is such that from no load to full load there is extremely small variation in speed.

COCHRANE HEATERS, with the title, "The Profitable Utilization of Exhaust Steam as Accomplished with Cochrane Heaters," the Harrison Safety Boiler Works, of Philadelphia, has issued a handsome octavo pamphlet of 112 pages which thoroughly considers the merits of open feed-water heaters in general, and of the Cocrane heater and oil separator in particular. The publication has more the character of a treatise on feed-water heating and purification than of the usual trade pamphlet, and as such will be found of interest and value to all steam users.

FLAME ARC LAMP.—The operating characteristics and advantageous features of metallic flame arc lamps are discussed in circular No. 1145 of the Westinghouse Electric & Mfg. Company. It is stated that the metallic oxide lamp using 4 amperes at from 65 to 70 volts has an illuminating effect superior to that of an enclosed carbon arc lamp using 6.6 amperes at from 75 to 80 volts. Moreover, the life of the metallic oxide electrodes exceeds that of the carbon electrodes of the enclosed arc lamp. A 12-in. electrode consisting of iron oxide in an iron tube has an average useful life exceeding 150 hours.

THE SPRAGUE ELECTRIC COMPANY, New York, [illegible] new bulletin, "Electric Power in the Printing and Allied Trades," has traced the remarkable progress made by it in equipping different kinds of printing machinery with Sprague motors. The list of printing establishments given as having been supplied covers a great number of concerns in domestic and foreign countries. This bulletin No. 229 contains 74 pages, 8 x 10½ inches, and is filled with information and suggestions invaluable to the progressive printer and those having to do with binding, electrotyping and stereotyping machinery.

PRICE LISTS.—The trade will be interested in the New Idea Catalogue of electric light and power supplies and net price list issued by the "Commercial" Electrical Supply Company, of St. Louis, Mo., the special features of which are as follows: It contains the 1907 Fire Prevention Bureau Rules. The price list is made up with light-faced type for factory shipment material and heavy-faced type for stock shipment material. On the front cover of the price list are two columns to indicate change in prices during the current month, one indicating goods advanced, and the other goods declined. It also contains complete information pertaining to conduit construction. This book will be sent upon request.

ELECTRICAL MEASURING INSTRUMENTS.—Catalogue No. 65 of [illegible] in addition to describing various lines of switchboard and portable voltmeters and ammeters for direct-current circuits, contains an interesting discussion of the constructive details which render the instruments exceptionally accurate and reliable. One of the most valuable features of these instruments is found in the fact that the ammeters are provided with inter- [illegible] pair of leads and any ammeter movement, and the readings will be cor- [illegible]

LAGONDA VALVES.—Just what can happen when a steam main bursts or a fitting on the line breaks, or one boiler of a battery gives way, is vividly told in a newly issued pamphlet describing the Lagonda automatic boiler cut-off valve. The pamphlet also explains the dangers from ammonia explosions and the way in which the cut-off valve may be used to stop the flow before enough of the ammonia gets out to do any harm. A number of interesting tests are given to show the certainty with which this type of automatic valve does the work in case of accident. The valve is illustrated [illegible] had free by writing to the Lagonda Manufacturing Company, Springfield, Ohio.

[illegible] COMPANY [illegible] reality a selection from over 800 pages of its printed matter, and its sec- [illegible] the special features of design and construction connected with its name. A special feature of the design is the placing of all valves above the cistern top, where they may be examined or repaired without displacing any other parts than the bonnets over each one. Provision is made for easily taking up lost motion, and in most of the pumps small parts are interchangeable. In pumps of small and medium sizes the tank or cistern acts as the stand or foundation. Attention is called to the fact that the pumps are built so that they do not trap air, which is the most annoying feature of hydraulic work.

"ELECTROLESS" [illegible] which the H. W. Johns-Manville Company, 100 William street, New York City, has just issued a neat little folder. Electroless pipe covering is the direct outgrowth of the demand for a preventive of electrolysis in underground pipes. It is a sectional covering of a specially prepared asbestos paper in laminated form, thoroughly impregnated, and coated with a high grade water-proof insulating compound, which presents an effective barrier to the transmission of electric current. This covering acts as an insulating medium between the pipe and ground, and, being made of indestructible materials, is permanently durable and has a lasting efficiency. The covering is ¼ to ⅜ inch thick, and is furnished in 3 feet sections, to fit various sizes of iron and lead pipes. All longitudinal and abutting joints are securely sealed by means of strips and insulating cement, which are furnished with the covering. For sleeve couplings, etc., a special sleeve of Electroless pipe covering is provided.

DECAY OF POLES.—The Universal Pole & Post Preserving Company, of Circleville, Ohio, has issued a pamphlet on the "Decay of Poles," by Dr. Howard Jones. The method of the company under the patented process of Mr. H. P. Folsom is to remove the earth around the pole to a depth of about 16 inches. Then all the decayed wood is scraped or cut away with special tools and a hole is bored to the center of the pole to discover if the center is sound. If the center of the pole is hollow this is filled with a chemical in solution with water. An asbestos and asphalt jacket of special manufacture is then placed around the pole, leaving a space between the jacket and pole of about one inch. This space is filled with a composition of germicidal chemicals mixed with sand, and the top is sealed and a good finish is placed upon it with cement. The appliance is more indestructible than the pole, and together with the chemicals will protect the pole for a period of many years. The chemicals applied to the pole will kill the fungi and destroy the enzyme, and at the same time will harden the wood. Poles treated seven years ago show no infection at the present time. The jacket is so durable that, at the end of a given number of years, the contents can be freshened by the injection into the space between the jacket and pole [illegible]

SINGLE PHASE INDUCTION MOTORS.—The general characteristics of small self-starting single phase induction motors are fully discussed in bulletin No. 3100 of the Emerson Electric Manufacturing Company, St. Louis, Mo. The motors described are started by the split phase method, the starting coils being disconnected automatically by centrifugal force when the speed has increased to a proper value. Bulletin No. 3111 deals with single-phase motors of .025 hp and .05 hp designed for starting without load. Bulletin No. 3112 describes a .05-hp single phase induction motor that starts from rest under full load torque. Motors rated at .10 hp and .125 hp with a full-load torque at starting and intended for intermittent serice are treated in bulletin No. 3113. A .17-hp motor capable of starting up with full-load torque is described in bulletin No. 3114. Light-load automatic-start motors rated at .125 hp and .17 hp are discussed in bulletin No. 3115, while those rated at the same value but intended for intermittent service are dealt with in bulletin No. 3116. Bulletin No. 3117 is devoted to .17-hp and .25-hp motors designed for starting under full load torque. Motors of the same type but rated at .25 hp and .33 hp are [illegible] motors rated at .125 hp and .17 hp, designed for full-load automatic start and for intermittent service. Back geared motors of .25 hp and .50 hp are described in bulletin No. 3122.

[illegible] USE" is the title of a handsome publication just issued by the General [illegible] cover and contains illustrated descriptions of small apparatus particularly [illegible] ship's lighting plant, usually of more than ample capacity for intermittent load, offers at once an available source of supply, which, utilized for cooking, heating, etc., would provide numerous real and profitable conveniences with small increase in cost. The electric heater on account of its compactness, neatness, easy regulation and simplicity is ideal for stateroom use. One or two quart water heaters, electric wash bowls and electric shaving mugs are familiar conveniences and electric flat irons in sizes from three to twenty-four pounds are supplied for the laundry. Among special devices particularly serviceable on shipboard may be mentioned electric soldering irons, glue pots, curling iron heaters, surgeon instrument steril- [illegible] elements are used by the General Electric Company, known as the cart- [illegible]

efficient application of the heat and sufficient radiating surface so that nearly all the devices may be left in circuit indefinitely without fear of burn out.

Business Notes.

THE ELECTRIC CITY PUBLISHING COMPANY, Chicago, has moved its offices from the Edison Building to the Electric Block, 89 Market Street, where the entire second floor is occupied by the several departments of *The Electric City*.

THE U. T. HUNGERFORD BRASS & COPPER COMPANY, Pearl and Park Streets, New York, has nearly completed another warehouse for storing stock, known as warehouse No. 2, at 486-492 Pearl Street. The building, which occupies a site 100 x 127 feet, is of two stories and basement, and has a storage capacity of 5,000,000 pounds.

THE CONTINENTAL FIBRE CO., of Newark, Del., incorporated last year, reports such a demand for its product that it has already been necessary to double the capacity of its plant. These improvements are now about completed and the usually active fall trade will find the company equipped to make immediate deliveries in practically unlimited quantities. Each of the incorporators of this company has been connected with the vulcanized fibre business since its infancy. To this experience, together with sufficient capital and thorough organization offices, the company's success is attributed.

THE STANDARD UNDERGROUND CABLE COMPANY has reopened offices in San Francisco, in the Shreve Building, moving there from its temporary quarters in Oakland. Mr. A. B. Saurman continues as Pacific Coast manager. The new Oakland factory of the company is four times as large as the factory which was destroyed by fire shortly after the earthquake last year. It is as nearly fireproof as possible, and equipped with new up-to-date machinery for the manufacture on short notice of insulated wires and cables for practically any service. It is also equipped with complete warehouse facilities for handling the products of the Eastern factories carried in stock for Coast delivery.

HESS-BRIGHT MANUFACTURING COMPANY, Nineteenth and Hamilton Streets, Philadelphia, has just received the following letter from Glaenzer & Cie., its French representatives: "We have the pleasure to submit to you some matter that will permit you to judge of the last success due to our ball bearing D.W.F. (Hess-Bright) in the race for 'The Emperor's Cup' (Kaiserpreis). Of the first ten cars to arrive, seven had our ball bearings D.W.F. (HB). These ten cars belonged to six different makers, and five of these (Pipe, Opel, Isotta Fraschini, Itala and Mercedes), use D.W.F. (HB) ball bearings. The crankshaft of the Pipe was mounted on D.W.F. (HB) ball bearings." This, it is said, but repeats previous history, as practically every race of international importance has been run and won on HB—D.W.F. ball bearings.

FRANK B. COOK, of Chicago, reports the following as among orders recently secured for distributing boards and protectors: Omaha heads the list with 6000 pairs of protectors; Spokane, Wash., has an order in for 2500 pairs, and Edmonton, Canada, for 1000 pairs. The Tri-State Telephone & Telegraph Company, of Minneapolis, is installing an addition of 4720 pairs of Cook's protector and orders have also been received from the following: Alhambra, Cal., 300 pairs; Westfield, N. Y., 400 pairs; Seattle, Wash., 800 pairs; Lexington, Ill., 400 pairs; Wheeling, W. Va., 310 pairs; Oakland, Cal., 1000 pairs; Nebraska City, Neb., 700 pairs; Beaver Falls, Pa., 1000 pairs. The first order for terminals for Omaha has also been received, thus assuring the use of Cook protectors throughout the entire plant. The initial order is for 900 terminals, part of them being Cook's new porcelain type of terminal. Among other large orders for subscriber's station protectors are from the American Union Telephone Company, New Castle, Pa., 1000, and the Rochester Telephone Company, Rochester, N. Y., 1000.

THE HOLOPHANE COMPANY has recently augmented its sales force by the addition of Mr. Morgan P. Ellis and Mr. Harry P. Struben. The former comes from the Electric Appliance Company of Chicago and will travel the Northwestern States. Mr. Struben was, until lately, connected with the engineering department of the Pennsylvania Railroad Company, with headquarters at Baltimore. He will travel in the Southwest. The large number of gas and electrical engineers, architects and central station men who are becoming interested in illuminating engineering, and who call upon the Holophane Company for data in this branch, has led to the engagement of Mr. T. R. Pemberton, in the position of office salesman and demonstrator. The Holophane Company has a very complete demonstration room, in which the illumination value of its product is shown. The engineering department of the company has been increased by the addition of Mr. T. R. Rolfe, engineer, and Mr. C. W. Heck, designer. Mr. Heck resigned from the Safety Car Heating & Lighting Company to establish a department of special fixture designing for the Holophane Company, this department being necessary to take care of the growing number of large lighting installations being handled by the Holophane illuminating engineers.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 10, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 31 Park Row, N. Y.]

865,367. FLUORESCENT ELECTRIC LAMP; Thomas A. Edison, Llewellyn Park, N. J. App. filed May 19, 1896. Renewed April 29, 1902. A fluorescent screen or surface composed of tungstate of calcium, substantially as set forth.

865,368. SYSTEM OF ELECTRICAL DISTRIBUTION; Justus B. Entz, Philadelphia, Pa. App. filed Dec. 30, 1905. Relates to voltage regulator or system of distribution including a storage battery and its complementary booster. The booster has three field influencing coils in the load circuit, in the battery circuit and a third circuit opposing the first-mentioned coil.

865,377. AUTOMATIC SUSPENDING REEL FOR ELECTRIC INCANDESCENT LAMPS; John H. Gordon, Snoqualmie, Wash. App. filed Jan. 11, 1907. A hollow metallic drum is journaled between depending standards and has a spiral spring at one end by which it is normally wound up like a spring roller. The circuits are completed through the journal bearings.

865,379. COMBINED JACK AND RESTORING DROP; E. J. Grenier, Menominee, Mich. App. filed April 18, 1906. Construction having sector arm repeatedly movable to ordinal divisions.

865,383. CONTROLLING DEVICE; Arthur E. Handy, Providence, R. I. App. filed Dec. 31, 1904. A system of contactors separated by a single longitudinally movable rod impelled by a solenoid and controlled by a dash pot.

865,412. ATTACHMENT FOR ELECTRIC MOTOR CONTROLLERS; Albert H. Mathewson, Thompsonville, Conn. App. filed March 28, 1907. A mechanical arrangement for the handle of a motor controller, including inclined blades and balls which co-operate wherewith to insure a momentary stoppage at the notches of the controller when [illegible]

865,470. PRINTING TELEGRAPH; John E. Wright, New York, N. Y. App. filed May 6, 1904. Improvements in that class of telegraph in- [illegible] definite number and character transmitted over the line.

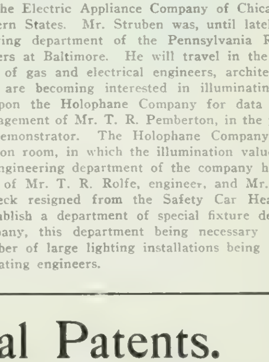
[illegible] Arthur, Manchester [illegible] App. filed April 5, 1907. A rigid cast iron [illegible] established

865,474. TROLLEY; Joseph Ashurst, Chicago, Ill. App. filed March [illegible] vertically journaled rolls with the flanges at their lower end which receive the trolley conductor between them.

865,483. INSULATING COUPLING; Gustave F. Dreher, Schenectady, N. Y. App. filed April 9, 1906. A strain insulator comprising a T-shaped casting and C-shaped casting which interlock together, there being provided an insulating sheet between the two.

[illegible] the anode and cathode elements are built up of a plurality of units. Has an element of pervious insulating support, secured to and surrounding the units and embracing the structural portion of the elements, together with lateral braces of insulating material to support the structure.

865,516. ELECTRIC REGULATOR; Frank C. Newell, Wilkinsburg, Pa. App. filed Oct. 22, 1904. An electric regulator comprising a main generating circuit having a rheostat in series, a second circuit for



865,503.—Electrical Accumulato

exciting the field of the generator and having one terminal connected to the main circuit, and a magnetically operated shiftable contact member for the rheostat constituting the other terminal of the second circuit.

865,527. HEATING DEVICE; Albert A. Radtke, Chicago, Ill. App. [illegible] lining formed of a resistance elem[illegible] circuit by a local snap switch.

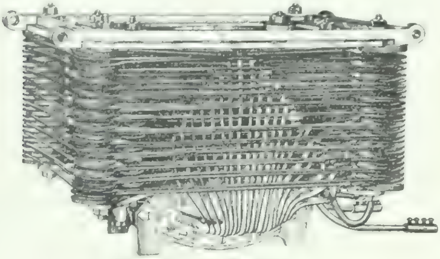
865,536. SELECTOR FOR AUTOMATIC TELEPHONE EXCHANGES. C. E. Scribner, et al. App. filed April 10, 1905. Renewed July 1, 1906. A selector comprising a number of connection terminals, a movable switch, a ratchet adapted in its movement to advance said [illegible]

adapted to engage the teeth of said ratchet, and a magnet adapted [illegible]

[illegible] one end formed for contact with a socket terminal and the other end formed of reduced diameter and adapted to receive the terminal of a cartridge fuse, in combination with an insulating covering surrounding said portion of reduced diameter.

865,588. ELECTRIC SWITCH; Edward M. Hewlett and Theodore E. [illegible] switches for handling large electric currents and provides means which will respond effectively to a controller device located at a distant point from the point of installation of the switching member, and connected thereto by a pilot circuit.

865,604. TARGET; August C. Meyer, Worcester, Mass. App. filed Jan. 4, 1906. A target of the type having annunciator mechanism in which the correctness of the aim of a firearm is indicated without



[illegible]

actually discharging the firearm. Includes a plurality of shutters with lever connections, operating magnets.

[illegible] INSULATING MATERIAL AND METHOD OF PRODUCING THE SAME; Charles L. Norton, Manchester, Mass. App. filed Feb. 23, 1907. The process which consists in impregnating a porous body containing a free oxidizing agent, with a liquefiable, oxidizable hydrocarbon.

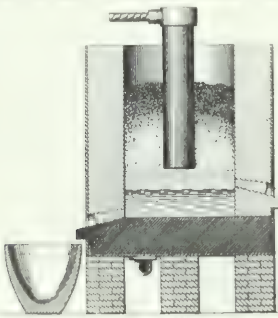
865,608. PROCESS OF BAKING CARBON ELECTRODES AND HEATING BY ELECTRICITY AND COMBUSTION; E. F. Price, [illegible] baking carbon electrodes, which consists in initially heating the elec- [illegible]

[illegible] PROCESS OF SMELTING REFRACTORY ORES AND PRODUCING LOW CARBON FERRO ALLOYS; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. Process designed for the production of ferrochromium and similar alloys, using ferrosilicon as a reducing agent.

865,617. INDUCTION MOTOR; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 7, 1905. In an induction motor, a secondary winding comprising hollow conductors of high resistance, a pipe connection from one end of said conductors to a fluid reservoir, and a pipe con- [illegible]

865,618. PRODUCTION OF NITROUS COMPOUNDS; C. P. Steinmetz, Schenectady, N. Y. App. filed April 20, 1907. The process of producing nitrous compounds, which consists in rotating a deflected electric arc within a current of air.

865,638. THERMOSTAT; Harry G. Geissinger, New York, N. Y. App. [illegible]



[illegible] Process of Smelting Refractory Ores and Producing Low Carbon Ferro Alloys.

ferent materials riveted together and located within a heating coil, so as to be deflected, and close an alarm circuit in case of excessive current in the coil. The strip of thermal element has special features of construction.

[illegible] ELECTROLYSIS OF FUSED SALTS; [illegible] and George O. Seward, Holcombs Rock, Va. App. filed May 26, 1905. Process consisting in regulating the electrolysis so that the secondary reaction between the earth alkali metal and magnesium [illegible]

865,687. PROCESS OF MAKING NICKEL FILMS. Thomas A. Edison, [illegible] making films of metallic nickel which consists in depositing upon a suitable cathode alternating films of copper and nickel, in then strip- [illegible] the copper in an ammoniacal copper sulphate solution.

[illegible] PROCESS OF [illegible] METALLIC FILMS OR FLAKES; [illegible] formed, and in mechanically removing the said deposits from the cathode.

[illegible] INSULATOR; [illegible] Angeles, Cal. App. filed May 16, 1906. Form of insulator of substantially the ordinary outlines except that it is thicker on one side than the other and has a diagonal slot to receive the circuit wire.

865,701. ALTERNATE CURRENT GENERATOR AND MOTOR; A. Heyland, Brussels, Belgium. App. filed June 9, 1902. In an alternating current dynamo electric machine, the combination with relatively movable windings, of a commutator connected to one of said windings, brushes bearing upon said commutator, a circuit having a sensibly constant potential impressed upon it connected to certain of said brushes, and a circuit carrying current proportional to the current in the other of said windings also connected to certain of said brushes.

865,707. SELF-SUSTAINED FIELD MAGNET COIL; Elbert W. Jodrey, Lynn, Mass. App. filed Dec. 28, 1906. The method of producing a self-sustained universally wound wire coil which consists in [illegible] then winding on the remaining layers.

865,730. CONTROLLING SYSTEM FOR RAILWAYS; Max Trautmann, Dresden, Germany. App. filed March 21, 1907. Railway system in which a series of conductors are divided into two groups corresponding to the number of passing trains, which conductors lead from the lines to indicators, and at the place to be controlled are put in circuit by suitable line contacts operated by the passing trains.

865,732. DYNAMO OR THE LIKE; Charles A. Vandervell, London, and William H. W. Proctor, Coventry, England. App. filed March [illegible] A choke coil having a variable inductance is controlled by a centrifugal device. Particularly adapted for ignition systems [illegible] explosion engines.

865,771. ELECTRIC SIGNAL BELL; Harold W. Eden, Detroit, Mich. App. filed July 18, 1906. Details of construction of an electric bell composed entirely of sheet metal parts.

[illegible] Howell, Butte, Mont. App. filed June 25, 1906. Signaling device for electric trains in which a signal is automatically produced in two trains when they approach each other within a predetermined distance. Has special trolleys with circuit connections to the train.

865,811. SYSTEM OF MOTOR CONTROL; William H. Powell, Norwood, Ohio. App. filed April 16, 1906. The series including this patent and the following eleven patents relates to various features of motor control systems and methods. Covers separate motor installations, and systems having a special generator.

865,812. MOTOR-CONTROL SYSTEM; W. H. Powell, Norwood Ohio. [illegible]

865,813. METHOD AND MEANS FOR CONTROLLING ELECTRIC MOTORS; W. H. Powell, Norwood, Ohio. App. filed June 30, 1906.

865,814. MOTOR-CONTROL SYSTEM; W. H. Powell, Norwood, Ohio. [illegible]

865,815. SYSTEM OF MOTOR CONTROL; W. H. Powell, Norwood, Ohio. App. filed Sept. 29, 1906.

865,816. MOTOR-CONTROL SYSTEM; W. H. Powell, Norwood, Ohio. App. filed July 30, 1906.

865,817. SYSTEM OF MOTOR CONTROL; W. H. Powell, Norwood, Ohio. App. filed Dec. 19, 1906.

865,818. SYSTEM OF MOTOR CONTROL; [illegible] Ohio. App. filed Jan. 28, 1907.

865,819. MOTOR-CONTROL SYSTEM; W. H. Powell, Norwood, Ohio. App. filed Jan. 28, 1907.

865,820. MOTOR-CONTROL SYSTEM; W. J. Richards, Norwood, Ohio. App. filed March 25, 1907.

865,821. SYSTEM OF MOTOR CONTROL; [illegible] Ohio. App. filed March 1, 1907.

865,822. METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS; L. E. Bogen, Cincinnati, Ohio. App. filed May 27, 1907.

865,830. CIGAR LIGHTER; Clark D. Vaughn, Philadelphia, Pa. App. filed April 9, 1907. Cigar lighter having a fluid tank or receptacle and a sparker pivotally mounted thereon and means for closing an electric circuit including a wick in said receptacle and breaking said circuit and extinguishing the flame of said wick.

865,848. AUTOMATIC SIGNALING APPARATUS; James S. Anderson, Ames, Neb. App. filed May 20, 1907. A locomotive is provided with a pair of longitudinal bars or conductors extending from end to end at a point above the same and which contact with depending plates above the track.

865,866. BLOCK SIGNAL; Pierre I. Chandeysson, St. Louis, Mo. App. filed Dec. 23, 1905. A semaphore comprising an arm or blade movable into three positions and operated by an electric motor having a magnetic clutch to control the positions of such semaphore arm.

865,879. ELECTRIC CONTACT RAIL; Ed. W. Farnham, Chicago, Ill. App. filed July 17, 1905. Arrangement for increasing the conductivity of third-rails while reducing their weight. The third-rail is made of U-shaped cross-section having a cable enclosed therein.

865,907. COIL FOR ELECTRICAL PURPOSES; Elbert W. Jodrey, Lynn, Mass. App. filed Oct. 26, 1905. Has a tubular support formed [illegible] with their adjacent ends separated by a space, and a conductor connecting the terminals of said coils, said conductor being embedded in said support.

[illegible] TELEPHONE RECEIVER; E. J. Quinby, Portland, Maine. App. filed Nov. 22, 1905. A telephone receiver consisting of a hollow metal casing flared at its outer end, an insulating bushing secured within such flaring portion and formed with an internal rabbet in its outer end, the rim of said rabbet being flared internally, the magnet, a magnet head supporting the same and seated within said rabbet, the periphery of said head being flared to correspond with the flares of said rim; and means connecting the head and bushing for forcing said head into seated position.

[illegible] CONTROLLER FOR ELECTRIC MOTORS; [illegible] Troy, N. Y. App. filed June 4, 1906. Design of controller doing [illegible] tion with the contact cylinders. The controller is sparkless during the act of shutting off the power, and furthermore so arranged that the operator must successively engage the contacts of the controller to operate the same.

Electrical World

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NEW YORK, SATURDAY, SEPTEMBER, 28, 1907.

CONTENTS.

THE COLORADO CONVENTION.

The Colorado Electric Light, Power & Railway Association took up in its convention last week many problems of interest to central-station and power-transmission men the country over, as well as some special Colorado problems. Among the latter the "Colorado brand" of lightning came in for its share of attention. The mountain and foot-hill regions of Colorado have been recognized as badly afflicted in this respect ever since electric circuits were strung in that country. As President Tripp indicated in his address, Colorado is fast becoming a state of big power companies and transmission lines. It has had notable examples for some years of both water-power plants and steam plants located at the coal mines, and is soon to have still more notable examples. The Central Colorado Power Company is engaged on some mammoth water-power development work and on plans for very long distance transmissions on steel-tower lines over mountain ranges at 90,000 volts. The plant of the Northern Colorado Power Company, which the convention visited in a body, is a good example of a type of plant much talked about but seldom built, namely, one located at the mouth of a coal mine. Not the least interesting feature of this latter plant as far as many small companies are concerned, is the plan to run, below the transmission line, for its entire length, a 2300-volt line for farmers and other small power users.

In the commercial and business building end of central station work the Colorado convention is fortunate in having in its membership the Denver Company which always has something interesting going on in revenue-increasing methods, and does not seem by any means to have reached the saturation point in its territory. Considerable convention time was given to commercial topics, and one evening was devoted to the incandescent lamp outlook. Owing to the distance of Denver, it has been impossible to get more than an outline of the work done by the convention in this issue, but further reports properly classified for convenient reading and reference will appear in later issues, and will be found full of meat.

CALCULATION OF WIRE SPANS.

The determination of the proper span data for a transmission line is not a matter of easy calculation if the effect of all the factors entering are to be rigorously taken into account, owing to the complication of the formulas. And since the building of such lines has become a branch of engineering instead of merely lineman's work, as was too often the case in the past, it is desirable to have the technics of the subject placed in a condition similar to that of other branches of engineering. In our issue of Jan. 12, of this year an article by Dr. Harold Render presented a relatively simple formula for the relations between deflection, tension and temperature [illegible]

wire spans, based upon a thorough analysis of these relations published by Dr. Cary T. Hutchinson in 1899. On page 604 of this issue we print another contribution by Dr. Render to the subject, in which a further simplification is made by recourse to a graphical method. By means of two charts—one for long and the other for short spans—and with the addition of simple numerical computations of certain values with which to enter an accompanying table, the tension and corresponding sag can be determined at which a cable should be strung at a normal temperature to comply with a given tension at a limiting temperature, and also similar data on the assumption that the cable is loaded with a given coating of sleet and subject to a given wind velocity. While the charts as presented apply only to copper conductors, similar ones can be easily constructed for a different wire conductor.

The Problems of a Small Plant.

It is instructive to consider the impartial way in which engineering problems arise with equal insistance in all sorts of cases. The little Swedish plant which we describe in the current issue is as valuable an example of clever and resourceful engineering as has appeared in many a day, and incidentally sets a standard of economical construction very hard to live up to there or anywhere else. It is a case of a relatively small power utilized with discriminating care and scrupulous regard to low fixed charges. Plants of this size are hard to put through in this country save as private investments, for there is no room for "financing" at a total cost of $52.70 per kw at the station. One would find himself a voice crying in the wilderness if he tried to interest an American banker in a $50,000 plant installed on any such basis. Nevertheless, in Sweden there was enterprise enough to put in the plant and we hope later to hear the expected good things of the returns on the investment. Apparently the hydraulic situation was of a very remarkable character, allowing an effective development at extraordinarily low cost. When it came to the 10,000-volt line, however, the situation was less favorable and a nice balance had to be struck between going around, over, or under an estuary. As has frequently happened, a long span proved the best way out of the difficulty, so a long span went up, with a factor of safety, by the way, of five, which seems ample for the purpose. The construction of the span seems very simple and effective, and the factor of safety in the strain insulation is up to 6.6, the neutral points of the star-connected line being grounded.

One of the interesting features of the plant is the distribution, which is three-phase for a motor district near the transformer station and direct-current, three-wire in the lighting network, evidently to suit the existing wiring. The transformation to direct current is by motor-generators, the old steam-driven, direct-current generators thereby serving as a reserve, while a storage battery furnishes an effective temporary resource. It is worth noting that the direct-current enclosed arc at 7 amperes worked 2 in series across the mains has been adopted for the street lighting. Small as is Westerwek (there are only 65 street lamps the whole direct-current system is of underground cables. We note that on the line the water stream form of static protector is in use, and we hope that later details of its performance under various conditions may be obtained. The device is one considerably used abroad in various forms, but it has never been a favorite with American engineers, and there seems to be no general consensus of opinion as to its merits. It should certainly act as a relief on the line, but what its performance would be in case of a heavy lightning discharge or a formidable surge is somewhat doubtful. Altogether, this small plant is an admirable example of recent practice and shows how effectively a small water-power can be put to work for the supply of a small market. The world is full of such chances, though seldom capable of so economical utilization. Yet there are many American streams worth an attempt to develop in very similar fashion, and hence the particular value of this example. The trouble in this country at present is that the smaller chances are often overlooked, and attention is directed chiefly to large enterprises regardless of the fact that they very commonly present much less favorable chances for cheap utilization, and generally involve long transmissions. It would prove profitable to investors hereafter to keep a much sharper outlook than formerly for opportunities like that at Westerwik.

Magnetic Hysteresis Phenomena.

One frequently encounters the statement that the core flux in a stationary transformer is produced by the combined magnetizing action of the primary and secondary currents. Such a statement is not inaccurate in itself, but beyond doubt it frequently leads to incorrect assumptions by persons not thoroughly familiar with the internal actions of the transformer. Thus, the above statement may lead one to conclude that the currents are the independent variables and that the flux is forced to assume such value as the resultant current is able to produce in the core reluctance. That is to say, one initially unfamiliar with transformers would be justified in assuming from the statement above that, if under certain operating conditions, the core reluctance were suddenly increased, the flux would be proportionately decreased. It is well known that the value of the core flux is determined solely by the required value of the counter e. m. f. in the primary coils; the current is the dependent variable and it must have such a value that at each instant its magnetomotive force produces the instantaneous flux demanded by the counter e. m. f.

It is to the conditions here outlined that may be attributed the increase in the primary current with increase in the secondary current of the transformer. The value of the secondary current is determined solely by the relation between the internally generated secondary e. m. f. and the total impedance of the secondary circuit. The primary current under load must have a value such that its magnetomotive force at each instant is sufficient to counterbalance the magnetomotive force of the secondary load circuit, and also to supply additional magnetomotive force to produce the required core flux in the reluctance of the magnetic path. When a constant-potential stationary transformer is operated with open secondary circuit, the primary current wave of time-value is peaked, on account of the cyclic change in the reluctance of the magnetic path; moreover, the current has a less value when the magnetism is [illegible]

called "hysteresis" phenomena. The lag of the change in reluctance behind the change in the magnetizing force is a condition effect and not a time effect. That is to say, when the magnetism is taken throughout a certain cycle of change, the reluctance is the same at each relative condition of change in magnetism, whether the cycle be completed very slowly or with extreme rapidity.

An article by Mr. M. O. Bolser, on page 603 of this issue, describes an interesting device for showing the cyclic change in reluctance when a portion of a transformer core is revolved synchronously with the alternation of the flux, the equipment being similar to the one discussed by Dr. Steinmetz in his "Alternating Current Phenomena." On account of the fact that at all speeds below synchronism the cyclic change in the reluctance of the total flux path is unaffected by the speed, the apparent "hysteresis" loop is the same at all such speeds. However, the actual hysteresis loss in the rotor decreases with increase of speed, the result being that the rotor exerts at all speeds a constant torque having such a value that when expressed in synchronous watts it is just equal to the actual hysteresis loss in the rotor when stationary. When the speed is above synchronism the cyclic change in the reluctance of the rotor is such that the required primary current is less when the magnetism threading the primary coil is increasing than when it is decreasing. Thus the apparent "hysteresis" loop indicates that the rotor is giving out energy instead of absorbing it. That is to say, the machine is operating as a generator. The machine may operate at exact synchronism with any torque from the full motor value (corresponding to the stationary hysteresis loss in synchronous watts), through zero (under which condition the apparent "hysteresis" reduces to zero) to the full generator value at which the apparent "hysteresis" becomes negative. The conditions at exact synchronism are discussed in detail by Mr. Bolser in the article which appears in this issue.

RECENT HIGH-SPEED GERMAN PRINTING TELEGRAPHS.

In Germany, the Hughes printing telegraph has retained for many years its ascendancy. The same instrument was at one time largely used in Great Britain and also to a lesser extent in the United States. At present, the apparatus is almost limited to Germany. Messages are transmitted from a manual keyboard, somewhat like that of a pianoforte, and are printed at the receiving end in Roman type upon a paper tape. The gist of the system, as is well known, consists in maintaining synchronism automatically between two revolving disks, one at each end of the line, in such a manner that the revolving disk at the receiving end, armed with type on its periphery, can strike off inked impressions at the properly selected moments on the passing paper strip. The speed of rotation is limited by electromechanical conditions to about 150 r. p. m., and to about one printed letter per revolution, or, say, 30 words per minute. The advantage of the apparatus over ordinary Morse lies in the direct printing of the message by the receiving mechanism without the need of an expert transcriber.

Within the last year or two, Messrs. Siemens & Halske, of Charlottenburg, Berlin, Germany, have brought out an improved printing telegraph machine [illegible] letters per minute. Although still under experimental trial, this apparatus has been in successful commercial service for about a year on a few circuits. One of these is from Munich to Nurenburg, about 100 miles long. The message to be sent is written off on a special form of typewriter, which not only prints the message on a 1-in. strip of paper, but also perforates the same in a set of 11 rows of holes. One foot of the perforated tape holds about 110 letters. The tape is fed to an automatic transmitter, which causes for each letter one positive and one negative impulse to flow to line at the proper respective intervals. As in the Hughes apparatus, there are two rotating disks, one at each end of the line, maintained in synchronism; but the speed of rotation is about 2000 r. p. m., and a letter is sent in each revolution. In the rotating disk at the receiving end, the letters are carried in perforated Roman type. The impulses are so timed that a 20-kilovolt locally-generated spark is liberated behind this rotating disk, so as to illumine a strip of chemically prepared sensitive paper through the proper successive type perforations. The letters are thus successively photographed on the advancing paper strip, which passes through a developing trough, and then through a fixing trough. When a strip finally emerges from the chemical baths, the message in photographically printed Roman type is ready for gumming on a delivery sheet.

There is nothing remarkable in securing a speed of transmission of 400 words per minute over a short telegraph line. Such a speed is obtainable on the Wheatstone recorder, and far greater speeds have been obtained on Bain electrochemical recorders. The remarkable feature lies in producing printed Roman letters at this speed, as distinguished from Morse dots and dashes, which require expert transcription. Much ingenuity has been displayed in the photographic spark production of the receiving mechanism. Each time that a letter is printed, the spark must be produced, do its photo-chemical work, through the type-hole, on the paper strip and disappear, all within the forty-thousandth part of a second. More than 30 such letters have to be printed per second. The speed with which messages can be transmitted by such apparatus is, of course, several times as great as that of the hand Morse, and, at the same time, the expense is much less than that of the hand Morse.

In order to utilize to the fullest extent the powers of such modern type-sending and type-receiving telegraphs as this German system, the Rowland system in America or the Murray system in Great Britain, it would seem to be necessary to have a reduced tariff for telegraph messages between those head offices where such printing telegraphs can be maintained, keeping the regular tariff for all ordinary messages that have to travel over Morse lines. It is not conceivable, at present, that the Morse hand system can be superseded on the ordinary way circuit. That system has proved its complete adaptability for ordinary way traffic through half a century of practical experience. But on through lines, connecting large cities, the Morse hand system must eventually be replaced by fast printing telegraphs which are able to earn a dividend at a considerably reduced tariff per word, and which can find a largely increased traffic by the introduction of a properly reduced tariff on messages.

Power in Manufactures.

The Bureau of the Census has just issued Bulletin 88, which is a report on the power employed in manufactures. This report, which forms part of the census of manufactures of 1905, contains the statistics for the calendar year 1904, and was prepared under the supervision of Mr. William M. Steuart, chief statistician for manufactures, by Mr. Thomas Commerford Martin, expert special agent. The total power employed in manufactures, according to this report, was 14,641,544 hp. To this amount steam engines contributed 10,828,111 hp, or 73.9 per cent; water wheels, 1,647,969 hp, or 11.3 per cent; electric power, owned or rented, 1,592,483 hp, or 10.9 per cent; gas or gasoline engines, 289,514 hp, or 2 per cent; and other kinds of power, 283,467 hp, or 1.9 per cent.

When compared with the figures reported at the census of 1900, those of 1905 show that in five years the total horse-power increased more than 40 per cent. The largest relative increase for any of the kinds of power was one of 270.5 per cent reported for owned electric motors. Rented electric power increased 141.9 per cent, and the power of gas and gasoline engines, 114.9 per cent. The largest absolute increase however, was reported for steam engines, the horse-power of which increased 2,687,578, or 33 per cent. The power of water wheels increased only 13.3 per cent.

From these figures it is evident that although steam engines are by far the most important source of power, electric power and the power of gas and gasoline engines are becoming of increased relative importance in manufacturing. Waterpower, while increasing absolutely, is dimishing in comparison with other kinds of power.

Among the several geographic divisions the Middle states ranked first in the amount of power, reporting 5,000,367 hp. The Central states were second, with 4,077,298 hp; the Southern states third, with 2,386,330; the New England states fourth, with 2,254,264; the Pacific states fifth, with 474,397, and the Western states last, with 445,937. Perhaps the most striking fact revealed by these figures is that the Southern states reported more power than New England. This has not happened before in the history of the country. In this connection it is interesting to note that the development in the Southern states has been in the utilization of steam power. In the South 87.4 per cent of the power was derived from steam and 6.2 per cent from water, but in New England 59.3 per cent was from steam and 29.2 from water.

The effect of a heavy industry on the utilization of steam power is illustrated by the fact that Pennsylvania, the principal center of the iron and steel industry, reported 2,088,773 steam hp, or almost 20 per cent of the total for the whole country. Ohio reported 1,028,665, so that these two states have nearly 30 per cent of the entire steam power employed in manufactures, a fact which results largely from the use of steam power in the metal industries. New York ranked third, with 850,497 steam horse-power; Massachusetts fourth, with 690,467, and Illinois fifth, with 651,578.

A comparison of these figures with those reported at the census of 1905 shows a percentage of increase in steam horse-power of 21.6 for Pennsylvania, 40.5 for Ohio, 28.9 for New York, 19.8 for Massachuesetts and 28.4 for Illinois. As might be expected, the largest percentages of increase were shown for some of the Western States and territories, but the Southern states were also conspicuous for large increases.

The largest amount of water power used in manufactures at the census of 1905 was reported by New York. The capacity in that state increased from 335,411 horse-power in 1900 to 446,134 horse-power in 1905, giving that state 27.1 per cent of the total for the whole country. The continued leadership of New York in the use of water power is due largely to the utilization of this kind of power in the paper and wood pulp industry. Of the total water power reported by New York at [illegible] per cent.

The next largest utilization of water power in manufactures [illegible] followed closely by Massachusetts, with 183,427 horse-power. Wisconsin was fourth, with 112,665 horse-power. In Wisconsin, as in Maine and New York, the paper and wood pulp industry is the largest consumer of water power, while in Massachusetts the cotton and wool industries are the largest.

As might be expected, in some of the states and territories where the aggregate of water power is least the percentage of increase has been greatest, as the addition of a few hundred horse-power has been enough to double the capacity. It is worthy of note, however, that the increase between 1900 and 1905 was 33 per cent in New York, 27.9 per cent in Maine, and 21 per cent in Wisconsin. In Massachusetts and also in Connecticut and Vermont there was virtually no further development in water power—in fact, a tendency toward retrogression is visible in certain parts of the New England region. It may be possible that the greater use of steam in some of the industries in the Northern states may be due to the fact that the water powers have already been developed to their full capacity.

At the census of 1905 power derived from electricity was reported as 1,592,483 horse-power, which represents an increase over the amount reported at the census of 1900 of 1,099,[illegible] horse-power, or 222.9 per cent. The development was extraordinary in the states distinguished chiefly for heavy manufacturing on a large scale. The horse-power reported rose in Pennsylvania from 107,746 to 346,797, or 221.9 per cent; in New York from 77,598 to 222,111, or 186.2 per cent; in Illinois from 49,235 to 165,265, or 235.7 per cent; in Ohio from 42,157 to 144,467, or 242.7 per cent; and in Massachusetts from 32,828 to 91,017, or 177.2 per cent.

The increase in the number, size and total capacity of gas and gasoline engines has been another marked feature of industrial development. The number of gas and gasoline engines reported increased from 14,334 in 1900 to 21,525 in 1905, their horse-power from 134,742 to 289,514, and their percentage of the total horse-power employed in manufacturing establishments from 1.3 to 2. When it is recalled that at the census of 1890 the capacity of gas engines in manufacturing establishments was only 8930 horse-power and is now over 30 times as great, it will be seen that a really remarkable change has taken place.

Gas and gasoline power is used very generally throughout the country, being reported from every state and territory. Pennsylvania led in the utilization of power of this kind, reporting 68,209 horse-power; New York ranked second, with 44,288 horse-power; Ohio third, with 35,101 horse-power; Indiana fourth, with 21,171 horse-power; Illinois fifth, with 12,319 horse-power; and Wisconsin sixth, with 11,350 horse-power.

The gasoline engine is necessarily more widely used than the gas engine, as gasoline is obtainable everywhere, while the gas engine usually depends upon city gas works for its supply of fuel. Hence by far the larger number of gas engines, and those small ones, are to be found in the denser centers of population, where the engine can be employed for the countless minor or finer branches of industry. Unlike the steam engine, it can be installed practically on any floor of a building, when surrounded by appropriate safeguards against fire. It is in this respect, however, that of recent years the smaller gas engine has encountered the sharp competition of the electric motor. The latter, in many of the essentials of convenience, economy, adaptability and freedom from danger, comes into competition with the gas engine, as does that appliance with the steam engine.

Besides the power derived from steam, water, electricity, gas and gasoline, 92,154 horse-power was reported at the census of 1905 as owned by manufacturing establishments. A large part of the power included in this class is pneumatic, although probably some hot-air engines also are included. The general introduction of pneumatic tools has resulted in the installation in various shops and factories of large pneumatic plants to supply the compressed air to drive these tools.

Rented power increased from 319,475 horse-power at the census [illegible]

98.1 per cent. Of the total reported at the later census, 441,592 horse-power, or more than two-thirds, was derived from electricity and has already been counted under electricity.

The effect of the introduction of electricity has been to retard the increase of other kinds of rented power. The various electric lighting companies throughout the country have found renting power a large and profitable source of income, giving them a load for their generating apparatus in the daytime. Thus they are able to run their plants at nearly the full capacity at all hours of the day and night.

Educational Work for New York Edison Employees.

There will be inaugurated, Tuesday evening, Oct. 1, by The New York Edison Company, the most far-reaching scheme of technical welfare work which has hitherto been undertaken. An experimental lecture course will be given for the benefit of the employees of The New York Edison Company under the auspices of the Association of Edison Employees, in the auditorium of The New York Edison Company, 44 West Twenty-Seventh Street. The lectures will be under the direction of Prof. Sydney W. Ashe, who had charge of the welfare work for the Brooklyn Edison Company last year. The course will include 25 weekly lectures upon electrical engineering, beginning with the elements of magnetism and extending to electrical measurements, direct and alternating currents. Each lecture will be repeated so as to give both day and evening employees an equal opportunity to attend. A very elaborate syllabus has been prepared giving dates, topics, general information about the course and detailed notes about all experiments to be performed. The lectures will be both theoretical and practical, and no expense will be spared to make them thorough and interesting, and to obtain the best results. The lectures will be given at 1:30 p. m. and 8 p. m. The company is to be congratulated upon inaugurating this work, which it is hoped will achieve the great success it deserves.

Smelting and Refining of Copper.

The Bureau of the Census has just issued Bulletin 86, which contains special reports on copper, lead and zinc smelting and refining. These reports, which form part of the census of manufactures of 1905, were prepared by Story B. Ladd, under the supervision of William M. Steuart, chief statistician for manufactures. The statistics included in the bulletin are for the calendar year 1904, with the exception of those for Michigan, which cover the year ending June 30, 1904. According to these statistics, 103 establishments were reported as engaged in the combined industry of copper, lead and zinc smelting and refining. Their combined capital was $104,340,036. They employed 26,853 wage-earners, paid $20,058,200 in wages, consumed materials costing $382,723,480, and manufactured products to the value of $451,398,354.

At the census of 1900 the lead smelting and refining industry was the most important of the three branches, and copper was second, but at the census of 1905 the positions were reversed. At the later census the copper industry supplied 46.8 per cent of the capital, 47.5 per cent of the wage-earners, and 53.3 per cent of the value of products, while the lead industry furnished 38.8 per cent of the capital, 28.2 per cent of the wage-earners, and 41.2 per cent of the value of products. That the growth of the copper industry has been greater than the growth of the lead is partially due to an increase in the smelting of dry ores of precious metals with copper instead of lead ores.

Copper smelting and refining was the principal industry of 90 establishments, the combined capital of which was $76,824,640. These establishments furnished employment to 12,758 wage-earners, paid $10,827,043 in wages, consumed materials costing $196,736,986, and manufactured products to the value of $240,780,216.

When compared with the figures for the census of 1900 those for 1905 show a decrease of 14.9 per cent in the number of establishments, but an increase of 44.8 per cent in capital, of 12.6 per cent in wage-earners, of 26.9 per cent in wages, of 61 per cent in cost of materials, and of 45.8 per cent in the value of products.

The growth of the industry, however, has not been uniform in the sections east and west of the Mississippi. The figures reveal a tendency toward the growth and concentration of the refining industry in the eastern territory. In 1900 this territory reported only 86.8 per cent of the refining, while in 1905 it reported 98.8 per cent. The operations of the western establishments are now confined almost entirely to smelting, with, in a majority of cases, the conversion of the matte into blister copper, which is electrolytically refined in the East.

New Jersey is the largest producer of refined copper, and between 1900 and 1905 it increased its production of the total for the country. Of the 602,595,113 lbs. of ingots, wire, bars, etc., reported in 1900 New Jersey produced 28.3 per cent, while of the 933,809,701 lbs. reported in 1905 it produced 35.6 per cent. The refining industry in New York also made a great advance, so that the states of New Jersey and New York reported for 1905 nearly two-thirds of the refined copper product of the country. Michigan was third and Maryland fourth.

Convention of the Colorado Electric Light, Power & Railway Association.

The Colorado Electric Light, Power & Railway Association held its fifth annual convention at Denver, Sept. 18, 19 and 20, at the Savoy Hotel. The first session was called to order about 11:30 Wednesday morning, the 18th, with Mr. George B. Tripp, of Colorado Springs, president, in the chair. After rollcall President Tripp delivered his address. He recalled the day in August, 1903, when a few met in Denver to organize the association and also the first convention held in December of the same year. There were 37 active members on the roll at the first convention. There are now 43. The number of possible active member companies in Colorado is 57. He then reviewed the benefits resulting from the organization.

The most interesting part of his address was that relating to revolutionizing changes in the power situation in Colorado about to take place and due to cheap water power being developed by some of the large power companies soon to commence operation in different portions of the state. This cheap power would, he thought, make possible much mining development otherwise impossible. He predicted that in five years there would be a 50-per cent decrease in the amount of coal used by Colorado mines and mills due to the increase of the use of hydro-electric power, and that ultimately coal will mainly be confined to domestic uses.

The executive committee recommended that Montana and the Dakotas be added to the territory embraced by the association. This territory already includes Colorado, New Mexico, Arizona, Utah, Wyoming and Idaho. This was adopted at a later session.

On Wednesday afternoon, Mr. B. E. Buttles, of the Denver Gas & Electric Company presented a paper entitled "Notes on Modern Boilers." He called attention first to the fact that boilers are not selected with the same care as engines with respect to refinements and suitability to the work in hand. He laid special emphasis on ease of cleaning and repair, and and on the difference between test conditions with new boilers and operating conditions with old ones. Tests of boiler efficiencies are likely to be confused with furnace efficiencies. That boiler will probably be kept cleanest which is easiest to get at. He criticized points about various boilers which make both internal and external cleaning difficult. Soot and dust lodged in large quantities around a boiler are likely to cause damage as well as loss of efficiency.

Mr. C. K. Durbin asked the opinion of members as to the relative merits of water-tube and horizontal return flue boilers for small electric light plants.

President Tripp said that in a small plant in Trinidad where there were boilers of both kinds, the water-tube boiler had to be kept out of service longer for cleaning and therefore in a very small plant was less desirable than in a large one.

This was followed by a paper on "Central Station Power Problems" by Mr. Chas. Robbins, of the Westinghouse Electric & Manufacturing Company. An abstract of this paper and the extended discussion following it will appear in a later issue. The convention took up, also, a number of questions from the Question Box, which will be given later.

Thursday morning was given to the reading and discussion of a paper by Mr. Geo. E. Putnam, of the Denver Gas & Electric Company, on "Business Building by Commercial Departments." Some interesting facts on recent developments in Denver in obtaining increased business from old consumers were brought out and will be given in a later issue.

Thursday evening Mr. F. W. Willcox, of the General Electric Company, presented a paper on "The Incandescent Lamp Outlook," which will appear in abstract later. The discussion on lamps lasted until a late hour.

Friday morning a very interesting and profitable meeting was held to discuss "Lightning Protection in Colorado." Mr. Leonard Wilson, of the General Electric Company, opened this discussion with an address describing the kinds of arresters used in Colorado and their behavior, and various members then gave their experiences. It is the purpose of the association to print this as a symposium later, after those taking part in the discussions have furnished more complete data.

Friday afternoon Mr. Frank E. Johnson read a paper on "High-Tension Porcelain Insulators." He said that up to this time the insulators on high-tension lines had been mainly of the pin-supported type. With these the limit of good and satisfactory line construction has been reached at about 60,000 volts, if top-heaviness of insulators is to be avoided and if the insulators are not to be too enormous and difficult to manufacture. The suspension type of insulator will probably be used in the future for high-voltage work because it provides sufficient insulation for use on steel towers and can be built with a sufficient factor of safety to take care of all climatic conditions. The factor of safety on a high-voltage line should be three. Insulator porcelain is made of a mixture of clay, feldspar and quartz, baked at 2000 degrees. After pressing into form the mixture is dried, then dipped into the glaze and again dried before baking. If there is too little heat it will not become vitrified and if there is too much it will be porous. Answering a question as to why there is an unglazed spot on top of every insulator, he explained that after dipping they are set bottom up, resting on the top rather than on a lower part, as on the lower part the glaze could not be spared so easily. Mr. G. R. Hall described the suspension type of insulator to be used on several steel-tower lines now being built. A question was brought up as to how often it is advisable to patrol transmission lines. Mr. Rossi, of the Northern Colorado Power Company, expected to have that company's 44,000-volt transmission system patrolled once a day. Mr. J. F. Vail, of Pueblo, had one man on 40 miles of 25,000-volt line who spent his entire time patrolling. Mr. Hall mentioned a 22,000-volt line in Pennsylvania that was patrolled twice a week.

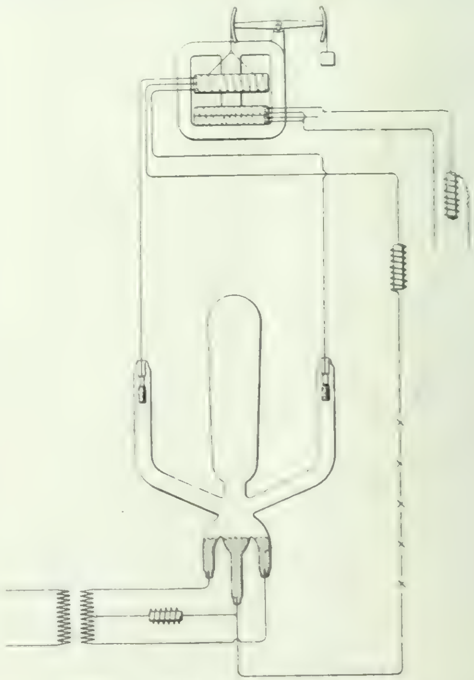
The executive and advisory committee reports were heard. The executive committee had compiled and printed the rates charged by members, for the use of member companies. The secretary and treasurer's report showed five new active members gained during the year, two lost by consolidation, and two applicants at this convention. Expenses for the year were $199.50, the balance in the treasury being $1,076. The new officers elected were as follows: President, Mr. W. G. Matthews, of the Denver City Tramway Company; vice-president, Mr. C. K. Durbin, of the United States Light & Traction Company, of Denver (controlling companies in several surrounding states); secretary and treasurer, Mr. J. F. Dostal, of the Denver Gas & Electric Company. Executive committee: Messrs. Geo. B. Tripp, W. T. Wallace and the officers. Advisory committee: Messrs. [illegible] J. F. Vail, [illegible] and J. J. Cooper. Membership committee: Messrs. T. W. Cargo, E. P. Dillon, B. K. Sweeny. Finance committee. Messrs. V. A. Sickman, W. E. Robertson, Geo. H. Maxam.

At the close of convention a special car was provided to take delegates to visit the plants of the Denver Gas & Electric Company and the Denver City Tramway Company. On Thursday afternoon the convention took a special train to Lafayette, about 25 miles north of Denver, where the power station of the Northern Colorado Power Company is just being completed. This is a steam plant located at the coal mines for the purpose of supplying current to a number of towns in that part of the state and to operate the single-phase electric service which the Colorado & Southern (a steam road) is preparing to inaugurate. It is equipped with Parsons turbines and obtains condensing water from a lake. The transmission voltage is 44,000 and below this line the entire length, it to be a 2300-volt, three-phase circuit for supplying farmers along the line.

Wednesday evening the convention was entertained at a theater party at the Broadway Theater, where Olga Nethersole played in "The Labyrinth." Over 20 operating companies were represented at the convention, many of them sending several men. Colorado men turn out well to their conventions.

Operation of High-Voltage Constant-Current Mercury-Vapor Rectifiers.

It has been found that when a mercury vapor rectifier has been transported from one place to another there is likely to be a small quantity of mercury on or about the anodes of the tube. If this mercury is not removed before the device is put in operation at high voltage, it may cause deterioration or even



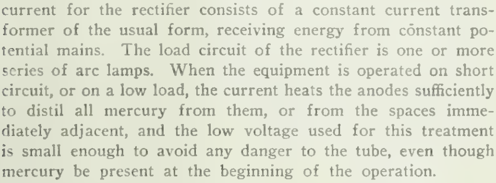
CONSTANT-CURRENT MERCURY-VAPOR RECTIFIER

destruction of the device. Mr. Samuel Ferguson, on September 17, obtained a patent for a method of removing the mercury from the anodes of a constant-current vapor rectifier by running the device at about normal current on short circuit for a time long enough to distil off any mercury which may have collected around or in the anodes during shipment. A view of a

constant-current rectifier, to which the method is applicable is given in the accompanying illustration. The rectifier tube consists of a central chamber and side arms, and is provided with carbon anodes. These anodes are mounted near the ends of the arms and are out of the direct path of the vapor blast emanating from the mercury cathode. The vapor device is provided with the usual auxiliary or maintaining anodes and supplied with energy from a separate transformer. The main source of current for the rectifier consists of a constant current transformer of the usual form, receiving energy from cônstant potential mains. The load circuit of the rectifier is one or more series of arc lamps. When the equipment is operated on short circuit, or on a low load, the current heats the anodes sufficiently to distil all mercury from them, or from the spaces immediately adjacent, and the low voltage used for this treatment is small enough to avoid any danger to the tube, even though mercury be present at the beginning of the operation.

Bipolar Motor Construction for Locomotives.

The most advantageous arrangement of the field and armature members of the motors of direct-current locomotives has proved to be the one in which the magnetic flux passes through the several armatures and pole-pieces of the propelling motors and thence through the mechanical frame of the locomotive. In practice the normal cross-sectional area of the mechanical frame of a locomotive is materially less than that required for the magnetic flux, and it therefore becomes necessary either to make the locomotive frame heavier than is necessary for mechanical purposes or in some other way to add sufficient metal

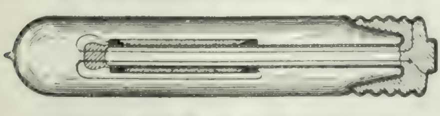


BATCHELDER ELECTRIC LOCOMOTIVE

to give the desired area at all points in the magnetic circuit. In a patent issued Sept. 17 to Mr. A. F. Batchelder it is proposed to arrange upon each of the driving axles two armatures, each of which has its separate pole-pieces, and to connect the field coils in such a manner that the magnetic flux passes longitudinally of the locomotive through one set of armatures and pole-pieces and back again through the other set. By the above arrangement, which is illustrated in the accompanying illustration, the only portions of the frame which carry the whole flux are the cross members to which the pole-pieces at the extreme ends are attached.

Selenium Cell.

A patent issued on Sept. 17 to Mr. W. J. Hammer discloses a form of selenium cell that is robust in construction, can readily be inserted in or withdrawn from circuit, and that is stated to be permanent in its characteristics. The central



HAMMER SELENIUM CELL

support of the selenium is a fused quartz tube covered with a thin film of aluminum, upon which the selenium is coated. The selenium is first heated to a high temperature so that it is softened to a putty-like consistency. While the selenium is in the plastic condition the tube is rolled between two plates of polished glass under moderate pressure, by which means the selenium is compacted to substantially uniform density and thickness. Upon the outer surface of the selenium there is placed a thin, transparent film of aluminum. The completed cell is sealed in a quartz tube similar in general form to an electric incandescent lamp. As shown in the accompanying illustration the two films of aluminum are used as the electrical terminals of the cell proper.

CURRENT NEWS AND NOTES.

ELECTRICAL SHOW.—As already announced, the electrical show in Madison Square Garden, New York City, will begin Monday, Sept. 30.

NORWEGIAN WATER POWERS.—The Norwegian legislature has passed restrictions upon the sales of real estate along watercourses to foreigners. Concessions of any character requiring the utilization of flowing water must first be obtained from the state authorities. Similar action is being taken in most of the countries of Europe.

PACIFIC COAST MEETING.—The Pacific Gas & Electric Association held its convention at Santa Cruz, Cal., beginning Sept. 17, at the Casino, when 75 delegates were in attendance. There were a number of papers and discussions and a good exhibit of apparatus. A banquet was given on Sept. 18, and next day the members visited the large cement works at Davenport.

THE TELEGRAPH STRIKE seems to be pretty near its end so far as it constitutes an actual factor in business and social life; but for the striking operators it must prove a serious affair as the places of many of them have been permanently filled. The Western Union Telegraph Company has removed from all its messages the reservation "subject to delay," although meantime the Railroad Commission of South Carolina has filed a decision sustaining the complaint of the Telegraphers' Union of Columbia, S. C., that the Western Union Telegraph Company is violating its charter in that state by using the United States mails for the transmission of messages filed for transmission by telegraph and upon which telegraphic tolls have been paid. The matter has been turned over to the Attorney General of the state, who is advised to institute proceedings against the Western Union if he can find sufficient law upon which to base a proceeding. This, however, does not apply to existing facts. The operators have been trying to involve newspaper and brokerage telegraphers, and again have implored the intervention of President Roosevelt but all this has been in vain, and the ocean of commercial activity has closed over the shipwrecked union.

ELECTRIC MAIL TUBES.—U. S. Vice-Consul H. M. Byington advises that a law having been passed for the institution of the electric post in Naples, Milan and Rome, the Italian minister of posts and telegraphs has nominated a commission to arrange for the opening of bids for the installation of the service. The electric post is an invention of a Neopolitan, Baron Piscicelli-Taeggi, who has also patented it in America. The invention renders possible the transmission of mail from one point to another with great speed. It is planned to reserve the electric post for the mail which has greater need of celerity, such as the transportation of special-delivery letters and local telegrams to and from the central office and the sub-stations, as well as late matter which could be sent from the central office to the railroad station 10 minutes before train time. The principal tube will be the one which connects the central office with the railroad station. If the service in the cities proves a success it is the ultimate intention to inaugurate a similar service between the principal cities in Italy. It is estimated that in this way the time between Naples and Rome can be reduced from five to two hours. It would seem that some other systems might beat this "all hollow."

ATLANTIC WIRELESS.—In an interview at Glace Bay, Nova Scotia, Mr. W. Marconi, on Sept. 23, fixed three weeks from that time as the commencement of commercial wireless business, the station on the other side being at Clifden, Ireland, where the apparatus is much more powerful than that at Poldhu, Cornwall, now to be kept as a reserve plant. The Government lines in England will handle the traffic, and on this side the Western Union and other lines will be available for message delivery.

CONTROL OF WIRES.—The Public Service Commission of New York State has not hitherto had any control of telegraph and telephone companies, but is now seeking to enlarge its sphere and to secure new legislation that will give the commission power over the service given by the companies, the rates to be charged, and the capitalization of the companies, so that, although engaged in business of an entirely different character, the telephone and telegraph companies will be on the same footing in their position toward the community as the traction and lighting companies now are.

PERAMBULATING WIRELESS.—A despatch from San Francisco states that Assistant City Electrician Charles N. Farmenter of Berkeley has erected a wireless pole on the site for the new Town Hall and is experimenting with a scheme to call policemen from their beats by wireless. A simple apparatus of compact form which policemen will carry in their helmets is the means by which he hopes to revolutionize the police and fire alarm systems. Though a policeman may not understand the communications thus received, he will know that he is wanted by the ringing of the bell in his pocket. He will then hasten to the nearest police box and telephone the police station.

AMBULANCE CHASING.—At the recent annual meeting of the Philadelphia Rapid Transit Company, President Parsons said: "During the past 12 months there has been considerable criticism about the affairs of your company, much of it of a frenzied character. This in a great measure accounts for the large sums paid out in the settlement of claims, which during the past year amounted to $1,217,586, an increase of $236,266 over the previous year. Ten years ago 2½ per cent to 3 per cent took care of the accident account. To-day it is approaching 7 per cent, which is equivalent to a dividend of $2 a share upon the stock. This increase is due largely to a new enterprise which has grown up and which has been termed 'ambulance chasing.' The slightest accident is hunted up and reported by runners in the employ of lawyers of doubtful standing, many of whom are briefless except for this class of business, but who are most expert in preparing cases of this character in such a manner that they will meet the requirements of the law and catch the sympathy of the jury. There are many physicians in league with these lawyers, whose testimony is of such a nature as to exaggerate the injury and to show that any trouble the claimant may be suffering from might have been caused by the accident."

TELEPHONY IN NEW ENGLAND.—The Massachusetts Highway Commission has made public a letter to President Sherwin, of the New England Telephone & Telegraph Company, including recommendations made as a consequence of testimony and facts brought out. The recommendations follow: 1. Discontinuance of furnishing frank books except to officers and employees of the telephone company and to officers of other telephone companies. 2. Discontinuance of furnishing free telephones except to officers and employees of the company, charitable institutions and such as may be necessary for maintenance of the plant. 3. That quarterly reports to the commission be made, containing names of all persons to whom frank books, or free telephones have been furnished, said reports to be open to public inspection. 4. Adoption of the same merit system in selection of employees in underground construction of street work as apparently obtained in other departments, and consequent permanent discontinuance of employment of men through political influence who do not render an equivalent for wages. 5. Readjustment of all discounts to municipalities to a uniform basis. The commission indicates that the recommendations are the result of finding that there were improper practices, and that in some instances violations of the law were apparent.

GEORGIA WATER POWERS.—As our readers are well aware, the water powers of the Southern States are rapidly coming to rival those of New England, and their development is due in no small degree to the work of the United States Geological Survey, which has for a number of years been making systematic studies of the flow of the streams and the conditions which affect that flow. The work in Georgia has been carried on for more than a decade, during which period all the more important streams and many of the lesser ones have been measured many times, and records have been kept of daily, monthly and seasonal variations in their flow. Most of the data thus collected have been published from time to time, but so many of the reports are out of print or otherwise inaccessible that Messrs. B. M. Hall and M. R. Hall, who have had charge of the work, have assembled all the data relating to the state in a report just issued by the Survey as Water Supply Paper No. 197. In addition to descriptions of the streams, records of daily gauge heights and estimates of monthly flow, the report includes tabulated elevations of the surfaces of the streams at specified points, by means of which the fall of the streams can be estimated for use as power, and indicates available undeveloped sites. A simple formula for determining the horsepower when fall and flow are known is also presented, and incidental descriptions of the topographic and geological features of the state are given. The paper is ready for distribution, and copies may be obtained without charge by applying to the Director of the U. S. Geological Survey, Washington.

EMPIRE STATE ASSOCIATION.—The annual meeting of the Empire State Gas and Electric Association will be held in the auditorium of the New York Edison Company, 44 West Twenty-Seventh Street, Wednesday, Oct. 2, at 10 a. m. This meeting will be one of unusual interest and importance. At the morning session there will be presented the report of the executive committee and the reports of the various sub-committees which have been appointed during the year. There will also be an account of the publicity work done on behalf of the association. Any business to come before the association will be taken up at this session. In the afternoon several very interesting papers will be presented and discussed. The subjects chosen will be of equal interest to representatives of gas or electric companies. A joint meeting and reception will be held under the auspices of the Street Railway Association of the State of New York and Empire State Gas and Electric Association in the concert hall of Madison Square Garden, New York City, on the evening of Oct. 1, 1907, at 8:30 o'clock. At this meeting addresses will be made as follows: Hon. Frank W. Stevens, chairman, Public Service Commission, Second District, "The Work of the Public Service Commission, Second District, and its Policies with Relation to the Corporations Under its Supervision;" Mr. Henry F. Pierre, president, International Railway Company, Buffalo, N. Y., "The Electric Railway Situation of To-day;" Dr. Alexander C. Humphreys, president, Stevens Institute of Technology, "Control of Gas Companies by State Commissions;" Mr. Everett W. Burdett, chairman of committee on public policy, National Electric Light Association, "Public Control from the Corporate Standpoint." Mr. C. H. B. Chapin is secretary of the Empire State Association. The regular programme of the Association besides special and stated committee reports includes the following papers and discussions: R. M. Searle, "The Meter Testing Situation and Report of Meter Committee;" Alfred E. Forstall, "Gas Standards;" E. L. Elliott, "Buying Light;" L. T. Palmer, "Franchise Taxation;" W. W. Cole, "The Agitation for Underground Distribution in Place of Overhead;" Glenn Marston, "Municipal Ownership in New York State."

STREET CAR BUILDING.—The adoption of electrical energy for traction on street railways has caused a great development of the industry of building cars and their repairs. The value of products for these industries increased generally fourfold between 1890 and 1905, viz., from $6,268,462 to $24,281,317. The number of street railway cars built in 1905 was 4094. valued at $9,902,310. No cable cars were built, and only 42 horse cars. Never was there a more triumphant and complete electric "clean sweep" than that.

N. E. L. A. BULLETIN.—The National Electric Light Association has issued the second number of its bulletin, and is once more to be congratulated upon this addition to its resources and means of usefulness. It contains special articles by Messrs. A. Williams, A. H. Grant and T. C. Martin, and the Question Box data are of unusual interest and value. The need of this means of intercourse among members is already shown by the fact that the first issue has practically gone out of print; and a price has been set for the extra copies that are called for by the member companies.

ELECTRO-GASOLINE CARS.—A special telegram from Appleton, Wis., of Sept. 20, says: "The new Milwaukee Northern Railway proposes to establish a line of electric cars without trolleys. The cars will be operated, if present plans are matured, by electricity generated by gasoline engines in each car. The system is now in use in Germany and has proved successful there. An expert, however, will study the German system before the decision to install similar machinery on the Wisconsin cars is finally taken. The Milwaukee Northern directors figure that a saving of 30 per cent would be effected by this system."

ELECTRIC JEWELS.—In a recent report from the Birmingham district, U. S. Consul Albert Halstead makes the following notes as to Coventry: "The business of hand-made watches is discouraging. The unfavorable conditions of watch making naturally affected the watch-jewel trade, but the jewel makers sought foreign markets. The development of the electrical industry, as that of watch making in the United States, offered a good field for such jewels. In connection with electrical works, sapphire meter jewels are necessary in phonographs. Coventry appears to be the only place in England where electric and watch jewels are manufactured, the sales of this article to the United States in the year 1906 amounting to $89,000.

TICKER TAPE.—When Prince Henry of Prussia drove up Broadway he and his carriage as they passed Wall Street were entangled in Circean folds of streaming ticker tape, just let loose on the breeze. The authorities of Trinity Church have been bothered lately by the tricks of messenger boys and clerks who, from the windows of adjoining skyscrapers, have tossed out coils of ticker tape, which the breezes have promptly festooned about the church and the monuments and trees of its yard. Decorated with the insignia of Mammon, Trinity has looked almost anything but the sedate old pile it really is. Complaints were lodged with the owners of near-by buildings, and now the superintendents have issued circulars to their tenants, who are doing their best to put an end to the desecration of old Trinity.

CENTRAL ELECTRIC RAILWAY ASSOCIATION.—The first regular bi-monthly meeting of the Central Electrical Railway Association, after the summer vacation, will be held at Columbus, Ohio, Sept. 26. The programme, which is now being prepared, will include the report of the standardization committee and two papers will be read, one on the "Single-phase System of Operating Electric Cars," by George D. Nichols, electric engineer of the Indianapolis & Cincinnati traction line, and the other on the "One Thousand Two Hundred Volt System of Operating Electric Trains," by a Westinghouse representative. A good attendance is anticipated, a number of traction men of Michigan, Illinois and Kentucky have been especially invited to attend the meeting.

EXPORT OF ENERGY.—A special despatch from Ottawa, Can., says: "Gen. Greene, of Buffalo, representing the Niagara & Ontario Power Company, has had a conference with Sir Wilfrid Laurier relative to the regulations drafted under the act of Parliament, passed last session, governing the export of electric energy. Before these regulations were finally adopted it was arranged that they should be discussed by the government and representatives of the power company, and a meeting for that purpose was set for to-day. Gen. Greene, however, was the only representative of the company to appear, and discussion of the regulations was postponed until Oct. 1."

TWO-CENT FARES are not popular with the courts, and the decisions against them multiply. The two-cent fare law enacted at the recent session of the Pennsylvania Legislature was adjudged void in its application to the Susquehanna River & Western Railroad Company in an opinion delivered last week at Bloomfield by Judge Shull, of the Perry County Court. The law, he declares, is in derogation of both the United States and the Pennsylvania constitutions. He quoted figures of the company's earnings to show that the enforcement of the rate would be confiscatory, and said that the act is a caprice of a Legislature, "many of whose members, without rhyme or reason, facts or figures, information or reputation, were pledged to perform the act in the name of 'reform.' We might say of reform as was said by Madame Roland of liberty in the days of the French Revolution: 'O Liberty, Liberty! How many crimes are committed in thy name.'"

EUROPEAN LACK OF TROLLEYS.—Mr. Hugh J. McGowan, head of the merger traction lines in Indiana, has returned from a three-month tour of Europe, where he traveled over 5000 miles in an automobile. Mr. McGowan says "that traction facilities in Europe—especially in England—are away behind." There are scarcely any interurban lines, and in the cities there is a poor effort made to carry or accommodate the people. We are away ahead of them when it comes to the traction business. Between Liverpool and London, a little over 100 miles, there isn't an electric line, while the land is as level as a floor. It is surprising that within a radius of 50 miles of Liverpool there is a population of 7,000,000, the most thickly populated country in the world, and not a trolley line in existence for their accommodation. Throughout Great Britain, France, Germany and the most of the other European countries there is a great opportunity for developing the traction business.

COMBINATIONS AND TRUSTS.—A conference will be held in Chicago, Oct. 23-25, under the auspices of the National Civic Federation on combinations and trusts. The attendance will be large, representative and authoritative. The first day will be devoted to the problems involved in the controversies between state and federal government, respecting jurisdiction over interstate commerce. The second day will be devoted to a consideration of the corporation. How should it be constructed? Should there be national corporations as well as state? What should be the basis of capitalization of corporations? their internal control? the provisions looking to the protection of investors and stockholders, as well as fair dealing with the public. Should there be a distinction between public service and other corporations? Should quasi-public utilities, like gas, electric lighting and street railways, be considered natural monopolies to be regulated by the municipality? The third and fourth days will be devoted to a discussion of the just and practicable limit of restriction and regulation, federal and state, of combinations in transportation, production, distribution and [illegible]

SPEED CONTROL OF AUTOMOBILES.—An effort is being made in England to compel the use on automobiles of automatic speed controllers to prevent a machine from running above a maximum speed on public roads.

NO CIVILITIES OVER TELEPHONE.—It is stated that the Keystone Telephone Company, of Philadelphia, has decreed that the word "please" shall not be used in colloquies over its lines on the ground that the word is unnecessary and that its use consumes an aggregate of 125 hours daily.

CHICAGO EXPOSITION.—At a recent meeting of the stockholders of the Electrical Trades Exposition Company, of Chicago, Mr. Homer Niesz was again elected manager of the show. Mr. Samuel Insull is president, with Mr. E. B. Overshiner, chairman of the executive committee. The major portion of the space has already been applied for and a larger and better show than ever before is assured for next January in the Coliseum.

ATLANTA TELEPHONE FRANCHISE.—A despatch from Atlanta, Ga., states that the City Council has granted to the Southern Bell Telephone & Telegraph Company a renewal of its franchise, and it has been accepted by the company. The company's right to do business in Atlanta is extended for 33 years, subject to a tax of 1 per cent on gross receipts. From this tax is to be deducted the amount of ad valorem taxes paid by the corporation on its tangible property.

STANDARD SYMBOLS FOR WIRING PLANS.—The National Electrical Contractors' Association has printed in definitive form the schedule of standard symbols for wiring plans as adopted and recommended by the Association and the American Institute of Architects. The chart may be obtained from Mr. W. H. Morton, Utica, N. Y., secretary of the association, upon payment of 10 cents for the wall-hanger form, or $1 per hundred in the form of specification sheets.

MOTOR CABS FOR CALCUTTA.—Consul-Ggeneral W. H. Michael, at Calcutta, reports that a London company, with a capital of £100,000, has offered to provide Calcutta with electric motor-cab service commencing in October next, providing the authorities will encourage the enterprise and afford facilities. The chairman of the corporation and commissioner of police have given the promoters assurance of welcome and protection. The cabs will be capable of covering 100 miles per day.

ITALIAN EDISON COMPANY.—A special despatch from London states that the Edison Power Company has arranged for an extensive supply of high-tension energy in Italy. Contracts have been made with the municipalities of Rome, Genoa, Naples and Milan. The installation will be begun at Milan this week. The Edison Company will first operate the tramways in Milan under an arrangement whereby the municipality will lay and own the tracks, the Edison Company owning the cars and paying the city mileage for each car.

STRANGE TELEPHONE STRIKE.—Advices from Helena, Mont., of Sept. 22, say that because the business men of Helena refused to discontinue the use of telephones pending a settlement of the Rocky Mountain Bell Telephone Company's strike the Helena Trades & Labor Assembly has decided to call a general strike in Helena this week. The result of this action, it is said, will be a complete tie-up of street-car service and the closing of hotels, manufacturing establishments, business houses, and even saloons where the use of telephones has not been discontinued.

STRAP HANGERS' RIGHTS.—The conductors of the New York Fifth Avenue electric omnibuses have much difficulty in enforcing a rule prohibiting passengers being taken on beyond the seating capacity of the vehicles. In some instances the refusal has been resented as a denial of a cherished right to occupy standing room if one chooses. In England it seems that public service companies have also difficulty in enforcing a similar rule. Recently a passenger on a London electric railway car was haled before a magistrate and fined one shilling and costs for the offence of standing in a car.

TELEPHONY IN AUSTRALIA.—U. S. Consul-General John P. Bray reports that the two leading cities of Australia, Melbourne and Sydney, are now connected by telephone. The line is a little over 600 miles in length and is composed of two exceptionally strong and heavy copper wires; the cost of construction was $227,198 and it took four months to complete. The fee for conversations, viz., 6 shillings. ($1.46) for three minutes is thought to be too high in business circles, but the postmaster-general, by whose department the line is controlled, has stated that if after three months' trial the line proves payable a series of progressive reductions in the rate will be made.

CHINESE WIRELESS.—U. S. Consul W. T. Gracey makes the following report regarding the German Government's new wireless telegraph station at Tsingtau, China: The local wireless station is on top of the Diederichs Hill, 328 ft. high, next to the signal station. For ships coming from the direction of Tschalien-tau light this hill appears as the farthest hill toward the south, and stands clear of the Bismarck, Iltis, and Prince Henry mountains, lying farther north. The square towered building of the signal station, as well as the near-by mast of the wireless apparatus, are easily recognized a long distance out at sea. The system in use is "Telefunken," of Slaby-Arco, with a mast, the distance of activity being about 100 nautical miles. The station is the property of the Kiaochow Government, and is used to communicate with men-of-war of the German navy, but will be thrown open for general public use before long on conditions which have not as yet been determined.

RINGEDALSVAND POWER.—U. S. Consul F. S. S. Johnson, of Bergen, reports that a tunnel is being constructed which will bring the water from the great Ringedalsvand of Norway (into which the Skjaeggedalsfos falls) down to the fiord, which is a very remarkable piece of work, a brief description of which is presented: First, from that lake there is a tunnel 300 meters long to another small one, known as the Lillevand. From this point there is a tunnel 4,600 meters in length, 3 meters wide and 2½ meters high, to the face of the rock facing the Sorfjord. From this tunnel the water will be conveyed in strong pipes down the 400 meters decline to the fiord. Down at the sea level and close to the wall of rock is the power station, from which the electrical energy will be conducted along the seven-kilometer (4.3-mile) stretch to the factory at Odda. The capacity available is estimated at 40,000 hp, of which 20,000 hp will be at once utilized when the factories are working.

PACIFIC CABLE BREAK.—It is announced by the officers of the Commercial Cable Company that there had been a break in their Pacific cable somewhere between the relay stations at Midway Island and Guam. They are inclined to think that an earthquake may have been responsible for the interruption in the cable service, but in the absence of all word from the operators at Guam they could not assign a cause positively. The cable that goes under the Pacific from San Francisco to Yokohama and the Philippines via Honolulu, Midway and Guam went dead on Friday, Sept. 20. Midway, which lies between Honolulu and Guam, reported that the spark went out of the submarine wires without warning and that all efforts to communicate with Guam had been unavailing so far this week. Since the Commercial Cable Company line is the only one connecting America with the Orient directly, all cables for the Philippines, Japan and points on the China coast will have to be sent around the other way at a rate about double that charged across the direct San Francisco-Yokohama line.

The Tofwehult-Westerwik Transmission System, Sweden.

By ARVID WESTERBERG.

AN electrical equipment recently installed in Sweden for transmitting energy from Tofwehult to Westerwik possesses some interesting details, which are outlined below. The plant consists of a power house at Tofwehult, a transmission line thence to the town of Westerwik, and transformer and converter stations in that town.

THE POWER HOUSE.

The natural surroundings of the waterfall at Tofwehult rendered it especially favorable for development, because it is situated between two lakes, and the connection between these, which forms the fall, consists of a deep cleft with almost vertical sides. (See Figs. 1, 2 and 3.) In consequence the hydraulic work was very simple and cheap; the costs of the hydraulic work and the power house building amounted to only $26,000, which, on the basis of the maximum output of 1300 horse-power, including the reserve, is only $20 per horse-power. The power house is built for three generating sets, two for 325 horse-power each, and one for 650 horse-power; only the two smaller sets are now installed.

The turbines showed under test an efficiency at full load of 81 per cent, and a speed variation of only 6 per cent at a load variation from full load to no load. An interior view of the power house is shown in Fig. 4. Each of the generators is built for 10,000 volts and 285 k. v. a. The major insulation of the armature coils consists of several layers of oiled cloth and a final coating of an insulating compound. At the insulation test of one of these coils, the breakdown occurred at 45,000 volts.

FIGS. 1, 2 AND 3.—FALLS BEFORE AND AFTER BEING HARNESSED; POWER HOUSE FROM BELOW AND ABOVE.

A separate extension of the power house is provided for the switch gear. As seen in Fig. 4, the lightning arresters are placed on the upper floor of this extension. The lower floor, which is separated from the generator hall by the switchboard, contains all other apparatus and instruments for low and high tension. The high-tension equipment is placed in a compartment separated by iron grating and accessible from both sides.

FIG. 4.—VIEW OF INTERIOR OF POWER HOUSE.

In order to prevent the accumulation of static electricity on the high-tension line a static protector is provided. This apparatus consists of six vertical glass pipes, two for each phase (Fig. 5), through which water flows continuously. The upper connection between the two pipes of each phase consists of an iron faucet which is connected to the corresponding bus-bar.

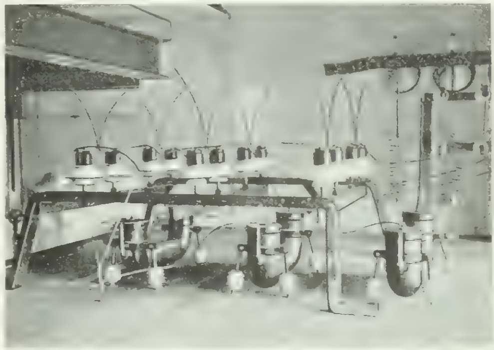


FIG. 5.—LIGHTNING ARRESTER EQUIPMENT.

The iron pipes, through which the water is carried to and from the apparatus and which are connected to the lower ends of the glass pipes, are grounded. The water being very pure and therefore its specific resistance being high, the current leaking through the apparatus is small, amounting to only 0.036 amp. per lead; this value is probably rather too small to secure a good efficiency of the device.

THE HIGH-TENSION LINE.

About half way between Tofwehult and Westerwik a deep bay of the Baltic cuts into the land. If the transmission line had been erected around this bay the length would have been increased by 3.75 miles above the straight distance of about 9 miles between the power house and the town. The increase could be avoided by crossing the bay by means of either a submarine cable or a long overhead span. In order to obtain sufficient security against breakdowns of a cable in the middle of an overhead line of 10,000 volts it would have been necessary to install special protection devices, and to erect two cables. Even if these provisions had been made the crossing by cable would not only entail a lower degree of working security, but would also cause higher running costs. Since, not far from the straight line between the power house and the town, the bay forms a narrow strait with steep shores, it was decided to build at this point an overhead span of sufficient height to avoid all sails. A view of this span is given in Fig. 6. The length of the span is 735 ft., and the height over the water is, at the lowest point, 131 ft. The conductors consist of steel-wire ropes, each 60 sq. mm. in cross section; they are supported by iron masts, each having a height of 82 ft., two on each side, which carry insulating supports.

A view of an insulating support is given in Fig. 8. It consists of an oak block, resting on six high-tension insulators. The insulators are cemented to the oak block, their iron pins being fastened to the brackets of the mast. The oak block is

protected against moisture by a coating of sheet zinc. In order to prevent the pull of the wire ropes from acting on the masts, a rolling device is provided. The rolling device consists of a cast-iron plate resting on the oak block, four cast-iron rolls and a cast-iron piece which rests on these rolls and to which the wire ropes are fastened by screws. The terminals of the wire ropes are anchored to the rock. Thus they act as a guy to the casting to which the wire rope is fastened, and prevent it from rolling out of the cast-iron plate. Slipping to the side is prevented by flanges on the rolls. Four wire ropes are mounted in this way, one of which serves as reserve. As stated above, the cross-section of each rope is 60 sq. mm. Each wire rope has, therefore, the same conductivity as a copper wire about 7 sq. mm. in cross-section. At 30 deg. C. the strain in the span part of the rope is 1300 lbs., and in the guy part 1650 lbs. Thus the maximum stress equals 17,800 lbs. per sq. in., corresponding to a safety factor of 5. The sag of the rope at 30 deg. C. equals 29.5 ft. In spite of this sag a contact between the ropes is impossible since they are mounted at different heights and the horizontal distance of about 6.5 ft. is ample. Moreover, it has been proved that even in a strong wind the wires do not swing; all of the ropes are deviated to the same constant angle from the vertical plane whereby the distance between the ropes is not changed.

FIGS. 6 AND 7.—VIEWS OF STEEL MAST USED ON LONG SPAN

As mentioned above, the wire ropes are anchored to the rock. Therefore, it is necessary to put special strain insulators into the guy part of the ropes. The strain insulator which is shown in Fig. 9, must withstand a mechanical force of 1650 pounds and at the same time secure a good insulation. The insulators are coupled in series by twos; therefore, at the regular working conditions each insulator is subjected to a voltage of 3000. Still, in order to get a high degree of security, each insulator was designed for 20,000 volts. The insulator is covered on the top and sides by a cap of sheet zinc whereby it is perfectly protected against moisture. The dry insulator in actual tests withstood a tension of 25,000 volts. As to the mechanical strength a lining of sheet lead between the iron and the porcelain effects an equal distribution of the mechanical pressure upon the latter and since porcelain possesses a great strength against pressure it was not difficult to make the span insulators sufficiently strong mechanically.

A telephone circuit is erected on the high-tension line poles. For this line common telephone insulators are used; the telephone lines are so transposed that one whole turn is made at every fifth pole. The high-tension line is transposed one turn at every 1000 ft. In telephoning over this line a humming sound is heard. The noise is not so loud as to disturb the conversation. It is probably partially caused by the grounding of the neutral point at both the transformer station and (through the static protectors) in the power house.

TRANSFORMER AND CONVERTER STATIONS AND DISTRIBUTING LINES.

In the main transformer station at Westerwik the e. m. f. is transformed to 500 volts, three-phase, and 3000 volts, three-phase. The former voltage is used for distribution within an industrial district in the neighborhood of the transformer station; the latter is used for transmission to the converter station which is built close to the old city plant. The converter station is arranged for four motor-generator sets; two of these are installed at present. The direct e. m. f. is 2 x 110 volts, but everything is so planned that later on an e. m. f. of 2 x 220 volts can be adopted without any difficulty. The station reserve equipment includes a storage battery, while the steam-driven direct-current generators of the old city plant also constitute a valuable reserve. Transformer station No. 2 supplies energy to some factories in its neighborhood by means of three-phase current at 500 volts.

The distribution of the direct current used in private lighting, for small motors and for the street lamps within the city is accomplished by means of earth cables. The street lighting is furnished by 65 enclosed 7-amp. arc lamps. Two of these lamps are connected in series across the 220-volt supply mains.

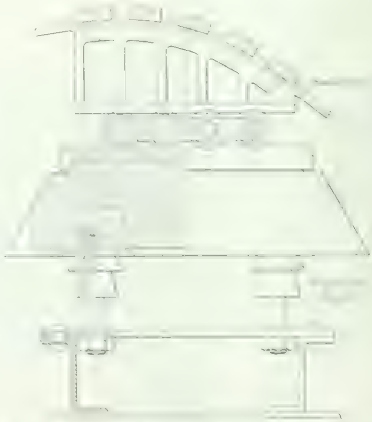


FIG. 8.—INSULATING AND ROLLING SUPPORT FOR LONG SPAN

The costs given below refer to the two generator sets installed at the present time. The total cost of the fully installed power house and equipment for 1300 horse-power would be about $46.000. Referred to the entire equipment including the

reserve, namely 880 kw, the cost was $52.70 per kw at the power house and $65.40 at the end of the high tension line; the corresponding costs per horse-power are $39 and $48, respectively.

The following list of costs of various items may prove of interest:

COST OF EQUIPMENT.

Dam and power house	$26,200.00
Two 325-hp turbines and two 45-hp turbines	4,800.00
Two 285-kw and two 30-kw generators	5,200.00
Station wiring and instruments	1,900.00
	$38,100.00
Nine miles (27 total) of circuit 19.6 sq. mm., including poles and right of way	$11,000.00
	$49,100.00

This plant was laid out by the engineering firm, David Bergman, of Stockholm. The cables and the arc lamps and the rest of the electric parts of the plant were furnished by the Elektriska Aktiebolaget, Stockholm.

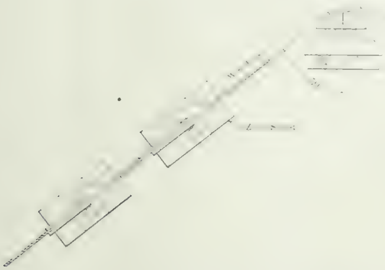


FIG. 9.—STRAIN INSULATORS FOR LONG SPAN.

Magnetic Hysteresis Phenomena.

BY M. O. BOLSER.

What hysteresis exactly is is often lost sight of and though often of no practical importance, occasionally cases may arise in which it is important.

In direct-current circuits the conditions can be represented by $I = \frac{E}{R}$, and similarly in magnetic circuits $\phi = \frac{(m.\,m.\,f.)}{\Re}$ where ϕ is the flux and $\Re$ the reluctance, or magnetic resistance. In alternating-current circuits, likewise, $I = \frac{E}{Z}$, in in which I can be ahead of or behind the e. m. f. E, in time-phase. Similarly in alternating magnetic circuits, the equivalent sine wave of flux ϕ can lag behind or lead the equivalent sine wave of m. m. f. The phenomenon connected with this time-phase displacement between the m. m. f. and the flux is known as hysteresis, and the angle of time-phase displacement is called the hysteretic angle of advance.

In Weber's molecular magnetic theory of magnetism, he considers each and every molecule of a magnetic material as a magnet. An unmagnetized piece shows no aggregate polarity merely because the axes of the molecules point in all directions at random. When a magetizing force is applied, the molecules turn into line and show an aggregate polarity. The completeness and degree to which the molecules turn depends upon the structure of the magnetic material and upon the magnetizing force. In a piece of magnetic material there must be magnetic ties between the different molecules. Whenever the magntizing force is sufficiently great to involve the breaking up of old ties and the forming of new ones, there is an unstable phase movement of some of the molecules. This tendency to hold to old magnetic ties is called "molecular magnetic friction." The energy imparted to the molecules in giving them kinetic energy is dissipated again as eddy currents in the neighboring molecules. In the ordinary case, hysteresis loss is a measure of this molecular magnetic friction loss. Fig. 1 shows this condition

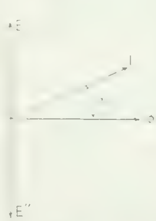


FIG. 1.—CONDITION OF CIRCUIT WITH NEGLIGIBLE RESISTANCE.

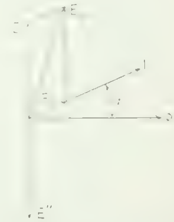


FIG. 2.—RESISTANCE AND REACTANCE DUE TO HYSTERESIS.

in a circuit of negligible resistance. E_0 is the e. m. f. impressed upon a coil containing an iron core. I is the current, ϕ the flux lagging behing I by the angle α, the hysteretic angle. E'' is the counter e. m. f. of self-induction. In this case $E_0 I \sin \alpha$ is a measure of the molecular magnetic friction loss and α is a measure of the "hysteresis."

At this point, it might be well to consider the effective resistance and effective reactance attributable to hysteresis. In Fig. 2, E_r is the e. m. f. to overcome the ohmic resistance drop, E_0 is the impressed e. m. f., E' the e. m. f. necessary to overcome, E'' the counter e. m. f. of self-induction.

If E_0 be divided up into power and wattless component, the effective resistance and effective reactance may be obtained. This is shown in Fig. 3. E'_r is the e. m. f. to overcome the effective resistance drop and is larger than E_r the e. m. f. to overcome the ohmic resistance drop.

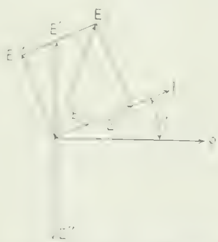


FIG. 3.—POWER AND WATTLESS COMPONENTS.

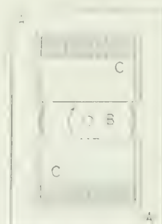


FIG. 4.—EICKEMEYER ENERGY-LOSS LOOP DEVICE.

E''' is the e. m. f. of the effective reactance drop, which is smaller than E' the counter e. m. f. of self-induction.

Thus, in a circuit of the above character, hysteresis makes the effective resistance higher and the effective reactance less than ohmic resistance and the magnetic reactance.

While the energy loss in molecular magnetic friction is essentially a constant quantity per cycle, but the apparent hysteresis loss as measured in the primary magnetizing circuit can be zero, positive or negative, and this apparent loss can be greater or less than the molecular magnetic friction, and therefore such apparent loss is not a measure of the true hysteresis loss under some conditions. In a circuit where the only expenditure of power is in the iron, the loss observed in the magnetizing circuit is a measure of the molecular magnetic friction. However, as soon as there is some other source of power present, or power can be consumed in some other way, this coincidence disappears and the "apparent" hysteresis loss has no direct relation to the true molecular magnetic friction.

For instance, consider an electric circuit interchanging energy cyclically with a laminated iron magnetic circuit in which some of the laminations are loose and free to vibrate. The "apparent" loss now not only supplies the power for molecular magnetic friction, but also that required to vibrate the loose laminations. The area of the so-called "hysteresis loop"

in this case gives not only the energy dissipated during each cycle in molecular magnetic friction, but also that in vibrating the laminations. Under proper conditions, with energy supplied from some source outside the electric circuit, the "hysteresis" loop may not only disappear, but it can overturn and become negative, thereby showing that more energy is taken into the electric circuit during each cycle than is restored to the auxiliary source.

The above-described phenomena were demonstrated by Mr. Eickemeyer, who made use of the device shown in Fig. 4. In this illustration *AA* are the laminated stampings of a shell-type "transformer;" *CC* is the winding; *B* is the center core, which is mounted in such a way that it can be rotated. If an alternating current be supplied to the winding *CC*, an alternating flux is set up in the center core, *B*. When this center core, *B*, is rotated at such a speed that it reverses direction just as the magnetizing force reverses, the speed is said to be "synchronous." When once brought up to synchronism, this apparatus will work as a synchronous motor and will give many peculiar energy-loss loops. When the friction and molecular magnetic friction are just supplied by some external driving power, the "loop" disappears, which merely means that its area reduces to zero. However, when this device is loaded as a motor, the energy-loss loop opens up to such an extent that during each cycle it takes energy enough from the electric circuit not only to supply molecular magnetic friction, but also to supply the

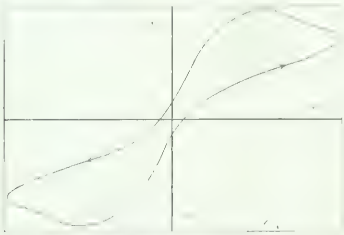


FIG. 5.—ENERGY-LOSS LOOP.

mechanical energy put out. Fig. 5 shows an energy-loss loop of this character.

If the auxiliary source supplies more energy per cycle than is necessary to overcome the friction and molecular magnetic friction the energy-loss loop overturns and the flux now leads, in place of lagging behind the magnetizing force in time-phase. Consequently, the energy-loss loop shows that energy is put into the electric circuit, and the machine might be called a "hysteresis" generator.

Fig. 6 shows an energy-loss loop under these conditions. Though a small part of this loop shows energy taken from the

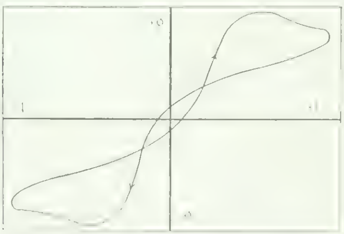


FIG. 6.—ENERGY-LOSS LOOP.

electric circuit, by far the larger part of the loop represents energy given into the electric circuit.

It will be seen from the above that molecular magnetic friction is constant per cycle of a magnetic circuit, but that the "apparent" hysteresis can have many values, depending upon the surrounding conditions.

The question now arises as to the method by which the energy is transferred from the primary to the secondary circuit of a transformer. A little consideration will show that the energy does not appear in the "hysteresis" loop. The m. m. f. which propels the flux through the core is not the m. m. f. that supplies energy for the secondary circuit and for the eddy currents. In other words, the primary m. m. f. can be split into two components, one of which balances the counter m. m. f.'s and the other of which propells the flux through the magnetic circuit. The area of the "hysteresis" loop represents the exchange of energy between the electric circuit and the magnetic circuit due to the pulsations of reluctance being unsymmetrically situated with respect to the alternations of the flux. This unsymmetrical situation can be caused either by molecular magnetic friction or by synchronous motion. In the first case, the maximum value of the flux always occurs at the same time as the maximum value of the distorted wave of m. m. f. However, in the second case this condition does not necessarily exist.

Tension and Sag in Wire Spans.

By Harold Pender, Ph.D.

THE accompanying charts* (No. 1 for long spans, No. 2 for short spans) enable one to determine without arithmetical computation the variation of the tension and sag in copper wire spans with the temperature and resultant load on the wire. Similar charts can be readily prepared for wires of any material.

The symbols used in the discussion below are as follows:

m = weight of wire per cubic inch in pounds.

α = coefficient of linear expansion of wire per degree Fahr.

M = modulus of elasticity of wire (pounds—square inch)

ρ = ratio of resultant of the weight of wire, the weight of sleet and the wind pressure to the weight of wire.

l = length of span in feet

t = rise in temperature in degrees Fahr.

T = tension in thousands of pounds per square inch

D = deflection at center of span in feet in direction of resultant force when points of suspension are on the same level

S = vertical sag at center of span in feet when points of support are on the same level.

The lines on the charts are plotted as follows:

The hyperbolic curves on the right have the equation $y = \left(\frac{\rho}{T}\right)^2$ where y is the ordinate and T the abscissa. A curve is plotted for $\rho = 1.0$, 1.2, 1.4 - - - - 4.0, The value of ρ for each curve is indicated at the top of the chart. It is to be noted that the horizontal distance between these curves at any level is directly proportional to the increment in the value of ρ. These curves are independent of the material of the wire.

The inclined straight lines have the equation $y = \frac{10^9}{6 M m^2 l^2} T$.

For a given material the equation of these lines depends only on the length of the span. The lines on the charts are drawn for copper wire for which $m = 0.321$ and $M = 12 \times 10^6$. The corresponding length of span is indicated on the right-hand margin of the charts. For any other material, the line for a given length of span will have a different slope.

The temperature scale on the X axis to the right of the origin is laid off so that $x = M\alpha t$. The scale given on the chart is for copper for which $M = 12 \times 10^6$ and $\alpha = 9.6 \times 10^{-6}$. This scale will be different for any other material.

The parabolic curves on the left of the chart have the equation $D = 0.0015\, m\, l^2 \sqrt{y}$, where D is measured off from the left of the origin. For a given material these curves are fixed by the length of the span. The curves given on the chart are for copper, for which $m = 0.321$. The corresponding lengths of span

*These charts were devised to obtain a graphical [illegible] of the equations deduced by the author in an article in the [illegible] W[illegible], Jan. [illegible], 1907, Vol. [illegible], p. [illegible]

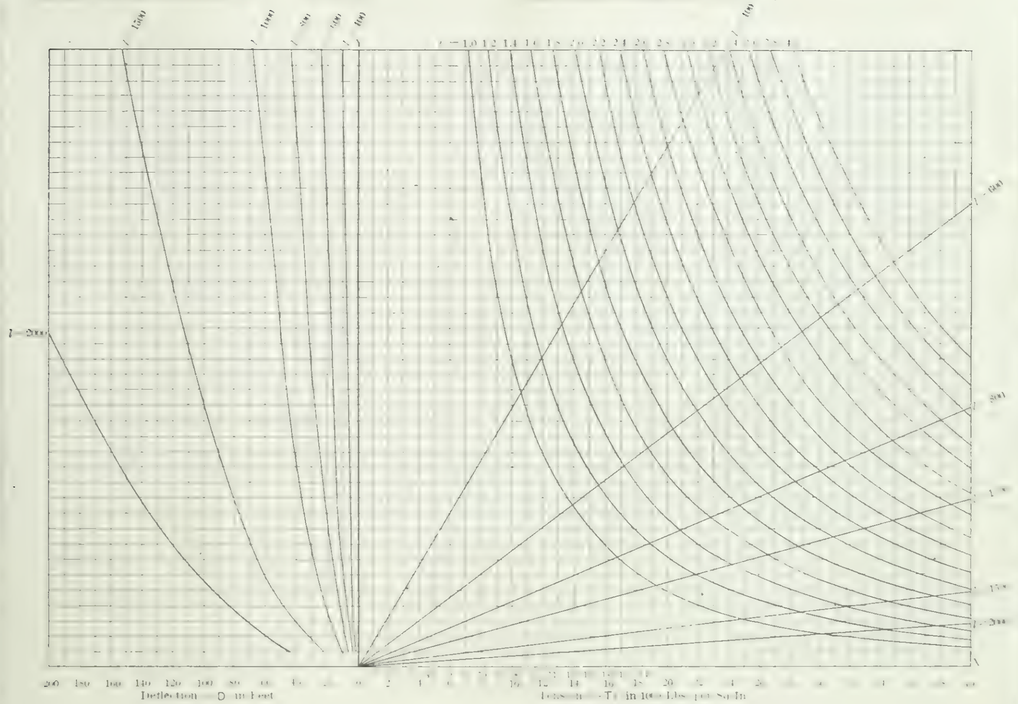


FIG. 1.—CHART FOR LONG SPANS.

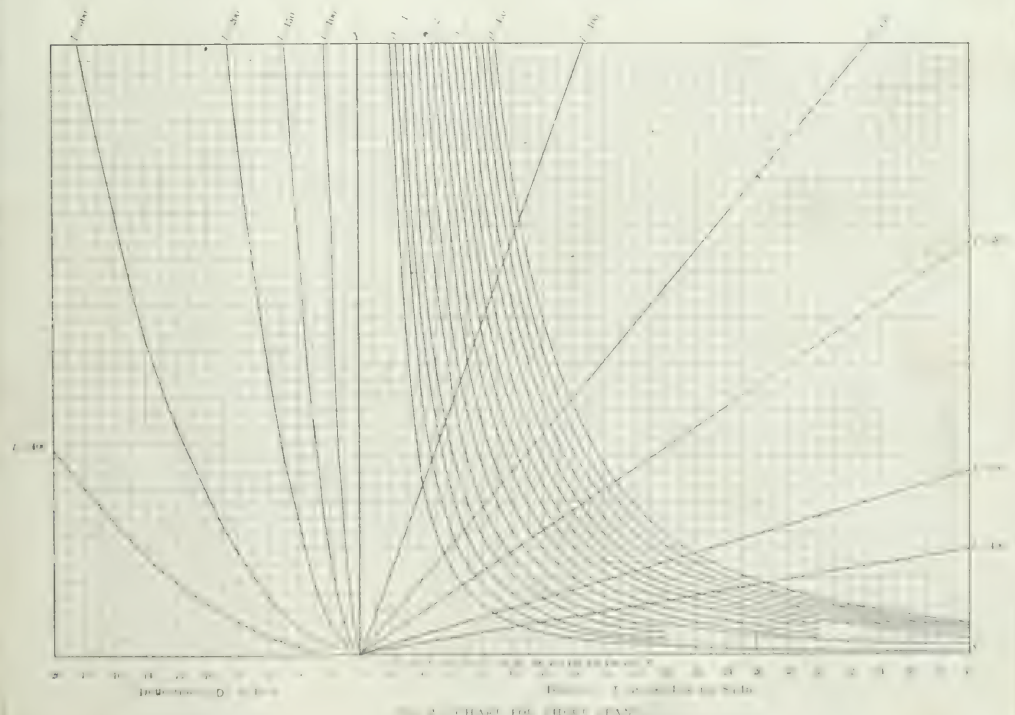


FIG. 2.—CHART FOR SHORT SPANS.

TENSION AND SAG IN WIRE SPANS.

are indicated on the curves. These curves will be different for any other material.

Rules for the Use of the Charts.

Given: A span of length l and the points of support on the same level; tension T_1; ratio of resultant force to weight of wire, ρ_1; to find the tension T when the temperature rises t degrees and the ratio of resultant force to weight of wire changes to ρ (for example, sleet melts off).

At the point 1 (Fig. 1) on the curve corresponding to ρ_1 and having the abscissa T_1 lay off $12 =$ the ordinate of the point 3 on the line corresponding to l having the abscissa t on the temperature scale.

Through 2 draw a line parallel to the line l: the abscissa of the point 4 where this line cuts the curve corresponding to ρ is the tension T at the temperature t when the ratio of resultant force to weight of wire is ρ. The abscissa of the point 5 where the horizontal line through 4 cuts the parabolic curve corresponding to l gives the corresponding deflection D at the center of the span in feet. Instead of actually drawing the straight line 24 a pair of compasses may be used; *i. e.*, lay off the distance 12, then open the compasses until the lower point touches the straight line l; then keeping the compasses vertical, slide the lower point along l until the upper point intersects the curve corresponding to ρ. If t is negative, *i. e.*, if the temperature decreases, lay off 12 in the opposite direction. To determine D with greater accuracy use the formula

$$D = .0015\, w\, l^2 \frac{\rho}{T}$$

Calculation of ρ.

Let $w =$ weight of wire in pounds per foot.

The weight of sleet (and hemp core, if any) in pounds per foot of wire is

$$w_1 = 0.314\,(d_1^2 - d^2) + 0.25\, d_0^2$$

where d is the diameter of the wire, and d_1 the diameter over sleet and d_0 the diameter of the core, all in inches.

The wind pressure in pounds per foot of wire is*

$$w_2 = 0.00021\, V^2 d_1$$

where V is the actual wind velocity in miles per hour; $d_1 = d$ in case of no sleet. The relation between indicated wind velocity (as given by U. S. Weather Reports) and actual velocity is as follows:

Indicated Velocity	Actual Velocity
[illegible]	9.6
[illegible]	17.8
[illegible]	[illegible]
[illegible]	[illegible]
50	40.8
60	48.0
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The ratio of ρ is then

$$\rho = \sqrt{\left(1 + \frac{[illegible]}{w}\right)^2 + \left(\frac{[illegible]}{w_1}\right)^2}$$

Calculation of Vertical Sag.

In case of no wind the vertical sag S is the same as the deflection D. The wind pressure gives a horizontal component to the resultant force so that the vertical sag when wind is blowing is

$$S = \frac{D}{\sqrt{1 + \left(\dfrac{w_2}{w + w_1}\right)^2}}$$

Example: A No. 00 stranded copper cable is to be strung in still air at 70 degs. Fahrenheit between two points on the same level 800 ft. apart, so that at a temperature of zero degrees Fahrenheit, with a coating of sleet ½ in. thick all around and wind blowing perpendicularly to the cable at 65 miles an hour (actual velocity) the tension in the cable will be 30,000 lbs. per square inch; (1) at what tension must the cable be strung and (2) what will be the vertical sag at stringing temperature, *i. e.*, 70 degs., also (3) what will be the sag at zero temperature when the cable is coated with ½-in. of sleet and wind is blowing with a velocity of 65 miles an hour, and (4) what will be the sag at a temperature of 150 degs. in the still air?

We have

$$w = 0.306$$

$$w_1 = 0.314\,(\overline{1.418}^2 - \overline{0.418}^2) = 0.425$$

$$w_2 = 0.00021 \times \overline{65}^2 \times 1.[illegible] = 1.2[illegible]$$

Therefore, at zero degrees with wind and sleet

$$\rho = \sqrt{\left(1 + \frac{0.425}{0.306}\right)^2 + \left(\frac{1.2[illegible]}{0.306}\right)^2} = [illegible]$$

(1) Measure off with compasses on chart No. 1 the vertical distance from $t = 70$ on X axis to the straight line corresponding to $l = 800$. Lay this distance off vertically above the point on the curve corresponding to $\rho = 3.72$ having the abscissa $T = 30$. Keep the upper point fixed, open the compasses until the lower point touches the line $l = 800$; then, keeping the compasses vertical, slide the lower point along the line $l = 800$ until the upper point intersects the curve $\rho = 1$ at $T = 8.95$; the cable must therefore be strung at a tension of 8950 pounds per square inch. (2) The abscissa of the point on the parabolic curve $l = 800$, having the same ordinate as the point

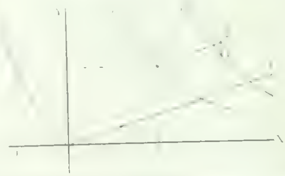


FIG. 3.—METHOD OF [illegible] CHARTS.

corresponding to $\rho = 1$ and $T = 8.95$ is $D = 34.4$ feet, which is the vertical sag S, in still air at 70 deg. F.

(3) The deflection at zero degrees with sleet and wind is the abscissa of the point on the parabolic curve $l = 800$ having the same ordinate as the point corresponding to $\rho_0 = 3.72$ and $T_0 = 30$, *i. e.*, $D_0 = 38.2$ feet.

The vertical sag is

$$S = \frac{38.2}{\sqrt{1 + \left(\dfrac{1.2[illegible]}{.731}\right)^2}} = 21.0 \text{ feet.}$$

(4) To find the sag at 150 deg. proceed as under (1) and (2) taking $t = 150$. The sag will be found to be $S = 36.8$ feet.

Wire Suspended from Points Not on the Same Level.

The charts also apply directly to the determination of the change in tension in spans when the points of support are at different heights. In this case, however, the vertical sag S_1 ($=$ deflection in case of no wind) below the highest point of support is given by the formula

$$S_1 = S\left(1 + \frac{h}{4S}\right)^2$$

where h is the difference in height of the two points of support and S is the vertical sag for a span of *equal* length but points of support on the *same* level: S is calculated by the formula given above, *i. e.*

* H. W. [illegible]

$$S = \frac{D}{\sqrt{1 + \left(\frac{w_2}{w + w_1}\right)^2}}$$

D being the deflection, taken directly from the chart, for a span of *equal* length but points of support on the *same* level; in case of no wind $S = D$. The distance of the point of maximum sag from the highest point of support is

$$\frac{l}{2}\left(1 + \frac{h}{4S}\right)$$

When h is greater than $4S$ the lowest point of support is the point of maximum sag, *i. e.*, the lowest point in the span.

Example: In the example given above suppose the difference in height of the points of support is 20 feet. Then (1) the tension at 70 deg. will still be 8950 lbs. per sq. in. (2) The corresponding vertical sag at 70 deg. in still air for points of support at same level is 34.4 feet, therefore, for the span under consideration the vertical sag from the highest point of support is

$$34.4\left(1 + \frac{20}{4 \times 34.4}\right)^2 = 45.1 \text{ feet.}$$

(3) The vertical sag at zero degrees with sleet and wind for points of support on the same level is 21 feet; therefore, for a 20-ft. difference in the height of points of support, the vertical sag from the highest point of support is

$$21\left(1 + \frac{20}{4 \times 21}\right)^2 = 32.1 \text{ feet.}$$

(4) The vertical sag at a temperature of 150 deg., for points of support on the same level is 36.8 feet, therefore, for a 20-foot difference in height of the points of support the vertical sag from the highest point of support is

$$36.8\left(1 + \frac{20}{4 \times 36.8}\right)^2 = 47.5 \text{ feet.}$$

The accompanying table, giving the value of T and ρ for various values of $y = \left(\frac{\rho}{T}\right)^2$ will be found useful in plotting the hyperbolic curves in case one wishes to make charts on a larger scale than those given herein, or similar charts for wires having different constants. The other lines are readily plotted from the equations given above.

Table Giving the Value of T for Various Values of ρ and $y = \left(\frac{\rho}{T}\right)^2$

Values of $y = \left(\frac{\rho}{T}\right)^2$	Values of ρ: 1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
.2	2.24	[illegible]	3.13	[illegible]	4.02	4.47	4.92	5.37	5.81	[illegible]	6.71	[illegible]	7.60	8.05	8.50	8.94
.17	2.43	2.91	[illegible]	3.88	[illegible]	[illegible]	5.34	[illegible]	[illegible]	[illegible]	7.28	[illegible]	8.25	[illegible]	9.22	9.70
.13	2.77	[illegible]	[illegible]	4.44	4.99	5.55	6.10	6.66	7.21	7.77	8.32	[illegible]	9.43	9.98	10.54	[illegible]
.10	3.16	3.79	4.43	5.06	5.69	6.32	6.96	7.59	8.22	[illegible]	9.49	[illegible]	10.75	[illegible]	[illegible]	12.65
.07	3.78	4.54	[illegible]	[illegible]	6.80	[illegible]	8.32	[illegible]	[illegible]	10.58	[illegible]	[illegible]	12.85	13.61	14.36	15.12
.04	5.00	[illegible]	7.00	[illegible]	[illegible]	[illegible]	11.00	12.00	13.00	14.00	15.00	16.00	17.00	[illegible]	19.00	[illegible]
.03	5.77	6.92	[illegible]	9.24	10.39	11.55	12.70	[illegible]	15.01	[illegible]	17.32	18.47	19.63	20.8	21.9	23.1
.02	7.07	8.49	[illegible]	11.31	12.73	14.14	15.50	[illegible]	[illegible]	19.80	[illegible]	22.63	[illegible]	25.5	[illegible]	[illegible]
.017	7.67	[illegible]	10.74	12.27	13.81	15.34	16.87	18.41	[illegible]	21.5	23.0	24.5	[illegible]	[illegible]	[illegible]	30.7
.014	8.45	10.14	11.83	13.52	[illegible]	16.90	18.59	[illegible]	[illegible]	23.7	[illegible]	27.0	28.7	[illegible]	32.1	[illegible]
.012	9.13	10.95	[illegible]	14.61	[illegible]	18.26	[illegible]	[illegible]	23.7	25.6	27.4	29.2	[illegible]	[illegible]	34.7	36.5
.010	10.00	12.00	14.00	16.00	18.00	[illegible]	22.0	24.0	26.0	[illegible]	[illegible]	32.0	[illegible]	[illegible]	[illegible]	40.0
.008	11.18	13.42	[illegible]	[illegible]	[illegible]	22.4	[illegible]	[illegible]	29.1	31.3	33.5	35.8	[illegible]	[illegible]	42.5	44.7
.006	12.91	15.49	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	41.3	43.9	[illegible]	[illegible]	[illegible]
.005	14.14	[illegible]	[illegible]	[illegible]	[illegible]	28.3	31.1	33.9	36.8	[illegible]	42.4	[illegible]	[illegible]	[illegible]	53.7	[illegible]
.004	15.81	[illegible]	22.1	25.3	[illegible]	[illegible]	34.8	37.9	41.1	44.3	47.4	50.6	53.8	[illegible]	60.1	[illegible]
.0035	[illegible]	20.3	[illegible]	[illegible]	[illegible]	[illegible]	37.2	[illegible]	43.9	47.3	50.7	54.1	57.5	[illegible]	64.2	[illegible]
.0030	18.26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40.2	[illegible]	47.5	51.1	[illegible]	[illegible]	[illegible]	65.7	69.4	[illegible]
.0025	[illegible]	[illegible]	28.0	[illegible]	[illegible]	[illegible]	44.0	[illegible]	[illegible]	56.0	60.0	64.0	68.0	72.0	76.0	[illegible]
.0020	22.4	26.8	[illegible]	[illegible]	[illegible]	[illegible]	49.2	53.7	[illegible]	62.6	[illegible]	71.6	[illegible]	80.5	85.0	[illegible]
.0015	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56.8	[illegible]	[illegible]	74.4	77.4	82.6	87.8	[illegible]	[illegible]	[illegible]
.0010	[illegible]	[illegible]	[illegible]	[illegible]	56.9	63.2	[illegible]	75.9	82.2	[illegible]	94.9	[illegible]	[illegible]	113.8	[illegible]	[illegible]
.0005	44.7	[illegible]	[illegible]	71.6	[illegible]	89.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	143.1	[illegible]	[illegible]	170.0	178.9

Lightning Arrester.

The accompanying illustration indicates the principle of a type of lightning arrester which formed the subject of a recent patent granted to Mr. Ernst J. Berg, of Schenectady, N. Y. It comprises an arrangement of condensers of the ordinary or electrolytic type for relieving the conductors from high frequency oscillation, and also a spark-gap and other elements for relieving the lines from disturbances of a lower frequency. The sketch shows the invention applied to a direct-current electric railway circuit of about 600 volts. The lightning arrester system is grounded and the line conductor connected to the motor through an impedance coil, shown at the top of the figure. Two condensers are placed in series in shunt with the reactance and have their common free terminals connected to ground.

The condensers serve the purpose of permitting a free path for any high frequency, high voltage oscillations and, therefore, reduce the potential gradient in the motor winding. The impedance causes a partial reflection point for the high voltage and, therefore, reduces the voltage on the motor winding.

The condenser should be constructed with as little inductive reactance as possible and the impedance as little capacity between turns as possible. The second path to the ground includes a spark-gap with a blow-out magnet (indicated to the left) arranged so that a direct and heavy discharge of energy may take place from the line conductor to the ground without passing through either of the condensers or through the impedance coil.

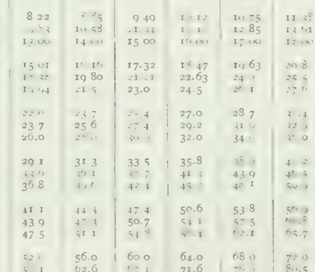


FIG. LIGHTNING ARRESTER.

Curtis Turbine Tests.

Recently tests were made in England on a 1000-kw Curtis steam turbine supplied to the Lancashire United Tramways, Ltd., by the British Thomson-Houston Co., the tests being carried out under the supervision of Prof. Ernest Wilson, of King's College, London, and Mr. J. R. Salter, M. I. E. E., engineer and manager of the Lancashire United Tramways, Ltd. The turbo-alternator set consisted of a vertical Curtis steam turbine, mounted on sub-base condenser, running at a [illegible] r. p. m. and [illegible] alternator,

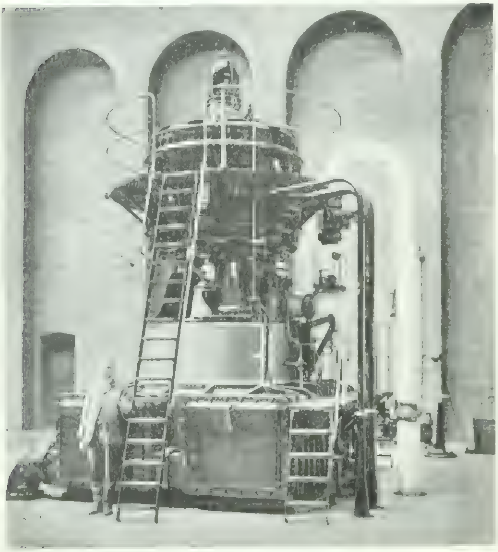


FIG. 1.—TURBINE ON SUB-BASE CONDENSER.

capable of giving a continuous output of 1000-kw (1250 kva) with 80 per cent power factor, the voltage being 7500 and the frequency 50.

The steam consumption tests were made by measuring the amount of water discharged into the hot well, the power taken by the air and circulating pumps being excluded. The test was run in the following order: Half load for 2 hours; full load for 6 hours; 1¼ load for one hour, after which the voltage regulation and insulation tests were taken.

In Table I is given a summary of the electrical data obtained during the run; Table II gives the steam consumption figures, and Table III the observed and calculated regulation.

The accompanying illustration shows the turbine set mounted on its sub-base condenser, with electrically driven air pumps, as erected in the power station of the Lancashire United Tramways Company at Atherton.

TABLE III.

Load	[illegible]	[illegible]	EXCITATION		
			[illegible]	K.W. in field coil	K.W. at [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		8.0	
[illegible]	Test	[illegible]	[illegible]	[illegible]	8.2

The specification provided that the test for steam consumption should be made under the following conditions:

(1) A steam pressure of 150 lbs. per sq. in. at the stop valve.

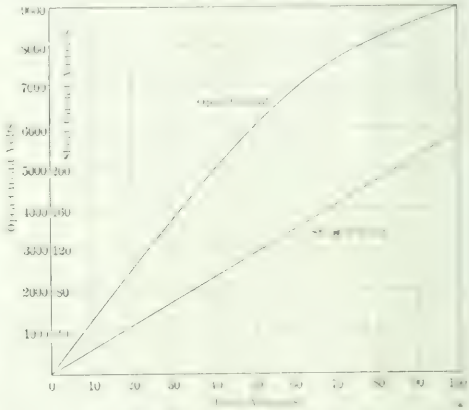


FIG. 2.—SHORT CIRCUIT CHARACTERISTIC.

(2) A vacuum of 28 ins. with the circulating water at a temperature not exceeding 80 deg. F., and when the power absorbed by air and circulating pump motors does not exceed 52 kw.

The guarantees were as follows: For 1¼ load, 20 lbs.; for full load, 19.3 lbs.; for half load, 21.8 lbs. The full load figures were subject to a penalty or bonus of £50 for every one per cent variation.

TABLE I.

Tests	LOAD: Average volts per phase	Average Amps. Phase 1	Average Amps. Phase 2	Average K.W. from Watt Hour Meters Phase 1	Phase 2	Average K.V.A. Phase 1	Phase 2	EXCITATION: [illegible] Start of Test	End of Test	Average Amps.	K.W. in field coil Start of Test	End of Test	K.W. at [illegible] Volts
Half Load	[illegible]	33	[illegible]			252	251	[illegible]	[illegible]	[illegible]	4.1	[illegible]	7.65
Full Load	[illegible]	66.7	66.4	506	505	500	498	71.0	78.0	[illegible]	[illegible]	5.63	8.25
1¼ Load	[illegible]	85.1	[illegible]	643	638	640	63[illegible]	[illegible]	81.0	[illegible]	[illegible]	6.45	[illegible]

TABLE II.

Test	Load	Steam: Pressure at stop valve	Temp. Deg. F.	Superheat Deg. F.	Exhaust vacuum	Barometer	Temperature of circulating water In	Out	Lbs. of steam per hour	Total Kw-hours	Kw-hours [illegible]	Net Kw-hours	Lbs. of steam per K.W.-hour
[illegible]	Half	[illegible]	384	18	[illegible]	29.60	58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.4
[illegible]	Full	[illegible]	389	22	[illegible]	29.66	58	81	[illegible]	1011	[illegible]	[illegible]	[illegible]
[illegible]	Full	[illegible]	466	100	28.88	[illegible]	58	81	18,940	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1¼	148	508	148	[illegible]	[illegible]	58	84	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

In each of the tests, the rate of consumption in pounds of steam per hour was obtained from the log sheets between the times set out in Table II, the tests being made by measuring the

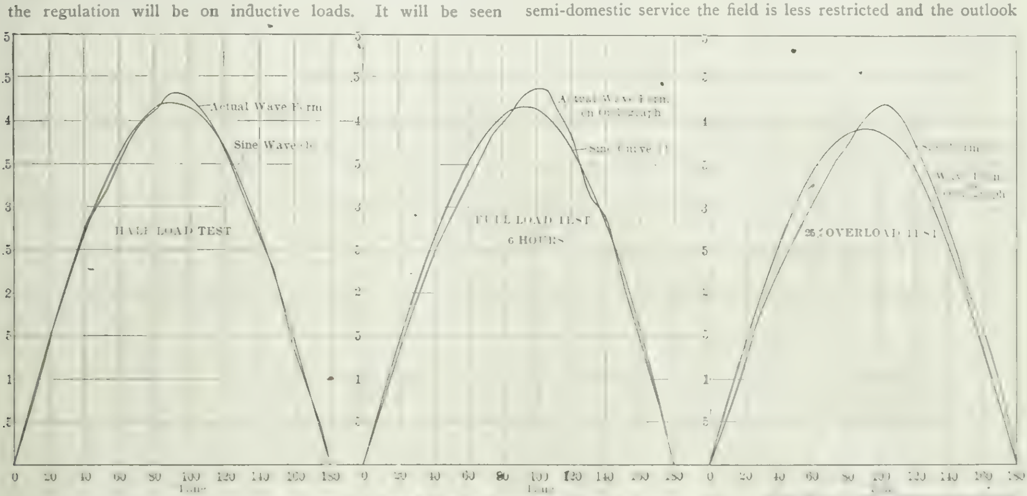
amount of water discharged into two tanks. The platform weighing machines used during the test have been certified as accurate by the Government Inspector of Weights & Measures, and all electrical measuring instruments were calibrated by the Board of Trade after the test.

Correcting the test results at full load to specification conditions as regards steam pressure, superheat and vacuum, and allowing for excitation losses and lubricating pump (9.8 kw) the full-load figures worked out to 18.5 lbs. per kw-hour. This is 4 per cent better than the guarantee, which thus entitled the contractors to a bonus of £200.

The specification allowed a rise of 75 deg. F. (41.6 deg. C.) in temperature after a 10 hours' run at full non-inductive load. The rise observed was 39.2 deg. C. with relation to a thermometer in one part of the room, and 31.2 deg. C. with relation to a thermometer in another part of the room. In either case, the rise was within the specification limits. The temperature rises were checked by resistance measurements, and agreed closely.

It will be seen from Table III that the regulation was within the specification limits. The short-circuit characteristic (Fig. 2) enabled an approximate idea to be formed as to what the regulation will be on inductive loads. It will be seen that the field coil, according to theory, will have to be supplied with the full 110 volts for the requisite excitation of about 115 amperes when the generator is hot.

Figs. 3, 4 and 5, give the wave forms obtained by an ondograph and the equivalent sine curve has been superposed thereon. That is the curve marked *b* in each of the figures which would give the same reading on the same voltmeter that the actual curve gave. The deviation from a sine curve is not beyond the limit given in the specification, and is satisfactory. The deviation becomes more pronounced as the load is increased, on account of the increased armature reaction.



FIGS. 3, 4 AND 5.—WAVE FORMS OBTAINED ON ONDOGRAPH

Possibilities of Electric Heating.

At the meeting, Sept. 9, of the Engineering Society of the Carolinas, Mr. Charles E. Waddell, second vice-president of the society, presented a paper entitled "Problems and Possibilities in Electric Heating." Referring to the electric heating apparatus now in the market, he states that one or more manufacturing companies guarantee for their product a life of 10,000 hours. The heating element consisting of a metal deposited on an enamel, which while very efficient in operation is open to the objection that the contact between the leading-in wires and the element is subject to deterioration eventually resulting in open circuit. More success in this respect has been realized with another type in which the heating element consists of a metal strip, similar to a Grecian border, whose terminals are an integral part of the strip itself and with greater carrying capacity. Depending upon the service the apparatus is to perform the current necessarily varies through wide limits in commercial apparatus. Thus in the case of the Vanderbilt Biltmore estate electric heating equipment, the plate-warmers are operated at a density of 0.8 watt per sq. in. of heating surface; the laundry mangle at 3 watts, and the iron stoves at 13 watts.

In the matter of switches, cut-out fuses, flexible cords and similar auxiliary appliances, the market to-day affords little choice. The requirements of heating apparatus are of the most exacting nature, and it is interesting to note in practice how quickly the "continuous carrying capacity" claims vanish when appliances so described are used with heating apparatus. The author stated that he had found it desirable to install switches, cut-outs and terminals of at least twice the capacity as rated by the manufacturers and to allow a generous margin in the capacity of fuses.

After discussing the general use of electric heating, the prospect for which is not found favorable, it was stated that in semi-domestic service the field is less restricted and the outlook more hopeful. For example, in laundries and large apartment houses there are many opportunities for economy from the use of electric heating. The Biltmore house is cited as an example of this kind. About a year ago a plant of about 160 kilowatts was installed there, superseding the high-pressure boiler that furnished steam for the laundry, plate warmers, etc., an ordinary type of hot-water heater burning anthracite coal, and a coal stove for the laundry irons. Three thousand gals. of water are heated to a temperature of 212 degs. F. per day of 24 hours, and except for heating the house, steam has been discontinued altogether. The success that has attended this initial installation leaves the hope that electricity may supersede steam for heating the house, a problem that is now being worked out.

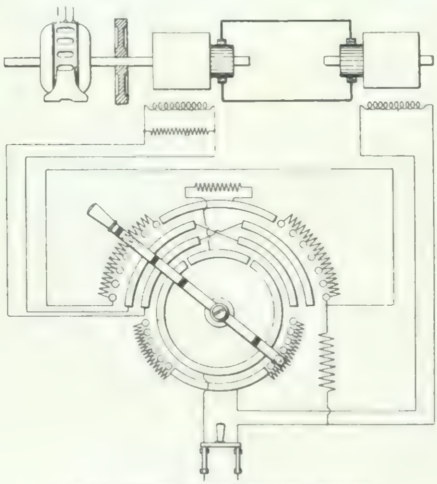
The company furnishing electric power to the Biltmore estate offers favorable rates for service furnished between midnight and morning in the winter months, and the plan now being worked out is to heat large quantities of water between midnight and morning to a temperature higher than the boiling point, keep the water under pressure in containing tanks thermally insulated. Throughout the remainder of the 24 hours the water will be liberated into the present hot-water radiation system, and being under a very little pressure will expand, liberate its heat, condense and be returned to the tanks. Where direct-steam radiators are at present employed, as in the bath rooms and similar places, it is proposed to substitute di-

rect electrical radiators. With this system it is believed the operating cost would be the same as with coal, the fuel being anthracite that costs $11 per ton.

Control of Flywheel Motor-Generator Sets.

On Sept. 10 there were issued to Mr. W. H. Powell nine patents containing a total of 401 claims covering control systems for motors used in rolling mills. The main part of the motor equipment consists of an induction motor direct connected mechanically to a variable-voltage direct-current generator which is electrically connected to a variable-speed reversible motor, which drives the rolling mill machinery. The induction motor is provided with a variable secondary resistance so that it has a drooping load-speed characteristic. In order to equalize the load on the induction motor a heavy flywheel is mounted on its shaft for absorbing energy kinetically when the motor speed increases and for giving off energy when the speed decreases. The patents mentioned above relate not so much to the motor equipment as to the control system, the arrangement being such that the direct-current machines are not required to be of much, if any, greater rating than demanded by the load, because the maximum current and the maximum voltage are used simultaneously. Moreover, the time required for the reversal is rendered short on account of the small "time constant ($L \div R$) of the generator field magnet winding.

The armature of the working motor (connected to the rolling mill machinery) receives its energy from a special generator, and the field strength of both the motor and the generator are variable, generally inversely and preferably in alternate steps, while the field flux of the generator is reversible. The field current of the generator and also that of the motor are obtained from some external source. When it is desired to bring the working motor quickly to rest and reverse its direction of rotation, its field strength is first increased and the e. m. f. across its armature is reduced to zero; then its field is weakened and the e. m. f. impressed across the armature is simultaneously



increased in a reverse direction. One method of arranging the apparatus and control circuits is shown in Fig. 1. Modifications described in other patents relate to self-contained exciting generators, and to the self-excitation or partial self-excitation of the direct-current machines.

Two patents containing a total of 78 claims covering additional modifications of the above system were issued on the above date to Mr. W. J. Richards. The scheme disclosed in one of these patents is shown in Fig. 2. The field coils of the direct-current generator A and the direct-current motor B are connected permanently in series and subjected to the full value of e. m. f. from an external source of supply. The currents in these sets of field coils are not maintained equal in value because the field coils of generator A are shunted by the armature of a "counter-voltage" generator C. The speed control of the whole equipment is obtained by varying the field strength of generator C. When the field circuit of this generator is open, the armature C generates almost no counter volt-

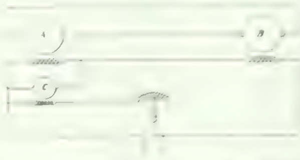


FIG. 2.—RICHARDS MOTOR CONT[illegible]

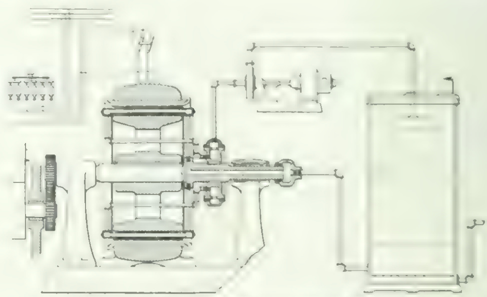
age, and its resistance being very low, almost no current passes through the field coils of generator A. The field current of motor B has its maximum value, but the armature exerts almost no torque because its current is of almost zero value. When the field strength of C is gradually increased more current passes through the field coils of generator A (less through the field coils of motor B) and it delivers a gradually increasing e. m. f. to the armature of motor B. In the second patent issued to the same inventor, the field coils of motor B are also shunted by the armature circuit of a "counter-voltage" generator, the e. m. f.'s of the two "counter-voltage" generators being separately controlled by manually operated field-circuit rheostats.

In a patent containing 46 claims, issued to Mr. L. E. Bogen on the same date, it is proposed to supply current to the field coils of the working motor, and of the generator supplying current to the armature of this motor, from separate sources of e. m. f., and to vary the e. m. f.'s of the separate sources inversely in order to control the speed and power of the working motor.

All of the above-mentioned 12 patents have been assigned to the Allis-Chalmers Company.

Artificial Cooling of Induction Motors.

Means for artificially cooling the rotor windings of an induction motor for driving rolling mills are disclosed in a patent



issued Sept. 10 to Dr. C. P. Steinmetz. The secondary (rotor) winding consists of a "squirrel-cage" whose bars are made of piping and whose end rings are hollow. Cooling water is drawn through the bars and end rings by means of a suction pump. The water being under a partial vacuum, a leaky joint merely admits air instead of allowing the water to escape. The secondary resistance is so high that the maximum torque occurs at about negative synchronism (at a slip of 200 per cent). The motor is, therefore, especially suited for work requiring

rapid reversal of rotation. The artificial cooling allows the rotating member to be extremely small and its inertia correspondingly low.

New Telephone Patents.

SUPERVISORY CIRCUIT.

All lamp supervisory circuits have included two elemental principles, viz., the initial control device which keeps the circuit inoperative except when the associated cords are in use, and the responsive device which effects the actual display of the signal. Usually the control part maintains the lamp signal open, it itself being normally on open circuit. Contrary to this custom, Mr. W. W. Dean has provided for the control a relay normally on closed circuit, which relay maintains the lamp circuit open in its energized condition. This relay becomes deenergized during the use of its cord circuit by any of the ready means. The control relay is, of course, wasting energy continuously, but the resistance is made some thousands ohms. The patent for this circuit is assigned to the Kellogg Switchboard & Supply Company.

INDUCTION COIL CIRCUIT.

D. M. Therrell, of Charleston, S. C., has obtained an additional patent on his resonance induction coil arrangement for improving transmission. Notice of his earlier patent, which sets forth the general principles, was given on page 831 of our issue of April 21, 1906, and an exposition of the principles and their application will be found in an article by Mr. Therrell on page 1344 of our issue of June 30, 1906.

AUTOMATIC SWITCH.

A novel sort of automatic switch forms the basis of a patent issued to H. G. Pope, of New York City. The switch is associated with the band of a head telephone so that when this clamps the head of the user the switch is closed. It may either be at the receiver end of the band, or in connection with a pad at the free end.

LETTERS TO THE EDITORS.

Apropos of the Niagara Illumination.

To the Editors of Electrical World:

SIRS:—It is with interest that the writer has read the description of the steam fountain apparatus installed in connection with the illumination of Niagara Falls, illustrated in the Sept. 7 issue of the ELECTRICAL WORLD. Therein it is stated that the apparatus was designed for the Jamestown Exposition, but not used for various reasons.

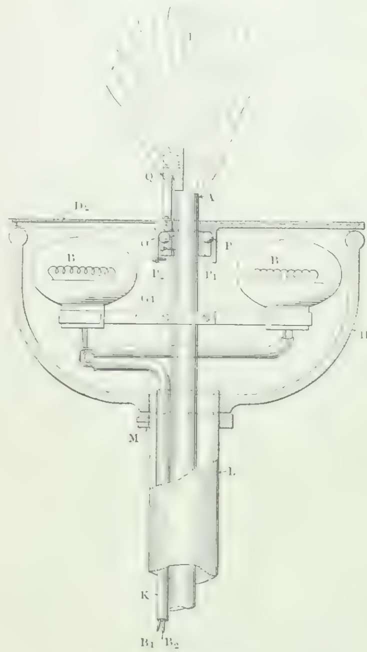
This means of spectacular illumination occurred to the writer some time in 1905. Application for a patent on a steam fountain head, illustrated by a sectional view in the accompanying diagram, was filed in the spring of 1906; and shortly thereafter the writer endeavored to induce the Jamestown Exposition authorities to adopt on a large scale a spectacular scheme of steam fountain lighting.

In the particular type of fountain head here illustrated, *A* is the nozzle of a pipe from which a low pressure steam jet *I* discharges. Rigidly attached to the pipe are the lamps, *B*, *B*, receiving current through the conductor *K*.

A transparent rotatable color disk D_2, carrying two or more colored sectors, is mounted on a center bearing supported by the steam pipe at P_2. A thin metal vane *Q* attached to the disk D_2 slightly projects over the nozzle so that the escaping steam will impinge against the vane, thus causing a pressure tending to slowly rotate the color disk. The entire mechanism is enclosed by the metal or porcelain shield *H* and the cover tubing *L*. The operation of the device is simple and automatic, and slowly shifting color effects are continuously obtained.

It was proposed to place a number of these fountain heads along cornices of certain of the exposition buildings, or on either side of the esplanade. A large central fountain was also proposed with powerful light reflecting thereon.

In view of the foregoing the writer believes himself entitled



ILLUMINATED STEAM FOUNTAIN HEAD.

to share in what small credit may be due to originating and introducing the luminous steam fountain.

NEW YORK. P. G. WATMOUGH, JR.

Distortion in Telephonic Transmission.

To the Editors of Electrical World:

SIRS:—In your editorial comment on my paper "Distortion in Telephonic Transmission," I note the following statement: "We note that in the present case, as in the case of other writers on the subject of telephonic distortion, the term distortion is connected only with the effect of attenuation. This use appears to ignore the fact that the effect of reactance not only attenuates differently the values of current components, but also changes their phase relations." If you will kindly refer to my paper on the "Telephone Repeater," published in your journal April 4, you will find that I specifically called attention to the fact that the phase displacement is one of the causes that produce distortion. The reason I did not mention anything about it in this paper is because I did not intend to deal with the problem of distortion in all its phases. I merely wished to call attention to the fact that resistance is a function of the frequency and this produces distortion. To make the argument clear I made some calculations to show to what extent the attenuation is affected by the change of resistance. It is understood, of course, that the phase displacement will be similarly affected, but I did not think it necessary to consider both factors which enter in the production of distortion. I thought that the discussion of one factor—attenuation—would be sufficient to illustrate the argument.

WASHINGTON, D. C. LOUIS COHEN.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-Phase Motor.—A well-illustrated account of the development of the Siemens-Schuckert single-phase commutator motor for traction purposes, on the basis of various papers by R. Richter. The motor is of the series type but differs from the ordinary series motor chiefly with respect to two features. The first of these features relates to an arrangement of the armature winding, whereby the high resistance leads, before reaching the commutator, are arranged in extra turns so situated as regards the impressed field as to contribute materially to the torque of the motor. It is claimed that some 10 per cent increase in the output for a given weight of motor is obtained by virtue of this construction. The stator windings differ from those customary with the series-type motor, chiefly with respect to certain special connections, which give to a portion of the windings a certain amount of shunt characteristic, subsidiary, of course, to the predominating series characteristic. This arrangement has been introduced with a view to suppressing still further the sparking at starting due to the transformer action from the main poles. Motors of this type rated at 125 hp are already in use on the Blankenese-Ohlsdorf Railway, and motors of 175-hp rating will be employed on the Heysham electrification scheme of the Midland Railway. This latter type of motor has a speed (at its 1-hour 75-deg. C. rating) of 700 r. p. m., and weight 2.77 tons. The weight of the remainder of the electrical equipment is 2.73 tons per motor, thus giving a total weight of electrical equipment of 5.50 tons per motor. The motors are ventilated by forced draft. If they were non-ventilated, and were run at a speed of 550 r. p. m. (which is more in accordance with approved railway practice) the total weight of electrical equipment would amount to some 7 tons, or some 40 kgs. per rated horse-power, as against some 17 kgs. per rated horse-power for first-class continuous-curent equipment for the same rating.—Lond. *Elec. Eng'ing,* Sept. 5.

Dimensions of Dynamos.—H. M. Hobart and A. G. Ellis.—The first part of an illustrated article on a method of determining the leading dimensions of large and high-speed continuous-current dynamos. In large and high-speed dynamos, especially for large rated outputs associated with high speeds, the commutation problem is the most difficult, while that of the losses and heating is less important. The method described by the authors embodies a general relation between the leading dimensions, armature strength, number of poles, rated output and speed, and the commutating quality. The latter is expressed in terms of the reactance voltage per segment.—Lond. *Elec. Review,* Sept. 6.

Repulsion Motor.—A note on a recent British patent of the Allgem. Elek. Ges. It relates to alternating-current machines whose magnetic field is excited by a rotor short-circuited through a commutator and brushes. In order to distribute the field more uniformly over the air-gap, the exciter brushes are arranged in a chord perpendicular to the short-circuit axis. Two sets of brushes may be employed on two chords, one on either side of the ordinary central position. A chord winding on the rotor may also be used in conjunction with brushes arranged as a chord.—Lond. *Elec. Eng'ing,* Aug. 29.

Automatic Speed-Control of Series Motors.—A note on a recent patent of Burnand. In order to vary at will the speed of a series-wound motor, the positions of the brushes are controlled by means of an eddy-current brake, one member of which is driven by the motor shaft, the other member of the brake is movable within certain limits, and its movement is controlled by a spring adjustable by hand. The movement of the brake mechanism is arranged to rock the brushes by means of a pinion and sector. Normally, the torque of the brake balances the pull of the control spring, but when the speed varies the torque varies, and the brushes are moved in either direction until the speed is restored to practically normal.—Lond. *Elec. Eng'ing,* Aug. 29.

Commutator Construction.—An illustrated description of mechanical details of fixing the commutator segments, recently patented by the Siemens-Schuckert Co.—Lond. *Elec. Eng'ing,* Sept. 5.

Traction.

Statistics.—The yearly statistical table on street and elevated railways in the United States and Canada. In the United States there were 1164 railway companies in 1906, operating street or elevated railways, with a total track mileage of 36,932, of which 719 track miles are operated by cable, steam or horses and the balance of 36,212 by electricity. The total capital stock was $2,039,948,875, the funded debt $1,725,369,000 and the capital liabilities $3,765,317, 875. Data are also given on the insular possessions of the United States, on Cuba and on Canada.—*St. R'y Jour.,* Sept. 7.

Contact Resistance.—P. M. Hall, P. C. Smith and C. B. Starbird.—An account of an experimental investigation of contact resistance in connection with rail bonding. Most of the results are given in diagrams. One of the objects of the tests was to determine the pressure of the rail bond against the steel rail which gives the best resistance value. This pressure was found to be from 25,000 to 30,000 pounds per square inch of contact surface. This pressure is within the elastic limit of steel; consequently steel does not take a permanent set when it is applied. It does not pay to increase the area of the bond terminal unless the pressure applied in the bond terminal is correspondingly increased; that is, if the contact surface of the bond terminal is doubled, it is necessary to double the pressure applied to the bond before any appreciable difference in contact is obtained. The contact resistance between annealed cast copper and steel is from 30 to 60 per cent higher than the resistance between annealed rolled copper and steel.—*St. R'y Jour.,* Sept. 14.

Surface Contact System.—An abstract of the last annual report of the municipal tramways of Wolverhampton where the Lorain surface contact system is in use. From the balance sheets it appears that the cost of electric energy has decreased from 3.982 cents to 3.686 cents per car-mile, while the cost of maintenance of the Lorain equipment has increased from 0.444 to 0.704 cents per car-mile. This increase is due to an increase in the cost of maintenance of the Lorain track equipment from 0.204 to 0.270 cents and to an increase of maintenance of car equipment from 0.24 to 0.434 cents per car mile.—Lond. *Elec. Eng'ing,* Aug. 29.

St. Petersburg.—An illustrated description of the electric tramway system of St. Petersburg. It is supplied from a new generating station containing three turbo-alternators which give a three-phase supply at 6600 volts to five rotary-converter sub-stations.. The line equipment is overhead and the route is of double track, 5-ft. gauge. Single deck two-axle cars are used with trailers.—Lond. *Electrical Engineering,* Aug. 29.

Single-Phase Traction.—An illustrated description of the rolling stock of the single-phase Vienna-Baden interurban line. As has been noted in the Digest, the electrical car-equipment is adapted for use on both single-phase and direct-current circuits. Full details of the controlling and brake systems are given.—Lond. *Electrician,* Aug. 30.

Standardization.—A report prepared for the recent convention of the German Street & Interurban Railway Association on standardization. Among the subjects treated are axles, journal boxes, tracks, brake-shoes and gearing.—*Street R'y Jour.,* Sept. 7.—The report on standardization of rail sections presented at the same convention suggests the standardization of 15 rail-sections, composed of five sizes each, for grooved, composite and T-rails respectively.—*St. R'y Jour.,* Sept. 14.

Glasgow.—An abstract of last year's report of the Glasgow tramway system which is one of the oldest municipal tramway systems in England, having been acquired in 1894. The total mileage is 176, of which 109 miles are within the city of Glasgow. The total expenses including capital charges per car-mile were 19.550 cents while the total income from all sources was 21.212 cents.—Lond. *Elec.*, Aug. 30.

Sunderland.—An abstract of the last annual report of the municipal tramways of Sunderland which comprise two miles of single track and nine miles of double track. The total expenses, including capital charges, per car mile were 15.638 cents, the total receipts from all sources 22.846 cents.—Lond. *Electrician*, Sept. 6.

Electrophysics and Magnetism.

Inductance.—K. Ogura and C. P. Steinmetz.—A mathematical paper on the inductance of straight conductors, giving formulas for infinitely long straight conductors and for straight conductors of finite length, and also for the mutual inductance of two finite straight conductors at considerable distance from each other.—*Physical Review*, September.

Pinch Phenomenon.—P. Bary.—An illustrated translation in abstract of his French paper abstracted some time ago in the Digest, on the mechanical action of currents on conductors.—Lond. *Electrician*, Sept. 6.

Rays of Positive Electricity.—J. J. Thomson.—The author has formerly shown that the rays of positive electricity in gases at very low pressures consist mainly of streams of two kinds of positively charged particles, the value of the ratio of electric charge to mass for one stream being 10,000 and for the other 5000. As these are respectively the values of the ratio of charge to mass for charged atoms and molecules of hydrogen, it might be thought that the rays of positive electricity are dependent on the presence of hydrogen in the discharge tube. However, this seems not to be the case, and experiments now described by the author show that the intensity of rays in different gases is not connected with the amount of hydrogen in the tube. He also found that positive rays are very widely distributed throughout the tube. The positive rays are to be found throughout the whole tube and not merely passing through apertures in the cathodes and in the layer of luminosity adjacent to it. The particles of positive electricity are shot off in all directions from a gas traversed by canal rays.—*Phil. Mag.*, September.

Ionization by Spraying.—A. S. Eve.—Since Lenard discovered the presence of negative electrification near water falls much work has been done on the generation of electricity by the splashing of liquids and by bubbling gases through them. The author has studied especially the electrical effects due to spraying. While making some experiments with an Ebert apparatus for measuring the ionization of the atmosphere, he blew with an ordinary garden hand sprayer a very fine mist all around the apparatus. The number of ions detected in the atmosphere was thereby increased many thousands. Negative ions were in excess of the positive and their ratio was about 1 to 4. The author has now studied this problem with more refined apparatus.—*Phil. Mag.*, September.

Radioactivity and Roentgen Rays.—A note by W. Wilson and W. Makower on the rate of decay of the active deposit from radium, and a paper by C. G. Barkla and C. A. Sadler on secondary X-rays and the atomic weight of nickel. Curves connecting the atomic weight of an element subject to X-rays and the general penetrating power of the secondary X-rays emitted by it (various absorbing substances being used) indicate for nickel an atomic weight of about 61.4.—*Phil. Mag.*, September.

Ether.—Lord Kelvin.—A highly theoretical paper on the motions of ether produced by collisions of atoms or molecules containing or not containing electrons.—*Phil. Mag.*, September.

N-Rays.—G. F. Stradling.—A useful résumé of the literature of the N-rays, the N_1-rays, the physiological rays and the heavy emission, with a bibliography.—*Journal of the Franklin Institute*, Aug. and Sept.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—F. Howles and N. Whitehouse.—Two papers on the fixation of atmospheric nitrogen in form of useful compounds. Howles gives a critical review of the different processes which have been proposed for the electrothermic combustion of atmospheric nitrogen. The conditions which must be fulfilled for successful operation are summed up by him as follows. The ordinary high-tension arc consists of three superimposed zones. In the lowest and hottest zone the oxidation of the nitrogen takes place, and in order to get a high efficiency it is important to get as high a temperature in this zone as possible. On the other hand the relative values of the second and third zones should be reduced as much as possible and the produced gas mixture should be removed from the sphere of influence of the arc as quickly as possible. A further important consideration is the concentration of large amounts of energy in a unit of plant. In the final part of the paper the author indicates as two elements of improvements which may be made, an increase in the flame temperature and the more rapid removal of the nitric oxide from the arc by means of greater air velocity and without increased dilution. These two effects could be obtained by treating compressed air in the arc. In the final part of the paper the absorption of nitric oxide and the proportion of nitric acid is discussed, and it is said that although the electrochemical production of nitric acid has attained a fair degree of efficiency in some processes, the problem of directly manufacturing from the furnace gases a 98-per cent acid has not yet been solved. The paper of Whitehouse deals with an experimental investigation on a cyclic process using a metal which is first made to combine with the nitrogen in the air so as to form a nitride whereupon the nitride is reduced by means of hydrogen so as to recuperate the metal with simultaneous production of ammonia; but it is found that none of the known metals fulfills the required conditions.—*Electrochem. and Met. Industry*, September.

Corrosion of Iron.—A. S. Cushman, W. H. Walker, A. M. Cederholm and L. N. Bent.—Two papers on the corrosion of iron as an electrochemical phenomenon. Both papers show that the carbon dioxide theory cannot be satisfactory since the presence of carbon dioxide is not necessary for the corrosion of iron. In a crucial experiment on the electrochemical theory the fact is established that iron dissolves in water which contains not more than a trace of electrolyte, no oxygen and no carbon dioxide. The dissolving of iron in the moisture is the first step, while the second step is the oxidation of the ferrous ions to ferric by oxygen of the air. The loose colloidal ferric hydroxide thus produced moves towards the cathode under the influence of the current and piles up there in the form of rust. The function of oxygen in the corrosion of iron is double. The secondary function is, as just explained, the oxidation of the ferrous ions. According to Walker, however, oxygen also must fulfill a primary function, namely to depolarize those cathodic portions of the iron upon which hydrogen tends to precipitate. Both Cushman and Walker have developed an indicator which shows to the eye where the cathode and the anode zones are on an iron surface. This is described in detail. There are two possibilities to limit rusting. The first is to make the iron so pure and to guard against unhomogeneity and bad segregation to such an extent that galvanic couples are not likely to be formed. The second method is to use the present commercial kinds of iron and steel and protect them by a coating such as a dilute solution containing bichromate. The subject is also discussed in a long editorial.—*Electrochem. and Met. Ind.*, September; The full paper of Cushman is published as Bulletin 30 of the Office of Public Roads, *U. S. Dept. of Agriculture.* The full paper of Walker is published in the *Journal American Chemical Society*, September.

Units, Measurements and Instruments.

Standard Magnetic Field.—R. Gans.—If magnetic fields could be reproduced like capacities, resistances, or inductances, it would mean a great convenience in magnetic measurements. An approach to such a desideratum is provided by standard

solenoids free from iron, which may be traversed by standard currents to give standard fields. The disadvantages are that the fields are weak, inaccessible and lacking in uniformity. This could be largely remedied by introducing iron cores, but not without introducing hysteresis and a lack of proportionality between current and field. The author indicates a method of avoiding these sources of error. Hysteresis is eliminated by introducing the current by small steps with reversals, and a proportionality between current and induction may be obtained at maximum permeability, where the tangent to the BH curve from the origin coincides with the curve itself for some appreciable distance. The author used a gapped ring of well-annealed wrought-iron rich in carbon, 62 cm. in circumference, with a gap of 0.6 cm. The formula connecting the field H in

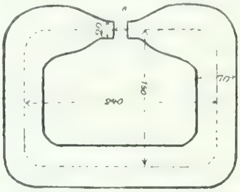


FIG. 1.—STANDARD MAGNETIC FIELD.

the gap with the current i in amperes was $H = 1348i$. The proportionality, however, only held good between 1.5 and 2.4 amperes, and varied with the direction of the magnetizing current. A better result was obtained with a ring with tapering pole-pieces, especially when made of soft cast steel. One such ring with 1700 turns and of the construction shown in Fig. 1 gave fields ranging from 3000 to 10,000 units, according to the magnetizing current, and these did not vary more than 0.2 per cent in one year.—*Phys. Zeit.*, Aug. 15, abstracted in Lond. *Elec. Engineering*, Sept. 5.

Energy Losses in Condensers.—W. EICKHOFF.—When the voltage between the two plates of a condenser is increased to a certain degree, fine brush discharges take place; for instance, in Leyden jars they pass from the rims of the condenser plates over to the glass surface. In the moment in which an arc passes through the air gap in the circuit, starting the high-frequency oscillations within the circuit, there is a strong brush light along the surface of the dielectric. This, of course, represents a certain loss, and the author emphasizes that the loss is by no means negligible compared with the loss in the spark. The brush light also causes a certain distortion of the resonance curve. With the condensers used by the author, in order to get sharp resonance, he connected them in series when the total voltage was beyond a certain limit. The lack of sharpness of resonance is not simply caused by the energy loss, but is primarily due to the variations in the frequency produced by the brush discharges.—*Phys. Zeit.*, Sept. 1.

Universal Instrument for High-Frequency Currents.—E. NESPER.—The conclusion of his illustrated description of a universal instrument for high-frequency currents and oscillations. In the present installment the application of the instrument to measurements of the damping of an oscillator and to the measurement of the damping of a resonator are described. —*Elek. Zeit.*, Sept. 5.

Telegraphy, Telephony and Signals.

Sounder.—An illustrated description of a new direct-reading polarized sounder invented by C. C. Vyle of the British Post Office. It can be placed directly in the line circuit without any relay or local battery and, with currents of from 4 to 5 milliamperes, gives firm, readable signals. With the exception of four terminals in place of two, the instrument is made to resemble in appearance the ordinary single-current pony sounder, the feet being provided with fixing holes at exactly the same centers as in the ordinary instrument. The winding is differential, and, as the result of a long series of trials with a view to finding the best value for practical work, each coil has been wound to a resistance of 500 ohms. For simplex working the coils can be joined in series with a total resistance of 1000 ohms, or in parallel, the resistance then being 250 ohms. When in use on duplex circuits, the inner terminals of the sounder are strapped together, the Vyle sounder being joined up in circuit in place of the ordinary relay. The chief feature of the instrument is the permanent magnet which is placed in the base and connected to the cores of the electromagnet. The interposition of a permanent magnet in the magnetic circuit with a view to reinforcing the electromagnetic action produced by the signalling current is interesting, particularly in view of the fact that by means of this arrangement condenser working on the leak principle is possible. The inductive effect of the permanent magnet on the cores of the electromagnet results in the armature being attracted, this force of attraction being overcome by the tension of the antagonistic spring. If the latter is in excess of the former the instrument works in the ordinary manner. If, however, the effects due to the spring tension and to the permanent magnet are equal, a remarkable result is obtained. The passage of a very small current will disturb the balance and the armature commences to descend. Now the force due to the spring tension varies as the displacement, while the force due to the magnetic attraction varies as the fourth power of the displacement. As the armature descends, therefore, the force of the permanent magnet rapidly increases its effect, and the momentum increases accordingly, the lever finally strikes the lower stop with sufficient energy to give a firm, readable signal. If the marking current is followed by a spacing current, the reverse conditions obtain; the spring tension falls off at a much slower rate than the magnetic force, the armature gaining momentum during the whole of the upward movement. It will be seen that the energy necessary to work the instrument is brought into action by a small external force under the control of the transmitting station. It is this property that enables the Vyle sounder to be worked on those circuits which it is necessary to work by small impulsive currents through a condenser or transformer. In such systems there is, of course, no permanent current on the line, and the sounders are adjusted to their most sensitive condition. The initial part of the signal—say, a dash—is formed by a momentary current in one direction, and terminated by a current in the reverse direction, the armature being held down for the formation of a dash by the attraction of the permanent magnet. The simplicity obtained by the use of the instrument is apparent from Fig. 2, which shows the connections for a simplex

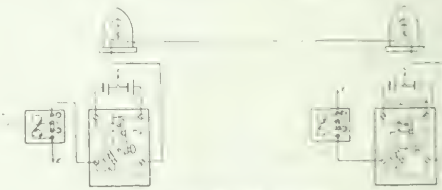


FIG. 2.—DIRECT LINE [illegible]

double-current circuit working from a split battery. The absence of the relay will be noted; the employment of the single-current key with switch enables a number of circuits at each station to be worked from a split battery. Since the sounder can be worked through condensers, it is specially valuable in preventing disturbances occasioned by the leakage of currents or magnetic storms. The sounder has also been designed to possess a high inductance which renders it insensible to inductive disturbances whether electrostatic or electromagnetic.—Lond. *Electrician*, Aug. 30.

Wireless Telegraphy.—C. A. [illegible].—An account of an experimental investigation in which the author studied the relative efficiency of several different types of receiving systems for wireless telegraphy when used under various conditions. The chief results are as follows: The resistance of the earth between the two stations is an important factor in the propagation of energy. The square of the energy received by a horizontal antenna is approximately proportional to its length.

Relatively small capacity-areas show equal efficiency in all planes of orientation about a vertical axis. Even in the case of capacity-areas whose length is great compared with the width only a slight decrease in efficiency is noticeable when the area is normal to the wave front. Open-circuited helixes are equally efficient in all planes of orientation. The energy received by such a helix having a given length of wire is a function of its dimensions. An aerial almost completely screened is but slightly less efficient than a similar unscreened system. In dealing with multiple-wired antennæ it is practically immaterial as to whether the component parts are connected at the lower, upper or both ends. In considering different types of receiving systems, the actual capacity is not so important as is the manner in which this capacity is distributed. Of the types tested, the system consisting of one or more wires normal to the earth's surface is by far the most efficient. Practically all of the energy is propagated through the surface of the earth and not by means of a free ether wave.—*Physical Review,* September.

Telegraphone.—E. HYTTEN.—An illustrated description of the latest commercial form of the Poulsen telegraphone for connections with telephones and for use in combination with the typewriter.—*Elek. Zeit.,* Sept. 5.

Railway Signals.—A. SOULIER.—An illustrated description of the electric signals on the Paris Metropolitan Railway. The Hall automatic block system which has been adopted there comprises two quite different types of installation: First, the track circuit system in which the control of the block apparatus is effected by the train axles short-circuiting the Hall relays, and, second, the pedal system in which the apparatus is controlled by a pedal worked by the wheels of the cars.—Lond. *Electrician,* Aug. 30.

Electricity, Gas and Telephones.—Abstracts of the report of the engineer to the City of London Corporation. He states that there has been a saving of $2450 in the cost of street lighting in the three areas where gas has displaced electric lighting. Mention is again made of the great inconvenience caused by the laying of telephone and electric lighting service wires, and the frequent and long-continued opening of the street boxes. In addition to laying 320 new service wires, the telephone manholes were opened on nearly 2000 occasions, exclusive of mere inspection. Overhead wires in the city continue to increase, there being now 731,500 spans crossing public thoroughfares, compared with 699,300 spans in 1906, and 260,000 spans in 1890.—Lond. *Elec. Eng'ing,* Aug. 29.

Concrete Poles.

The patents granted to Mr. William M. Bailey, of Richmond, Ind., on reinforced concrete poles have been assigned to The American Concrete Pole Company of Richmond, Ind., which will construct concrete poles under contract, and also sell the right to construct to other companies and users on a small royalty basis or sell the right of certain territory.

This type of concrete pole employs a reinforcement of twisted rods and spiral binding wires distributed in the column of cement and it is claimed that poles thus made are not only substantial and durable, but also possess remarkable elasticity. For instance, a pole 30 ft. in length will permit a deflection of 30 ins. before the cement cracks, corresponding to a horizontal strain at the top one-third greater than would be sufficient to destroy a cedar pole of the same dimensions. It is also claimed that cracking of the cement does not impair the strength of the pole, for after this takes place the reinforcement takes the entire strain, and the special rods will withstand a breaking strain of 50,000 lbs. per sq. in.

As will be seen by the accompanying illustrations, the poles [illegible] thus making the top of the pole octagonal in shape. This not only gives a handsome appearance but leaves corners without a sharp edge that would be liable to chip off.

[illegible] of an inch of the surface of the cement at the corners and then bound together by a spiral wire encircling the rods from top to bottom. This not only serves to tie the rods together but prevents danger of the cement shearing off, as the rods have a tendency outwards when the pole is subject to a lateral strain. Another important function performed by the spiral binding wire is that it ties the concrete together and increases the flexibility of the entire body.

The smaller poles, up to and including 35 ft. in length, are molded lying on the ground, and after they have been seasoned are set in place by means of a gin pole. The forms are laid with the butt near the hole and the reinforcement placed. Then the concrete is poured in and allowed to remain from three to seven days, according to the weather. The forms are then removed, so that they can be used again and the pole is left to season, which process requires about three or four weeks; the poles are then ready to be set and used. All poles

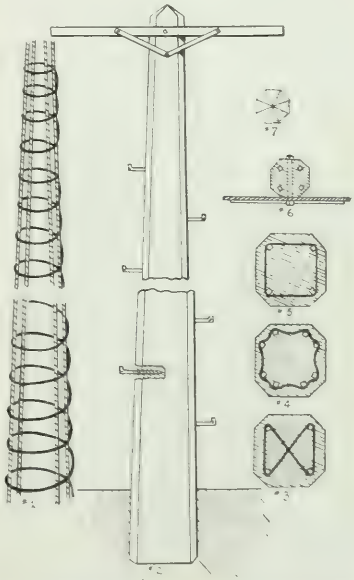


FIG. 1.—DETAILS OF CONCRETE POLE CONSTRUCTION.

should be built on the ground upright in the hole or in position to be set up, thus saving the cost of hauling or unnecessary handling, as this would increase the cost.

Poles 40 ft. in length and larger should be built standing as this is the most economical method. First, the hole is dug and then the form is set in place directly over it, and lined up straight and perpendicular, being temporarily guyed to hold it in position. The spiral binding wires are then put in place and the rods drawn up on the inside of the form and set. After the reinforcement has been properly secured, the side of the form that has been left out to receive the steel work is put in place and the bands or ties around the outside secured. The equipment is then ready to receive the concrete.

There are several methods of placing the concrete. One is by using a large bucket with pulleys and a horse. With this method, a 50-ft. pole can be filled in about two hours, including the mixing of the concrete. But the most economical plan is to have a wagon equipped for the purpose with a gasoline engine concrete mixer and grain elevator. With this equipment the material can be placed as rapidly as it can be mixed. The American Concrete Pole Company is now building wagons for the handling of concrete and concrete poles.

It is claimed that every pole is a lightning rod and not only protects itself from being shattered by lightning, but is a safe

[illegible] at each end of the line, as the major portion of the lightning will be conducted to the ground through the steel reinforcement.

Fig. 3 shows a line of concrete poles constructed across Whitewater River, at Richmond, Ind. These poles are from 40 ft. to 60 ft. in length and were built in a perpendicular position. Fig. 2 shows a pole in detail two years old which has been subject to all kinds of strain. In Fig. 1 are given details of pole construction and reinforcement, as follows: No. 1 shows the four steel rods as they are placed in the cement body, with the spiral binding wires pulled in place; 2 shows the shape of cement body as finished; the steps and other bolts and holes

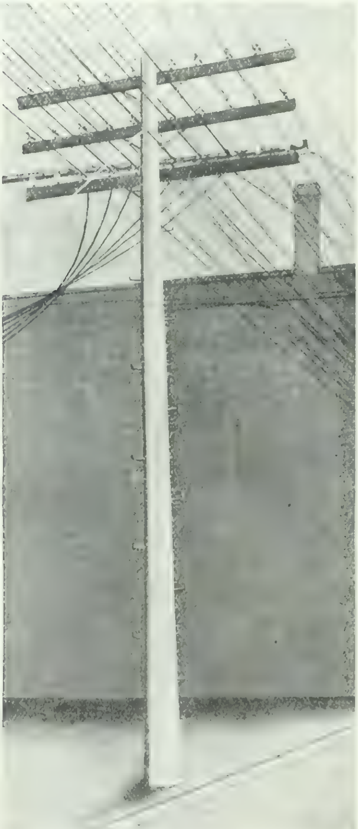


FIG. 2.—CONCRETE POLE.

are very easily made while the concrete is plastic; 3, 4 and 5 show cross-sections of a pole with three different methods of binding and also two different methods of reinforcing; the scheme represented in 4 is intended only for extremely heavy construction; 6 gives detail of the manner of securing cross-arms. A bolt or rod is placed in the form and removed within 24 hours after concrete has been in place; this leaves a clean hole through which the bolt that is intended to hold the cross-arm can be placed and the arm securely bolted on. Seven represents the top or roof of the pole, which is easily put on after the pole is finished, but is not necessary except for appearance.

Mr. Bailey has made applications for patents on forms varying in sections from 5 ft. to 15 ft. each and divided up so as to be easily handled. After the forms are assembled and put in place, the binding wires which have been previously wound [illegible] and placed ready to receive the rods. After the rods have been drawn in, the binding wire is stretched from bottom to top, which gives a tie around the rods about every 4 ins. The rods are then spread and placed back after the forms had been [illegible] the concrete is

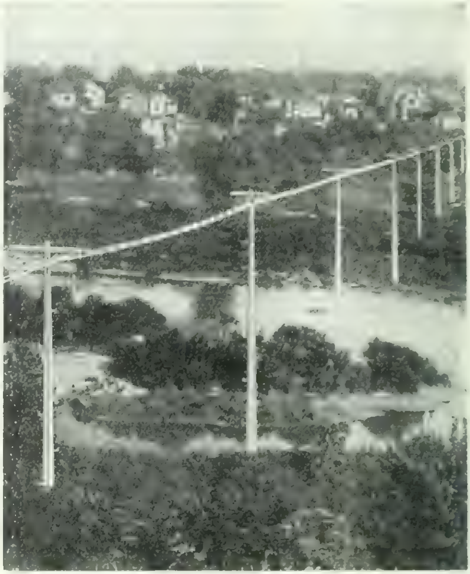


FIG. 3.—LINE OF CONCRETE POLES.

poured in and allowed to harden. After three or four days the forms can be removed and the pole left to be seasoned, and it will be ready for use in about three weeks.

Compact Panel-Board.

The accompanying illustrations indicate a panel-board in which the width has been reduced to the minimum. An appreciable reduction over standard practice has been obtained by raising the outer bus-bars and connecting them by bars to

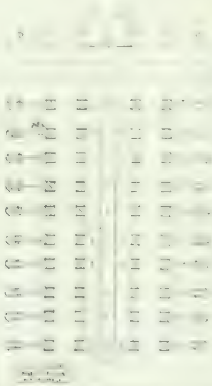


FIG. 1.—PANEL-BOARD.

the positive and negative fuse clips, respectively; the outer bars are separated by only .75 in., which is the limit allowed by the Code. The neutral bus-bar is not elevated. By means of the triangular arrangement of the bus-bars, there is obtained a saving of 4 ins. over the usual linear arrangement. The result is a neat and compact panel. Although the regular type of

three-wire switch-panel now on the market ranges in width from 16 ins. to 18 ins., the panel here illustrated is only 12 ins. wide. The same width is used in two-wire bus-bar panels,

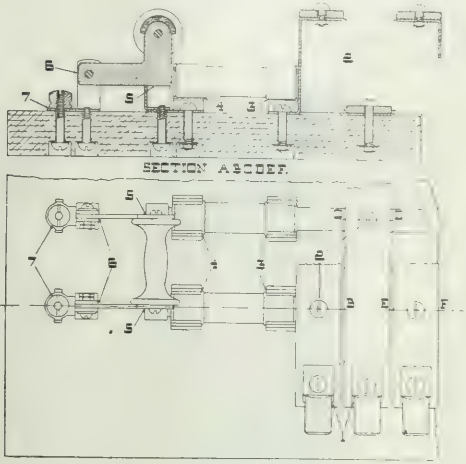


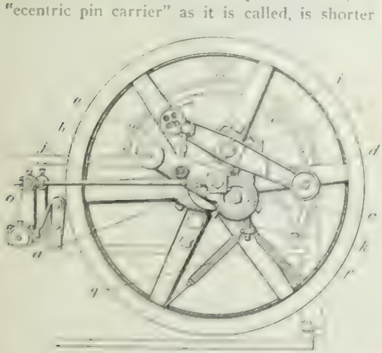
FIG. 2.—DETAILS OF THREE WIRE PANEL.

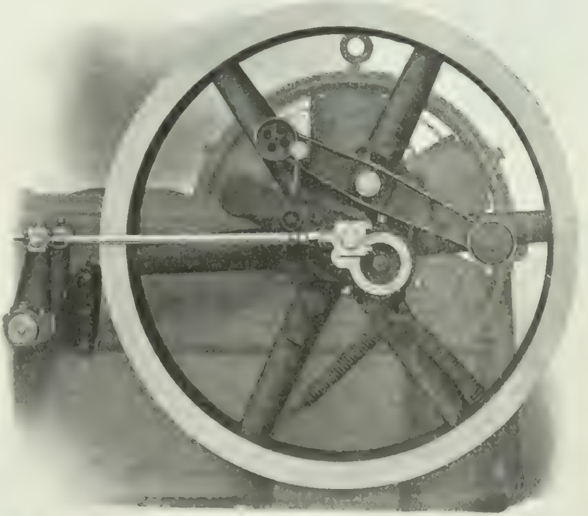
so that the same type and size of cabinet is employed for both two-wire and three-wire panels.

The panels here described have been placed on the market by Spranley & Reed, 61 Baronne Street, New Orleans, La.

A Balanced Automatic Governor.

The engine governor illustrated herewith has been developed as the result of an attempt to produce a governor that operates properly not only on the testing floor, but continuously after being placed in active service. The governor comprises the following parts designated by letters in Fig. 1: *A*, valve actuating stud; *B*, eccentric pin carrier; *C*, eccentric pin carrier bushing; *D*, governor weight; *E*, governor link; *F*, radial spring; *G*, tangential spring; *H*, knife edge; *I*, stop; *J*, ecentric rod, and *k*, governor eye-bolt. It will be noted from Figs. 1 and 2, that the center pivoted mass, or "eccentric pin carrier" as it is called, is shorter





FIGS. 1 AND 3.—AUTOMATIC GOVERNOR.

than in the earlier type of governor. It was found by experimentation that this extra mass could be dispensed with by slightly changing the proportions of the other members. The second apparent change is in the spring arrangement, where two springs, tangentially and radially arranged, are substituted for the single spring.

A two-weight system is employed to secure a governing effect, the rotative pull being the combined effect of angular inertia and centrifugal force, with the complete elimination of gravity forces as affecting in any way the behavior of the system. A centrifugal pull, varying with the speed, is produced by means of the eccentrically pivoted governor or weight arm, and secures gravity balance for the system by linking this outer arm with the concentrically pivoted eccentric pin carrier. The center of gravity of this member is so closely over the center of figure of the shaft that its swing produces practically no centrifugal force whatever, thereby avoiding the oscillations so disturbing in single-arm systems. This arrangement prevents any reciprocating swing, not only in the eccentric pin carrier, but also on the balanced governor or weight, and provides a very favorable condition for delicate action of the governor, which is especially adapted for the difficult regulation of heavily fluctuating loads.

A new feature of the present governor is the peculiar arrangement of the springs. Where a single spring is used the centrifugal force and gravity of the spring disturbs the functional balance of the system. As the wheel revolves more rapidly, the spring, bellying out under the action of the centrifugal force, has its tension increased, so that it over-restrains the weight arm and retards the decrease of travel of the slide valve necessary to prevent undue acceleration on the part of the engine.

By dividing the spring force into two springs acting at right angles to each other, one a tangent spring, the other radial, a resultant spring effect is obtained, acting in direct line with the governor eyebolt and knife edge. This arrangement completely suppresses swinging or pumping, and causes the spring arm and centrifugal arm to shorten together as the engine tends to speed up, maintaining a constant proportion between the two, hence a constant speed. At each stage of a revolution, the errors of swing and tension variation normally incident to one spring, are corrected by the other, maintaining a beautiful balance, which, apart from other advantages, very materially reduces the wear on the tool-steel knife edge.

If in testing the governor, the engine speed is found to fall off too much, the radial spring is made weaker; if the speed increases unduly, the tangential spring is made weaker than the radial spring. Thus, governing elements are secured which cannot get out of adjustment even after long usage, because wear is reduced to a minimum and the system's members are mutually corrective in their opposing tendencies.

Some months ago the American Engine Company, of Bound Brook, N. J., was granted very complete patent protection on the new self-contained governor, with which it now equips all of its engines. Experience and observation have shown that the governor will remain in adjustment for effective functioning for more than 18 months after setting, keeping the speed regulation well within one per cent under severe fluctuations of [illegible].

Fault-Finder for Cable Installations.

In the fault-finder illustrated herewith there is used a variable slide resistor which enables resistance to be obtained in practically infinitesimal steps, and yet it is substantial in construction. By means of the equipment, four methods can be used for locating faults, these faults being either grounds or crosses between the wires. Generally these methods may be used in succession for the same fault, in order to eliminate errors. Instructions for making the many kinds of tests to which the apparatus is adapted are given in simply expressed

FAULT-FINDER.

language and clear diagrams. The directions show that by connecting a telephone and a small buzzer to the posts, the distance from the station to the point where the wire is broken may be ascertained with simplicity and accuracy.

The simplicity of the apparatus, together with the clearness and fullness of the directions for using it, make it adaptable for the immediate use of unschooled persons who work on cables. The fault-finder has recently been placed on the market by the Leeds & Northrup Company, Philadelphia, Pa.

New Portable Relay.

In addition to its well-known line of voltmeters and ammeters for both portable and switchboard work, the American Instrument Company, of Newark, N. J., has recently developed an exceedingly sensitive, yet rugged and reliable portable relay. These instruments are built on the same principle as the regular type of "American" voltmeter having a movable coil mounted in jewel bearings in such a way that it can turn between the poles of a powerful permanent magnet. Instead of the usual pointer, a short platinum contact arm is securely attached to the moving coil. On each side of this contact is mounted an adjustable platinum contact point, so that a local circuit may be closed when [illegible] or the other of its normal position. The instrument may be closely adjusted, so that, within reasonable limits, any desired movement of the contact arm can be provided for. The winding of the moving coil and the controlling spring are adapted to give the best results under special conditions.

At maximum sensitiveness this relay requires .000002 watt to actuate it, this being on .0000002 ampere and .001 volt potential

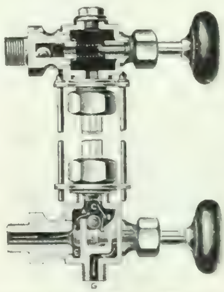
PORTABLE-RELAY.

difference. The resistance of the instrument usually supplied is approximately 500 ohms.

Special machinery has been designed for the manufacture of some of the parts of the instrument, which is suitably mounted in a polished wooden case as shown in the cut.

Automatic Water Gauge.

Herewith is illustrated the "Success" automatic water gauge, made by the Penberthy Injector Company, of Detroit, Mich. In the engraving, E is a double-seated valve to close both the gauge and the blow-off. It will be seen, therefore, that every time the lower handle is turned to blow-off the gauge the automatic device or ball D is moved by the stem on which it rests. In addition to this the stem follows the course of the arrows



[illegible]

B to the outlet G, creating a downward pressure on the ball D and rolling it about in the chamber in which it is located. This great agitation of this ball from three to six times a day prevents it from ever becoming limed up and stuck fast. When the glass breaks, everything is reversed: the steam rushes upward to the break, creating a strong vacuum at the lower end of the glass, when ball D is instantaneously raised to the location marked C, when the flow of steam ceases. The upper ball is forced to its seat by pressure from the boiler. The double seats of the valve E can be ground by simply loosening the stuffing nut on the handle.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—A perceptibly better feeling in trade circles was noted, due to more favorable conditions in various lines. There was improvement in the general financial situation, more favorable weather for crop development, and less strain in the time-money market. Retail trade was hardly as brisk as was expected, because the warm, forcing weather, while helping crops, did not stimulate fall buying to any great extent. Reports as to jobbing trade so far this fall are, in the main, favorable, though the undertone of conservatism is still perceptible, and the feeling is that frequent, rather than large, buying is to be the keynote of the autumn trade. Collections, as a whole, are better. Railroad earnings are good and there are reports of increasing difficulty in obtaining cars to move coal, merchandise and crops. There was a better feeling in the iron trade, more inquiry manifesting itself, but quotations were no firmer for leading products. Iron for steel making was stronger, but basic pig was offered at lower prices in the Pittsburg district. The demand for heavy steel rails was light, and orders for structural material were in fair proportion. Manufacturers of hardware report conditions fairly satisfactory, but orders ahead are not up to those of previous years, although many factories are working on orders for future delivery. The same condition obtains in the manufacture of brass goods and gas fixtures. The outlook, on the whole, is not considered so entirely discouraging as in 1906, although in some instances manufacturers are crowded for delivery and have plenty of work ahead. The principal cause of complaint, however, is difficulty of collection, and this appears to be general throughout the metal trade. Copper was weaker, as low as 15¼ having been quoted for Lake during the week, while 15 to 15⅛ was the price named for electrolytic, with 14¾ to 15 for futures. At the lower levels business became a little more active, chiefly on account of foreign consumers. Not much of a demand is looked for from domestic consumers, it being reckoned that stocks of finished brass and copper goods are heavy. The closing quotations were 15¼ for Lake, 14⅞ for electrolytic and 14⅝ for casting. Copper wire prices have been reduced 4 cents per pound. *Bradstreet's* reports 179 business failures during the week ending Sept. 19, against 172 in the week previous and 171 in the corresponding week of last year.

POWER IN NEW MEXICO.—Mr. A. D. Colman, of Albuquerque, New Mexico, has arrived in New York with the object of financing the Forest Power Company, of Silver City, New Mexico. His New York address is 1608 Amsterdam Avenue. The officers of the company are E. L. Woods, president and general manager; W. S. Cox, vice-president; R. P. Barnes, secretary; J. W. Carter, treasurer. The initial plant to be erected is 1000 hp., and the company already has contracts for 600 hp. It has a contract also for taking over the New Mexico Light, Heat & Power Company. The Forest Power Company is a corporation organized under the laws of the Territory of New Mexico to develop and sell electrical energy for industrial purposes in the towns and mining camps of Grant County, New Mexico. The charter has been secured under the laws of the Territory of New Mexico. The company has secured a site for its camp about sixteen miles in a northerly direction from the town of Silver City and on the Gila Forest Reserve, and has a license from the Government of the United States permitting it to erect its plant, and maintain its rights of way across the public domain. The company is incorporated for $750,000; $300,000 of this stock is preferred 6 per cent cumulative and $450,000 is common stock.

NOBLE ELECTRIC STEEL PROCESS.—It is stated that the Noble Electric Steel Company, 1380 Sutter stret, San Francisco, has been incorporated with a capitalization of $1,000,000, for mining and smelting Shasta County iron ores. It is stated that $150,000 of the stock issued at par value of $10 has been sold. The mines are located at Héroult on-the-Pit in Shasta County, where the feasibility of smelting Shasta County ore sand has been demonstrated to the satisfaction of those interested. The company has now on hand, according to the *Iron Age*, some 25 tons of pig iron, the product of its last run. The mine is being opened up and a surface track from the mine to the furnace, a distance of some 8000 ft., is in course of construction. Plans for an electric plant and for the manufacture of charcoal are well under way. Shipments of material for the completion of the plant are being held up until the Sacramento Valley & Eastern Railroad, now being built, reaches this point, which will probably be early in November. It is hoped that the new furnace will be in operation on a commercial scale in the spring. The officers of the company are as follows: H. H. Noble, president of the Northern California Power Company, president; C. B. Morgan, secretary.

PLANT FOR BLUE RAPIDS, KAN.—It is stated that within a short time incorporation papers will be taken out for the Blue Rapids Power, Light & Ice Company, with Jesse Axtell and Carson A. Axtell as the incorporators. The charter will provide for three lines of business: The installation of an electric power plant to furnish current for electric motors; the operation of an electric light system, and the installation of an ice plant. The promoters intend to put in their power plant just as soon as they can work out the details and secure the necessary machinery. The incorporators own the Anderson power lot with 100 horse-power and have purchased lots carrying an allotment of 275 horse-power with privilege of using the same through any wheel pit on the river. They intend to build their power plant on the Anderson lot, where they already have a foundation, and they will put the generator above high-water mark. They are intending to put in a generator of 200 horse-power capacity to start with. Quite a little power has already been spoken for.

THE HILLES & JONES COMPANY, Wilmington, Del., has taken steps toward the electrification of its entire works, in anticipation of the equipment with electric motors of the new machine shops recently completed. The motors selected as best suited for the purpose are of Allis-Chalmers Company's make and comprise the following machines, all being of the new type "K" for direct current and all shunt wound. A 140-hp motor to operate at 300 r. p. m., three 30-hp machines to operate at 575 r. p. m., two 15-hp motors with a speed of 425 r. p. m., three 10-hp to operate at 475 r. p. m., and one 10-hp for 475-900 r. p. m. When the entire plant is ready for operation the Hilles & Jones Company will have an output of power punches, shears and bending rolls far beyond that obtained from the older plant.

THE JONES & LAUGHLIN STEEL COMPANY is a recent purchaser of additional heavy Allis-Chalmers electrical machines in the shape of two 1000-kw, 6600-volt generators wound for 25 cycles, three-phase, and designed to operate at 94 r. p. m. These units, together with a 600-kw, direct-current generator, 2400-volts and operating at 110 r. p. m., will be installed in the new Aliquippa Works, situated on the Ohio River several miles outside of the city of Pittsbur.g A new 500-kw motor generator set, comprising a synchronous motor rated at 6600 volts, wound for three-phase, 25 cycles, and a 250-volt, direct-current generator is also being added to the structural shop to carry a portion of the steel mill load.

AUGUST FOREIGN TRADE.—The chief of the Bureau of Statistics in the Department of Commerce and Labor reports the foreign merchandise commerce of the United States for August and eight months ending August as follows:

	1907	1906	1905
Imports	[illegible]	[illegible]	[illegible]
Exports	[illegible]	[illegible]	[illegible]
Excess exports	[illegible]	[illegible]	$21,836,957
Eight months ending August:			
Imports	$1,001,803,305	$805,540,383	$770,285,198
Exports	1,196,625,415	1,098,994,662	966,567,559
Excess exports	[illegible]	[illegible]	$196,282,361

PLANT FOR NEW ZEALAND.—No-term tenders will be received by the corporation of Napier, New Zealand, for the installation and working of combined electric light, power, and tramways. Address the Town Clerk.

[illegible] National Conduit & Cable Company says with regard to the present situation: "Wide fluctuations have marked the course of the copper market lately, and the downward tendency of values has induced buyers to wait for settled conditions before placing heavy orders. The world's demand for copper has undergone a large and rapid contraction since Jan. 1, and on that account the market has declined sharply within the past 30 days. From July 1 to Sept 7 electrolytic wire bars have receded from 25¼ to 18 cents, and since the latter date there has been a further loss of 1½ to 2 cents per pound. Prices now quoted are 16½ asked. This reactionary course in prices has been the direct outcome of a heavy falling off in consumption and a high money market, and these factors have exerted their power in all their concentrated force upon the copper market. As a result of present conditions the total buying power for the last six weeks has proved utterly inadequate to sustain the semblance of stability, and prices have come down to the level of those of two years ago. The effect of recent developments and the striking events which have thrust themselves into the foreground are producing their legitimate result in the curtailment of business and the withholding of orders until the copper market gives unmistakable evidence of being on a firm foundation. Consumers of copper naturally have been conservative for some time past, and wisely so, but they will welcome the return to stability again by which they can secure a much bigger volume of business than is possible in the present unsettlement and uncertainty. It is becoming more and more evident that capital must be in more plentiful supply before the industrial interests of the country will be put to work on the extensions and improvements now held in abeyance until the monetary stringency is relieved. The present slowing down in business should have the tendency of diverting capital into other channels where it will be satisfied with more moderate returns on money invested in solid properties rather than in those more hazardous enterprises which dazzle the investor with short-lived earnings of abnormal size. When money is in sufficient supply at fair rates it will be surprising if there is not a big expansion in business all along the line. Improvement in the financial world would no doubt revive activity in electrical circles, where plans have had to lie dormant until the task of financing them successfully could be accomplished. On account of the suspension of much important electrical work, the demand for wire has fallen off greatly, and the copper market cannot expect to reach a permanently strong position before the wire users are ready to place large orders. With the underconsumption of wire and other finished metal goods there has been the simultaneous over-production of copper. The consequence of all this is that there is now a heavy accumulation of copper, which furnishes a strong argument in favor of the exercise of a most judicious conservatism among consumers. It will be necessary to work up the enormous floating supply before the copper situation will be in an absolutely sound condition. Curtailment of output or a shut-down of certain important mines is talked of, and it would seem as if the actual position called for some heroic remedy to prevent further demoralization. The situation will eventually cure itself and we will again see active times in copper, but meanwhile the safest course to pursue is that of the utmost conservatism carried out on a strictly cash basis. It is no time to take rash ventures or run big risks."

SOUTHERN PACIFIC TROLLEYS.—It is announced from San Francisco that the Southern Pacific Railway Company has awarded a $900,000 contract for the erection of a power house at Fruitvale. The power house will be the central station for Oakland, Berkeley, Alameda and Fruitvale lines, and the expenditures for overhead work and for sub-stations will bring the total cost up to $2,000,000. The contracts were let in New York by Mr. A. H. Babcock, electrical engineer for the road. As the Southern Pacific does the largest suburban business of any railroad in the world, the enterprise of electrifying its suburban line south of San Francisco is being watched with great interest. The cars will be run in solid trains with a motor car at each end of the train, the electrical energy being delivered by overhead trolley. Each car will have a seating capacity of 80 persons. It is stated that the necessity for electrification came with the great increase in suburban traffic, which crept up from 1,000,000 to 2,000,000 a month after the San Francisco fire. Three new ferry steamers are being built to accommodate this travel. Since the ferry system was established 300,000,000 pas- [illegible]

WASHINGTON UNION DEPOT.—A special despatch from Washington says: "Plans developed for lighting the new Union passenger station and terminals in Washington, D. C., contemplate the use of 480 500-watt arc lamps, 500 high efficiency lamps and about 3600 16-cp incandescent lamps. To light the pipe and wire tunnels betwen the power plant and the station and express building requires 190 incandescent lamps, or one every 10 ft. To care for the wires used in this great lighting system required the installation of about 88,000 ft. of conduit of various sizes in the station and about 68,000 ft. in the express building, power plant and K street signal tower and about 12,000 ft. in the train sheds. In addition to the lighting conduits, about 20,000 ft. of conduits are required for the telegraph and telephone wires at the station and about 12,000 ft. at the express building, power house and K street signal tower. Owing to the unusual size and height of the ceilings and some of the rooms in the station, special lighting schemes were resorted to. Natural light is provided by the use of semi-circular windows located at about the elevation of the spring line of the ceiling arch."

THE GRAPHIC ARTS COMPANY, Buffalo, N. Y. recently purchased a new Allis-Chalmers 45-kw type "K" generator with a complement of seven 5-hp type "K" direct-current shunt motors built by the same company for operation at a speed of 1050 r. p. m. and two 3-hp type "K" motors for operation at 1025 r. p. m. Five of the 5-hp motors are for belting to presses and the equipment is to be so arranged as to secure a speed range of from 1200 to 1500 impressions per hour. One 5-hp motor belted to a paper cutter, another to a roughing machine, while a 3-hp machine will be mounted on the bronzing machine.

CHILEAN POWER.—United States Consul A. A. Winslow, of Valparaiso, reports that the German Transatlantic Electric Company has a concession to erect a hydraulic electric power and lighting plant on the River Maipo, above Santiago, at an estimated cost of $4,015,000 United States gold, of which about $1,295,040 will be for materials and machinery that must be imported. It is estimated that it will take about five years to complete the undertaking. The company has petitioned the government of Chile for the free entry of their machinery and material for a period of five years.

STANLEY WORKS.—Beckwith & Pike have been awarded the contract for the erection of the new annealing building for the Stanley Electric Manufacturing Company, Pittsfield, Mass. The building, which is to be known as No. 7, will be of brick and steel construction, will be located north of the main shops. It will be 120 ft. by 120 ft., two stories high, and is to cost about $30,000. This will probably be the last building erected by the company this year.

PLANT FOR EGYPT.—Tenders will be received until November 1st by the Egyptian Government for an electric installation for the port of Alexandria, comprising five large and seven small transporters, six 4-ton cranes, thirty-six 2-ton cranes and twenty-five capstans: also cables, accessories, construction and installation of central power station. Address Directeur des Ports et Phares, Alexandria, Egypt.

HILL-WRIGHT ELECTRIC.—Mr. T. Wesley Wright, selling agent of the Hill-Wright Electric Company, of 105-107 Reade street, New York City, states that the company proposes to have an equipment ready by Jan. 1 to turn out 2500 lamps a day. The company will continue its "renewal" business, the new lamp department being a separate feature, but the principal part.

BOSTON EDISON GROWTH.—The Boston Edison Company reports for 1907 in the various cities and districts that it supplies 20,375 customers, as compared with 18,063 in 1906. Outside of Boston in the suburban districts the company has a 16-cp equivalent installed of 155,865 units, as compared with 133,758 last year.

AMERICAN BRIDGE COMPANY.—According to Pittsburg advices, the American Bridge Company in August broke all records for work completed, finishing 59,000 tons of fabricated steel. This is said to be 1500 tons higher than the record of any structural plant in the world.

THE CATTARAUGUS CUTLERY COMPANY, Little Valley, N. Y., has recently purchased extensive new machinery equipment for an addition to the present capacity of its two factories in Little Valley. The new machines comprise Allis-Chalmers engine, generator and motors. The engine is an 18-in. x 42-in. horizontal heavy duty Reliance Corliss engine [illegible]

cycles, three-phase, current 440 volt. The motor equipment includes three 40-hp Allis-Chalmers standard induction motors designed for a speed of 850 r. p. m., a 30-hp motor for the same speed, and three 5-hp machines for 1130 r. p. m. each.

ALLIS-CHALMERS COMPANY has been doing an enormous business the past year, and its inventory of work and tools and material passing through the shops has increased in proportion, so that like other great industrial concerns it has had to have more capital for handling its orders. The last four months in particular have seen an extraordinary expansion of production and contracts. The financial aid necessary has been freely forthcoming, chiefly, it is understood, from the influential steel interests prominent in the concern, and to cope better with the production necessities, a change is being made in the executive personnel, so as to secure the undivided attention of a first-class man. This ability has been secured in the selection of Mr. W. B. Kelley, the energetic president of the American Steel Foundry Company, who is to become chairman of the executive committee, and who will move to Milwaukee in order to deal with the problems right on the spot. Judge Gary will remain chairman of the finance committee, and with Mr. E. D. Adams will continue a director of the company. These gentlemen, have thus reinforced their own consummate financial and business ability with that of a man whose reputation has already been made in kindred fields, and whose own career is a pledge of high efficiency and success. It is predicted that in a very short time Mr. Kelley will have made a mark in his new chairmanship and put this great industrial organization where it belongs by reason of its history, its resources and its command of a vast field of consumption.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was more or less irregularity in the movement of stock prices, yet the tendency, so far as the prominent railroad issues were concerned, was in the direction of improvement. The chief feature of the week was the activity of the Hill stocks under the lead of Northern Pacific. Reading also developed strength on the publication of the favorable annual report. The publication of Chairman Gary's conservative, though reassuring, interview regarding steel trade conditions and the position of the United States Steel Corporation was followed by a moderate recovery in the steel issues.

NEW YORK.

	Sept. 17	Sept. 24		Sept. 17	Sept. 24
Allis-Chalmers Co.	[illegible]	8¾	General Electric	123	[illegible]
Allis-Chalmers Co. pfd.	18	[illegible]	Hudson River Tel	—	—
Am. Dist. Tel.	—	[illegible]	Interborough Met. com.	9	9
American Locomotive	[illegible]	[illegible]	Interborough Met. pfd.	[illegible]	25
Amer. Locomotive pfd.	[illegible]	[illegible]	Mackay Cos.	63	63⅜
American Tel. & Cable	75	[illegible]	Mackay Cos. pfd.	[illegible]	[illegible]
American Tel. & Tel.	[illegible]	[illegible]	Marconi Tel.	—	—
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	[illegible]	—
Electric Boat	33	—	N. Y. & N. J. Tel.	—	—
Electric Boat pfd.	[illegible]	—	Western Union Tel.	[illegible]	[illegible]
Electric Vehicle	—	—	Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd.	—	—	Westinghouse pfd.	—	[illegible]

BOSTON.

	Sept. 17	Sept. 24		Sept. 17	Sept. 24
American Tel. & Tel.	[illegible]	[illegible]	Mass. Elec. Ry. pfd.	[illegible]	[illegible]
Cumberland Telephone	[illegible]		Mexican Telephone	[illegible]	—
Edison Elec. Illum.	—	—	New England Telep.	[illegible]	—
General Electric	—	—	Western Tel. & Tel.	[illegible]	[illegible]
Mass. Elec. Ry.	13	—	West. Tel. & Tel. pfd.	[illegible]	[illegible]

PHILADELPHIA.

	Sept. 17	Sept. 24		Sept. 17	Sept. 24
American Railways	[illegible]	[illegible]	Phila. Electric	[illegible]	[illegible]
Elec. Co. of America	[illegible]	[illegible]	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery	[illegible]	[illegible]	Phila. Traction	[illegible]	[illegible]
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Sept. 17	Sept. 24		Sept. 17	Sept. 24
Chicago City Ry.	—	[illegible]	National Carbon	[illegible]	[illegible]
Chicago Edison	—	[illegible]	National Carbon pfd.	[illegible]	[illegible]
Chicago Subway	—	18¾	Union Traction	[illegible]	[illegible]
Chicago Tel. Co.	—	—	Union Traction pfd	[illegible]	[illegible]
Metropolitan Elec. com.	—	[illegible]			

[illegible]

[illegible] continued weak, [illegible] selling down to 28 and rallying to 62, after which it continued to be very variable, which was also true of Anaconda, American Smelting and others of the same class. The traction securities were comparatively neglected, and the [illegible] simply followed the course of the leaders without developing any special activity. General Electric closed at the highest point of the week, 128, which is a net gain of [illegible] points, and Allis-Chalmers, both common and preferred, also closed at a fractional [illegible]. On the curb market Allis-Chalmers bonds and Steel Foundry bonds were dull and weak. Copper stocks were inactive, with little change in prices. New York City [illegible] per cent bonds advanced steadily and attained new highest records, and noteworthy gains were made by several important industrials. The closing quotations of Sept. 24 are given in the accompanying table.

DIVIDENDS.—The Memphis Street Railway Company has declared its regular quarterly dividend of 1¾ per cent on the preferred stock. The Knoxville, Tenn., Railway & Light Company has declared its regular quartely dividend of 1½ per cent on the preferred and 1 per cent on the common, payable Sept. 30. The Hudson River Telephone Company has declared its regular quarterly dividend of 1 per cent, payable Oct. 15. The directors of the Duluth Edison Electric Company have declared the regular quarterly dividend of 1½ per cent on its preferred stock, payable Oct. 1. The Chicago Telephone Company has declared its regular quarterly dividend of 2½ per cent, payable Sept. 30. The United Railways Company of St. Louis have declared the regular quarterly dividend of 1¼ per cent on the preferred, payable Oct. 10. The American Cities Railway & Light Company have declared a quarterly dividend of 1½ per cent on the preferred, payable Oct. 1. The Havana Electric Railway Company has declared the regular quarterly dividend of 1½ per cent on the preferred stock payable Oct. 15. The Tri-City Railway & Light Company has declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Oct. 1. The Aurora, Chicago & Elgin Railway has declared its regular quarterly dividend of 1¼ per cent on the preferred stock and the first dividend of ¾ per cent on the common. The Bell Telephone Company of Philadelphia has declared a regular quarterly dividend of 1½ per cent, payable Oct. 15. The American Telephone & Telegraph Company has declared its regular quarterly dividend of $2 per share, payable Oct. 15. The International Nickel Company has declared a dividend of 1½ per cent, payable Oct. 10.

GENERAL ELECTRIC BUSINESS.—Advices from Boston financial circles say as to electrical manufacturing: "So far as the General Electric Company is concerned the facts are these: There has been a little let-up in the volume of new orders coming in, but this decrease is nowhere nearly so great as is generally supposed and has so far been chiefly confined to railway apparatus such as motors, controllers, etc. From Jan. 31 to Sept. 14 the gross orders of the General Electric Company were $5,700,000 in excess of the corresponding period of 1906. Up to the middle of June gross business showed a gain of $5,200,000 over the same period of last year. In the last two months, therefore, gross earnings have not only held their own with the same months of 1906, but show an actual gain of $500,000. It will be noted, however, that the increase is only 10 per cent of what it was the first four and one-half months of the fiscal year, which began Feb. 1. This is the real gist of the let-up in business. Gross orders have to date not shown a dropping off as compared with last year, but they have failed to show the same ratio of increase that was recorded in the first four or five months of the current fiscal year. The General Electric Company has from time to time let some of its employees go. At present there are upwards of 25,000 employees carried on its books. This is a decrease of about 3000 from the 28,000 employees which the company was employing at the close of the last fiscal year."

NEW YORK CITY RAILWAY RECEIVERS.—In course with anticipated action, and by means of a petition alleging the insolvency of the New York City Railway and a confession of the charge on the part of that company, the surface lines in Manhattan comprising the Metropolitan Street Railway system, went into the hands of receivers this week. The application was made before Judge Lacombe, in the United States Circuit Court, Sept. 24, by the Pennsylvania Steel Company and the Degnon Contracting Company, creditors, and was in the form of a bill in equity, asking that the court take charge of the affairs of the New York City Railway and by the appointment of receivers provide for the liquidation of the company's indebtedness without its corporate disintegration. It was a "friendly" application, with Paul D. Cravath and De Lancy Nicoll of counsel for the traction interests, and James Byrne of the petitioners' counsel present and in entire harmony. Adrian H. Joline and Douglas Robinson, were appointed receivers, and they immediately qualified in the sum of $250,000 each, the bonds being furnished by the National Surety Company.

TOLEDO [illegible].—Application has been made to list on the New York Stock Exchange $1,875,000 additional capital stock of the Toledo, Ohio, Railways & Light Company

BELL TELEPHONE GROWTH.—At the regular monthly meeting of the directors of the American Telephone & Telegraph Company the following statement of net earnings for the nine months to end September 30 was read:

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

The figures for the nine months this year are partly estimated, but they have been conservatively figured and will probably exceed the balance for dividends of $10,960,000, shown above. On the basis of the present amount of stock outstanding these net earnings compare as follows:

	[illegible]	[illegible]
Balance for dividends	$10,960,000	$9,575,000
Capital stock outstanding	142,514,000	131,551,400
[illegible] on stock	[illegible]	[illegible]

In June the company offered to stockholders $21,925,200 new stock at par, half of which was payable on July 25 and the balance Oct. 25. The present outstanding stock, without making allowance for the few slight payments in full, which were made on July 25, may be figured at $142,514,000. To base share earnings on this capitalization is a little less than strictly just to the company, inasmuch as net earnnigs for seven out of the nine months were actually made on the capital stock outstanding Dec. 31 last. It is figured that when the company has received the full benefit of the recent abolition of night-rate long-distance calls there will be realized an addition of nearly $500,000 yearly to net earnings. It would not be at all surprising if final net earnings for dividends this year came close to $15,000,000.

PACIFIC GAS AND ELECTRIC.—The assessment of $10 a share on the stock of the Pacific Gas & Electric Company of San Francisco, which became delinquent on Aug. 31, has resulted in an unusual transaction in the securities of that company. The entire issue of common stock, amounting to $20,000,000, has been turned back into the treasury of the company, while the assessment on the preferred stock has been paid in full in cash, amounting to a total increase in the resources of the company of $1,000,000. The issue of $20,000,000 of the common stock had been held by the banking firm of N. W. Halsey & Company. The entire transaction was completed on Aug. 31, at which time $1,000,000 in cash was paid in by the shareholders of the preferred stock, of which John Martin and Eugene de Sabla are large owners. This fund will be used to pay for restoration work and extensions of the service made necessary in the last sixteen months. Instead of paying the assessment on the common stock the holders turned it back to the company, thus adding, it is claimed, more to the ultimate resources and financial soundness of the corporation than if the assessment had been paid, and the stock disposed of in the Eastern markets, as was the original intention. It remains a matter of curiosity in San Francisco financial circles to see what the corporation will do with the common, which is now virtually treasury stock. There have been persistent rumors of a purchase of a controlling interest in the Pacific Gas & Electric by the Goulds in connection with the electric power plans of the Western Pacific, and it is rumored that the Western Power Company may purchase the stock which has been returned to the treasury.

MASSACHUSETTS ELECTRIC.—Note is made in Boston of the fact that all through the depression of the local market there has been persistent buying of Massachusetts Electric common stock at $12.50 per share by several houses, and private bids for good-sized blocks of the stock are reported. In some quarters it is thought possible that the New Haven Railroad, appreciating that the management of the Massachusetts Electric Companies has expended $13,000,000 in placing the properties in excellent condition, is endeavoring to add them to its present extensive trolley system. The 900 miles of street railway of the Massachusetts Electric system (90 per cent of which has within the past few years been reconstructed) would prove a valuable addition, especially at the present market value, for the stocks are selling for about one-half their cost. There are now slightly in excess of 190,000 shares of subsidiary company stocks in the treasury of the Massachusetts Electric Companies, and these stocks will all show divisible earnings this year of about 5 per cent. The Boston & Northern will probably declare a 5 per cent dividend, while the Old Colony Company will declare a dividend of 4 per cent, as against 2 per cent last year. These declarations will give the Massachusetts Electric Companies an additional $800,000 for its treasury. The Massachusetts Electric preferred stock will not receive any cash dividend disbursement this fall, but when the bond market improves sufficiently to permit the sale of some underlying bonds it is planned to take steps to pay off the accumulated dividends, which amount to 14 per cent up to Jan. 1, probably in stock.

BELL TELEPHONE CONSOLIDATION.—From Washington come advices of the consolidation of the Bell Telephone Company of Philadelphia, the Pennsylvania Telephone Company and the Chesapeake & Potomac Telephone Company, all licensees of the American Bell Telephone Company, operating in Southern New Jersey, Eastern Pennsylvania, Delaware, Maryland, the District of Columbia, Northern Virginia and West Virginia. The companies involved operate more than 300,000 telephones. The purpose of the consolidation is greater economy and efficiency in administration and operation and greater facility in financing future extensions and enlargements. The authorized capital stock of the new company will be $60,000,000, which is less than the combined capital and outstanding indebtedness of the old companies. The capital stock provided for is sufficient, it is stated, to retire all of the old stock, discharge the floating indebtedness of all the companies and provide for several years' growth. The shareholders of the Philadelphia and Pennsylvania companies will receive an equal amount of the new stock for the stock surrendered, while the shareholders of the Chesapeake & Potomac Company will receive two shares of the new stock for three shares of the old stock. Mr. U. N. Bethell has for some time past been the inspiring and controlling spirit of this vast organization.

WESTINGHOUSE NOTES.—The Westinghouse Electric & Manufacturing Company has sold an issue of 20,000,000 francs in collateral trust notes in Paris. Application was made last week to list the notes, which run five years and bear interest at the rate of 5 per cent, on the Pittsburg Stock Exchange. An official of the Westinghouse Electric & Manufacturing Company, in explanation of the transaction, said it related to the business of the Société Electrique Westinghouse de Russie, organized for the purpose of executing a contract of over $5,000,000 with the municipal authorities for the St. Petersburg tramways. It is also for the purchase of electrical works in Moscow for the manufacture of machinery needed in the execution of the contract. These securities are to be offered by the Société Générale for subscription in France and other European countries, but not in America. The listing of the securities at Pittsburg is one of the formalities necessary in connection with the listing of the notes on the Paris Bourse. The sale of the entire issue provides the working capital for the business of the Russian Westinghouse Electric Company and 7,000,000 francs additional working capital for the French Westinghouse Company.

LAKE SUPERIOR CORPORATION.—The directors of the Lake Superior Corporation, the successors of the Consolidated Lake Superior Corporation, which three years ago passed through many financial vicissitudes, have decided not to make any payment this year on the $3,000,000 issue of income 5 per cent bonds, which were put out at the time of the reorganization of the old company. This decision was not the result of earnings, for these have been good, but was due to the desire to use all of the company's funds in its business. Earnings this year are nearly, if not altogether, as large as those of last year. At the same time, as the company is borrowing money for the conduct of its business, the directors thought it to the best interests of the stockholders, as well as of the income bondholders, not to make any distribution at this time. The company was handicapped during the year by the destruction by fire of its pumping station and by the necessity of blowing out two of its furnaces for the purpose of relining them. The loss by fire was fully covered by insurance, but the destruction of the pumping station nevertheless served to reduce the company's earnings.

OHIO TRACTION & LIGHT.—The Northern Ohio Traction & Light Company has issued a circular to stockholders offering them the right to subscribe for $1,000,000 treasury stock at $20 a share, payable 25 per cent on each Sept. 20, Oct. 20, Nov. 20, and Dec. 20, the proceeds to be used for improvements. An underwriting syndicate has been formed to take whatever part of the issue may be left after the stockholders' subscription.

CHICAGO EDISON MERGER.—At a meeting on Sept. 16 the Chicago Edison stockholders voted unanimously for consolidation with the Commonwealth Electric Company. Edison stockholders receive $160 in new stock for each $100 of present holdings and 60 per cent additional in trust certificates for capital stock of the Commonwealth Edison Company.

GENERAL NEWS

Construction News.

BRUNDIDGE, ALA.—This city will soon have a complete and up-to-date electric light plant and water works system. The electric plant has been completed and was put into operation for the first time Sept. 9. The two plants cost the city about $20,000.

HUNTSVILLE, ALA.—Francis N. Lawton, general manager of the Huntsville Railway, Light & Power Company, has announced that plans have been drawn for doubling the capacity of the power house and for extension of the street railway system.

ASHDOWN, ARK.—T. C. Ambrey, of Verda, La., is reported interested in the construction of a lighting plant.

DUNSMUIR, CAL.—The Southern Pacific Railway Company is preparing to install an electric light power plant to operate its shops at Dunsmuir. The work will consist of the construction of a dam, pipe line and the installation of water wheel and generators. No power house will be erected as the generators will be placed in the railway shops. The plant will have a capacity of 300 horse-power and will cost about $20,000.

LIVERMORE, CAL.—The Stanislaus Electric Company will soon commence the construction of its transmission line through this valley.

LOS ANGELES, CAL.—Plans have been made by the Los Angeles Railway for the immediate construction of several extensions of its lines in Los Angeles.

REDLANDS, CAL.—The stockholders of the Southwestern Home Telephone Company have authorized the creation of a bonded indebtedness of $1,000,000. Of this, $100,000 is to be used to pay floating indebtedness of the company, and the remainder to be used for further extension and improvements.

SAN BERNARDINO, CAL.—F. A. Worthley, of Riverside, has purchased the controlling interest of the Lytle Creek Power Company of this city. It is said that extensions are to be inaugurated at once.

SONORA, CAL.—Preliminary surveys are being made east of Bridgeport for the site of the power plant to be erected by the California-Nevada Electric Power Company, and also for the Nevada Mines Company, which will supply the Tonapah and Goldfield country with electricity for light and power.

STOCKTON, CAL.—The new steam plant of the American River Electric Company on Banner Island, in this city, is nearly completed and will soon be put into operation. The plant has a capacity of 3000 horse-power and will be used in connection with the company's large plant on the American River.

STOCKTON, CAL.—The plant of the Standard Electric Company at Electra was badly damaged recently by a bucket breaking loose from one of the large water wheels. The foundation of part of the building and a large generator were destroyed. Only part of the plant can be operated, and it has been necessary for the company to place its auxiliary steam plant in the city in operation. It is estimated that the loss will be more than $250,000.

YREKA, CAL.—The Gold Ball Mining Company has commenced work on the construction of its transmission line, which will furnish electricity for both the Gold Ball and King Solomon mines, also to other mines in this vicinity. The company has purchased the large ditch and flume formerly owned by the Salmon River Hydraulic Mining Company.

DILLON, COL.—The Summit Power Company has placed contracts for [illegible] worth of machinery and supplies, is laying pipe lines, and will soon commence the construction of a power plant in Dillon. The company contemplates an expenditure of $1,000,000 or more in Summit County.

LAS ANIMAS, COL.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Nov. [illegible] for the construction of a power plant, building and machinery at U. S. Naval Hospital, New Fort Lyon, Col. Plans and specifications may be obtained at the bureau or from the medical officer in command of the hospital, Las Animas. Col. William M. Smith is acting chief of bureau.

MONTEZUMA, COL.—The Montezuma Mines Development Company has secured water rights on the Snake River and proposes in the spring to construct a power plant to furnish electricity for lighting and power for the mines in the district.

DANIELSON, CONN.—The New York, New Haven & Hartford Railroad Company has appropriated $[illegible] for improvements to the Dyer Dam electric plant about [illegible] of the village. It is proposed to take out the two 400-kw generators now in the plant and install new [illegible] of more modern type and to change the type of the motor power machines.

TERRYVILLE, CONN.—McCabe & Behler, the contractors who are excavating the tunnel through the mountain for the railroad, have decided to erect an electric light plant in order to complete the underground work. The plant will provide for at least 200 lamps of 32 cp.

WILMINGTON, DEL.—Plans are being made by the Philadelphia, Baltimore & Washington Railroad Company to install a new electric lighting system in the office building and the new elevated station. The company proposes to transmit electricity for the system from its shops at Todd's Cut. The present capacity of the plant consists of three dynamos of 200 kw. Another machine has been ordered and will be installed to provide for future needs. The Wilmington City Electric Company now supplies the railway company with electricity. George Woodward has charge of the work.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct. 1, to furnish at the navy yards and naval stations the following supplies: Boston, Mass., schedule 318—damp-proof wire, interior fittings, switches, steel enamel conduit fittings; schedule 319—copper rivets, copper wire, etc.; schedule 321—sheet brass, copper, rolled bronze; schedule 323—copper pipe, etc. New York, N. Y., schedule 291—engine lathes, boring mill, boring, drilling and milling machines; schedule 314—carbons, incandescent and arc lamps, electric wire, dry batteries, electrical supplies, etc. Naval Academy, Annapolis, Md., schedule 317—insulating tape, bells and buzzers, plugs, signal and deck lanterns, etc., glass tube fuses, switch handles, link fuses. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster General, U. S. N.

PUNTA GORDA, FLA.—The citizens have voted to issue bonds for an electric lighting plant. The bonds have not yet been issued.

ASHBURN, GA.—An election will be called soon to vote on the proposition to issue $55,000 in bonds, of which $45,000 is to be used for the construction of an electric light plant and water works system.

MILLEN, GA.—The citizens have voted in favor of issuing $30,000 in bonds for the installation of an electric lighting system and water works.

WRIGHTSVILLE, GA.—The citizens have voted to issue $10,000 in bonds to enlarge the municipal electric lighting plant.

BOISE, IDAHO.—The Boise & Interurban Railway Company has decided to construct a street railway line in Caldwell and to extend its present line from that city to the Canyon County fair grounds, which are located about a mile distant.

IDAHO FALLS, IDAHO.—The plant of the Idaho Power & Transmission Company has been completed and is now in operation. The company is negotiating with the city of Idaho Falls to furnish electricity for the municipal lighting system and for pumping, which will require about 200 horse-power. A transmission line is now under construction in the valley reaching the towns of Ammon, Lincoln, Iona, Elva and Rigby and possibly Rexburg. The line to Rigby will be 24 miles in length. The company is contemplating installing another unit of about 500 kw, to be completed by the latter part of the year.

CHERRY VALLEY, ILL.—W. H. Poulton and W. W. Mockey have purchased the Cherry Valley mills and electric plant. The new owners contemplate making improvements to the plant and installing new machinery.

CHICAGO, ILL.—Oscar Heineman, silk manufacturer, will erect a three-story building at a cost of $135,000. The machinery will be driven by electricity.

CHICAGO, ILL.—Certificates of consolidation of the Chicago Edison Company and the Commonwealth Electric Company have been filed. The consolidated company will be known as the Commonwealth Edison Company. The board of directors consists of nine members as follows: Henry A. Blair, Edward L. Brewster, Joseph Leiter, Robert T. Lincoln, John J. Mitchell, Erskine M. Phelps, Lambert Tree, A. A. Sprague and Samuel Insull. The capital stock of the company is $30,000,000.

CRESTON, ILL.—The capital stock of the County Mutual Telephone Company has been increased from $2,500 to $6,000.

JACKSONVILLE, ILL.—Plans are being considered for the construction of an electric lighting plant in this place.

KINGSTON, ILL.—Frank W. Plane, of Belvidere, manager of the Boone County Rural Telephone Company, has been granted a franchise by the village board to extend the telephone system from Belvidere to Kingston.

ROCK GROVE, ILL.—The capital stock of the Rock Grove Farmers' Mutual Telephone Company has been increased from $1,200 to $6,000.

CRAWFORDSVILLE, IND.—The Commissioners of Montgomery County have granted a franchise to the Chicago & Western Indiana Traction Company to construct and operate an electric railway through the county.

GOSHEN, IND.—The Bonita Furniture Company, of this city, has started its new addition, [illegible] feet, two stories high, entirely equipped with electric motors. The motors were installed by the Hawks Electric Company. The new factory [illegible] will also be equipped [illegible] electric machinery.

HUNTINGTON, IND.—The Huntington Light & Fuel Company has notified its patrons of a reduction in the minimum rate of $[illegible] cents a month. The present rate is [illegible] cents per kw-hour.

[illegible] pany, of Terre Haute, to establish a large electric power plant near [illegible] section. A company will soon be formed with a capital stock of $1,000,000. The company has acquired the property of the People's Light & Heat Company, which includes a franchise covering the whole city, [illegible]

[illegible] Company has awarded the contract for the construction of its extension from this city to Patoka, a distance of four and one-half miles, to Jones Brothers, of Columbus.

WATERLOO, IND.—The Home Telephone Company is said to be making preparations to construct and equip a new and modern exchange and to extend its lines to Fort Wayne and other points. The company was recently reorganized.

TAHLEQUAH, I. T.—The telephone exchange of the Pioneer Telephone & Telegraph Company is reported to have been destroyed by fire [illegible]

DECORAH, IA.—The Standard Telephone Company is planning to rebuild the local telephone exchange.

FORT MADISON, IA.—The Fort Madison Street Railway has been [illegible] to the Mississippi Valley Electric Company, projectors of the Madison, Nauvoo & Carthage Interurban line, now under construction.

NEWTON, IA.—Extensive improvements and additions will be made to the municipal electric light plant and new machinery and equipment will be installed as follows: One 560-hp Murray boiler, Murray engine [illegible] kw. Westinghouse generator and a [illegible] switchboard. A. C. Gates is superintendent.

OSAGE, IA.—The Osage Electric Light & Power Company has applied for a license, which will permit it to raise the dam across the Cedar River about 24 inches. The company states that the present dam will not supply sufficient power to operate the present heating system of the company.

WATERLOO, IA.—The directors of the Corn Belt Telephone Company have decided to increase the capital stock of the company from $300,000 to $500,000 to provide for the great increase in business.

JACKSON, KY.—Repairs to the local electric light plant have been completed and will soon be put in operation, after lying idle for three years. The plant has been purchased by a new company.

LOUISVILLE, KY.—Bids will be received until Sept. 27 by the Board of Public Works for a new power plant and steam heating apparatus in the City Hall annex and old engine house and for remodeling apparatus in the old City Hall.

MIDDLEBORO, KY.—Judge Moss, of the Circuit Court, has appointed Henry Steele as receiver for the East Tennessee Telephone Company in Bell County.

MIDDLESBORO, KY.—C. W. Chandler, of London, has purchased the telephone franchise, which was sold at public auction Sept. 7 for $650. Mr. Chandler and associates operate telephone systems in London and Pineville.

PADUCAH, KY.—The Southern Construction Company has awarded a contract to the American Engineering Company, of Indianapolis, to survey a route for the interurban railway projected from Hickman to Paducah. Two routes have already been surveyed and rights of way have been secured.

WHITECASTLE, LA.—The City Council is considering a proposition submitted by Alphonso Kahn to furnish electricity for lighting the city. Dr. E. A. Pierce is Mayor.

PORTLAND, ME.—F. E. Ebersole has been appointed receiver for the Northeastern Telephone Company by Justice Peabody of the Supreme Court. A bill in equity was filed by the Portland Trust Company, declaring that the company had defaulted interest on its bonds and asked that a receiver be appointed.

BERLIN, MD.—Orlando Harrison, Mayor, writes that the City Council has decided to extend the time for granting of the franchise for water works and electric light plant from Sept. 20 to Oct. 31, with the prospect of placing an ice plant in connection with same.

FOREST GLEN, MD.—The Forest Glen Land Company is contemplating the construction of a central lighting and heating plant in this town. B. Wood Burch, Equitable Building, Baltimore, is president of the company.

AMESBURY, MASS.—It is reported that the Hamilton Woolen Company has awarded a contract to the M. B. Foster Electric Company, of Boston, for the installation of an electric lighting plant at an estimated [illegible]

AMHERST, MASS.—The water privileges of the "Bobbin Hollow" [illegible]

[illegible] plant. Work will soon commence on the construction of the power house.

BERRIEN SPRINGS, MICH.—The citizens have voted in favor of [illegible]

GRAND RAPIDS, MICH.—[illegible] increased its capital stock from $3,000,000 to $3,500,000.

STANDISH, MICH.—The electric light plant of the Citizens' Manufacturing Company was recently destroyed by fire.

COLLINS, MISS.—An election will soon be held to vote on the proposition to issue $5,000 in bonds to extend the electric light and water plant.

COLUMBIA, MISS.—[illegible] franchise to Grayson & Elder, of Biloxi, to erect and maintain an electric light plant in Columbia. It is agreed to have the plant in operation within eight months and to install a 20-ton ice plant.

FOREST, MISS.—The Forest Ginning & Manufacturing Company is planning to install an electric lighting plant to furnish electricity for lighting the town. E. Cahn, of Meridian, is interested in the project.

OXFORD, MISS.—The trustees of the University of Mississippi have decided to rebuild the power house and electric light plant, which was recently destroyed by fire.

MEADVILLE, MO.—J. D. Dunn, of Meadville, writes that nothing definite has yet been done toward the construction of an electric light plant.

ST. JAMES, MO.—Plans are being made for the erection of a new power house at the Soldiers' Home to take the place of the one recently destroyed by fire. The State Legislature has appropriated $10,000 for the erection of a new plant. The old plant was insured for $2,800, which will give $12,800 with which to erect the new plant. Captain H. E. Warren is president of the executive board.

FREMONT, NEB.—J. W. Andrews, city engineer, writes that bids will be received on Sept. 30 for the construction of building and smokestack for the municipal light and water works plant. Contracts for engines, boilers and dynamos have been let.

RENO, NEV.—The construction of a 42,000-hp plant to supply the cities of Nevada, also Marysville and the northern part of the Sacramento Valley in California with electricity, is the scheme of Dick Phelan. The promoter has already started the construction work and is in Reno seeking the aid of the prominent business men. Mr. Phelan owns six lakes just across the California border, near Sierra City, Gold Lake, Eagle Lake and the Four Bear lakes, and he also controls the water rights on the upper streams of the Feather and North Yuba rivers. He estimates that he can install a system for Reno at a cost of $50,000 and reduce the rate for power one-half. Mr. Phelan is general manager of the Sierra Mercantile Mining & Power Company, which also contemplates building an electric line from Marysville to Reno.

ATLANTIC CITY, N. J.—Chairman Donnelly, of the Council lighting board, is reported to have approved the plans for the system of illumination for Atlantic Avenue as prepared by Carrere & Hastings, of New York, N. Y. It is said that the City Council will authorize a bond issue of $30,000 to provide for installing the system.

BELVIDERE, N. J.—The Easton & Washington Street Railway Company is contemplating building its line through the town from the Oxford township line to the Delaware River.

DOVER, N. J.—The Dover Electric Light Company is building duplicate transmission lines from its power station in Dover to supply electricity in Rockaway. E. L. Thompson, owner of the Dover plant, has recently secured control of the Rockaway Electric Light & Improvement Company and plans to light Rockaway from the Dover plant. It is expected that the Rockaway plant will be dismantled.

HAMMONTON, N. J.—The Town Council has contracted with the Hammonton Electric Light Company and the Hammonton & Egg Harbor City Gas Company to light the streets of the city for a term of five years. [illegible]

JERSEY CITY, N. J.—The Street and Water Board has adopted a resolution directing the Public Service Corporation to place all its electric wires on Grove Street, between Grand Street and Newark Avenue, underground as soon as possible.

MORRISTOWN, N. J.—The Public Service Corporation of New Jersey, as lessee of the United Electric Company, will contest in court the [illegible] writ of certiorari to review the granting of a public lighting contract to the Morris & Somerset Electric Company.

PALMYRA, N. J.—[illegible] ter system of street lighting. For several years the streets have been lighted by electricity, but during the last few months the service has been very unsatisfactory, and it is probable that gas may be tried. Bids for lighting have been asked from the Cinnaminson Electric Light, Heat & Power Company, which now has the contract, and the Public Service [illegible]

WHARTON, N. J.—[illegible] with the Dover Electric Light Company to light the streets of the borough [illegible] to be $18 per year for each additional lamp. The contract will amount [illegible]

BROOKLYN, N. Y.—The New York & New Jersey Telephone Company [illegible]

Ward, including Rockaway, and is removing about 200 poles, preparing to place its wires in subways. The entire work is to be completed before winter. The work of removing poles and wires in Richmond is also being pushed rapidly.

CANANDAIGUA, N. Y.—Plans are now under consideration by the Canandaigua Southern Electric Railroad Company for extending the road from Atlanta to Wayland, and thence by the way of Pittsburg and Shawmut line to Hornell. It is proposed to electrify the Pittsburg and Shawmut road from a point just outside of Wayland to Hornell, and the cars of the Canandaigua Southern road will run from Canandaigua, through Naples, Cohocton, Atlanta and Wayland, to Hornell.

DUNKIRK, N. Y.—The American Locomotive Company is asking for bids for the construction of a $30,000 power house, to be erected on the Roberts Road.

FLUSHING, N. Y.—Bids will be received until Sept. [illegible] by C. B. J. Snyder, superintendent school buildings, New York, N. Y., for installing ventilating, heating and electric generating apparatus and electric elevator in the Parental School, Flushing, Borough of Queens.

HEMPSTEAD, N. Y.—The Highway Commissioners of Hempstead have granted the South Shore Traction Company a franchise to build an electric railway from Central Avenue to the town line at Seaford.

NEW YORK, N. Y.—Bids will be received until Sept. 30 by C. B. J. Snyder, superintendent school buildings, for installing electric equipment in addition to and alterations in School 59, Borough of Manhattan.

NEW YORK, N. Y.—The Direct Line Telephone Company has been incorporated with a capital stock of $1,000,000 to manufacture all kinds of telephone apparatus and to establish a system of telephone lines. The incorporators are A. Koch Andriano, of San Francisco, Cal.; John A. Potter and Charles W. Smith, of New York City.

NEW YORK, N. Y.—Commissioner John O'Brien, of the Department of Water Supply, Gas and Electricity, has notified the New York Central Railroad Company that it must place its high-tension electric wires between Spuyten Duyvil and 96th Street underground.

SYRACUSE, N. Y.—The Board of Trustees of East Syracuse has granted the Syracuse Rapid Transit Company a franchise to construct a double track railway in that town.

SYRACUSE, N. Y.—The lighting commission, appointed by Mayor A. C. Fobes, to investigate the lighting situation as affecting the city and consumers of gas and electricity, has advised against municipal ownership of a lighting plant at the present time, but recommends that steps be taken to secure authority for the erection of a plant for lighting streets, parks and public buildings, subject to approval of voters; the commission also favors the construction of a municipal subway system. Prof. Delmar E. Hawkin is secretary of the commission.

SENECA, N. C.—The Council is reported to be considering the question of establishing an electric light plant.

ENDERLIN, N. D.—The plant of the Enderlin Electric Light & Power Company has been completed and is now in operation. The company is contemplating extending its lines to Sheldon, a distance of eight miles, to furnish electricity to light the town, and also expects to double the capacity of the plant within 18 months. The equipment of the plant consists of a 60-kw, single-phase, 60-cycle, 2200-volt Westinghouse alternator, and 85-hp Buckeye engine and a 60 x 16 boiler made by the North Star Iron Works, of Minneapolis, Minn. M. A. Abbott is vice-president and [illegible].

GRAND FORKS, N. D.—The Northwestern Interurban Railway Company has applied to the City Council for a franchise to construct and operate [illegible]. The company proposes to construct a [illegible] Grand Forks to [illegible]ngton in connection with the local [illegible].

CLEVELAND, OHIO.—The Youngstown & Ohio River Railway Com[illegible] $1,500,000 will be issued to cover the cost of construction of the road, while the remainder will be retained for future use. The company is building an electric railway from the terminus of the Salem Railroad [illegible]

COLUMBUS, OHIO.—[illegible] doned Hocking Canal from its junction with the Ohio Canal at Carroll to [illegible]

COLUMBUS, OHIO.—[illegible]

[illegible]

MT. WASHINGTON, OHIO.—[illegible] pany is negotiating with the [illegible] ing franchises. The first involves a 10-year franchise for lighting the streets, and the second for a 25-year franchise for commercial lighting privileges. The street lighting is now furnished by gasoline lamps.

NORWALK, OHIO.—Sherman Culp, vice-president of the Sandusky, Norwalk & Mansfield Electric Railway Company, is projecting a line between Norwalk and Sandusky, which, it is said, will shorten the distance traversed by other lines. Mr. Culp states that capital has been interested in the road and that it will be built within a year or two.

RAWSON, OHIO.—F. P. Folk, city clerk, writes that the Council has taken no definite action, but will probably construct an electric light plant. For further information address E. W. Burkett, Mayor.

TOLEDO, OHIO.—The County Commissioners have granted a franchise to the Toledo & Delphos Electric Railway Company to use the streets in Neapolis. The line when completed will be known as the Toledo, Wabash & St. Louis Railway. It is the intention of the promoters to construct the line through to St. Louis by the way of Wabash.

ELDORADO, OKLA.—W. B. Bryan and W. B. McKenney, of Mangum, Okla., are members of an electric company that are considering the erection of a plant in this town. The company has secured a franchise and 500 service contracts. Application for charter has been made.

KLAMATH FALLS, ORE.—The Klamath Falls Light & Water Company, which has already expended a large sum of money in the improvement of its system this year, is planning still further extensions. The system will be extended out to the Hot Springs addition on the east, and into Lakeside and Riverside additions on the west side. Besides laying the pipe lines the company will construct two new storage reservoirs, one near the end of the Esplanade in Hot Springs, and the other on the hill across the river.

MARSHFIELD, ORE.—The Coos Bay Gas & Electric Company is planning to increase the capacity of its plant and will soon install four new 100-hp boilers, one 650-hp simplex Corliss heavy duty engine, a 450-kw, 3-phase, 60-cycle, alternating-current dynamo, and a direct-current generator of 250 kw capacity. The company will also be in the market for two street cars and equipment and a number of alternating-current motors and transformers. Seymour H. Bell is treasurer and manager.

ALLEGHENY, PA.—The City Council has passed the ordinance for the issue of $75,000 in bonds for the purchase of a turbo-generator set for the municipal electric light plant.

EASTON, PA.—It is reported that a new electric railway is to be built between Easton and Flemington, to be in operation about July 1, 1908. The proposed route will run from Phillipsburg via Springtown, High Bridge, Lansdowne to Flemington. It is proposed to erect a power house at Hampton Junction to supply electricity to operate the road.

HARRISBURG, PA.—The Pennsylvania Central Telephone Company, which has operated all the Bell exchanges in this part of the state, has been merged with the Bell company of Philadelphia. The headquarters of the Pennsylvania company will be transferred to Philadelphia.

HUNTINGDON, PA.—Contracts will soon be let by the Raystown Water & Water Power Company for the construction of dam No. 1 in connection with the hydro-electric project being promoted by the company. The specifications call for a dam about 500 feet long and 30 feet high. Between 5000 and 6000 horse-power will be developed.

JOHNSTOWN, PA.—J. R. Potter & Company, of Philadelphia, have been awarded the contract for grading the new electric railway of the Southern Cambria Company, between Johnstown and South Fork.

LANCASTER, PA.—The management of the Oxford & Southern Railroad has decided to convert it into an electric road, and will secure electricity to operate the road from the power plant of the McCall Ferry Company on the Susquehanna River.

LANCASTER, PA.—Notice has been filed in the State Department by the Lancaster & York Furnace Electric Railway Company of an extension of route from Pequea to York Furnace Springs, Mount Nebo and McCall Ferry, a distance of eight miles. [illegible]

LEBANON, PA.—The Cornwall Ore Bank Company is contemplating the construction of a large power plant at Lebanon and will transmit electricity to Cornwall to operate the machinery for crushing iron ore, etc. Quincy Bent, manager of the Pennsylvania Steel Company, is interested in the enterprise.

LOCK HAVEN, PA.—Work has commenced on enlarging the power house and car barn of the Susquehanna Traction Company.

PITTSBURG, PA.—The Bureau of Building Inspection has granted a permit to the Convent of Mercy to erect a two-story power house on Fifth Avenue to cost $25,000.

ROYER, PA.—Frank W. Moore, of Indiana, Pa., engineer, writes that the proposed electric light plant to furnish electricity for lighting and [illegible] Bids will probably not be called for until 1908.

SCRANTON, PA.—The Clark, Summit & Lake Winola Street Railway [illegible]

TREVORTON, PA.—The North Franklin Colliery has recently been equipped with electrical machinery to operate the mines. The machinery [illegible]

[illegible] on the [illegible]

WAYNESBORO, PA.—[illegible] of the Chambersburg, Greencastle & Waynesboro [illegible] Company [illegible] has been approved by Governor Stuart. The company has been reorganized and will increase its capital stock, which increase has been practically all subscribed by local people, which had previously organized the Chambersburg & Southern Electric Railway Company, which has been merged with the Chambersburg, Greencastle & Waynesboro Company.

WOMELSDORF, PA.—W. W. Lengel, borough secretary, writes that the citizens voted on Sept 13 to issue bonds for the construction of a municipal electric light plant. F. W. Darlington, Real Estate Trust Building, Philadelphia, is engineer.

YORK, PA.—Arrangements are being made to consolidate the York & Wrightsville, York & Dallastown, Red Lion & Windsor, York & Dover, York & Hanover and the York Street Railway companies. The Wrightsville & York Street Railway has filed notice of an increase in its capital stock from $66,000 to $3,397,000. It is announced that the Wrightsville & York Company will be the medium through which the capital will be provided for improvements and extensions contemplated. It is proposed to extend a line into Harrisburg in the near future, surveys for which have already been made. The consolidation will be known as the York Railways Company.

PANAMA.—Bids will be received at the office of H. F. Hodges, general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Oct. 14, for automatic fire alarm telegraph systems, marine electric fixtures, batteries, dynamite and blasting material, wire hoisting engines, etc.

WESTERLY, R. I.—The Westerly Railway & Lighting Company has awarded to R. A. Sherman's Sons Company the contract to erect a substation at Stonington. The company is now erecting a transmission line between Westerly and Stonington to transmit electricity to that borough for lighting purposes.

BISHOPVILLE, S. C.—Owing to the installation of a new engine and other improvements being made to the plant of the Bishopville Light & Power Company, the streets of the town are not lighted at night. The Town Council made a contract with the Lee County Manufacturing Company to furnish power for the dynamo until the new engine could be installed, but the company failed to comply with the agreement, and the town will be in darkness until the engine is placed. It is expectetd to have the plant in operation by October 1.

EASLEY, S. C.—John C. Cary, of Lockhart, S. C., is interested in a project to establish a plant at Dunham's Bridge, about five miles from Easley, to develop the water power of the Saluda River.

McCORMICK, S. C.—Paul B. Wilson, of Abbeyville, S. C., has been awarded the contract to install a 35-hp electric lighting and power plant. The contract calls for 360 incandescent lamps, of which eight of 100 cp arc for the streets.

SENECA, S. C.—The city clerk writes that bonds have been issued for the construction of an electric light plant.

UNION, S. C.—Plans are being made to improve the electric lighting service furnished by the municipal electric lighting plant. E. M. Anderson, superintendent, has left for New York with authority to purchase a new dynamo, which will be installed as soon as possible.

VERMILLION, S. D.—The Northwestern Telephone Company has been served with notice to vacate the public highways within 60 days. For two years the company has been operating without a franchise, and its refusal to accept one proposed by the City Council, which calls for a tax of three per cent of the gross earnings of the local exchange and a reduction of 25 per cent in the charge for private lines, has resulted in the order to vacate. A local company, headed by former Governor Andrew E. Lee, wants the franchise.

CHATTANOOGA, TENN.—It is reported that the Tennessee Construction Company, recently chartered under the laws of West Virginia, is to build the Georgia-Tennessee Interurban Electric Railway, which is being promoted by S. W. Divide. It is understood that the company will construct the road from Chattanooga to Chickamauga Park. The Tennessee company has elected the following named officers: Samuel B. Smith, president; S. W. Divide, vice-president; W. M. Elliott, secretary and treasurer. Surveys have been completed and the rights of way purchased for the road as far as Chickamauga Park and beyond to Catoosa Springs.

CLARKSVILLE, TENN.—Because of a controversy between the Cumberland Telephone Company and the City Council, the Mayor ordered the wires and cables of the company cut, putting two-thirds of the company's plant out of commission. An injunction has been granted by Judge Stout enjoining the City Council from interfering with the wires. It is understood that the company will repair the lines at once. The matter of placing the wires underground will be decided in the courts.

KNOXVILLE, TENN.—The Central Telephone Company has purchased from the Gainesboro Company all its lines, telephones and exchanges in Morgan and Scott counties, Tenn., and Whitney County, Ky.

MEMPHIS, TENN.—Application has been made to the City Council by K. D. McKellar, representing the Memphis Light & Traction Company, for a franchise to operate a street railway in the city.

NASHVILLE, TENN.—A special election will be held Oct. 10 for the purpose of voting on the proposition of issuing $400,000 in bonds for the [illegible] additional street lighting. [illegible]

AMARILLO, TEX.—The City Council has instructed the city attorney to [illegible] a proposition to the people for authorizing the town to build or purchase and maintain a water and light system.

FORT WORTH, TEX.—The Northern Texas Traction Company, it is said, is contemplating doubling the capacity of its power house, which will involve an expenditure of about $150,000.

SAN ANGELO, TEX.—The San Angelo Water [illegible] changed its system from 132 to 60 cycles, three-phase, and is installing a [illegible]-kw turbo-generator set. W. A. [illegible] is manager.

WACO, TEX.—Joseph J. Henry, vice-president of the Consumers' Light & Power Company, has closed contracts for machinery, etc., for the new plant, and states that it will be ready for operation by Dec. 1.

SALT LAKE CITY, UTAH.—The Utah Lake Land, Water & Power Company has filed an amendment to its articles of incorporation with the county clerk. M. B. Whitney is named as president and R. H. Thomson, secretary. The capital stock of the company is $620,000.

SALT LAKE CITY, UTAH.—Plans have been completed for the reorganization of the Utah Independent Telephone Company. Heber J. Grant & Company will be in charge of the reorganization. It is proposed to raise $1,200,000, which will be sufficient to acquire all bonds and stocks and pay off the indebtedness of the company, and in addition will provide, approximately, $75,000 for new installation. In addition it is proposed to put $300,000 in bonds into the treasury as a reserve for future extensions and to cancel the remainder of the bond issue, and to increase the capital stock from [illegible]

FORT ETHAN ALLEN, VT.—Bids will be received until Sept. 28 at the office of the constructing quartermaster at Fort Ethan Allen for the construction, plumbing, wiring and fixtures for electric lighting of one brick double set civilians' quarters at this post. Proposals should be addressed to Lieut. M. G. Holliday, quartermaster.

RICHFORD, VT.—The firm of Sweat & Cumings is building a flume 200 feet long, which will extend from the mill dam to the site of the new electric power plant, which is to be completed by Jan. 1 at a cost of $35,000. The water company will furnish 450 horse-power for the electric plant. The plant when completed will furnish electricity to operate the furniture factory, grist mill and sawmill.

FREDERICKSBURG, VA.—The City Council has voted to appropriate $4,000 to install an incandescent lighting system in the municipal electric light plant for lighting private residences and stores.

BUCKLEY, WASH.—The plant of the Buckley Electric Company is being enlarged to meet the increasing demands for electricity. The company has purchased a 75-kw generator and an engine of 125-hp capacity, which will be installed at once.

CENTRALIA, WASH.—B. E. Clements, of the Independent Telephone Company, of Portland, Ore., has been granted a franchise to install a local telephone system in connection with the Northwestern long distance system.

RAYMOND, WASH.—The City Council has instructed the city attorney to notify the Pacific States Telephone Company that it would be allowed 15 days in which to make application for a franchise [illegible] business in this city. In case the company fails to make application its poles will be removed.

SEATTLE, WASH.—Owing to the municipal electric lighting plant having reached the limit of its capacity, the lights and lighting committee of the City Council has decided to authorize the superintendent of lighting to purchase electricity from private concerns if possible. The new extensions to the plant, which will more than double its present capacity, will not be completed for six months.

SPOKANE, WASH.—The Washington Power Company is planning to build a power transmission line into Big Bend County, west of Spokane. Electricity will be furnished for lighting towns and operating manufacturing plants and mills at Davenport, Ritzville, Reardan, Harrington, Sprague and Paha. The company expects to have the transmission line from Post Falls to the Cœur d'Alene mining district completed within two months.

SPOKANE, WASH.—Announcement has been made that the Power Development Company, which is a subsidiary of the Spokane & Inland Railroad Company, will have a surplus of from 10,000 to 15,000 hp from the new power plant at Nine Mile Bridge when completed. It is proposed to utilize the power by supplying electricity for lighting and power in Spokane, under the franchise purchased by Jay P. Graves and associates from Frank P. Hogan. The plant was built to furnish electricity to operate the Spokane & Inland Railway system.

SPOKANE, WASH.—The Big Bend Water Power Company has applied to the City Council for [illegible] transmission lines to furnish electricity [illegible] of Spokane. The measure provides that the company shall build a power plant 28 miles down the Spokane River and have it in operation in three years. It is estimated that 20,000 horse-power can be developed. The company proposes to operate 132 miles of electric railway and to furnish electricity for lighting and power purposes in Spokane. The plant, including duplicate transmission lines, it is stated, will cost [illegible] 100 feet high and 489 feet wide. The power house will occupy the middle of the dam [illegible] which is placed at [illegible] the dam wall to seven pairs of turbines. The dam will raise the river for a distance of [illegible]

cubic feet. Besides supplying electricity in Spokane, the company is planning to supply various mines in the Cœur d'Alene district and a transmission line to Murray, a distance of 132 miles, is under consideration. R. C. Lowry, of Seattle, is engineer for the company, and J. E. Ross, of Seattle, is electrical engineer.

BLUEFIELD, W. VA.—A franchise has been granted by the City Council to E. L. Bailey and E. T. Oliver to erect poles and wires on the streets of the city to operate a street railway system and to manufacture and distribute electricity.

CHARLESTON, W. VA.—A charter has been granted to the Elkins Power Company to operate an electric railway in Randolph, Taylor and Barbour counties. The company is capitalized at $75,000, and the incorporators are H. G. Davis and others.

PADEN CITY, W. VA.—Work has commenced on the construction of the new plant of the Pittsburg Chain & Forge Company, of Pittsburg. Plans have been prepared for the erection of an ironclad building 60 x 100 feet, to be devoted to the manufacture of hand-made chains for dredge and crane service. A power plant will be installed in the building, consisting of a gas engine and generator to furnish electricity for lighting the building and power for the motor-driven machinery, including a 200,000-pound testing machine, forges, etc.

CONCONCULLY, WIS.—The construction of a telephone line between Twist and Conconcully is under consideration. An organization has been effected by the election of L. H. Bowman, chairman, and E. F. Magee, secretary. The proposition is for the citizens of the county and the United States Forest Service to co-operate in building the line, the Government to furnish the wire and the citizens to do the rest.

EAGLE RIVER, WIS.—The town is building a reservoir on the Eagle River, about three and one-half miles west of the town, which will supply power for the electric light plant and water works system, and will also furnish water power for factories and other industries. The dam when completed will cost about $100,000 and will furnish 1000 horse-power.

MADISON, WIS.—John Corscot, general manager of the Madison Gas & Electric Company, writes that the company is installing an Allis-Chalmers steam turbine of 500-kw capacity, and a 500-hp Sterling boiler, with the necessary pumps, heaters and other accessories in its plant at a cost of about $75,000. The work will be completed in a month or six weeks.

MADISON, WIS.—The Railroad Commission has received petitions from five utility corporations for authority to increase their rates for service. The companies asking for permission to increase their rates are the Merrill Electric Railway Light & Power Company, of Merrill; the Fox River Electric Light & Power Company, of Pardeeville; the Colby Telephone Company, of Colby; the Brodhead Telephone Company, of Brodhead, and the Watson Heating Company, of Marinette.

MENOMONEE FALLS, WIS.—The Menomonee Falls Telephone Company has acquired by purchase the Richfield, Menomonee and the Holy Hill Telephone Company's lines, which will extend the local company's lines into new territory, including Goldenthal, Richfield, Plat, Hubertus and other points.

NEENAH, WIS.—Arrangements are being made by the Wisconsin Telephone Company for the construction of a new telephone exchange building on Commercial Street, the cost of which is estimated at $75,000.

PRENTICE, WIS.—The Prentice Light, Water & Light Company has been granted a lighting franchise, and work will be started at once on the installation of the system.

SPARTA, WIS.—The La Crosse Water Power Company has entered into a contract with the Sparta-Melrose Electric Railway Company to furnish electricity to operate its road.

RAWLINS, WYO.—Local business men have formed a telephone company and propose to install a local exchange.

AMHERST, N. S.—The Maritime Coal, Railway & Power Company has installed an electric plant at its mines, located about eight miles from Amherst. The power plant has a capacity of 600 horse-power. Provision has been made for the addition of a second unit when necessary.

BRANTFORD, ONT.—Contracts will shortly be awarded by the Grand Valley Radial Company for the construction of a railway between Brantford and Port Dover, a distance of [illegible] miles.

CHATHAM, ONT.—The Chatham, Wallaceburg & Lake Erie Railway Company is planning to extend its road from its terminus at Lake Erie to Wallaceburg. Robert E. Kizer is general manager.

LONDON, ONT.—O. Ellwood, [illegible] writes that John [illegible] is engineer in charge of the water system and power plant which is to be erected in London at a cost of about [illegible]. The date of opening [illegible] has not yet been decided upon.

KINGSTON, ONT.—The contract for the construction of the power house of the Sydney & Glace Bay Railway at Dominion No. [illegible] has been awarded to Rhodes, Curry & Company, of Amherst, N. S. The cost of the plant and machinery is estimated at [illegible].

GUADALAJARA, MEX.—The Compania de Tranvias, Luz y Fuerza, of Guadalajara, has under consideration the construction of a double transmission line from its [illegible] plant on the [illegible] River to the mining districts of [illegible] and [illegible]. It is proposed to [illegible] in the State of [illegible]. It is estimated that the cost of [illegible] will be $900,000. The company has submitted a proposition to the mining men of the districts to be supplied [illegible], that they advance one-half the sum of the cost of the proposed double line, the loan

to be paid off with power and the money thus advanced to draw 8 per cent per annum. The price to be asked by the company for the electrical energy is $120 a horse-power per annum.

MEXICO CITY, MEX.—The Compania Electrica del Alameda has been organized to furnish electricity in this city, and has obtained a concession from the Federal government for the system, and has also made the necessary money deposit as a guaranty that it will live up to the terms of the concession. The company will build a large hydro-electric plant at the waterfall of Rio Alameda, situated about forty miles from Mexico City, and will erect transmission lines from the plant to this city. The company already has a power plant at the waterfall, which is to be enlarged. The new plant will have a capacity of about 8000-hp. The firm of Donadiue & Veyan, of this city, are largely interested in the new project.

MOLINO DEL PROGRESO, MEX.—José Martinez and associates have taken steps to erect a hydro-electric plant on the Tula River, state of Hidalgo, near the town of Molino del Progreso. The power will be used for industrial purposes.

SABINAS, MEX.—A large electric power plant is to be erected at Sabinas, state of Coahuila, by Dr. Braulio Montemayor, of Saltillo, and associates. Transmission lines will be built to a number of industrial centers of that part of Mexico.

SAN NICOLAS DE LA JOYA, MEX.—The Canadian Electric syndicate has had plans prepared for a hydro-electric plant, which it will install at San Nicolas de la Joya on the Conchos River, in the state of Chihuahua. W. F. Tye, an electrical engineer, is in charge of the project. The initial power will be obtained by constructing a large dam across the Conchos River. It is expected that more that 2500-hp will be developed. Transmission lines will be built to the cities of Parral, Chihuahua, Santa Rosalia, Jiminez and to a number of mining districts.

TEZUITLAN, MEX.—The Tezuitlan Copper Mining & Smelting Company has begun the erection of a hydro-electric plant near its mines at Tezuitlan, state of Vera Cruz. The plant is located on the Atoyac River. The power will be used to operate the machinery of the mine and smelter.

New Industrial Companies.

THE CONANT, WHITING & COMPANY, Inc., of Boston, Mass., has been incorporated with a capital stock of $4,000. The company proposes to do electrical engineering work. The incorporators are George H. Conant, Herbert S. Whiting and Eugene H. Mahoney.

THE GERMAN-AMERICAN ELECTRIC COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000. The directors are Waldemar P. Leonhardt, Edith Grant and Arthur H. Grant.

THE F. C. NEWELL MUTOGRAPH CORPORATION has been organized under the laws of New Jersey, with a capital stock of $1,000,000, with headquarters at Cleveland, Ohio. The company has been formed to manufacture and place on the market the "Mutograph," an electric bulletin printing device invented by F. C. Newell. The officers of the company are as follows: F. C. Newell, president and consulting engineer; Benjamin B. Avery, vice-president; Charles E. Kennedy, secretary, and W. J. Telling, treasurer.

New Incorporations.

VAN BUREN, ARK.—The Van Buren Light & Fuel Company has been incorporated by James Brizzolara and others to establish an electric light plant.

GREENVILLE, KY.—The Greenville Light & Water Company has been organized with a capital stock of $[illegible] to furnish light and water. J. A. Gilman is engineer.

KANSAS CITY, MO.—The E. S. Cowie Electric Company has been chartered with a capital stock of $10,000 by Ernest S. Cowie, Charles Pierson and G. H. Jewett.

ALAMOGORDO, N. M.—The Sacramento Power Company, of Alamogordo, has filed papers of incorporation at Santa Fé with $1,000,000 capital. The directors are U. S. Houghland and John A. Gilchrist, of Kansas City; M. and A. T. Payne, of Oklahoma City, Okla. A large storage dam will be built for irrigation purposes.

CIRCLEVILLE, OHIO.—The capital stock of the Circleville Light & Power Company has been increased from $70,000 to $80,000.

MANSFIELD, OHIO.—The Delaware, Mt. Gilead & Mansfield Electric Railway Company has been organized to build an electric railway. The officers of the company are: J. A. Shoemaker, of Delaware, president; S. P. Gage, of Mt. Gilead, secretary; A. H. Breese, of Mt. Gilead, treasurer.

GRANITE, OKLA.—The Granite Electric Company has been incorporated with a capital stock of $[illegible] by R. C. Knox, H. J. Hayes and others.

MARKES, PA.—The Conoocheagre Electric Light and Heat & Power Company has been incorporated with a capital stock of $[illegible] by J. B. Duel, Seth Lehmaster, of Markes, and others.

SHARON, VT.—The Sharon Power Company has filed articles of association with the Secretary of State with a capital stock of $50,000. The company proposes to erect an electric plant to furnish electricity for lighting, heating and power purposes in Sharon.

Legal.

[illegible] the Middle District of Tennessee by the General Electric Company against the city of Nashville, Tenn., to restrain the city from the further use of some Bullock alternating current generators. These generators have laminated pole pieces attached to the revolving field spider by means of bolts from the spider engaging a transverse bar embedded in the pole piece, a construction covered by the Parcelle patent No. 463,704, granted Nov. 24, 1891, which has been heretofore sustained by the courts. Judge Clark holds that the defendant has not produced any new matter tending to invalidate the patent and that, therefore, there is no reason [illegible] case against the Bullock Company on the same construction. The court [illegible]

BOILER CLEANING DEVICE.—In the suit of the Liberty Manufacturing Company versus the American Brewing Company, in the United States Circuit Court for the Eastern District of Pennsylvania, an injunction for infringement has been granted by the court. The patent sued under was that of W. S. Elliott, covering a steam turbine cleaner for steam boilers. With this device is used a turbine of smaller diameter than the tube to be cleaned, which is attached to a hose. To the shaft of the turbine, which shaft may be provided with a universal joint to allow the device to follow the end curvature of tubes, is attached a head which constitutes the Elliott device. This head is provided with four longitudinally extending arms pivoted at their rear ends in inset openings at four equi-distant points on the periphery of the head. A set of two arms of longer length and a set of two of shorter length are mounted at right angles. On the forward, free end of each arm a toothed movable cutting wheel is mounted on a shaft extending lengthwise the arm. When the turbine shaft is rotated at high speed, the forward extending arms on the head by centrifugal force fly outward, bring the cutters in contact with the scale and deliver a rapid succession of blows on both a revolving and striking character. This blow is variously described in the proofs as a sidewise or swiping blow and the process is styled a picking action. By these blows the crust is broken into small pieces, which are washed out ahead of the device by the exhaust of the turbine. The court held that no weight should attach to the claim that Faber was a joint inventor with Elliott, and that the devices of Bradley and Weinland did not involve prior uses.

RIGHTS OF TELEPHONE COMPANIES IN MINNESOTA CITIES.—The question was recently put to the United States Circuit Court whether a telephone company had the legal right to establish a telephone exchange in a city in Minnesota, which would give local service to the citizens of the city and also long distance service to points without the state, without the consent of the local authorities. The Northwestern Telephone Exchange Company, having obtained authority from the city of St. Charles, Minn., to erect its lines in certain streets, proceeded to establish itself in other streets of the city. A statute of Minnesota gives telegraph and telephone companies the right to erect poles for their wires in any road or highway in the state, providing that they should not use streets or alleys in any city or village without obtaining a franchise from such city or village. It was argued by the company that it was engaged in interstate commerce and that the statute of a state restricting its rights was invalid as an interference with interstate commerce. The statute was held valid and the company was declared to have no right to occupy the streets of the city of St. Charles without first being properly authorized by the authorities of that city. While any interference by the Legislature with an established instrument of interstate commerce might be a subject of criticism, still the fact that a line of telegraph or telephone will, when completed and in use, be used for the purpose of interstate commerce, gives no right to the persons or corporations projecting the establishment of a concern of this kind to do so upon terms different from what others would be required to submit to in the establishment of a similar enterprise. Northwestern Telephone Exchange Company vs. City of St. Charles, 154 Fed. Rep. 386.

DOMESTIC PATENT EXPIRES WITH PRIOR FOREIGN PATENT ON SAME INVENTION.—The patent act provides that, if a patent is granted upon a device already covered by a foreign patent, the domestic patent shall expire at the same time that the foreign patent runs out. In a recent action to restrain an infringement of the Thomson patent No. 448,894, for an electric meter, issued March 24, 1891, this provision was depended upon as a defense, and it was shown that an English patent which expired in 1904 had been granted upon substantially the same device. The plaintiff claimed that, on account of certain additions to the original invention, the domestic patent covered a different invention from that protected by the English patent, and that, therefore, the case was not a proper one in which to apply the provision of the patent act mentioned. It was held that the additions made in the American patent did not constitute invention and that the American patent rights ceased with the expiration of the English patent. A patent cannot be exempted from the operation of the law by merely adding new improvements to the invention. Otherwise it would be possible to easily evade the statute. The claims of the respective patents which the plaintiff sought to differentiate [illegible]

[illegible] Claim 2 of British patent: "An electric meter having stationary coils in a main circuit, and movable coils forming an armature in a shunt circuit around the work, and a supplemental resistance in the said armature circuit; combined with a retarding device comprising a close conductor moving in a permanent and constant magnetic field, which is independent of and uninfluenced by the currents flowing in the aforesaid coils, for the purposes above specified." Thomson-Houston Electric Company vs. McLean, United States Circuit Court of Appeals, 153 Fed. Rep., 883.

Obituary.

MR. SAMUEL SLOAN, [illegible] ager, died this week in his ninetieth year. He left a deep mark on American railroad development. He was for many years a director in the Western Union Telegraph Company.

MR. J. EDWARD ALLEN, [illegible] Mr. Allen was 70 years of age and is survived by a widow and three sons and one daughter. He was well known among the Masonic bodies, and [illegible]

Personal.

H. M. HIRSCHBERG.

MR. H. M. HIRSCHBERG, president of the Excello Arc Lamp Company [illegible] Europe, in the interest of his company. As a result of the visit several new designs of flaming arc lamps will soon be placed on the American market. To the untiring energy of Mr. Hirschberg may be attributed a considerable portion of the present popularity of the flaming arc lamp in this country. He has concentrated his efforts during the past eighteen months on the introduction of the lamp and on the commercial exploitation of its advantages. The recent trip of Mr. Hirschberg to Europe involved his [illegible] hundred and eleventh crossing of the Atlantic. Since his first trip across, in 1873, from England, where Mr. Hirschberg received his early training and education, he has been continuously associated with engineering and mechanical undertakings. He was among the first to introduce National Cash registers, check perforators and such like. Always musical, he dabbled locally in concert direction with such success that he, upon the suggestion of many leading musical artists, removed to New York in 1894 and went into the management of high-class musical attractions, introducing to American audiences many leading singers and instrumentalists. It was while visiting Europe in 1905, in search of new attractions in this field, that his attention was directed to the Excello flaming arc. Realizing its great commercial possibilities, he gave up the profession of impresario and secured the Excello rights for the United States and Canada. Mr. Hirschberg undertook it purely as a good business proposition and knew absolutely nothing then about electrical goods or illuminating projects. The success of his undertaking is too well known to need comment and is another striking illustration of what persistence and foresight can accomplish.

MR. C. A. COFFIN has returned home, his trip abroad being suddenly curtailed by the sad death of his only son, Mr. E. R. Coffin, as noted recently, at Omaha, Neb., while on a Pacific Coast journey.

MR. J. F. McLAUGHLIN has been appointed chief of the Electrical Bureau of the city of Philadelphia to take effect Oct. 1. He has been engaged for some years past in expert and consulting electrical work, and has taken out several patents.

MR. A. C. GILPIN, [illegible] made Eastern agent for the Pratt Chuck Company, Frankfort, N. Y., manufacturers of electro-galvanized pressed steel outlet boxes. He will carry a complete stock in New York.

MR. J. C. FARRAR has been appointed electrical engineer of the "Randolph Lines" in Arizona and Mexico, with headquarters in Tucson, [illegible]

MR. HENRY FLOY has just returned from a two months' trip through [illegible] the development of three-phase traction in these countries, which is being [illegible] exclusively in the coming electrification of steam roads.

MR. A. A. KNUDSON, [illegible] as expert in connection with the litigation between the Toronto Street [illegible] Mr. C. L. Anderson, consulting engineer, of Franklin, Ohio.

MR. F. E. DRAKE, managing director of the French Westinghouse Company, is in this country again for the first time in some years. He speaks most favorably and hopefully of the Westinghouse growth and developments in Europe, particularly those of the French and Italian companies. He will be here some time and is meeting a host of old friends.

MR. HENRY L. DOHERTY, the well-known lighting expert and financier, who has been spending the summer on the other side of the Atlantic, has returned home on the *Lusitania* greatly benefited by his holiday. He took occasion while abroad to make a study of lighting conditions, and some of his remarks on the subject have already appeared in these columns.

MR. J. A. EMERY, who recently resigned as vice-president and general manager of the Birmingham Railway Light & Power Company, of Birmingham, Ala., is one of the incorporators of the Emery Steel Company, of Birmingham, Ala., just incorporated, which will do a general business in castings and machinery. Associated with Mr. Emery are Mr. R. C. Foster and Mr. J. H. Pritchard.

MR. A. N. BRADY, who has been taking the baths at Carlsbad, has just returned from Europe. Mr. Brady said he had studied the traction situation while on the other side of the Atlantic, and added that we were far, far ahead in this country. "If the kickers would go over to the other side they would find something to really kick about." He might have added that the same is generally true of the lighting.

MR. HARRY DE STEESE, of New York City, has recently been appointed by the International Timber Preserving Company, of Chicago, manufacturer of the public-service timber preserver, "Neosote," as Eastern representative. For sixteen years Mr. De Steese has been constantly identified with various branches of public-service work, both in this country and in Europe. His earliest experience was gained under Postmaster-General Payne at Milwaukee, and from 1896 to 1900 he was manager of the railway department of the Western Electric Company, of New York, leaving that position to take charge of the establishment of a supply business in London, England. Mr. De Steese's friends will be glad to learn of his new connection, and the International Timber Preserving Company is to be congratulated on having secured so able and energetic a representative.

Trade Publications.

ELECTRIC LIGHT SUPPLIES.—The H. T. Paiste Company has issued price list No. 8 dealing with electric light supplies.

ENGINE GOVERNOR, valve gear and piston details for Reynolds-Corliss engines are illustrated in Leaflet No. 2002 of the Allis-Chalmers Company, Milwaukee, Wis.

SWITCHBOARDS.—The General Electric Company has issued Bulletin No. 4517 dealing with isolated plant switchboard panels for e.m.f.s of 125 and 250 volts and for from [illegible] to [illegible] amperes.

PORTABLE INDICATING INSTRUMENTS.—Indicating voltmeters, ammeters and wattmeters of the Thomson inclined coil type are illustrated and described in Bulletin No. 4514 of the General Electric Company.

VERTICAL ENGINES.—The B. F. Sturtevant Company, Hyde Park, Mass., has issued Bulletin No. 125 dealing with Class VS5 vertical engines, which are intended for non-condensing operation and vary in rating from 6 hp to 85.5 hp.

SEWING MACHINE MOTORS rated at .05 hp and intended for family use are described in bulletin No. 3904 of the Emerson Electric Manufacturing Company, St. Louis, Mo. The motors may be of either the single phase induction type or of the direct current type.

OIL FILTERS.—The advantages of employing a reliable oil filter and descriptions of filters which are stated to be entirely reliable are presented in an illustrated catalogue recently issued by the Franklin Filter Company, [illegible] N. Commercial Street, St. Louis, Mo.

WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has issued catalogues A-10 and A-12. The former is devoted to reversing motor starters, and A-12 has as its subject self-starters. Both are illustrated and each is accompanied by a specification.

DIRECT-CURRENT BALANCERS for three-wire work at 250 volts between the outers are dealt with at length in Bulletin No. 4503 of the General Electric Company, Schenectady, N. Y. This bulletin also treats of direct-current generators ranging in ratings from 1.5 to 17.5 kw.

CONVEYING MACHINERY.—In its general catalogue No. 35, the Chain Belt Company, Milwaukee, Wis., gives numerous illustrations of elevating, conveying and power transmitting machinery in actual service, and also views and price lists of the various parts used in the equipments.

LUNKENHEIMER.—The Lunkenheimer Company, of Cincinnati, Ohio, has just issued a 24-page booklet on its latest blowoff valves, illustrating and describing the various types that it now manufactures. The apparatus is admirably shown in the cuts, and data are given as to sizes and prices.

BLUE-PRINTING MACHINES.—A ninety-two page pamphlet issued by the Buckeye Engine Company, Salem, Ohio, consists almost entirely of facsimiles of letters received from large manufacturing companies using the Buckeye electric blue-printing machine, which in every case is highly commended.

MERCURY LIGHTING.—A very neat and interesting little list has been published of typical installations of mercury vapor lighting made by the Cooper Hewitt Electric Company, 220 West 29th Street, New York City. It ranges through the entire field of industry and includes a number of large equipments.

STEAM PUMPS.—The 1907 edition of the catalogue of the Buffalo Steam Pump Co. contains 132 octavo pages describing lines of pumps covering almost every possible pumping application. A considerable part of the catalogue is devoted to centrifugal and turbine pumps, most of those illustrated being electrically driven.

OIL BURNERS.—The National Oil Burner & Equipment Company, of St. Louis, in a 16-page pamphlet, illustrates and describes its several types of burners for use with fuel oil under boilers. Other apparatus used in connection with oil burners are also briefly mentioned, such as furnaces, traps, tanks, etc.

SPRAGUE ELECTRIC BULLETINS.—Bulletin No. 229, the Sprague Company, has for its subject direct-current motor equipments for printing presses and allied machines. It is adorned with a handsome cover in colors, and the text on seventy-four pages is enclosed in an artistic border. Throughout the publication, which has the character of a catalogue rather than of a bulletin, is a fine specimen of typography. A hundred or more excellently executed half-tones illustrate all manner of applications of the electric motor to the printing art. Bulletin No. 108 describes a type of electro-dynamometer for testing gasoline engines, consisting of an especially constructed direct-current generator with compensating poles, the field-core being so mounted as to admit of oscillating concentric with the armature, and therefore admitting of the torque to be determined by means of a lever arrangement. Bulletin No. 230, which is also very attractive typographically, has for its subject the electric equipment of a modern factory. Twenty-three well executed engravings illustrate the application of Sprague motors to machine tools. Bulletin No. 231 describes the direct-current motor equipment of Mergenthaler type-setting machines.

Business Notes.

THE BENOLITE COMPANY. Mr. G. A. Berney, president of the Benolite Company, manufacturer of the Benolite insulating and protecting varnishes, Pittsburg, Pa., informs us that a portion of its new factory will be in operation this week, and that it expects to be able to fill all orders from that time.

THE MILLS ELECTRIC COMPANY, of Peoria, Ill., has sold its contracting business to the McLean Electric Company, of Galesburg, Ill., and now will engage only in the electrical supply business. The company is preparing new headquarters and will carry all lines of electrical apparatus.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. [illegible], 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

866,9[illegible]. VARIABLE VOLTAGE TRANSFORMER. Thomas M. Barnes, Jr., Philadelphia, Pa. App. [illegible]. [illegible] variable voltage transformer of the type [illegible] the primary [illegible] is shifted into and out of inductive relation to the secondary winding so as to vary the induced secondary voltage.

866,9[illegible]. ELECTRIC LOCOMOTIVE. A. [illegible], Schenectady, N. Y. App. [illegible]. [illegible] of armature and pole pieces [illegible] of the locomotive, cross members in each [illegible] connecting a magnetic circuit through said series, and means for producing a magnetic flux through said magnetic circuit.

866,997. ELECTROMAGNETIC VARIABLE SPEED MECHANISM. Alexander [illegible], New York, N. Y. App. [illegible]. Electrical variable speed [illegible] a plurality of electromagnetically actuated [illegible] a wide range of speed variations from a source of [illegible] constant speed.

86[illegible]. METHOD OF IMPROVING VAPOR ELECTRIC DEVICES. Samuel [illegible], Schenectady, N. Y. App. [illegible]. [illegible] rectifier with a relatively low-voltage current to distill from the anodes any impurities [illegible].

8[illegible]. ARC LAMP. [illegible], and [illegible]. [illegible] Has a movable non-consuming electrode, a movable consuming electrode, and a [illegible] for engaging said consuming [illegible] in the feeding [illegible].

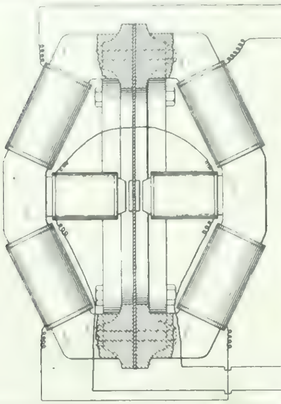
86[illegible]. TELEPHONE [illegible]. Rudolf Knoll, Vienna, Austria-Hungary. App. filed Aug. 11, 1905. Relates to details of sheet metal [illegible].

8[illegible]. WATER JET GROUNDER FOR PROTECTION AGAINST EXCESSIVE POTENTIALS IN ELECTRICAL SYSTEMS. [illegible], Berlin, Germany. App. filed [illegible]. [illegible] with an electrical conductor to be protected from [illegible].

[illegible]

ELECTRIC [illegible] CLOCK; [illegible] the circuit by which the electromagnets are excited and then returns [illegible] like, whereupon the electric circuit is again closed.

[illegible] OF SEPARATELY EXCITED GENERATORS; Georg Stern, Berlin, Germany. App. filed Jan. 23, 1907. Relates to the control of separately excited generators and provides means by [illegible]



[illegible] Device for Transmitting Sound Through Water.

[illegible],090. FUSE BOX; Lewis E. Troutman, Schenectady, N. Y. App. filed Nov. 11, 1905. Thermal cut-out or fuse box having line terminals provided with clips, and a removable fuse carrying block.

[illegible],105. FLUSH RECEPTACLE AND PLUG; George P. Whittlesey, Washington, D. C. App. filed Sept. [illegible] Connector for electric circuits in which a receptacle containing main-line terminal contacts is let into a wall flush with the surface thereof, while the terminal contacts of the branch line are carried to a plug adapted to be thrust into the receptacle so as to bring the two sets of contacts together.

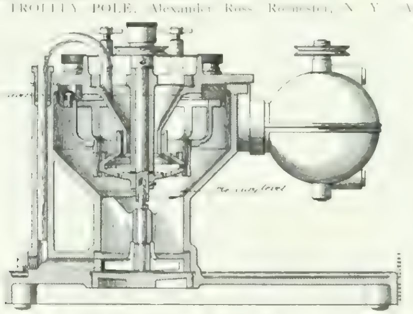
[illegible],128. DEVICE FOR TRANSMITTING SOUND THROUGH WATER; Elisha Gray, Highland Park, Ill. App. filed Dec. 1, 1899. System of submarine telegraphy having winding plate in a magnetic circuit and constantly polarized thereby and vibrated by additional magnets in an alternating current circuit.

[illegible],138. TELEPHONE SYSTEM; Henry F. Joeckel, Clayton, Ill. App. filed Feb. 23, 1904. Details of subscriber's circuits.

[illegible],180. COMBINED APPLICATOR AND DILATOR; Cutler T. Ball, Decatur, Ill. App. filed June 13, 1907. Details of an electrode for a medical belt or battery.

[illegible],193. TROLLEY GUIDE; Frank G. Clark, San Francisco, Cal. App. filed Feb. 20, 1907. The trolley pole has a pair of horns or projections extending upward therefrom and flexible so as to yield rearwardly in passing an obstruction.

[illegible] TROLLEY POLE; Alexander Ross, Rochester, N. Y. App. filed Feb. [illegible] The trolley pole [illegible] tion and [illegible] joint.



866,[illegible] Mercury Interrupter.

[illegible],261. RAILWAY TRAFFIC CONTROLLING SYSTEM; Clarence W. Coleman, Westfield, N. J. App. filed Jan. 10, 1907. Complete mechanical features and electrical circuits of a signal system having sectional track rails energized by a direct current and operating home and distance signals.

[illegible] COMMUTATOR; Clarence W. Coleman, Westfield, N. J. App. filed Jan. 24, 1907. A commutator for an electric motor used in a signal box or other exposed location and designed so as to be protected against injury by ice and snow.

[illegible],266. TELEPHONE SYSTEM; Wm. W. Dean, Chicago, Ill. App. filed June 19, 1903. Circuits for common battery exchange system.

[illegible],281. RAILWAY SIGNAL; William H. Jordan, Brooklyn, N. Y., and George T. Hanchett, Hackensack, N. J. App. filed June 14, 1905. Relates to signals for electric railways which derive their power from the same source as that employed to propel the cars; has tappets adjacent the track rails instead of the usual sectional rail construction.

[illegible] ELECTRIC GENERATOR AND MOTOR; [illegible] vided into separate sections which have individual and common windings.

[illegible] MERCURY INTERRUPTER; [illegible] oxidation of the mercury and decomposition of the oil at the surface where the circuit rupture occurs.

866,331. RAILWAY SIGNAL; Frederic B. Camors and Charles Pelletier, New Orleans, La. App. filed May 1, 1906. Details of signal system having special trolleys between the usual track rails and having depending brushes from the locomotive to establish signal circuits to the engine cab.

866,349. TROLLEY-POLE SUPPORT; Hugh W. Fellows, Cahuenga, and Ira A. Cammett, Hollywood, Cal. App. filed Sept. 15, 1905. Relates to trolley pole supports and has means for holding the trolley wheel in contact with the wire and automatically releasing and dropping it when the wheel jumps from the wire, said means being set in action by the abrupt upward movement of the pole.

866,363. TROLLEY WHEEL; Henry L. Humphrey, Monroe, Mich. App. filed Oct. 12, 1906. The trolley wheel has a globular or ball joint with its axle so as to be capable of movement out of its plane of rotation.

[illegible] PUSH BUTTON; George H. [illegible], New York, N. Y. App. filed March 16, 1907. Features of construction of push button having an insulated base plate and metallic T-shaped contact plates arranged radially on said base plate and a spring actuated button having an interior metallic rim extending over the inner ends of the contact plates and an enclosing casing.

866,385. PROCESS FOR PRODUCING TECHNICALLY-PURE DUCTILE TANTALUM; M. von Pirani, Wilmersdorf, Germany. App. filed June 23, 1906. The process for producing technically-pure tantalum in ductile form, which consists in heating a mixture of vapors of tantalum chlorid and hydrogen, and in heating the hydrogenated tantalum thus formed to a white heat in a vacuum.

866,387. GALVANOMETER; Jules Richard, Paris, France. App. filed Jan. 27, 1905. A galvanometer having two magnets with pole pieces curved on concentric lines, the pole pieces of one being located within those of the other and a galvanometric coil mounted to turn around the center of the pole pieces.

866,421. PROCESS OF EFFECTING CHEMICAL REDUCTIONS AND PRODUCING METALS OR ALLOYS; F. M. Becket, Niagara Falls, N. Y. App. filed Jan. 31, 1907. The process of reducing oxids, which consists in effecting partial reductions by the oxidation of a non-metal and further reduction by the oxidation of silicon.

866,444. PROCESS FOR THE MANUFACTURE OF SOLID FORMS; Geo. Egly, Charlottenburg, Germany. App. filed Dec. 2, 1905. A process for the manufacture of solid forms which consists in mixing silicon with a material which is inert at temperatures up to that at which silicon combines with nitrogen, fashioning the mixture into a form, and heating the form in an atmosphere containing nitrogen.

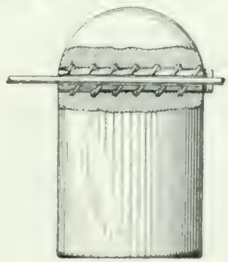
866,462. SELENIUM CELL; W. J. Hammer, New York, N. Y. App. filed Feb. 5, 1907. In a selenium cell, the combination of a support for the selenium with connections for its insertion in an electric circuit, and an inclosing vessel consisting in part at least of fused quartz.

866,471. ELECTRIC BELL; Robert L. Hunter, Lakewood, Ohio. App. filed June 9, 1905. A vibrating electric bell having a solenoid with a plunger instead of the usual pivoted armature.

866,484. ALARM; Thomas R. Kinsella and Christopher W. Hodgetts, Hartwell, Ohio. App. filed March 21, 1907. The handle of the controller has a push button inset therein so that the motorman may operate an electric gong whenever desired in a convenient way.

[illegible] METHOD OF MELTING THROUGH MASSES OF MATERIAL; [illegible] and W. Zollenkopf, Cologne, Germany. App. filed [illegible] A method of melting through masses of metal and masses containing combustible parts, consisting in temporarily heating the part of said mass to be melted by first passing and then extinguishing an electric arc and in thereafter supplying gases containing oxygen to said heated parts, substantially as described.

866,556. LIGHTNING ARRESTER; Azel Ames, Jr., New York, N. Y. App. filed [illegible] Lightning arrester of the [illegible] type having a winding on a cylinder of refractory material with an inset [illegible] the winding.



866,[illegible] Lightning Arrester.

866,590. ELECTRICAL SWITCH; Michael J. Kehoe, Fort Wayne, Ind. App. filed Nov. 2, 1905. Electric switch for the transmission of high-tension currents. Includes features of construction of the insulator and the supporting trellis, particularly designed to withstand severe weather conditions.

[illegible] INSULATOR; [illegible], Los Angeles, Cal. App. filed [illegible] threaded passage and a slot extending thereto and a screw-threaded [illegible]

[illegible] PROCESS OF PRODUCING MANGANESE SILICID; F. [illegible], Niagara Falls, N. Y. App. filed [illegible] tablishing an electric arc within the charge, surrounding the zone of [illegible] body of the charge, and withdrawing the product and supplying the charge-mixture as required, as set forth.

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CONTENTS.

Uses of Electrical Energy.

It may be said without any fear of contradiction that never before were so many uses of electrical energy from central-station circuits found under one roof as are now to be seen at the electrical show in Madison Square Garden. Along such lines a kindred exposition might well be given each year with advantage. The electrical manufacturer who deals with lighting or traction companies, or with a jobber, has no particular inducement or reward for going into a popular electrical show, though he does well to make a display at the annual conventions; but the central-station company has the whole great universal public for its field of possible patronage. Every effort made by way of education brings its return in the sale of energy; and every device shown in operation is needed by somebody or other. Hence we can find only words of commendation for the scope, spirit and character of the present show. It must do good. Even the exhibit of milking cows by electricity in a city where cows are not allowed has the charm of popular novelty. Probably some New Yorkers never saw a cow; a great many have never seen one milked; none before this has had a chance to see the milkmaid supplanted and her work done by electricity. And the cow evidently likes it, too!

The New Illuminants and Gas Competition.

One of the important questions regarding the new electric illuminants is their probable effect upon the competition of the gas companies with their mantle burners. When the question between gas and electricity narrows down merely to the production of the highest possible candle-hours for a dollar, irrespective of quality and of convenience, the former has long been admitted to have the better of the argument. The importance of the other factors mentioned in actual practice is sufficiently well shown by the magnitude of the electric lighting industry, which has from the beginning thrived upon competition with an illuminant admittedly cheaper, candle-power for candle-power. Save in the poorer business quarters, the use of electricity to the exclusion of its rival is pretty general. In the poorer streets of shops and the like, where there has to be pinching economy in expenses, gas has the field. In residential districts of every class gas is greatly predominant where it is available, with the exception possibly of occasional small districts where the houses are of the most elaborate description. There is a considerable amount, also, of street lighting by gas for reasons of economy or politics, and a rapidly increasing use of gas for power, cooking and occasional heating.

Starting from these data, in how far will the new illuminants like graphitized and metallic-filament lamps and high-efficiency Nernsts change the situation? It is tolerably evident that where cost is the determining factor the result will hinge upon the effect of the new lamps upon the bills for an approximately equal amount of light. Wherever, for example, large

incandescent units are now in use, they can be replaced, for instance, with tungsten lamps with a considerable reduction of expense. Where gas lamps are in use, the same replacement can take place in many instances, enough probably to more than make up for the lower bills on the former class of business. In residences, however, the case is somewhat different. The very wide use of gas stoves gives gas the entrée, so to speak, and from long custom it is not easy to introduce a second service to displace gas lighting. The residential lighting on an electric service is usually upon the maximum rate, which is generally far higher relatively than the maximum rate for gas, and electric cooking and heating is progressing rather slowly for this very reason. A successful attack upon this stronghold of gas lighting requires reduction of bills, not the mere bestowal of more light for the same money. The tantalum and tungsten lamps, if the latter become available in small units, will enable some progress to be made. At anywhere near the same cost, electric lighting will be preferred by the average householder. He does not, however, gain advantage, as does the small tradesman, from increase of light for the same total cost.

Of course, many central station men affect to hold residential lighting in contempt, but we fancy few of them would really enjoy seeing the gas company step in and elbow them out of what little they had been able to secure. The gas man manages to earn pretty good dividends on residence lighting, and the more sinews of war he thus acquires, the more successfully he can push the gas-engine business on the other flank. In street lighting some of the new lamps, especially the series tungsten lamps, are going to be important. The mantle burner goes well enough in street work to give the central station man a good many bad quarter-hours. The tungsten lamp should save him these and enable enough new work to be taken on to much more than make up for decreased bills on old work. Street lighting is the one branch in which the amount of business has been very seriously held back by high costs, whether gas or electric. The average street is to-day very inadequately lighted, and unless costs are reduced, it will remain so. A lamp taking only half the usual energy for given intensity makes possible equally good lighting at reduced cost and will inevitably lead to a great increase of total business, and in a form very desirable from the standpoint of economical operation. Some of the new arcs bid fair to be of use in the same way. The modern city ought to have something like double its present amount of street illumination if the current course of civilization keeps up. At a casual overlook of the situation it appears then that in street lighting lies the most successful line of attack on the present field of competition with gas, with the new lamps as weapons. Small shops also afford a good chance, but residential work requires a radical change in the usual rates policy in order to secure the business. From a strategic standpoint, however, residence lighting, as we have frequently pointed out, is of no small importance and deserves to be cultivated.

Electric Heating on a Large Scale.

Elsewhere we print an interesting article by Mr. Charles E. Waddell describing the extensive electric heating plant installed under his supervision in Biltmore House, the Vanderbilt residence near Asheville, N. C. The present plant is the most extensive application of electric heating to household purposes yet made, and in a paper recently presented by Mr. Waddell before the Engineering Society of the Carolinas, we learn that plans are under advisement whereby the electric service will be further extended to heating the house, principally by means of water storage of heat from energy transmitted during hours of the night, the present hot-water distributing system to be utilized. That an actual economy has resulted in the substitution of electric heat is not surprising in view of the high cost of coal and the low cost of electrical energy at Asheville—the former being $11 per ton and the latter 0.85 cent per kw-hour in this instance, owing partly to the existing large storage battery plant creating a favorable load condition. On the other hand, the extensive use of electric heat to raise water to high temperatures militated against economy. While the Biltmore plant owing to its special character does not furnish a lesson in electric heating of general application, it is an excellent example of the application of engineering principles to the working out of a special problem that might not have been attacked if current general opinion as to the possibilities of such a case had been accepted. Every branch of electrical engineering has at one stage or another suffered by the application of general considerations in cases where a careful study of the special conditions would have developed new data pointing the way to success where failure had been predicted. Electric heating has in particular been handicapped by viewing its economic possibilities too largely from the thermal unit standpoint, and the real lesson from Biltmore is that no electric heating proposition should be cast aside without a close canvass of all of the conditions affecting its possibilities.

Railroad Management and Safety Devices.

The *Journal* of the Franklin Institute for April, 1907, contains an interesting paper by Mr. J. C. Irwin on the safety devices which are in general use on railways in the United States, and particularly those which are being installed in the electric zone of the New York Central Lines terminating at the Grand Central Station. Power for operating the signal system will be taken from the Port Morris and Yonkers generating stations. These stations generate three-phase, 25-cycle currents at 11 kilovolts, and transmit the energy to the sub-stations along the track. The sub-stations are equipped with rotary converters to deliver 666 volts to the track. They will also be equipped with transformers for delivering 3000-volt alternating currents to the signal transmission line. The signal transmission line, divided into suitable sections, one to each sub-station, consists of a No. 0 bare copper wire, carried on the pole line. It supplies the primary windings of step-down signal transformers, which are placed on signal bridges, and which deliver single-phase alternating currents at 50 volts pressure. One side of each secondary winding is grounded directly. The signals on the bridges are set and controlled each by an independent ¼-hp alternating-current motor at 50 volts. The current to these signal motors is turned off and on at the contact points of track relays. The track relays, in their turn, are of the induction-motor type, permanently energized by 50-volt alternating currents, but operated by low-voltage alternating currents through the track, controlled by the car wheels of the passing trains. The angular play or movement of the rotor in the track relays is limited to about one-tenth of a revolution. By this means each train sets and clears its own block signals behind it.

It is evident from the paper that careful study has been given to the problem of combining electric propulsion by direct currents, and electric automatic signalling by alternating currents, using the same track for both systems simultaneously. No amount of mechanical skill displayed in automatic safety devices on a railroad can dispense with the necessity for continued vigilance on the part of the operating crews. After every appliance that can be recommended has been installed, there will still be accidents due to oversights and misunderstandings. Nevertheless, the liability to accident will be minimized, if no loophole is left for any catastrophe except by unavertable causes or those due to casual careless errors and oversights of the employees entrusted with the care of moving trains. Until we have patent perfect human beings, the best of mortals are liable to err occasionally.

Reinforced Concrete Poles for Overhead Lines.

The rate at which the North American forests are receding and disappearing is a matter of universal concern. The effects of rapid tree-felling are varied and far-reaching. The immediate industrial effect is a steady rise in the price of lumber, which is not wholly a misfortunte, since it gives the most effective possible incentive to public investigation and attention. The more remote effects are climatic, influencing the rainfall and river floods. These, although eventually serious, come about so slowly as not to attract public attention. The diminution in the forest wealth of North America has already become sufficiently evident to involve Federal Government action in the protection of forest reserves, while associations of private citizens have also been formed in various states with a view to urging further forest protection and prevention of waste. One of the heavy drains upon the forests is the supply of wooden poles for new overhead electric lines, as well as for the maintenance of existing lines. The ordinary wooden telegraph poles have been so cheap and easily procured in the past, that it has not been considered worth while to apply a preservative treatment to them, although in Europe, where lumber is more costly, it has been for many years the practice to subject wooden poles to preservative processes. As time goes on, however, and lumber advances in price, it will become increasingly necessary either to increase the working life of wooden poles in North America, or else to find a commercial substitute for them in some other material.

On suggesting substitutes for wooden poles, steel poles are naturally first thought of. We have long been familiar with steel poles, of both the tubular and lattice frame varieties, in trolley construction for city streets. But lumber must still advance very much in price before it can be directly economical to use steel poles in preference to wooden poles on the score of first cost. Moreover, steel poles, unless kept in good surface condition by regular applications of paint, are apt to be no more durable than some kinds of wooden poles in the ordinary temperate zone climate. Rust will destroy the steel poles at the ground line as certainly as bacteria will destroy the wooden poles. In the case of long-distance transmission lines, however, it has already become economical to employ steel towers in place of ordinary wooden poles, and these towers can readily be afforded periodical inspection and protection; but the rank and file of poles for all classes of ordinary telegraph, telephone and electric-light service cannot expect such patronage. A more recent substitute for wood has, however, been offered by reinforced concrete, or concrete holding and supported by steel rods. On a large scale of construction, such reinforced concrete poles could be built less expensively than the ordinary steel poles. A great advantage of reinforced concrete is the wonderful fact that the steel it contains does not rust, but is indefinitely preserved. Three substances are needed, either simultaneously or successively, in the presence of steel, in order that oxidation may be effected and rust ensure, namely, moisture, air and carbonic acid. Moisture at least finds its way to the surface of the steel embedded in the concrete, but whether it be the absence of the other ingredients or not, experiment shows that rust does not form so long as the steel is covered by a concrete layer. It is evident, therefore, that reinforced concrete poles should last indefinitely without inspection or repainting. In fact, the well known difficulty with reinforced concrete is its relative indestructability. A wooden structure can be readily dismantled, or destroyed by fire, in case of need for removal, but reinforced concrete structures are not to be dismantled except by dynamite, and are almost as expensive to remove as to erect.

It will probably not pay in the near future to replace wooden poles by reinforced concrete poles merely on the score of purchasing cost. Even at the present rates of advance in price, the ordinary wooden pole is likely to remain the cheaper for a long time to come. But it is quite possible that taking only into account the value of security against sleet storms, the concrete pole can already compete. At the present time, the ordinary wooden telegraph pole has not a sufficient reserve strength for lateral wind stresses, when the wires which it may carry are loaded with frozen sleet to a diameter of an inch or more. On such happily rare occasions we know by sore experience that the ordinary wooden poles are liable to break by the dozen. It is practically impossible to secure the necessary factor of safety for such emergencies with ordinary wooden poles. But with reinforced concrete poles of somewhat larger diameter than the ordinary, such a factor of safety could be secured, without an unreasonable extra cost. Moreover, the concrete poles would be straighter and more sightly in appearance than the wooden poles, a distinct gain for the average landscape and for the people who have to live with it. It is interesting to notice that the Pennsylvania Railway Company has recently been experimenting with concrete poles and that the results of some of the experiments were announced at the Atlantic City convention of the Association of Railway Telegraph Superintendents last June, as reported in our issue of June 29.

Lightning Protectors for Transmission Lines.

A very common device for protecting transmission lines in Europe from lightning is the "horn" arrester. It is not often used in America, although it has found some favor in the West. It consists essentially of two stout copper wires supported opposite to each other, on insulators, in such a manner as to offer a suitable length of air-gap. Above the air-gap the two wires bend away from each other like a pair of ram's horns, so that at the top they spread apart for a considerable distance. If an arc forms at the gap it rises up the wires until it breaks of its own length. A suitable water resistance to

ground is usually connected to one horn, the other horn being connected to a high-tension line. The disadvantage of the device, which is very simple and inexpensive, is that the rupture of the arc may occur on the top of an alternating-current wave and set up oscillations in the line circuit, whereas an oil-switch, when operating properly, always suppresses an arc at or near the zero point of current, thereby avoiding the establishment of oscillations. Another plan which is extensively used in Europe, with considerable evidence of success, is the water-jet arrester. Each high-tension transmission line is connected to an insulated metallic cup. Into this cup a thin stream of plain water pours, in a column of suitable length, from a grounded reservoir above. It also empties by a similar stream into a similar grounded cup beneath. The jet orifices are so shaped, in every case, that splashing or interruption of the liquid column is avoided. The water supply is kept up continually and the total flow is quite small. The result is that each of the lines is permanently grounded through a pair of liquid columns of such dimensions that the waste of energy is insignificant; but no dangerous rise of pressure is allowed to form. A jet protector of this kind may be applied at each end of a long transmission line.

Another lightning protective device which has recently come into service in Central Europe for transmission lines of fairly high pressure is the condenser. Condensers with attached fuses were tried at one time in the United States on low-tension overhead lines as lightning arresters, with the object of absorbing sudden electric stresses; but since they usually became punctured in doing their duty, and thus went out of service when perhaps most needed, they were soon given up. As now built the condensers are glass tubes about an inch in diameter and a yard long, lined internally and externally with a chemically deposited metallic coating, and containing water in order to distribute readily their internally generated heat. A group of half a dozen such tubes forms a unit for connection, in parallel, to a single high-tension line, where the same enters a station and just before connection to a choking coil. It is claimed that these condensers are able to withstand very considerable surge pressures without being punctured, and that they greatly supplement the action of the usual choking coil arresters.

Prepayment Meters.

The discussion on "Prepayment Watt-Hour Meter" at the last Michigan Electric Association convention, seems to indicate that this instrument is about to enter on a new era of usefulness in central-station work. It has long been recognized that the prepayment meter, whereby the customer pays a little at a time by putting coins in the meter, meets a real need with respect to a certain class of customers. The main trouble has been the high price of prepayment meters in the past, such meters costing so much more than ordinary meters that central-station companies did not feel that they could install them very extensively among the numerous small customers where their use would be most desirable. The price difficulty seems to have been overcome recently, however. It is among the small users that prepayment meters will be used most extensively. Many people who live in a hand-to-mouth fashion will use electric light if they can pay for it a small amount at a time, as is allowed by the prepayment meter. Then, too, in apartment houses in large cities where tenants move frequently, the prepayment meter does away with all the waste of labor due to discontinuing service for an outgoing tenant and replacing it again for an incoming tenant. It also, to a certain extent, takes the place of a solicitor to look after incoming tenants, because with a prepayment meter already in place, and connected up, many a customer will drop coins in the slot and go ahead using the electric light, whereas he might do something else if it were a question of going to a distant office and signing an application. While there may be some loss due to tampering with meters in various ways by customers, it is not likely to be as large as the expense connected with the collection of a large number of small accounts from customers.

Competition in Electric Cooking.

In cities where gas is available for cooking it is not reasonable to expect that the wholesale introduction of complete electric cooking outfits will be easy. That many such outfits will be used in the future, even in spite of gas competition, is certain; but we doubt the wisdom of large investment in educational campaigns which have as their object the introduction of complete electric cooking outfits in cities where gas is available. Where gas is not available the case is entirely different. Electricity can compete with gasoline, coal and wood much better than with gas, because the difference in convenience and cleanliness between gas and electric cooking is not nearly so great as between the latter and cooking with gasoline or coal. Where gas is in common use for cooking, the wise policy for the central-station company appears to be not to make extravagant expenditures to educate people to use electric ranges to supplant gas ranges. It is much better, instead, to concentrate efforts on the introduction of certain devices against which gas cannot so successfully compete. It has already been well demonstrated that the electric flatiron is so far ahead of other irons that it is almost beyond competition. When we come to cooking devices, the first point of attack should be at the dining-room table, where there can be no real competition from other methods of heating. A great variety of electric cooking appliances can be used successfully on the dining-room table, but the one which is of most universal usefulness and the one which is likely to produce the best revenue when well introduced, is the chafing dish. There are dozens of every-day cooking operations that can be performed with a chafing dish, although that utensil at the present time has the reputation of being principally a show affair for the concoction of various indigestible dishes at irregular hours. We believe that if the central-station companies of the country during the next few months would concentrate their electric cooking campaigns on the chafing dish and educate the public to the general usefulness of that utensil, the returns would be much more immediate than by attempting to cover the whole field of electric cooking. A breakfast as elaborate as is desired by many a small family can be prepared with a chafing dish and a coffee percolator, and the variety of dishes need not be below average either.

Special Efforts for Residence Wiring.

We are pleased to note at the present time the increasing number of companies which are making special efforts to secure the wiring of old houses. We have persistently advocated strenuous work to build up central station residence load, because

this load when secured in large enough quantities is a better revenue producer per dollar invested than many more spectacular classes of lighting which have not nearly as good an aggregate load factor. We are also glad to see that some of these special efforts are being directed squarely at securing the smaller residences, which are really the best paying kind of residence customers. One plan that works well is to make a standing offer to wire for half a dozen lamps in a residence for a fixed amount, perhaps making this amount payable in installments. The cost of this small number of outlets does not frighten the customer as the complete wiring of his house might, and once the half dozen lamps are in use, it is only a question of time until the customer will gradually extend the wiring system to cover the whole house. It is an easy way of getting an entering wedge. Some companies are crediting each customer with a certain amount of the cost of his wiring on his monthly bills. In other words, the company makes the customer a present of a certain amount of energy consumed in order to secure him as a customer. The drawbacks to the plan are that it requires a customer to pay considerable cash down at the start, and that existing customers may be inclined to question the fairness of making new customers a present of energy, when old customers have to pay full, rates.

As to the plans for wiring residences and taking payment by installments covering one or two years, they are unquestionably good. If the company does not do construction work itself, arrangements can usually be made with local wiring contractors, the company carrying the accounts if necessary. One matter in this connection, however, does not appear to be receiving the attention it deserves, in spite of the fact that central-station men in general have been the first to recognize the necessity for good illuminating engineering. In connection with some of these special efforts and offers for residence wiring, it is frequently necessary and advisable for the company to have made up a large number of inexpensive and simple fixtures to install under these special contracts. It is right here that the central-station company has a splendid chance to recommend to the customer and to get installed fixtures and glassware which will not be the notorious complaint-producers that much of the junk installed to carry electric lamps has been in the past. The ultimate popularity of electric light in the small home is to depend entirely on the results obtained and the economy. It is therefore of very first importance that fixtures and glassware, even though they be cheap (and they need not be expensive), should be such as to give satisfactory results with reasonable lighting bills. The average fixture manufacturer knows and cares little about the results. The central station that depends on him for advice is lost. It is up to the central-station company to insist on proper design. We have known altogether too many companies who through oversight have not done this, even though the company had competent engineers in its employ.

Illuminating Engineering as a Business-Getter.

Much has been said about the necessity of illuminating engineering knowledge in the commercial department of central-station companies, but there has not as yet been enough detailed effort either to acquire this knowledge or to put it into practice. It is not to be expected that all the men in the commercial department of a central-station company should become proficient illuminating engineers on short notice. Neither is it expected that they should become motor experts in a short time. Nevertheless, as time goes on the successful central-station solicitor and commercial man must acquire a good knowledge of illuminating engineering and put it in practice if he is to be of the most use to himself and his company. In the larger companies probably many of the solicitors appreciate in a general way that it is a good thing for the company to have electric light employed in an efficient way by its customers. We doubt, however, whether many of them appreciate how immediately valuable illuminating engineering can be in getting contracts. In canvassing small houses along the company's lines (of which there are always many) it is worth much to the solicitor to be able to point to examples in the neighborhood where customers who have recently had their houses wired and the illumination planned according to sound principles, are getting very satisfactory light with very small monthly bills. A few examples of this kind in a neighborhood are apt to be worth more than all the other influences put together in getting this class of business. Take, for example, the house cited in the Electrical World of Nov. 3, 1906, in "Electricty vs. Kerosene for Residence Lighting," where by virtue of economy in use and good illuminating engineering, the average bills for the first year amounted to only $1.28 per month, with $1 minimum bill and high rates. Practical examples of this kind can only be obtained and brought home to a neighborhood by a solicitor planning the lighting of a few houses in each neighborhood as an introduction. Then by keeping the matter well in hand, in order that extravagant installations may not be made, he may expect continued success in securing small residence lighting in his district.

But some central-station men will say that there is no profit in customers with such very small bills. This may be true, but that does not tell the whole story. The first year's consumption of a customer is seldom a true indication of the revenue to be expected from him. The first year he regards as a period of experiment with something which is likely to be very costly if wasted. After he finds that it will not bankrupt him, he gradually becomes more liberal in the use of energy and, perhaps, adds small heating appliances. It is to the new customers, however, that prospective customers are most likely to look for examples and to which the solicitor should direct attention, because they represent usually the greatest economy obtainable. Another way in which illuminating engineering is of immediate practical value is in retaining dissatisfied customers in both the down-town and residence districts. A customer retained is better than a new one gained. It is seldom that the improvement of a customer's installation means any permanent loss of income from him. In the case of stores, the cry is usually for more light for the same money, rather than for the same light for less money. Even where a solicitor by suggested changes reduces a merchant's lighting bills, it is usually the case that before long the customer will sign up contracts for additional business of the more profitable sort, such as window, sign and display lighting, so that in the end he will be spending more money with the company than he did at first and spending it more cheerfully. Then there is the question of competition with other illuminants. It goes without saying that the man who can make the most use of a given amount of electric light is the solicitor who can show the best results in [illegible] competition.

Empire State Gas and Electric Association.

[illegible] Association has been holding its annual meeting in New York City. The regular sessions were held on Wednesday, Oct. 2, in the auditorium of the New York Edison Company, 44 West Twenty-Seventh Street, but the convention was preceded by a special joint meeting with the Street Railway Association of the State of New York at the concert hall of the Madison Square Garden, and many of the members stayed during the week to devote time to the interesting Electrical Show now being given in the Garden.

The joint meeting on Tuesday evening was of a notable character, and was well attended. Addresses were delivered by Hon. Frank W. Stevens, chairman of the Public Service Commission of the Second District on the work and policy of the body. Mr. Henry J. Pierce, president of the International Railway Company, Buffalo, spoke upon the electric railway situation of to-day. Dr. Alexander C. Humphreys, president of the Stevens Institute of Technology, discussed the control of gas companies by state commissions, and Mr. Everett W. Burdett, chairman of the Public Policy Committee of the National Electric Light Association, read a paper on public control from the corporate standpoint.

Commissioner Stevens, without mentioning the names of the companies, told of complaints of the inefficiency of some of the railroads, and expressed his horror at the numerous deaths and injuries caused by contributory negligence. He said that the commission will do all in its power to promote the efficiency of railroads, but that in doing so the legal rights of the corporations will be protected. The commissioner said that it was time that the power of the State was invoked to remedy certain evils, and the Public Service Commission deserved to have the support of the corporations. "The companies are entitled to a fair compensation; the public will pay a liberal price for efficient service, but not for poor service. We will do our duty to the public, but I assure you that it will be done without any theatrical effects. There will be no attempt to coerce the corporations or hamper trade."

In his address Dr. Humphreys reviewed the course of recent agitation, investigation and legislation directed at corporations with such indiscriminate zeal and expressed his belief that real reforms would be secured, although labor and capital were both likely to suffer from the loss of credit and confidence. "While a panic has thus far been averted, properties have been tremendously depreciated, and innocent investors have been injured." Moreover, many people had overlooked the evils involved in the creation of powers of inquisition and control, and the centralizing of power in bureaucracies. He continued as follows:

As we are gathered here to listen not only to generalities but to that which possibly may be more directly helpful, I will take occasion now to urge the gas men of New York State, particularly as represented in the Empire State Association, to co-operate with other bodies in the efforts now being made to develop a uniform system of accounts and records, and, in that connection, to do everything in their power to co-operate with and secure the co-operation of the two New York State commissions. It is well that the Empire State Association has appointed a committee on uniform accounting, but we do not want this uniformity confined to one state. We should have one system for all the companies of the United States and then we may hope that the state commissions will find that they can secure the maximum of efficiency in this regard by taking advantage of the system so developed.

Many people speak quite glibly as to the possibility of developing a uniform system of accounts. Those who start out to develop such a system, thinking they have an easy problem to solve, are from the first doomed to failure and disappointment. I have had perhaps an unusual experience in this direction and I do not hesitate to say that let the companies working under a uniform system be absolutely under one government, let that control be concentrated even in one man, let the system be devised with consummate skill and maintained and operated with unflagging zeal, discretion and loyalty, it will still be difficult and, perhaps, impossible to have the accounts so that they are at once absolutely comparable. All the variations and the conditions cannot be covered by one system of accounts, records and instructions, and even if they could be, unavoidable variations as to the application of the instructions would be developed through the personal equation. But let us do all in our power as public service corporation managers and as good citizens to keep this variation down to a minimum.

One very disturbing element in the uniformity of accounts, and especially the records of costs, is the, in some ways, intangible and, in other ways, very real element of depreciation. Unless our commissions can come to a realizing sense of the difficulties they have to meet in connection with this matter of uniformity of accounts and records, they too are doomed to failure, at least to the extent of making unjust decisions.

For many years the gas companies of the State of Massachusetts have been governed by a commission, and, in some ways, well governed. In other ways, injustices have been done to the stockholders and these injustices have been in part due to the accounts as kept by the companies, and in part to the way in which the returns have been required and treated by the commission. One point certainly has been demonstrated, namely, that the returns as published are not tabulated according to a uniform system, in other words, that you cannot take the published records of the Massachusetts commission and make fair comparisons on the basis of the data so furnished.

Here comes in an injustice, not only to the companies of Massachusetts, but still more to the companies outside of Massachusetts, for they have no power of correction. Those who are not fully informed take it for granted, because they find certain data tabulated apparently according to a uniform system, that all the figures in a certain column must represent the same thing for each company represented. In many cases this is far from being the truth, as I have shown in my New England Association paper referred to and will show in the paper which I am about to read before the American Gas Institute.

Therefore, in New York State, in endeavoring to co-operate with and secure the co-operation of our new gas commissions, we have to consider not only our duty to our own companies, but we have to consider our duty to the other companies throughout the United States, for throughout the United States no doubt will be published the results of our workings, and, unless the accounts are correctly kept according to a uniform method, correctly reported and correctly tabulated, unwarranted and misleading comparisons will be made.

Mr. E. W. Burdett discussed public control from the corporate standpoint under three heads: past, present and future. He showed how eager the public had been to foster modern corporate utilities into existence until they had become commonplace adjuncts of daily life. The clamor for their introduction had become that for regulation, and railroad rate legislation had been the first outbreak. But here at once the interposition of the Federal judiciary had withstood spoliation.

The Supreme Court, while affirming the right and exclusive authority of state legislature to regulate rates and fix maximum charges, has also subjected the reasonableness of legislative action in this respect to the test of judicial inquiry. It has insisted upon rates which are sufficient alike to give a reasonable return upon a reasonable investment and at the same time be inherently fair and reasonable to the public. While insisting that ordinarily a corporation is entitled to some profit upon its enterprise, the court has not as yet undertaken to say what that profit shall be, except in one case (192 U. S., 201:—1903) that the rates of a water company may be lawfully reduced by legislative action to a point where the business will yield only 6 per cent upon the fair value of the investment.

It seems natural and appropriate to suggest at this point that one of the most important functions of the newly created Public Service Commission of the State of New York may be to determine, in the first instance, what a reasonable return is upon capital invested in the public service corporations which are under

their supervision and control; and it is at least reasonable to indulge the hope that they will not undertake to limit that return within the narrow margin which has been accepted by the court as sufficient in the case of such a comparatively simple and well-established enterprise as that of the supply of water. There is very little analogy between the cases. If the return on capital invested in what can be properly described as essentially experimental industries, such as street railway and electric enterprises, is to be confined to any figure as 6 per cent, it will, in my judgment, be a sorry day, not only for those who have their money at hazard in these enterprises, but for the public at large whose interest lies in their proper development and extension.

As conservative a man as President Eliot, of Harvard University, has recently said: "In such enterprises there are often heavy risks . . . Hence men will not undertake them for the ordinary return on safe investments. They must be induced to venture their capital and their capacity by a prospect of unusual returns." ("The Ethics of Corporate Management," Chicago, March 10, 1906.)

So far as I know, public service corporations other than steam railroads have in but rare instances been made the subject of state regulation or control, by special tribunals created for the purpose. They have ordinarily been left at the mercy or state legislatures or, worse yet, of the various municipal authorities where they operate. They have thus been forced more or less into state and local politics, a course justified, if at all, by the dictates of "the first law of nature"—that of self-defense. But in 1894 the State of Massachusetts entered upon a more enlightened experiment in public regulation and control of quasi-public enterprises; and since that time the capitalization, debt, rates, service and general conduct of the public service corporations of Massachusetts have been within the control and regulation of public bodies created for the purpose. What has been the result of this experiment can, I think, be fairly gathered from the fact, which I think is a fact, that those concerned with corporate, as well as those concerned with public interests in Massachusetts, will be found to be in practical agreement that the laws referred to and their administration have been fairly satisfactory, and that no considerable force could now be mustered from any quarter to repeal them.

The one primal defect in the laws of Massachusetts regulating and limiting the stock and bond issues of its public service corporations—an error which ought to be avoided in the administration of the law in New York—lies in the failure to discriminate between new enterprises or hazardous extensions of old enterprises, on the one hand, and well-established industries on the other. Admitting that the securities of the latter can properly be limited to amounts sufficient only to cover the reasonable expense of ordinary additions to plant, and the returns upon them to the going rates of interest or profit legitimate in established business of like character, the reasonableness of the rule disappears when applied to extensions of unusual character or into fields of doubtful profit, and particularly to cases of incursions by new enterprises into hitherto unexploited fields. The pioneer who first dares to explore hitherto unexploited territory, or the inventor who is willing to increase the usefulness of his enterprise by extending it into channels of doubtful profit, should not be treated in the matter of initial securities or the returns upon them with the same strictness as the conservative investor in an established business. To quote President Eliot again: "There is much to be said on behalf of the proposition that there shall be no water in the stock of public service corporations; yet if this principle had been applied to all street railway and lighting companies during the past 35 years, the public would have waited long for facilities which they have greatly enjoyed and profited by."

The great authority of the Supreme Court of the United States, as expressed in the case of Handley vs. Stutz, 139 U. S., 417, stands for substantially the same proposition.

The present attitude of New York corporations is one induced by necessity. It is a condition and not a theory which confronts them. Whatever may have been their former attitude is immaterial; at present they have no choice except to submit themselves to a control more drastic and complete than any heretofore known in this country. They are necessarily on their good behavior. They may not like the commissions, but they cannot afford to make faces at them.

What, then, shall the future attitude of the corporations be toward public supervision and control? In my opinion it should be a friendly, and not a hostile, attitude. If I were in charge of a large corporation in the State of New York I would not, if I could, repeal the existing law, though I confess I should favor some radical amendments of it. The greatest objection to it is, as I have said, that everything depends upon the men who administer it. It does not announce the principles upon which they shall act, nor undertake to outline the policies which they shall adopt. Assuming, however—as I am glad to think I have a right to assume—the high character and capacity of these gentlemen, and their disinterested and patriotic purpose to administer the law in the interest of invested capital, as well as of the public, I believe that a great opportunity lies before the corporations of this state to so influence the opinions of the commissioners that the highest good to all concerned will result from their construction and administration of the law. But this cannot be successfully done if gone at in a narrow, partisan, or altogether selfish manner. The settling of the questions which will arise before the commission will involve great principles of law and of public policy, alike of interest to the community and of vital importance to the companies. All fears of adverse results are dissipated if one entertains the conviction, as I have no doubt the body of the commissioners do, that the true interests of both the corporations and the public are substantially the same; that the necessity for injustice to either in order that justice may be done to the others does not exist. It is not for the interest of the public that the corporations shall be crippled in their activities or unreasonably limited in their profits; and, on the other hand, it is not in the interests of the corporations that the public shall be subjected to exorbitant rates, poor service or contemptuous treatment. Time does not permit, and perhaps this would not be the proper occasion, to undertake to develop and demonstrate the truth of these general propositions, but reliance may well be put upon the fact, which I think cannot be successfully disputed, that both in this country and abroad the public are best served where the corporations are most prosperous, and the corporations are most prosperous where the public is best served.

This state of things will, in my judgment, be greatly promoted in the future by the application of a principle, or, perhaps, it should hardly be called more than a device, which, while successfully applied abroad, has not as yet had much attention in this country, to wit, the so-called "sliding scale," under which, when a proper relation has once been established between a company and its customers, the profits of one are made directly dependent upon the economies to the other.

Mr. Henry J. Pierce in dealing with the electric railway situation pointed out that the public was ever demanding greater facilities, all of which meant increased expense, while at the same time the authorities were constantly increasing taxation. This meant one of four things—poorer service; price of labor or material reduced; rate of fare increased, or taxation reduced. Private or industrial plants could be closed down or limited in dull times, but a public service corporation is required to keep working up to the limit. There was no practicable chance to increase fares, but with lesser burdens in taxation, street railways could do something to meet the demands on them for constant improvement in the service. For himself and fellow managers of street railways, he could promise cheerful acceptance of the new law, but the acts of the commissions must not all tend one way and discriminate against the corporations, which to-day simply could not raise money for improvements because of hostile legislation and regulation. He closed with an earnest plea for a reduction in the burdens of taxation in this time of vast demands and colossal requirements.

Electric Light Companies at the New York Electrical Show.

[illegible] in Madison Square Garden, New York City, on Sept. 30, and which will continue until Oct. 9, differs greatly from previous electrical shows held in New York in that the local electric light companies are preeminent among the exhibitors. The New York Edison Company, the Edison Electric Illuminating Company of Brooklyn and the United Electric Light & Power Company of New York, are all conducting a campaign of education for the benefit of their respective patrons and for the general public. The central-station feature predominates and this fact is blazed from the Madison Square Garden tower by large electric signs with the names of the three companies.

Each of the companies, besides making an extensive exhibit, has given to its patrons or placed at their disposal tickets of admission, of which privilege most customers have availed themselves. Nor has frugality prevailed. Realizing that only by an appropriate setting can the advantages of electricity be best presented to the lay mind the proper environment has been provided and the sum expended by the three lighting companies to secure it aggregates not less than $60,000. The lighting companies have also as if by common consent, specialized, so to speak, in their displays. The New York Edison Company makes the industrial application of electricity the keynote of its exhibit; the Edison Electric Illuminating Company of Brooklyn, shows its many domestic applications, and the United Electric Light & Power Company features the various uses both industrial and domestic to which alternating current may be applied.

The booth of the New York Edison Company is in the center of the arena, and is shown herewith. Everything in it is in actual operation. In one corner are shown two hydraulic pumps, one direct-connected to a 4-hp motor, and the other belt-driven by a 10-hp motor. Adjoining these are a small circular saw, hacksaw, bench-drill, and a line of motor-driven buffing machines, grinders and blowers. In the opposite corner are three pieces of apparatus of interest to printers; [illegible] motor-driven proofing press, and a Jordan job press. On a table beneath the dome are various motor-driven meat-choppers, coffee-grinders, buffers, vibrators, etc., and two oscillating fan-motors on ornamental pedestals. In the rear corner of the booth is a line of electric breast drills, grinders and hoists, and immediately at the left is a motor-driven dough mixer, and also a floor-surfacing machine and an electric potato-peeler. Automatic air pumps, letter-copying machines, vibrators, and a large motor-driven turbine cleaner complete the exhibit. Needless to state the booth is attractively decorated and illuminated and the New York Edison's well gotten-up literature is distributed.

Blazoned in letters 12 ft. high and 93 ft. long, the word Brooklyn stands out in sharp contrast at the west end of the spacious Garden. This sign is over the booth of the Edison Electric Illuminating Company of Brooklyn, whose display is one of the features of the show. The company shows a complete home of seven rooms, with doorways leading from one to the other, started with an office or reception room. In this office is the registering staff for visitors who call. The row of seven rooms is open to public view from the outside, but entrance is only through the office. Twelve courteous lady attendants and demonstrators, attired in pink, accompany visitors through the apartment and explain the various devices shown.

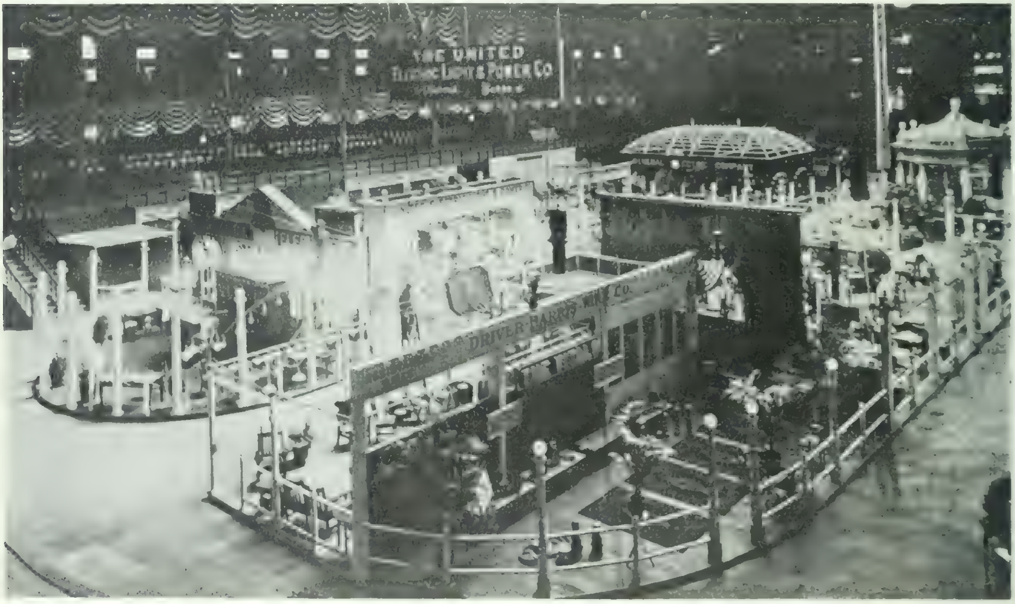


FIG. 1—GENERAL VIEW OF THE ELECTRICAL SHOW IN MADISON SQUARE GARDEN.

The aim of the company is to place before the public in concrete form an illustration of the advantages of an electric service in the home—the "tone," conveniences and comforts it adds to the household.

A feature of the first room is the telharmonic. Here are also found an electric cigar lighter, an electric fountain, and an electrically driven sewing machine. Next to the office is the bed chamber tastefully fitted and decorated in Nile green. Here are shown such electrical appliances as a hot-water bottle, bed-warming pad, curling iron, foot warmer, nursery milk-warmer and a system of lighting which is very convenient. Adjoining the bedroom is the drawing room. An electric grate lends a homelike appearance to the room. In one corner is a piano with a Tel-electric attachment. A neat little hall leads from the parlor to the dining room and shows what can be

done in the lighting of a house. By simply pressing a button all the lamps may be switched into circuit, or a solitary lamp left lighted for the late comer. An electric heater is also shown in the hall. A Flemish dining room adjoins the drawing room. Here is to be found a chafing dish, coffee percolator, hot-water heater, warming pan, vacuum carpet sweeper and other articles of a well-appointed dining room, all operated by electricity. In the kitchen are shown a dish-washing machine with a rotary action and an additional machine for rinsing. There is an electric stove with four heaters and an oven, and an electrically operated hot-water heater. Other useful articles are a coffee

FIG. 2.—EXHIBIT OF THE NEW YORK EDISON COMPANY.

grinder, soup kettle, deep fat kettle, broiler and a ventilating fan. In the laundry there is to be found an ice machine and refrigerator, and also an electric washing machine, consisting of a washtub and wringer. The color display in the decorating of the various rooms is most artistic and the furnishings are in keeping with the decorations.

The United Electric Light & Power Company occupies the four spaces on the north side of the center aisle as one enters the Garden. The booth proper is divided into four parts, showing lighting, heating, motor and industrial exhibits.

In the lighting part of the booth are shown various types of alternating-current carbon, metallized-filament, tantalum, tung

FIG. 3.—BOOTH OF THE UNITED ELECTRIC LIGHT & POWER COMPANY.

sten and Nernst lamps and various styles of electroliers and portables. A particularly beautiful portable is that representing a water fountain.

In the electric-heating part of the exhibit an electrical range is shown in operation as well as various modern household heating appliances, such as irons, hot-water bottles, radiators and curling irons.

[illegible]

Electrical massage machines and buffing machines are shown, [illegible] A Wappler & Bartlett electrical massage machine is also shown for the first time.

Electric fountains are shown in operation in the arches of the exhibit. In these the lamp is hidden under vari-colored glass, over which the water is caused to play by means of a small motor-driven pump, enclosed in the lamp stand. By this means the same water is used over and over again.

In the industrial part of the exhibit two applications of alternating current are predominant. One feature brings to notice the extended use of alternating current in the plant of the National Biscuit Company at Tenth Avenue and Fifteenth Street, New York. This exhibit and the one of the newest machine exhibited at the Garden, that of an automatic spot welding machine, manufactured by the Universal Electric Welding Company, attract much attention. This machine makes 85 welds per minute, and is used for attaching handles to can covers, plates, knives and garden implements. Souvenirs showing this electric welding are distributed among the patrons of the booth.

The arch covering the booth contains at its top 10 tungsten lamps fitted with 8-in. Holophane globes. Over the top of the entire booth is a huge electric sign, 8 ft. high and 32 ft. long, containing 519 lamps, reading "The United Electric Light & Power Company, 1170 Broadway, Alternating Current." The booth proper is banked with palms, and these, with the other furnishings, are very pleasing to the eye. In addition to the 8-in. Holophane globes at the top of the arch, the booth is surrounded by 20 pillars, on the top of which are 8-in. sand-blasted globes. Uniformed attendants take care of the advertising matter of the company and the booth also contains a business place in charge of a representative of the sales department, where bills are received and contracts can be signed.

Fall Meeting of the American Electrochemical Society.

The fall meeting of the American Electrochemical Society will be held at the Chemists' Club, 108 West Fifty-Fifth Street, New York, Thursday, Friday and Saturday, Oct. 17-19. There will also be a reception at the club on Thursday evening and a banquet on Friday evening at the Liederkranz Club. An excursion has been arranged on Friday afternoon to the laboratory of Thomas A. Edison, and on Saturday afternoon several power plants in New York and vicinity will be visited by different parties. An excursion to the large electrolytic copper refinery at Chrome, N. J., has been arranged for Saturday afternoon. A final entertainment will be tendered to the members in the form of a "smoker" by the Chemists' Club on Saturday evening.

On Thursday evening Dr. George F. Kunz will deliver a lecture on "The Diamond and Moissanite," following which Mr. E. G. Acheson will lecture on "Defloculated Graphite" with experiments. The meeting of Friday morning, to be held at the Chemists' Club, will be devoted to the subject of "Electrometallurgy of Iron and Steel." On Saturday there will be a morning session at Columbia University for the reading and discussion of papers. Following is the programme of papers:

[illegible]

"On the Electrothermic Reduction of Iron Ores," by Messrs. Albert E. Greene and Frank S. MacGregor. "The Electric Furnace Experiments for the Production of Pig Iron at Sault Ste. Marie," by Dr. Joseph W. Richards. "Electric Furnace Experiments," by Dr. H. N. Potter. "Discussion of Moissan's Experiments on the Boiling Points of the Metals," by Dr. O. P. Watts. "The Electrometallurgy of Zinc," by M. Gustave Gin. "A New Application of Chlorine in Metallurgy," by Mr. C. E. Baker. "The Heat Conductivity of Carbon," by Mr. F. A. J. FitzGerald. "Granular Carbon Resistors," by Prof. S. A. Tucker.

Saturday Morning Session:

"Physico-chemical Notes on the Aluminates of Soda," by Mr. P. B. Sadtler. "Action of Ammonium Persulphates on Metals," by Mr. J. W. Turrentine. "Note on the Use of the Capillary Electrometer for Alternating Voltages," by Mr. M. G. Floyd. "Electroscopic Determination of Radium in Some Tufa at Hot Springs, Arkansas," by Dr. Herman Schlundt. "Electrolytic Separation of Silver and Copper," by Mr. H. W. Gillett. "Electrolytic Determination of Minute Quantities of Copper," by Mr. E. E. Free. "Electrolytic Reduction of Nitric Acid," by Dr. H. E. Patten. "Electrochemical Methods for the Qualitative and Quantitative Determination of Free Silicon in the Pressure of Silica, Silicates, Oxides, Free Carbon and Carborundum," by Mr. W. R. Mott. "On the Nature of Electrolytic Conductors," by Dr. L. Kahlenberg. "The Electrolytic Theory of the Corrosion of Iron," by Dr. A. S. Cushman, with demonstrations. "On the Treatment of Storage Battery Elements Before Putting them Out of Commission," by Prof. O. W. Brown. "A Further Study of Concentration Cells," by Dr. Henry S. Carhart.

Prof. S. A. Tucker, Columbia University, is chairman of the New York committee of the society, and Mr. Alois von Isakovics, Monticello, N. Y., is the local secretary. During the meeting there will be an exhibition of some new electrochemical product apparatus.

CURRENT NEWS AND NOTES.

STREET RAILWAY CONVENTION.—At the Atlantic City street railway convention, Mr. W. J. Clark has promised to read a paper on the important subject of "Municipal Ownership in Great Britain and in the United States." For a long time past he has made a special expert study of this great modern problem and its data.

PUBLIC POLICY.—The report of the Public Policy Committee of the National Electric Light Association, together with all the reports of that committee's sub-committees, is now available in printed form, and in accordance with the statement recently made in the monthly bulletin of the association, extra copies of this can be obtained from the association at the price of $1 each.

THE TELEGRAPH STRIKE still continues, but no further bodies of men have been called out, and in Canada there has been a wholesale return of the operators to such positions as might be open to them in the Great Northwestern System, owned by the Western Union. A petition for better service has been made by some 50 members of the Produce Exchange in New York City. The exchange has over 1000 members. An investigation of the alleged delays is being made.

NEW YORK INTERSTATE TELEPHONE.—Last week at Syracuse, the following officers were elected at the meeting of the New York Interstate Telephone Association: President, J. H. Griswold; vice-president, Wilbur H. Johnson, Buffalo; secretary, R. Max Eaton, Niagara Falls; treasurer, George R. Fuller, Rochester; executive committee, B. T. Bellander, George B. Wright, Williamsport; J. H. Griswold, Albany; Wilbur H. Johnson, Buffalo, and C. H. Poole, Utica. The members of the executive committee were elected as delegates to the convention of the National Telephone Association which will be held in Chicago in December.

AN EDISON ENGINEERING COMMISSION has been appointed by the executives of the Edison Illuminating Companies of New York, Chicago, Boston, Philadelphia and Brooklyn, to make a thorough investigation and to report with recommendations on the design, construction and operation of the generating, transmission and distribution systems of each of the five companies. This commission is composed of three engineers from each company, and is organized as follows: W. F. Wells, of Brooklyn, chairman; P. Junkersfeld, of Chicago, secretary; W. C. L. Eglin, of Philadelphia, treasurer; L. L. Elden, of Boston, chairman, committee on operation; P. Torchio, of New York, chairman, committee on design, and W. C. L. Eglin, of Philadelphia, chairman, committee on purchased apparatus.

A. I. E. E. MEETING.—The next regular meeting of the institute will be held in the Engineering Societies Building, New York City, on Friday, Oct. 11, at 8:15 p. m., when a paper will be read on "The Grounded Neutral, With and Without Series Resistance, in High-Tension Systems," by Paul M. Lincoln, engineer of power division of the Westinghouse Electric & Manufacturing Company. Experience papers will be presented on the same subject by F. G. Clark, superintendent of power station of the Pennsylvania Tunnel & Terminal Railroad Company, and George I. Rhodes, assistant-engineer of the Interborough Rapid Transit Company of New York. The papers and discussions cover advantages and disadvantages of the grounded connection under various conditions, more particularly the possibility of cutting out faulty feeders without interrupting the service. The function of the series resistance in the ground connection will be considered both theoretically and practically.

DR. STEINMETZ'S LECTURES ON LIGHT AND ILLUMINATION.—The Polytechnic Institute of Brooklyn offers the following interesting course of lectures on radiation, light and illumination by Dr. Charles Proteus Steinmetz. The lectures will be given in the evening and will be illustrated by occasional experiments. The dates and subjects are as follows: Nov. 7, Radiation as a Form of Energy; Physical and Chemical Effects of Radiation; Nov. 21, Physiological Effects of Radiation; Visible, Infra-red, Ultra-violet and X-radiation; Dec. 12, Black-body, Gray-body and Colored-body Radiation; Jan. 9, Selective Radiation of Gases and Vapors, Arcs and Discontinuous Discharge; Jan. 23, Efficiency of Transformation into Radiant Energy; Feb. 13, Measurement of Radiation and Photometry; Feb. 27, Commercial Illuminants, Flames, Incandescent Lamps and Arc Lamps; March 12, Illumination and Illuminating Engineering.

TELEPHONE SIGNAL SERVICE.—Something unique in navigation aids will be the telephonic marine signal service which is now being established on the St. Lawrence River between Quebec and Montreal, and which will be in use early in October. The service is to provide for a system of communication between ships and shore, and will enable the owners and agents to know of the progress of ships between these two cities. It will also enable the captains of vessels to learn of the condition of affairs in the river and to avoid any unusual or unexpected danger. There is no such service in existence anywhere else in the world, and, with no experience to be guided by, the engineers were obliged to originate a service. At each station will be erected a mast 65 ft. high with a cross-spar 25 ft. in length, placed about 20 ft. from the top of the mast. From this cross-spar signals will be displayed, one side for down-stream and the other for up. When signals are to be displayed, an ensign will be flown from the masthead. At night a white light at the masthead will call attention to signals. A set of flag signals has been prepared for day use, and a set of lamps arranged for use after dark. One signal will enable vessels which desire to pass through Quebec to take on a pilot without carrying on the continuous whistling performance which now annoys people in Quebec. The various messages received and to be sent will be dispatched from one station to another by telephone to either Montreal or Quebec, and then to the agents of the ships interested.

ENGINEERING AT UNIVERSITY OF MICHIGAN.—Nearly 500 freshmen engineers have been enrolled this year at the University of Michigan.

HARVARD ENGINEERING COURSES.—The enrollment in the Harvard Graduate School of Applied Science, which now enters its second year, is more than double that of last year. A degree, such as A. B. or B. S., is required for admission to this school, but engineering is also taught at Harvard as an undergraduate study.

THE MAILING LIST.—The Technical Publicity Association devoted the first meeting of the year, Sept. 26, to the consideration of "The Mailing List." N. W. Gage of the "Buyers' Reference" and Burdette Phillips, of the "Central Station List" and "Electric Railway Directory," addressed the association, and a long discussion followed in which various members told their experiences in making and using mailing lists, and in some instances compared this form of advertising with trade magazine advertising. It was decided to take up other phases of this broad subject at the October meeting of the association.

WIRELESS ENERGY TRANSMISSION.—A special cable dispatch from Paris of Sept. 26 says: "A young Lyons scientist asserts that he has discovered a means of transmitting electrical energy without wires. Experiments are now proceeding in the grounds of the Château du Cret, belonging to a Lyons manufacturer named Auguste Villy. A miniature car, running on rails, was recently propelled a distance of 200 yds. by means of energy from an electric transmitter. Details of the process are withheld for the present. Patents were taken out in August. A syndicate of bankers has been formed to work the invention."

INDUSTRIAL EDUCATION.—As a preliminary to its gathering of manufacturers, trades-unionists and educators in Chicago on Dec. 5 to discuss industrial education, the National Society for the Promotion of Industrial Education has sought the views of 300 manufacturers and labor men. Of the early replies received a large majority of both classes favored strongly the introduction of public trade and technical instruction. Bulletin No. 3 of the society, which can be obtained free on application to C. R. Richards, secretary, care of Teachers' College, New York, gives the views of some of the manufacturers and labor men.

FIVE THOUSAND MEMBERS.—The American Institute of Electrical Engineers has just passed the five thousand member mark, and bids fair to gain at a rate of over one thousand a year. This does not include students. The past year has been one of great success and usefulness in every direction, and Dr. Samuel Sheldon, as president, has shown remarkable energy and executive ability, winning commendation in every quarter. In fact his work as an administrator has attracted such general attention, as to lead to his recommendation for the presidency of the Massachusetts Institute of Technology, an institution for which his high technical training and wide experience as a teacher also give him notable qualifications. In short it may truly be said that Dr. Sheldon leaves the Institute presidential chair with a well-deserved and greatly enhanced reputation.

WIRELESS TELEGRAPHY IN FRANCE.—Consul-General Skinner, of Marseilles, reports the following information, received from the French Director of Posts and Telegraphs, concerning government wireless telegraph stations: "At present there are two stations for wireless telegraphy, one at Ouessant and one at Porquerolles. These two stations are prepared to handle private messages, to which may be added the station at Dieppe, which belongs to the Western Railway Company. Two other stations are about to be opened, one at Saintes-Maries-de-la-Mer (near Marseille) and the other in the environs of Algiers. It has been determined, according to an agreement reached between the interested departments of the Government, to establish stations at Boulogne, Havre, St. Nazaire, La Coubre, Nice and Cape Corsica. This programme has been established tentatively and is susceptible of modifications."

RADIUM IN ALPS.—A recent investigator has found numerous traces of radium around the new Simplon Tunnel, and attributes to it the extreme heat noted there. This may be a new source of supply. In the current *Harper's Weekly* Dr. Truman Abbe, in an article entitled "The Most Costly Thing in the World," says as to the difficulty of procuring radium: "Some idea of the difficulties in the way of extracting radium from the pitchblend waste may be appreciated when we learn that pitchblend, the mineral that is richest in radium, contains but one-millionth part of 1 per cent of radium, less than the proportion of gold in ocean water. We would think it a pretty thankless task to mine gold, or extract it, from sea water; but the work would be far easier, and we should get more gold from a cubic yard of sea water than we would radium from a ton of pitchblend. Perhaps, then, it will not be hard to appreciate how little radium there is in the world—less than twenty grains, certainly not half a teaspoonful of pure radium bromide A grain of gold can be had for 5 cents or less. Diamonds are worth by weight, much more, perhaps $10 a grain, but the cost of radium is truly fabulous—$7,200 for a single grain."

MEETING OF THE A. S. M. E.—The American Society of Mechanical Engineers will hold the first monthly meeting this fall on Tuesday evening, Oct. 8, at 7:45, in the main auditorium of the Engineering Societies Building, at 29 West Thirty-Ninth Street, New York. The subject of this meeting—Industrial Education—is one in which manufacturers are very much interested. The college technical courses and the student apprenticeship courses will be discussed at length by men who have been in charge of theoretical and practical institutions. Prof. John Price Jackson has written a paper on the college technical courses and apprenticeship courses offered by manufacturing establishments. He gives data in the form of letters from several of the largest manufacturing establishments in America. in which they outline the courses offered by the factories, and explains the matter of conducting the same. Dr. Henry S. Pritchett, president of the Carnegie Foundation and president of the Society for the Promotion of Industrial Education, and Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology and president of the Society for Promotion of Engineering Education, will deliver short addresses on the subjects allied to their societies. Manufacturers have been invited to speak informally of their experiences, and altogether it is expected that the meeting will prove interesting and instructive.

INTERPLANETARY SPACE has been the subject of a good many theories, speculations, inquiries and bold statements. At the meeting in Dresden, Germany, on Sept. 25, of the Congress of German scientists a remarkable statement was made by Prof. Hergesell, of Strassburg University. He says that atmosphere at high altitudes is coldest over the equator and warmest above the poles. This surprising result, he explains, was determined by balloon ascents made last July in various latitudes. The observations, which were taken with automatic instruments attached to unmanned balloons, have not yet been worked out in detail, but Prof. Hergesell finds his conclusions abundantly proved through the data collected. Balloons which reached altitudes of 11 to 12½ miles in the tropics were found to have registered about 148 deg. below zero, F., while in the latitude of Central Europe the temperature was only 76 to 85 below zero at the same heights. Another fact established by these balloon ascents is that the greatest cold of the upper atmosphere is reached at heights from 6 to 6¾ miles. Above that height, contrary to the assumption of scientists hitherto, the air actually grows warmer. This warmer stratum of air is highest at the equator and lowest at the poles, where it is estimated to begin at about 4⅓ miles. Prof. Hergesell concludes that the atmospheric conditions affecting the weather do not reach higher than 7 miles.

RULES FOR UTILITIES.—The up-state section of the Public Service Commission has, like that for New York City, drawn up a series of rules and regulations governing the nature of franchises, issuance of bonds, etc. Copies are furnished from the office in Albany.

DEVELOPING PEAT.—A meeting will be held at the Jamestown Exposition from Oct. 15 to 18 to form an organization to be known as the American Peat Association. The object of the association is to utilize the many acres of swamp land throughout the country, at the same time reclaiming it for agricultural and other uses, and to provide a cheap fuel. It is also proposed to demonstrate the manufacture of by-products from peat.

ACCIDENTS IN AMERICA.—At Berlin, on Sept. 28, Dr. William H. Tolman, social economist, of New York City, read a paper before the International Congress of Hygiene and Demography on "Industrial, Sanitary and Safety Devices." He described the work of the council of the editors of the American scientific and industrial journals to reduce the number of casualties in the industrial army. In America, Mr. Tolman asserted, these were continuously as great as were the casualties during the American Civil War and the Franco-Prussian War.

A NEW ELEMENT.—Mr. Bertram B. Boltwood, of Sloane Laboratory, Yale University, writes to the editor of *Nature*, under date of Sept. 9, that from various experiments conducted in the Sloane Laboratory, he thinks there is good cause for believing that the uranium minerals contain an element emitting "alpha" rays which is different from other elements that have been identified and which produces no emanation. The new element resembles thorium in its chemical properties. "The activity of this element," continues Mr. Boltwood, "appears to be about the same as that of radium itself. It is without doubt a product of uranium and is probably the immediate parent of radium."

MAINE WATER POWERS.—Kennebec River and its important tributaries furnish some of the best water powers of the country, besides affording many excellent sites for further development and the welfare of the whole state of Maine is involved in the wise extension of the use of this river and its branches for water power, for log driving and lumbering, and for municipal and other purposes. To meet the constant demand for information in regard to the hydraulics of this great drainage basin, the United States Geological Survey has just issued, as Water Supply Paper No. 198, a report embodying all available data in regard to the flow of the streams and the possibilities of regulating that flow by means of storage, opportunities for which are exceptionally good.

DIRECT HAVANA CABLE.—It is announced that the Commercial Cable Company's new cable service, giving direct communication between this city and Havana, is now expected to be in operation by Oct. 15. The cable steamer *Silvertown*, owned by the India Rubber, Gutta Percha & Telegraph Works, of London, England, the concern which obtained the contract for manufacturing and laying the New York-Havana submarine cable, is due at Havana about this time and promptly after her arrival there will begin the work of laying the cable from that port to New York. This task is expected to take only about two weeks. The new cable, which will be approximately 1300 miles in length, will be the only all sea cable line between New York City and Havana.

LONDON SHOW-WINDOW LIGHTING.—According to our English contemporary, *Electrical Times*, London shopkeepers are learning to appreciate the advertising value of the electric light in shop windows after closing hours. Referring to one prominent example, it says: "On a fine evening the crowd of well-dressed people gathered round these windows is considerable. Of course the exhibition is ten times as attractive by night as it is by day; that is the first point to recognize. The educational work of the window continues long after the business of the counters has come to an end, and the function of the window is a vastly important one. The sex that inspects the windows for ten days as the preliminary of spending money for ten minutes, will find that illuminated windows shorten the intervals between successive openings of the purse."

WIRELESS AT LEAGUE ISLAND.—A new wireless station is being established at the League Island Navy Yard, at Philadelphia. The sending and receiving apparatus formerly used in Pensacola, Fla., has been shipped to the navy yard there. Prof. Stone, who has an experiment station at Harvard University, will take personal charge of the wireless system. The plan, first hit upon by officials at the Washington Navy Yard, of using smokestacks in lieu of regular wireless telegraph masts, which are quite expensive, has been followed at League Island. The tall stacks of the power houses between the old and new dry docks are being utilized for this purpose. When finished the station at League Island will complete the chain along the Atlantic coast, the break between New York and Washington having been at this point. The station nearest to Philadelphia up to this time has been at Cape Henlopen. This will become a sub-station to the one at League Island, and both will be under the charge of Captain Henry Hutchins.

TELEPHONY AND POLITENESS.—In referring to a recent circular of an American telephone exchange requesting that the word "please" be omitted from communications to the operator, our London contemporary, *Electrical Times*, says that the incident, though quite unimportant in itself, may serve for a useful object lesson as to the vast importance that the hustler attaches to the future. "He is a pilot forging ahead towards some wondrous object on the horizon, an object so vastly important that 'Please,' and 'Thank you,' together with the luncheon hour, must be thrown overboard in order to lighten the vessel. Surely the perspective is all wrong, when any object looms as large as this. It is to be hoped that the request of the telephone company will not be complied with. But if it were, it would have one of two effects. Either it would cause perceptibly greater delay in the case of courteous persons who marked the omission of 'please' by an awkward halt—naturally one would attempt to word the petition less bluntly—or it would train all Philadelphians to cast off 'please' and 'thank you' from ordinary conversation. The former alternative wastes more time on the telephone than 'please'; the latter would ensure the Philadelphian very scant attention in his commerce with beings less highly civilized than himself; also a question of dollars."

PLENTY OF ACCIDENTS.—Last week, the secretary of the Public Service Commission, Travis H. Whitney, turned in his first report of accidents reported by the various New York traction companies. The time covered was from Aug. 5, when the board's order became effective, until Aug. 31, 26 days, the number of accidents reported in Greater New York reaching the enormous total of 5500. The list of accidents as given in the report was as follows: Persons injured in car collisions, 145; persons injured in collision with vehicles, 465; persons struck by cars, 405; persons injured boarding cars, 641; persons injured alighting from cars, 1263; employees injured, 641; derailments, 33; injuries on stairways, 26; other accidents, 1881; total, 5500. Of the total number of accidents reported a majority, it will be seen, were of a serious nature. In the 26 days 189 persons were either killed or seriously injured. The further classification on the report shows: Persons killed, 42; fractured skulls, 10; amputated limbs, 10; broken limbs, 44; other serious injuries, 83; total, 189. The traction companies are required to report all accidents within three days, and the commission has every serious occurrence of the character investigated at once. The records of the commission, however, are not open to "ambulance chasers," and may not be used in damage suits. It is said the board will begin an investigation to determine some means of further safeguarding human life.

The New Power Plant of the Lowell Electric Light Corporation.

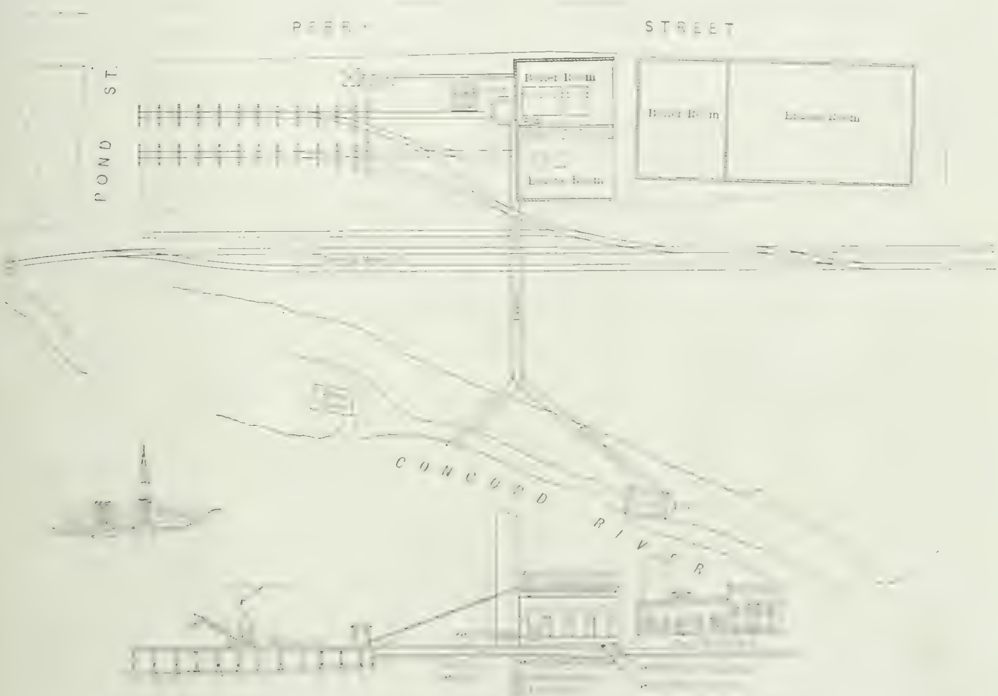
A NEW turbine power station is now under construction for the Lowell Electric Light Corporation, at Lowell, Mass., under the designs and supervision of the Stone & Webster Engineering Corporation, of Boston. The plant is located at the corner of Perry and Pond Streets, about half a mile from the center of the business district and adjoining the present plant of the Lowell company on the east bank of the Concord River. The building is in a sense an extension of the existing plant, but the plans provide for the remodelling of the old plant and replacement of old machinery as the new plant expands. Fig. 1 shows the lot plan and general arrangement of the two stations. The expansion of the new plant will at first proceed in the direction of the old station, but the company's real estate holdings also provide for extension in the opposite direction if it becomes desirable.

The new building is a brick structure with concrete foundations and steel framework; the floors and roof being of rein- [illegible] ins., width 108 ft. When extended, the station is designed for an ultimate capacity of eight 1500-kw turbo-alternators.

The old station is shown in plan in Fig. 3. It contains a number of belted and direct-connected units, the largest being a 675 kilowatt set. The total capacity of the old plant is upwards of 3300 kilowatts. Thirteen Scannell & Whaley boilers of 150 horse-power each constitute the steam generating equipment. The service includes 2200 volts alternating current, 550 volt direct current and constant-current arc lighting from tub transformers. Some of the direct-connected machines are in [illegible] some time to come. The comparison of the old station plan with that of the new plant, however, shows that a more symmetrical expansion, greater compactness and a much more convenient operating arrangement, with higher efficiency of production, are possible in the new installation. By retaining the old equipment in service as long as it is desirable to do so and at the same time being in possession of plans for complete modernization, the company is in a position to enjoy the benefits of a progressive design without interfering with the regularity or its present service in any way. No abrupt change from one station to another will be necessary as the development proceeds.

A track of the Boston & Maine Railroad passes the plant on its west side, and as shown in Fig. 1 a spur track leading from this connects with a siding, and also with two parallel tracks running from north to south at the north of the power house. The coal handling and storage system of the station is one of its most interesting features. The tracks are carried on trestles above a yard, which has a storage capacity of 5000 tons, and are traversed by a 10-ton locomotive crane, having a boom of 40 ft. maximum radius and 12 ft. minimum radius. The crane is shown in elevation in Fig. 1. The locomotive crane was supplied by the Brown Hoisting Machinery Company, and its lifting capacity at 40 ft. radius is 7000 lbs. or 28,000 lbs. at 12 ft. radius. It is provided with a grab bucket of 54 cu. ft. capacity and can be operated simultaneously for hoisting, rotating and truck traveling. At full load the speed of the hoisting grab bucket is 120 ft. per minute, or 164 ft. per minute with empty hook. The track travel speed at full load is 500 ft. per minute, and the crane will climb a 6 per cent grade with full load.

The crane is unusually rugged in design, particularly with respect to the supporting platform and car, the latter being an eight-wheeled unit with a 22 ft. 4 in. wheel base. The crane consists of a boom, drum and motor mounted on a bed and



[illegible] OF NEW AND [illegible]

rotating on the main platform. The latter is formed of a heavy center casting to which is bolted a frame made of heavy steel channels and beams, the truck axle bearing brackets being fastened to the under side of this frame. The center casting carries on its top a support for a steel slip ring by means of which the crane is rotated on its axis. Above this is the rotating bed or housing upon which all the mechanism is assembled. The motor is mounted on the rear of this bed and between the motor and the mechanism is located the operating platform, with all the levers within convenient reach. Two standard four-wheel trucks like those of a 50-ton freight car are used, and the motor is an 80-hp General Electric machine wound for 600 volts, direct-current. A double trolley wire of No. 00 section is used, and to enable the locomotive to be operated on the Pond Street tracks, where no overhead trolley construction was allowed, provision is made for a flexible cable and plug connection with jack boxes on poles at the side of the

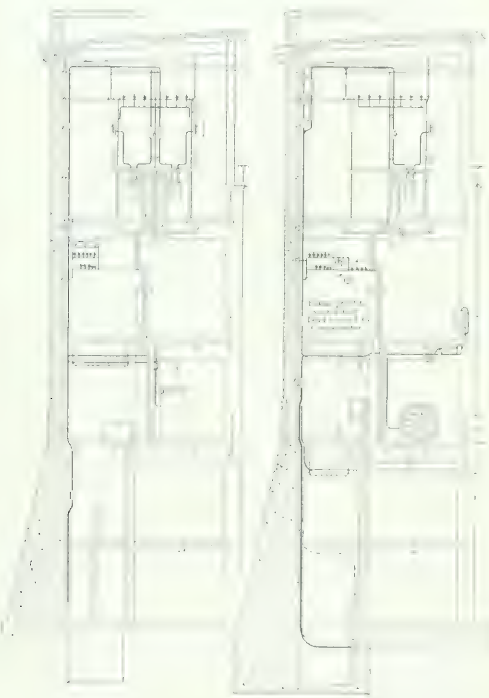


FIG. 2.—ELEVATION OF SWITCHING GALLERIES.

track. The length of the locomotive crane boom made it necessary to support the double trolley wires 45 ft. above the rails, and this called for poles of chestnut varying from 55 ft. to 75 ft. in length. The flexible cable for the locomotive crane consists of 500 ft of No. 1 copper. The crane has been invaluable during the construction of the power plant.

After coal is delivered from the cars into the yard beneath the trestle tracks it is hoisted by the crane and deposited in a crusher located at the west side of the yard. The coal handling system from this point to the bunkers in the power house was supplied by the Exeter Machine Works, of New York. The pocket in the power house has a capacity of 500 tons, and the system, a capacity of 50 tons per hour. The crusher is of the steel-toothed type, and is driven by a 20-hp, 550-volt General Electric direct-current motor. Coal is carried up to the pocket over the boiler room by a 16-in. belt conveyor. Beneath the coal bunkers in the boiler room is a 1000-lb. traveling weighing hopper, hand-operated, with chutes which deliver to the boiler room floor in front of any desired boiler. These chutes are designed so that they can be superseded by chutes connecting with mechanical stokers, in case it becomes advisable to give up hand firing in the future. The power house roof is designed for a load of 40 lbs. per sq. ft. About 280 tons of structural steel were required in the plant.

The boiler room is at present 75 ft. 9½ ins. long, its width being 49 ft. 6 ins. inside. It is separated from the turbine room by a 17-in. brick fire wall. Most of the auxiliary equipment is located in the basement. There are at present three 525-hp Stirling water-tube boilers in the plant, each being equipped with a superheater in the middle pass, for 150 degs. superheat. The boilers are provided with six sets of Gardner rocking grates, and each boiler has 5267 sq. ft. of heating surface, 91 sq. ft. of grate surface, and 1162 sq. ft. of super-heating surface. The draft is controlled by a Mason damper regulator. Eight-in. New Bedford stop valves are used with Walworth pipe fittings. Beneath the boilers is a 16 ft. 8 in. basement. Ashes are collected in hoppers here and dumped into ash cars running on a 36-in. gauge track which leads to an ash pit just beyond the chimney. This pit is 15 ft. square and 10 ft. deep, and has a capacity of four carloads. The cars have a capacity of 50 cu. ft. each and the ash hoppers under the boilers, 250 cu. ft. each. The basement floor is drained by a pitch of ½ in. in 10 ft. to sumps, the latter being freed through a soil pipe system ultimately leading to the river. Steam, water and oil piping was erected by the Middlesex Machine Company.

At present four feed pumps are planned for, the pumps being Platt Iron Works outside packed outfits located in the basement of the turbine room. The operation of the two stations as one, of course, makes it unnecessary to carry the reserve equipment usually installed in a new plant. The flue is carried beneath the boiler room to the stack, the latter being a Kellogg radial brick chimney 195 ft. high, 11 ft. inside diameter, with an extra firebrick lining extending 50 ft. above the foundation. The first 25 ft. of this lining is 9 ins. thick and the balance 4½ ins. In the space between the lining and the stack are set radially eight 2-in. wrought-iron pipes installed for ventilating the usually dead air space. Half of these are located about 12 ins. from the stack foundation, the rest being near the top to provide circulation. A ring of tile is placed above the opening between the top of the lining and the stack to prevent moisture or soot from entering the annular space below. A baffle wall, with a maximum thickness of 12 ins., is built in the chimney for a height of 45 ft. above the bottom to provide against cross impinging of flue gases in case the stack is used as an outlet for the steam from the boilers on the north side of the power house.

At present the engine room contains but a single turbine. This is a 1500-kw, three-phase, 60-cycle, Curtis-General Electric unit, normal speed 900 r. p. m., and full load current, 377 amperes per lead. It is expected that the full load steam consumption of this unit at 180 lbs. pressure and running condensing with not over 2 ins. absolute back pressure will be about 20 lbs. per kw-hour and about 18 lbs. with 125 degs. superheat. Not over 2 per cent variation from no load to full load in the speed is expected, and not over 4 per cent momentary variation. Substantially the full load water rate is expected from the turbine at 50 per cent over load, both with and without the slight superheat figured. The turbine auxiliaries are a Knowles hydraulic accumulator, a 36-in. Alberger barometric condenser, a single-stage horizontal rotative dry vacuum pump, and a 12-in. volute centrifugal pump driven by a 9 in. x 10 in. Harrisburg engine. All the condensing equipment is of the Alberger type. The barometric condenser column is located in the boiler room between the boiler batteries and the engine-room wall, with hot well below. Two step-bearing pumps are supplied for the turbine. The balance of the auxiliary equipment includes two duplex low pressure Platt oil pumps, a Platt horizontal open heater, capacity 50,000 lbs. of water per hour, from 80 degs. F. to 210 degs. F.; a Clayton climax air compressor, capacity 150 cu. ft. per minute; a 30-ton Niles electric crane, an auxiliary feed service and fire

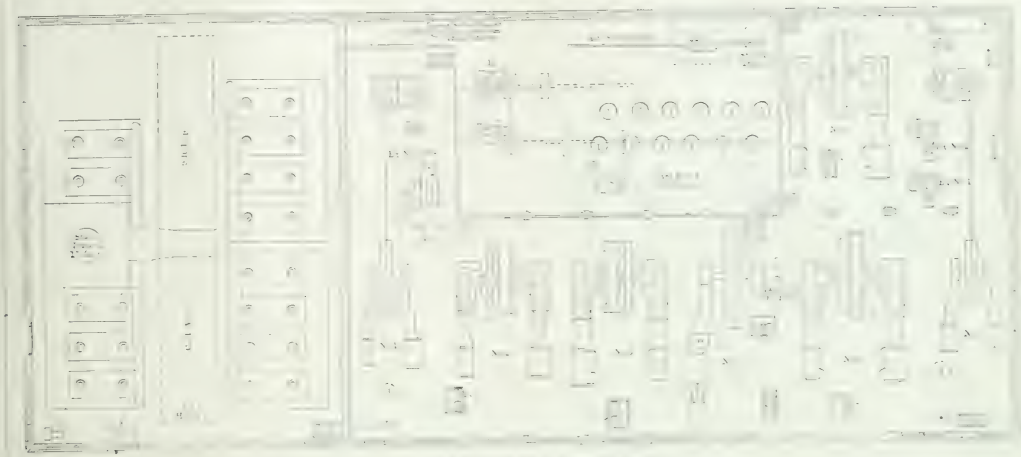


FIG. 3.—PLAN VIEW OF OLD POWER HOUSE.

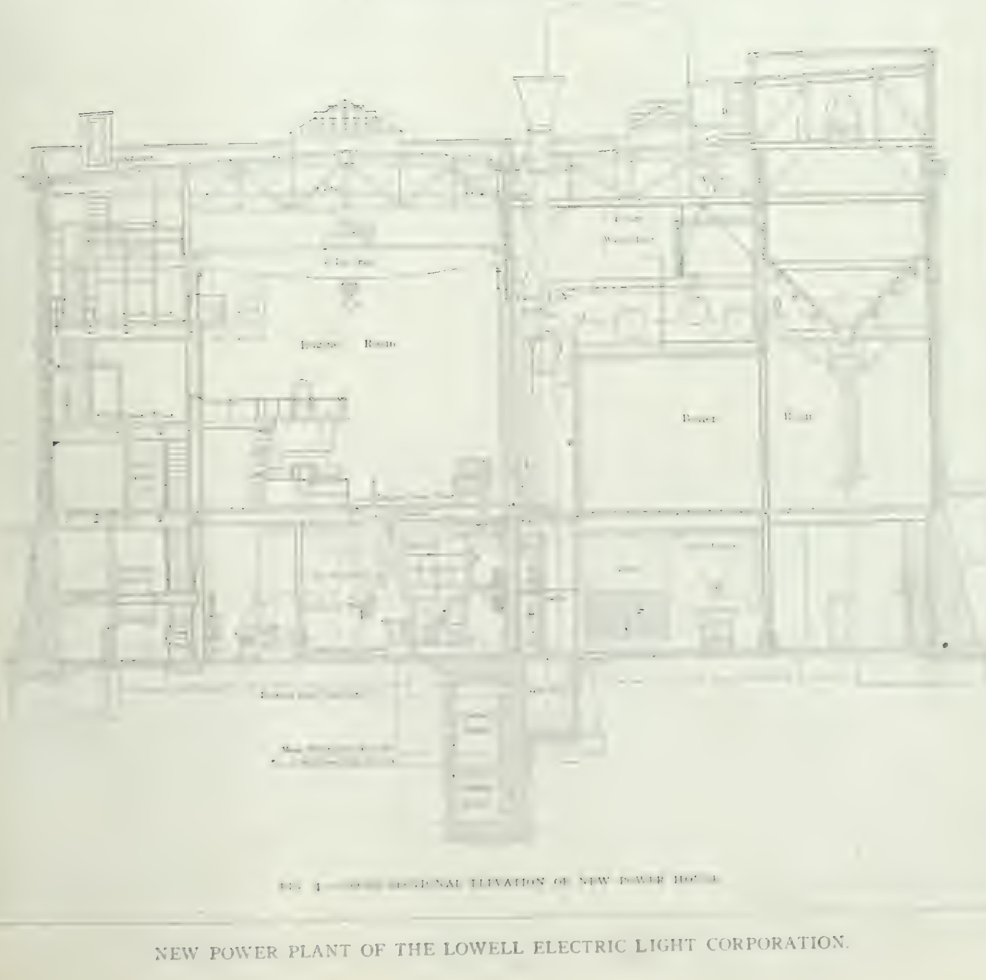


FIG. 4.—LONGITUDINAL ELEVATION OF NEW POWER HOUSE.

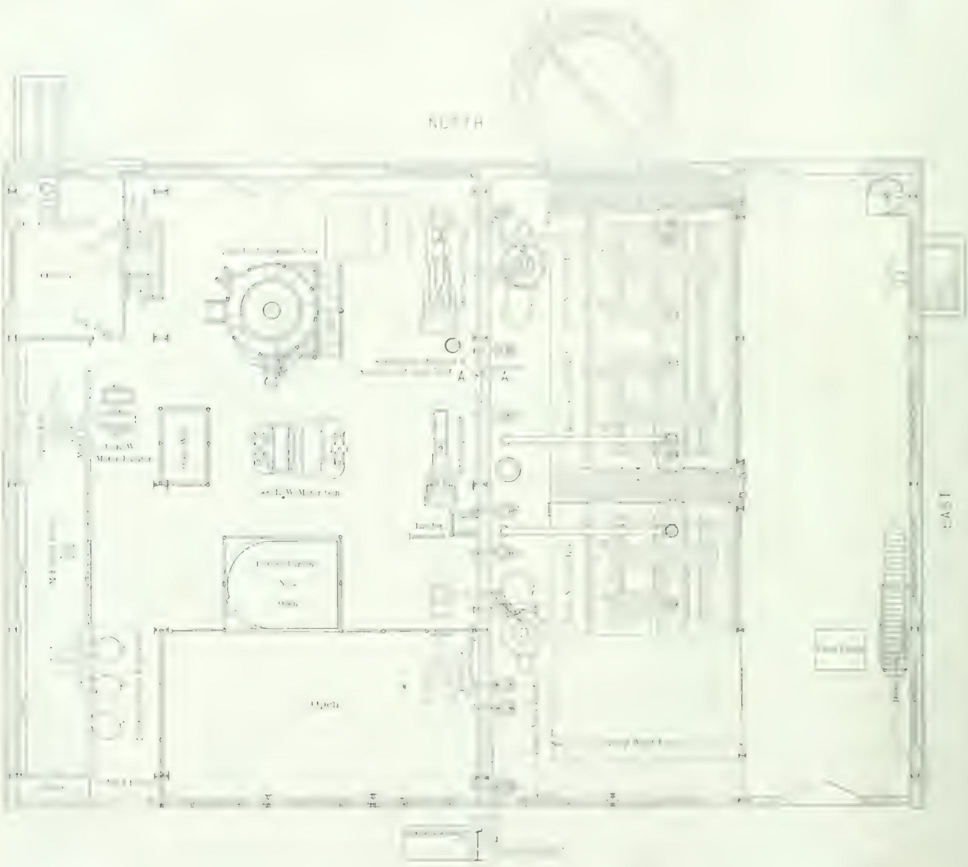
NEW POWER PLANT OF THE LOWELL ELECTRIC LIGHT CORPORATION.

pump, and a low-service pump. The air compressor and dry vacuum pump are the only steam-driven auxiliaries located in the turbine room. The rest are in the basement, which is 18 ft. high, and provided with floor plates so that the machinery can be handled with ease by the turbine room crane. The turbine room contains a 500-kw synchronous motor generator set, consisting of a three-phase, 2300-volt motor direct-connected to a 500-volt, direct-current generator, and also a 40-kw, 125-volt exciter direct-driven by a 2300-volt induction motor. No steam-driven exciter is provided in the new plant, as the old station is supplied with this equipment.

The condenser has a capacity of 30,000 lbs. of steam cooling per hour with 70 degs. F, circulating water, the vacuum be-

A double set of screens has been provided at the intake well for cleaning; a traveling hoist, I-beam 4 ft. long outside the building and a platform are to be built to facilitate washing the screens when they are lifted up from the well. The gate house is unusually complete for a central station design. The well below the gate house is of concrete, reinforced with twisted rods. Chapman steel gate valves are specified.

The design of the new plant provides for an unusual degree of comfort for the employees. Lockers and lavatory for the firemen and coal passers are located in a special room in the boiler room basement, and below the turbine room on a mezzanine floor is a special locker room and lavatory for the engine room staff. At one end of this floor is a barrel runway lead-



ing equal to 1 lb. absolute pressure. Circulating water is drawn from the river through an intake tunnel 18 ins. thick, shown in Fig. 1, and delivered back to the river through a discharge tunnel located above the latter as indicated. The intake is 5 ft. x 5 ft. in cross-section, and the discharge 5 ft. x 6 ft. The intake is controlled by a gate house located on the edge of the river, from which a wooden intake 150 ft. long and 10 ft. x 2 ft. 6 ins. in section extends towards the middle of the stream. At this writing the intake is being built inside a coffer dam. The excavation in this plant has been unusually troublesome on account of the boulders found in the soil, some of these being 10 ft. in diameter, and even larger. Two charges of dynamite have been required in one or two of the larger cases.

ing downward from the street, to facilitate the handling of oil. A special oil filter plant, designed by the Engineering Corporation, will be tried out on this mezzanine floor. The piping courses may be seen in a general way in the plans reproduced. The boiler live steam leads are 8 ins. in diameter, and drop down back of the boilers to a 12-in. horizontal steam main in the basement. A 10-in. line connects the main with the turbine through a Cochrane separator. The turbine exhaust is carried through a 36-in. trunk line to the condenser; the usual outboard exhaust being provided also. The piping is arranged for the installation of a water measuring system later, if desirable, in addition to the usual meter. The auxiliary piping is practically standard, a special exhaust line and a separate

supply line being maintained for the auxiliaries in groups. The Holly loop system will be installed.

Fig. 2 illustrates in elevation the general wiring scheme of the plant. There are two sets of 2300-volt, three-phase bus-bars carried on a framework in a compartment above the turbine room floor. The generator leads are carried in cable form to an oil switch in this compartment, and knife switches are provided for transferring from one bus to the other when the oil switch is open. The main operating switchboard is located on a gallery, also above the turbine level, and just below the 2300-volt compartments. All the current handled at this board will be low tension. Remote control is provided for the 2300-volt oil switches; the starting compensator, rheostat handles, exciter bus-bars, the line connection with the old station, etc., are all located on the main switchboard gallery. The outgoing circuits from the station, such as lamp and motor feeders, are brought down from the bus-bars and oil-switch compartments to cables which enter underground conduit lines for distribution. The plans provide for the most flexible sharing of the load between the two stations. The switchboard panels are set in their final positions, with gaps between the used sections for the sake of symmetry in the ultimate arrangement. An interesting feature of the new plant is the provision made for lighting the station. Provision is also made for controllying the main steam header from the engine room.

System at Minneapolis for Distributing the Energy Transmitted from Taylor's Falls.

The first issue of the Electrical World for July contained an article descriptive of the Taylor's Falls power plant, 40 miles from Minneapolis, recently built to supply energy to the Minneapolis General Electric Company. The present rating of this plant is 10,000 kw, but the final rating will be 20,000 kw. In the first issue for September, the 50,000-volt transmission line between this power plant and Minneapolis was described in detail. It is the object of the present article to describe the provisions made in Minneapolis for receiving and distributing the electrical energy.

The general plan is to decrease the e. m. f. from 47,500 to 13,800 volts at the city limits. From a step-down sub-station at the city limits 13,800-volt, three-phase lines connect with the two old generating stations of the company, and also supply energy to a number of small distributing sub-stations, from which it is distributed at 2300 volts, three-phase, to large industries located in the immediate vicinity. It will be noted, therefore, that the distribution system possesses many features which have not heretofore been employed to any extent in large city systems.

Sub-station at the City Limits.

At the city limits is a main receiving sub-station, energy is received from the 40-mile 50,000-volt three-phase line described in the previous article before referred to. The building is thoroughly fireproof, and every precaution has been taken to prevent interruption of service, because all of the energy from Taylor's Falls must pass through it. This sub-station contains nine Westinghousue 900-kw transformers. A view along

Fig. 2.—Switchboard Room over Transformer Room.

the middle of the transformer room is given in Fig. 1. Each transformer is mounted on a truck and can be run out onto a turn-table and from there over a track along the middle of the building to the door. The building is provided with concrete floors, the under side of the second floor being shown in Fig. 1. Water for cooling the transformers is obtained from a deep well by means of a pump. There is also a cooling pond adjoining the station into which water is discharged after passing through the transformers. Water can either be circulated from the well or from the pond. The sub-station is provided with pipes for transformer and switch oil, so that oil can be run into any transformer case. There is also an oil-treating tank similar to that in the power station, as described in the article on the power station. The second floor of this sub-station is the switchboard and switch room, shown in Fig. 2. The 47,500-volt wires are kept on one side of the station and the 13-800-volt wires on the other side. Some of the high-tension wiring in the upper part of this floor of the building is shown in Fig. 3, where the 47,500-volt wiring is seen on the right. The general scheme of the wiring of this main sub-station is shown in Fig. 5. The incoming 47,500-volt transmission line after passing the disconnecting switches, choke-coils and series transformers is taken to an oil switch and thence through another set of disconnecting switches to the 47,500-volt bus-

Fig. 1.—Step-down Transformer Room and Turn-table.

Fig. 3.—[illegible]

bars. The ultimate plan is to have two sets of 47,500-volt bus bars which can be connected with an oil junction switch. Every other bank of transformers is connected to one set of bus-bars and the remainder to the other set. The 13,800-volt terminals of the transformers are connected to two sets of bus-bars in a similar manner. The city transmission lines are taken off from these latter bus-bars and are led through oil switches and potential and series transformers to the transmission lines.

[illegible]

There are three transmission lines leaving the main sub-[illegible]

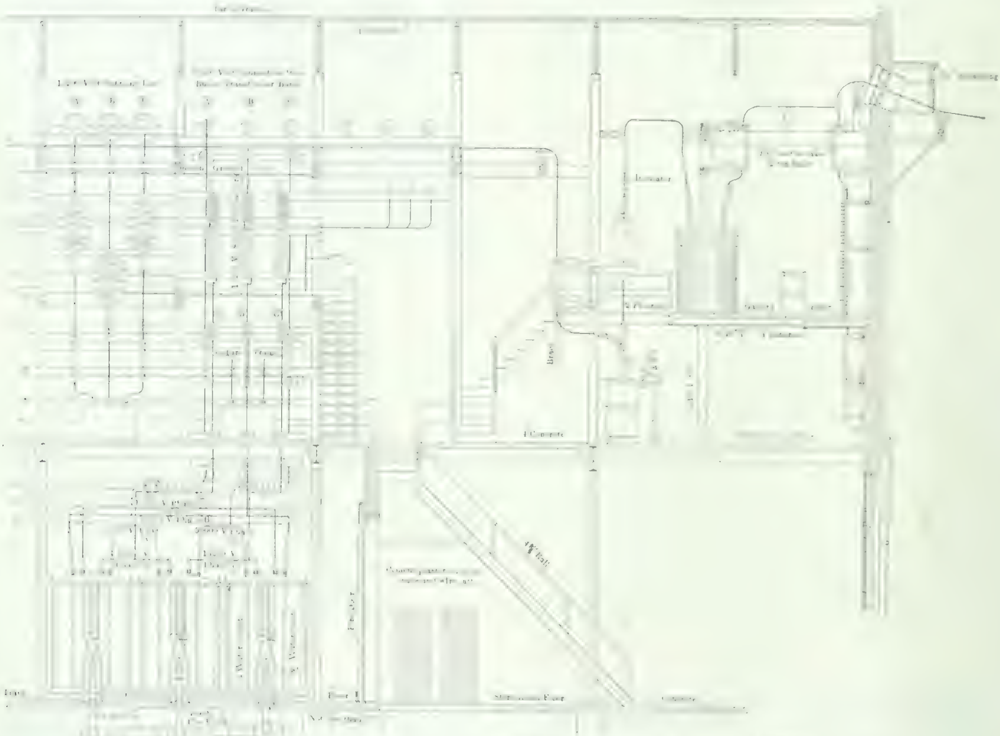


FIG. 4.—LONGITUDINAL SECTION OF MAIN SUB-STATION, SHOWING [illegible]

the Minneapolis General Electric Company. This station has heretofore been the principal generating plant. It contains both water power and steam machinery, as will be briefly outlined later. This plant will act as a kind of distributing center. At it the e. m. f. will be decreased to 2300 volts for single-phase distribution for lighting purposes over the entire city outside of the down-town district. The down-town district is served with direct current from the Fifth Street station, which is connected with the Main Street station by two 13,800-volt, three-phase lines, from which energy is obtained for operating motor generators, step-down transformers and rotary converters. The company's offices are in this sub-station; the building in this respect is very similar to the Edison buildings in a number of the large cities of the country. This station is well located to supply energy to the direct-current, three-wire network in the down-town district. The district is limited in area, extending only about a half mile in any one direction from the sub-station. When the area increases, more direct-current sub-stations will be established.

The details of the overhead lines are of considerable interest, because of the use of an e. m. f. of 13,800 volts for general city distribution. On the standard pole-top for the 13,800-volt lines, there are no lower voltage lines. The top cross arm is designed for use with grounded guard wires, as will be explained later. The transmission wires are placed 2 ft. apart. On a pole used for both 13,800 and 2300-volt lines at a sub-station, the 2300-volt lines are placed on the lower cross-arm. An elaborate pole framing at a sub-station is shown in Fig. 7. This particular pole carries a telephone arm which is necessary on some of the lines.

Unusual provisions for lightning protection on the 13,800-volt lines had to be taken because of the severity of the lightning storms and by reason of the fact that there are so many changes from overhead to underground lines. Two grounded guard wires are placed on the ends of the top cross-arm. At every third pole the guard wire is grounded to a coil in the bottom of the pole hole for new poles or to a pipe driven in the ground near the old poles. The guard wires are mounted on 2300-volt insulators.

All of the 13-800-volt lines are laid underground except those in very sparsely settled portions of the city. One of the lines leading from the main sub-station, to a secondary sub-station passes underground at two railroad crossings before it reaches the underground district. Lightning arresters are placed at all points of change from overhead to underground. To do this, miniature houses of asbestos lumber were built on the pole tops. Fig. 9 shows the exterior appearance of these houses where the cable terminals are placed on the same poles. Here the cable is led up into a terminal box and the choke-coils are mounted between the poles. For the underground 13,800-volt lines cambric and paper insulated cables are used. Cambric is preferred to paper because it is less liable to become injured when handled roughly, and it is less susceptible to moisture. The cable, which was made by the Standard Underground Cable Company, has 6/32-in. insulation over [illegible]

lead sheath. In making a joint on this cable, after the conductors have been spliced each conductor is wrapped with cambric, and cambric tape sleeves or thimbles are used to hold

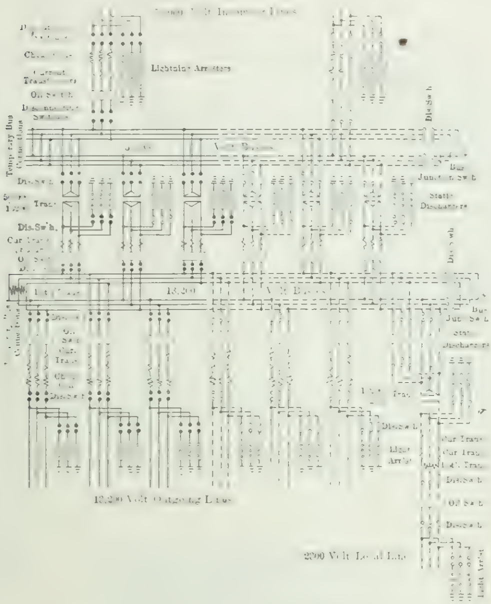


FIG. 5.—WIRING DIAGRAM FOR MAIN SUB-STATION.

the conductors apart when the joint is being finished. The joint, after being covered with lead is impregnated with Minerallac or G. E. 67 compound. The insulators on the 13,800-volt overhead lines are of the Locke No. 3-¾ type, of brown porcelain, and are placed on birch pins.

DISTRIBUTING SUB-STATIONS.

Between main sub-station No. 2, and the Main Street station,

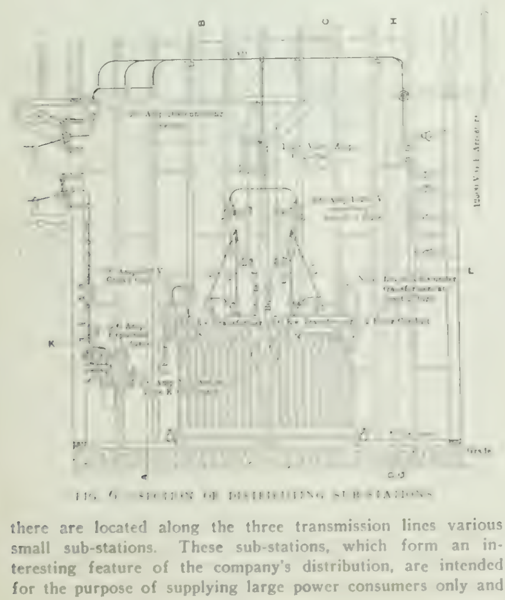


FIG. 6.—SECTION OF DISTRIBUTING SUB-STATIONS.

there are located along the three transmission lines various small sub-stations. These sub-stations, which form an interesting feature of the company's distribution, are intended for the purpose of supplying large power consumers only and each contains simply three step-down transformers for reducing the e. m. f. from 13,200 to 2300 volts, three-phase. There are no attendants at these sub-stations. They are located near

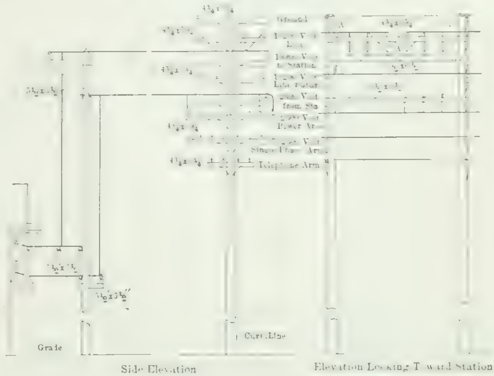


FIG. 7.—POLE DIAGRAM AT DISTRIBUTING SUB-STATIONS.

large power users; it is the intention to limit their output to 2000 kw. Since more power than this will almost never be required at one plant, it is considered better to build another sub-station when the 2000 kw limit is reached rather than to increase the size of the existing stations. Both the 13,800 and the 2300-volt lines are delta connected. The buildings are of galvanized corrugated iron. Since they are usually located in the railroad and manufacturing districts, their appearance is not of great importance. Fig. 6 shows the interior arrangement of one of these distributing sub-stations. Fig. 8 shows the general schemes of wiring a sub-station, the three legs of the circuit being indicated as one wire. The 13,800-volt lines enter at one end of the building and pass down as shown in Fig. 6 through choke-coils and a new type of compound switch and fuse rated at 300 amperes. The lightning arresters shown

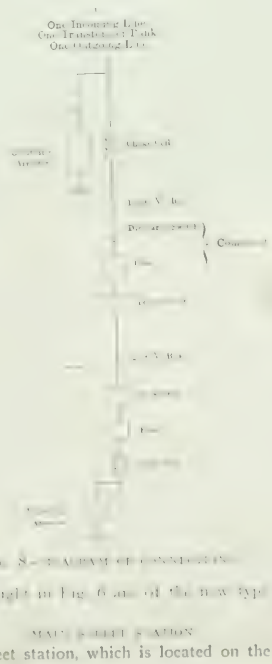


FIG. 8.—DIAGRAM OF CONNECTIONS.

mounted at the right in Fig. 6 are of the new type of shunted gap.

MAIN STREET STATION.

The Main Street station, which is located on the Mississippi

River in the heart of the city, was the principal generating station of the company's system before the circuits from Taylor's Falls were erected. This station is now operated partly by water power taken from the pondage above the St. Anthony Falls dam, partly by steam, and partly by electricity brought in over the tie lines from the main step-down sub-

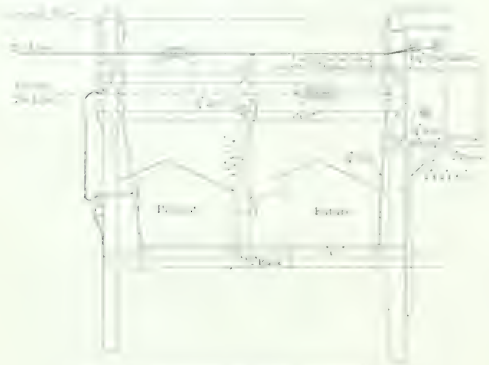


FIG. 9.—LIGHTNING ARRESTER TERMINAL POLE.

station of the Taylor's Falls system, mentioned in a previous article. The station is also arranged to act as an auxiliary to supplement the Taylor's Falls system at times of low water or accident.

The general layout of the station consists of line shafts on one of which is mounted a 1000-kw, 13,200-volt, three-phase machine which can be used to drive the shaft from energy received direct from the Taylor's Falls system or to be driven by the prime-movers in the station, to deliver energy over the 13,800-volt tie lines to the step-down sub-stations of the Taylor's Falls system or to the various sub-stations scattered through the wholesale distributing district. The line shafts are normally driven by the water wheels which are three in number, with a total capacity of 2400 hp assisted by the 1000-kw machine operating as a motor. The relay capacity of the station is still further increased by a recently installed 1500-kw, 2300-volt Curtis steam turbo-generator which is arranged to deliver energy directly to the 2300-volt bus or through the tie line transformers to the tie lines or to the before-mentioned motor on the line shaft. Energy is supplied from this station for 2300-volt, two-phase, 60-cycle distribution, 500-volt, direct-current distribution and for both alternating-current and direct-current arc circuits from machines belted to the line shafts, from motor-generators and from constant-current transformers. In addition to its use as a motor or generator the 1000-kw machine on the line shaft is used as a synchronous condenser to control the power factor of the system. The station is arranged to allow the installation of additional machines of this type, and the general tendency is to simplify and consolidate the apparatus.

FIFTH STREET STATION.

The Fifth Street station is the main sub-station of the Minneapolis system, located at the business center of the city, where it is in the proper position to supply energy to the Edison low-tension system and to control the bulk of the business lighting. The station receives energy from the Main Street station and the Taylor's Falls system; it contains steam auxiliary units and storage batteries. The steam auxiliary equipment consists of 600-kw rating of 230-volt, direct-current, direct-connected, engine-driven generators, 1050-kw of 35-cycle rotary converters, 650-kw rating (on one-hour discharge) of storage batteries; two 100-kw, three-phase, 125 and 250-volt rotary converters, and 1125-kw rating of 13,800-volt air-blast transformers and feeder regulators for the proper control of the potentials of distribution from this station. The high-tension and a large part of the low-tension apparatus of the station is operated from a remote control switchboard.

The Electrical Heating Plant of the Biltmore Estate.

By [illegible]

A little over a year ago, under the head of "Current News," the ELECTRICAL WORLD announced that an electrical heating plant was being installed in Biltmore House on the Vanderbilt estate, near Asheville, N. C., and commenting thereon expressed the opinion that while the installation might prove an interesting experiment it was scarcely to be hoped that economy would result. The author was convinced that the reverse was true, but preferred giving the plant a year's trial before controverting the opinion. Since just the opposite has proved to be the case, it goes to show that the application of abstract principles to concrete cases may often lead to erroneous deductions, although as an abstract principle the opinion is generally accepted as correct.

In this article the author makes no pretense of offering a technical discussion of the relative merits of electric heating as compared with other sources of heat, but shall confine the text to a consideration of the conditions that lead to the change, a description of the plant, and an account of its performance in daily service.

Separate and apart from the plant that heats Biltmore House there was prior to the installation of the electric heating apparatus a plant which furnished high-pressure steam for operating the laundry and the refrigerating machinery, and in addition thereto a hot-water heater which maintained a constant supply of boiling water throughout the premises. The fuel

FIG. 1.—100-KW HOT-WATER HEATER.

used was anthracite coal which cost $11 per ton at the boilers. The plants, of course, required the constant services of an attendant. With the item of labor duly apportioned the net cost per annum for this service approximated $2,000.

Electric power is purchased from a hydro-electric plant, and prior to the installation of the electric heating plant electricity was contracted for on a semi-retail basis, the price being 2.5 cents a kw-hour, the load factor and the peak determining the price. By increasing the minimum contract quantity and by maintaining a fairly even load line, energy was to be had for 0.85 cent per kw-hour, an easy condition with which to comply since Biltmore House contains a large storage battery. With these facts in hand it was concluded that the substitution of electric heat might effect an economy.

The refrigerating plant was disposed of by replacing the steam pump and steam compressor with a direct-current motor-driven apparatus. Direct current was selected as the apparatus is more noiseless, and with the proper type of motor, variable speed may be secured.

The contract for the electric heating apparatus was placed with the Hadaway Electric Heating Company, and the success that has attended the installation is largely due to the personal attention Mr. Hadaway accorded it together with his extended knowledge of the subject and its limitations.

Exhaustive tests lead to the conviction that to supply an adequate supply of hot water it was necessary to raise 3000 gallons to the boiling point each day of 24 hours; to accomplish this an electric heater similar in appearance to a horizontal tubular boiler was installed beside the anthracite heater. The illustration conveys a very clear idea of this piece of apparatus; the heating elements are 20 in number, are arranged in concentric circles, are of a capacity of five kw each, and operate at a potential of 230 volts. The controlling switchboard stands immediately in front of the heater, and contains three banks of switches, each switch being connected with an element, and the three rows connected in star to three transformers on the three-phase circuit. The segregated arrangement is particularly desirable in balancing the load on the main sub-station. It was estimated that it would require 21,600 kw-hours per month to do the work; the records indicate the average for the past 11 months has been 12 per cent less than anticipated. The operation is the acme of simplicity. Normally 30 kw are required, two switches on each bank are kept closed, and the elements are worked in rotation from day to day. Unless something out of the ordinary occurs the plant requires no attention whatever. In passing it may be remarked that the power factor of the heating load is unity and the load resembles in many particulars that of the ordinary lighting service.

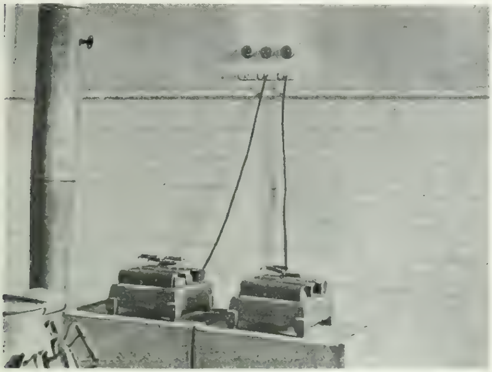


FIG. 2.—ELECTRIC STOVES FOR HEATING LAUNDRY IRONS.

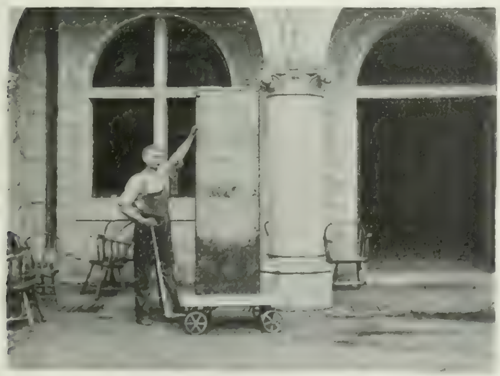


FIG. 3.—SECTION OF HEATING ELEMENT FOR DRYING ROOM.

The laundry presented a far more complex problem than did the hot water heating. The apparatus in the laundry consists of a mangle, stoves to heat the irons, tub boilers, and dry-room equipment. The mangle was a comparatively simple proposition as it was only necessary to equip the steam cylinder with heating elements and to provide the conventional form of collector rings, taps being brought out for several degrees of heat.

The variety of sizes and shapes of irons led to the adoption of an electric stove rather than the installation of the electric iron. In the electric stove a more rugged form of apparatus could be secured, the item of first cost was materially less, and in case of failure of current supply, resort could be made to the old stove, or in case of an extraordinary rush, both forms of heat could be called into requisition.

By far the most interesting specimens in the whole plant are the tub boilers. An article was demanded that would be economical, quick in operation, safe, and above all "fool-proof"—qualifications that are sweeping and conclusive. Of a number of suggested methods the one adopted consists in introducing hot water into a form of vertical boiler in which the temperature is raised above the boiling point, and from which steam passes into the former steam vents in the tubs. The outlet vents are not throttled, and with the admission pipe once adjusted the manipulation consists in merely turning on the hot water and closing the switch. It was at first thought that it would be desirable to provide some interlocking system that would insure the water being turned on previous to closure of the switch; results have not, however, indicated the necessity of the complication, simplicity appearing to outweigh all other considerations.

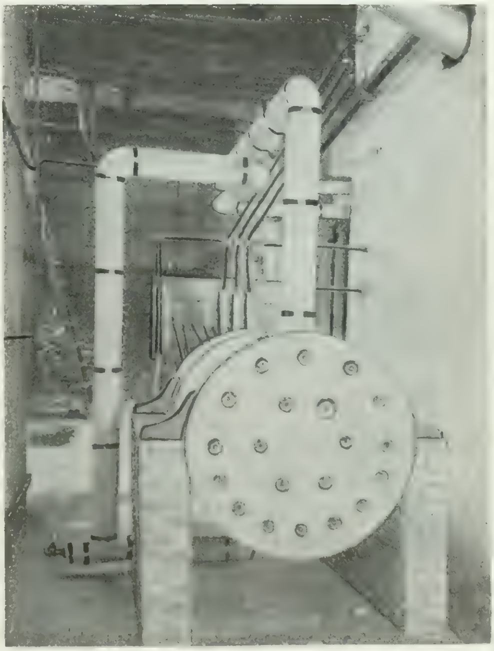


FIG. 4.—REAR VIEW OF ELECTRIC HOT WATER HEATER.

Formerly the dry room was heated by means of steam coils, and as the room was provided with no means of ventilation, the temperature was above 100 deg. C.—how much above cannot be stated as the thermometer with which the observation was made had not sufficient range to register higher. To maintain any such temperature with electric heat was out of the question, and the solution of the difficulty was the most gratifying incident connected with the installation. To provide a relatively small quantity of heat and relatively large circula-

[illegible] was at first contemplated. The cost of operating this, however, coupled with the probability of noise, led to its exclusion, for a prime requisite in all apparatus on the premises is absolutely noiseless operation. Nearby the dry room a large chimney rises which extends through the main part of the house and above the roof, and it was concluded to pipe the dry room into a flue in this chimney, providing the flue with a damper, and ascertain the result. The artifice proved the solution; a draft

FIG. 5.—TUB HEATER FOR BOILING CLOTHES.

was created that answered all purposes, and gravity by a natural law now does the work at no cost whatever. In service it has been found that a very small opening of the damper sufficed The relatively dry air of the surrounding rooms is sucked into the dry room where it becomes laden with moisture and passes off.

The difficulties attending the installation of this heating plant can easily be fancied when the facts in the case are stated. Tersely expressed, these were as follows: Service had to be maintained without interruption; no dirt or litter was to be tolerated on the job; work was to progress without noise or other evidence that anything out of the usual was happening; conduits of 500,000 circ. mil cables and branches, had to be run through stone walls 6 ft. thick, through marble floors, glass tile wainscoting, and the completed work was to match the surroundings in all respects.

In conclusion, it may be stated that for the year 1905-06 the cost of electric service plus the cost of steam service in this particular branch of the department was approximately $4,100. The cost for the identical service as performed by electricity alone in the year 1906-07 was approximately $500 less.

Municipal Lighting Plant at Clinton, S. C.

Clinton is one of the latest South Carolina towns to install an electric light plant. With over 3000 inhabitants, a large college, and prosperous manufacturing enterprises, it is probable that Clinton would have had electric lamps long ago if its citizens could have been made to realize that the building of such a plant would not mean the destruction of their beautiful shade trees, of which they were so justly proud. Recently, however, the matter was taken up again with the result that quite a little electric light system has been installed that does not in any way interfere with the trees.

The plant, which has just been completed, is owned by the city and is operated in connection with its water works. The power house is a substantial brick building, conveniently located near the center of distribution. The equipment consists of a 100-hp Harrisburg medium-speed engine, one Westinghouse 50-kw, 2200-volt, single-phase, 60-cycle generator, a Westinghouse 25-arc regulator, and such other accessories as usually go with a plant of this size and character. Twenty-four arc lamps, and over 400 108-volt incandescents are now in use, with a demand for practically twice as many of the latter. The plant is, therefore, much too small for the town, and the question of doubling its capacity is already under consideration. At present only night service is given, but during the next month or two it is expected that a day service will be inaugurated.

A unique feature of this little plant is that practically all of its lines are run trolley fashion, in the middle of the streets. This is accomplished by suspending an ordinary four-pin cross arm by a quarter-inch strand from opposite poles. Where arc lamps are needed they are hung beneath the arm, the connection with the circuit being facilitated by the use of a two-point break arm in the place of one of the pins. Transformers are mounted on the poles in the usual manner, their primaries being led up to arms above, thence entirely across the street, and connecting with the street mains at the point where they intersect. Here, ordinary line spreaders are used to give rigidity to the lines and maintain the proper distance between them.

Continuous night service is maintained, and all energy is sold on a meter basis. It has not yet been definitely decided what charge will be made for energy, but until the cost of producing it has been determined, a uniform rate of 12 cents for lamps will be in force. Rates for motors will be decided upon later.

House wiring is done by the town under the supervision of the plant superintendent. The cost of this, including the meter, is borne by the consumer; but the town supplies without charge the transformer and the service wires up to 100 feet, and lamp renewals at schedule prices.

The control of the plant is vested in a council committee at present consisting of A. B. Blakely and C. W. Stone. J. F. Seay is superintendent of the lighting plant, and W. A. Shands is mayor of the town.

Power Investigation on Maine Rivers.

The field work on the government inspection of the power of the principal Maine rivers has just been completed, and the results will shortly be presented in a report to the U. S. Geological Survey. A party headed by Prof. H. S. Boardman, of the University of Maine, and under the supervision of H. K. Barrows, of Boston, district engineer of the U. S. Geological Survey, has just returned from a trip into the valleys of the upper Penobscot River, where measures were taken of various tributary lakes and streams. The purpose in general was to secure data for determining what amount of water, properly collected by a stream or reservoir, is available for power purposes in dry seasons.

The maximum flow of the Penobscot is 60,000 cu. ft. per second; but this is obtained only in the spring freshets, while in very dry times the quantity of water is enormously reduced. Measurements along this river, also around the head waters of the Kennebec, Androscoggin and Saco, are intended to be of great ultimate benefit in preventing waste of water. The water power of the West branch of the Penobscot has been thoroughly measured by previous surveys, so that the work of Professor Boardman's party this year has been entirely in the East branch. Levels were established showing the elevation and area of various lakes and ponds from Chamberlain Lake to Grand Lake dam, the survey including all the principal possibilities in the way of storage reservoirs.

The data will be worked up in the coming winter, and will later be issued in bulletin form for the benefit of those who are considering the establishment of power plants on the East branch. Many large hydro-electric developments have already been started in connection with the principal Maine streams, and additional data of this kind will be valuable to engineers and also to bankers interested in power transmission projects in the state.

The Incandescent Lamp Outlook.

In a paper read before the recent convention of the Colorado Electric Light, Power and Railway Association, Mr. Francis W. Willcox, of the General Electric Company, discussed the present incandescent lamp situation. Referring to the "Gem" or graphitized-filament lamp, he said that by two heatings in the electric furnace (before and after the regular hydro-carbon treatment or "flashing" of filament) the carbon filament is reduced to such a refractory condition that it will give three and one-half times the life (with equal candle-power deterioration) that is given by the ordinary carbon filament, or it will operate at 20 per cent higher efficiency for the same life.

This filament, which has now been on the market for two years, is made in a number of sizes from 250 watts down to 50 watts and substantial progress has been made in its development. The past six to eight months have, he stated, brought forth an improvement of from 30 to 40 per cent in useful life, and materially greater possibilties appear to be in store.

Referring to the tantalum lamp, Mr. Willcox said that over 250,000 have been put into service in this country in the past year, and considerably more would be in use had the manufacturers been able to supply the demand more rapidly. The light of this lamp is distinctly more brilliant than the ordinary carbon lamp. It is made in two sizes, consuming 50 and 80 watts. The 80-watt lamp provides a very economical high candle-power tantalum unit, as a substitute for the ordinary 32-cp carbon lamp with 25 per cent increase of candle-power, or for the 100-watt Gem lamp with the same candle-power.

On direct-current the average life of the tantalum lamp is over 700 hours for the smaller size and 1000 hours for the larger size lamp. The life of an alternating-current appears to be reduced on 25 cycles to about two-thirds and on 60 cycles to about one-half of the direct-current life.

Taking up the subject of the tungsten lamp, Mr. Willcox said that tungsten metal fuses at about 3200 degs. C. and this enables a filament of it to be operated at the remarkable consumption of 1¼ watts per candle with good life—approximately 1000 hours—or, in other words, about three times the efficiency of the present carbon lamp. As tungsten cannot be drawn into a wire, a filament has to be built up, so to speak. One process is as follows: A paste is made of the tungsten powder and some binding material and this paste is then squirted through a die into a thread or filament form. This filament thread is dried, the binding material is removed by suitable processes and the particles of tungsten welded into a continuous wire by the passage of an electric current.

Although the tungsten lamp is fragile, this defect can be minimized by greater care in handling the lamps. Fragility has never proven an insuperable difficulty in any event. What is more fragile than the gas mantle, and yet the difficulty has been overcome and the mantle made commercially satisfactory. It took Edison three days and two nights of steady work to make a carbon filament at first that was strong enough to mount in a bulb. And so it would appear that the fragility of the tungsten is but a temporary difficulty to be overcome.

Mr. Willcox stated that the first tungsten lamp will be a 100-watt type uniform with the present 125-watt Gem lamp. It can be employed on the same reflectors as an incandescent unit and will give just double the candle-power value of the 100-watt Gem lamp.

The added cost of the Gem lamps is so slight that they can be supplied on equal terms with the carbon lamps, and this is the general policy pursued by central stations. With the tantalum and tungsten the case is different, owing to the higher cost of the lamps.

The point in rates where it is economical for the consumer to use these high efficiency lamps can be determined as follows: For the same illumination the Gem saves 20 per cent, the tantalum 33 per cent, and the tungsten 60 per cent in energy over the 3.1-watt carbon filament lamp. If, therefore, the cost of lamp renewals (either the absolute cost or excess cost over carbon lamps according to the policy of the central station) is less than the product of the above percentage saving, times the kw-hour rate, it will be economical to use the lamp; otherwise, it is not. For example, with a 3-cent per kw-hour rate, to economically use the tungsten lamp the renewal cost must be less than 60 per cent of 3 cents, or 1.8 cent; and similarly for the tantalum the renewal cost must be less than 33 per cent of 3 cents, or 1 cent.

There exists perhaps a greater need for a high-efficiency street series incandescent lamp than for any other single type. For this class of service, where low-voltage lamps are chiefly used, the tungsten lamp is specially adapted. For these reasons it has been deemed best to develop this type of tungsten lamp ahead of other types, and the General Electric Company has listed the following types of street series tungsten lamps, the watts per candle being 1.35:

Ampere Range	Candle Power.	Avg. Total Watts	Avg. Volts. Per Lamp
4. (3.7 to 4.3)	32	43	10.8
	40	54	13.5
	60	81	[illegible]
5.5 (5.1 to 5.9)	32	43	7.85
	40	54	9.8
	60	81	14.7
6.6 (6.1 to 7.1)	82	43	6.54
	40	54	8.18
	60	81	12.27
7.5 (7. to 8)	32	43	5.7
	40	54	7.2
	60	81	18.9

It will be noted that this list covers only ampere ranges from 4 to 7½ and three candle-power sizes. In this an attempt has been made to eliminate a large number of the present types of electric incandescent lamps for series street lighting service which appear to be unnecessary.

Central stations having present circuits running below four amperes can have their transformer coils rewound so as to raise the current to come within the ranges listed. The candle-power sizes below 32 have been eliminated, as it would seem desirable with the improvement in efficiency to adopt higher candle-powers than have heretofore prevailed for street lighting. The previous standard averaged about 25 candle-power, but it is considered that 40 candle-power will be the desirable unit in the tungsten lamp, as this will give an average illumination fully equal to that of the Welsbach street gas lamp.

As street lighting service is sold by the lamp-year, a higher efficiency lamp does not reduce the income (as it might do were energy sold by meter on the watt-hour basis. Central stations should, therefore, receive the full benefit of the saving this new lamp secures. It will even be possible for central stations to introduce the 40-cp tungsten lamp in place of lower candle-power sizes now in use (such as the 25-cp lamp), without any change in rates, and yet secure a material saving, as a simple calculation will show.

A recent test of over 200 30-cp, 5.5-ampere tungsten series lamps on the circuits of one of the large Eastern central stations, gave an average life of 1350 hours.

If we take the 40-cp tungsten as competitor of the ordinary Welsbach street gas lamp, we have the following comparison:

The Welsbach street lamp consuming 3½ cu. ft. of gas for 1000 hours service would cost at $1 per thousand for gas, $3.50. The 40-cp tungsten lamp consumes for 1000 hours 54 kw-hours, which would give an equal cost for the above gas estimate at a rate of about 6.4 cents per kw-hour. For 4000-hour service per year there would be three renewals of tungsten lamps at a total cost of $3.60, and the renewal charge for Welsbach mantles will probably be not much less than this.

Inasmuch as this is a long-hour burning class of service and a load of considerable size, it would appear that stations could profitably compete with Welsbach lamps for this class of service.

Street series lamps, of course, are not sold on the kw-hour basis, but on fixed charge per lamp per year, covering energy and lamp. With the 40-cp, 54-watt tungsten lamp an annual (4000 hours) service would amount, at 6 cents per kw-hour, to $13. Adding to this the cost of tungsten lamp renewals ($3.60) we have a total cost for annual service with lamp renewals of $16.60 per lamp per year. The rate of 6

[illegible]
stations could perhaps figure profitably at a lower rate.

Incandescent lamps have obvious advantages in street lighting work, as with the low candle-power sizes described they can be distributed at frequent intervals, thus securing a very uniform distribution of light as compared to the massing of greater total candle-power at greater distances apart, necessary with high candle-power illuminants.

Central stations need not fear any reduction in revenue from the introduction of these high-efficiency lamps, as it will hardly be possible to introduce the lamps fast enough to produce any immediate effect. As for permanent effect, the increased business resulting from the introduction of more efficient types of lamps will more than offset any reduction in revenue from the use of such lamps by present customers.

Electric lighting probably does not do more than 20 to 25 per cent of the lighting service of our cities, and there exists in the remaining 75 to 80 per cent of competitive forms of light a large lighting business which the introduction of these high-efficiency lamps will enable central stations to capture.

High Efficiency Lamps and Central Station Revenue.

By H. S. Knowlton.

One of the sustained undercurrents in the minds of central-station men at this time is the probable effect upon their revenue of the coming high-efficiency lamps. Anxiety is not lacking that the general use of the public of individual lighting units approximating a consumption of 1.2 watts per candle-power or lower will result in a shrinkage of income, which will not be offset by any widespread increase in the use of electricity for illumination. This feeling was expressed at the recent convention of the Canadian Electrical Association in Montreal, though the majority of speakers had faith that the industry will not be injured by lamp improvements.

Looking at the matter in a broad way, it is difficult to see any real ground for apprehension. The central station is secure enough at present, for the lamp manufacturers could scarcely manage without many sacrifices to produce the new types on the enormous scale required for a general change from the carbon filament in less than five years. There is plenty of time to think about the problem, and without doubt the Canadian association did wisely in appointing a committee to consider it during the following year in a serious and careful way. Conditions vary so much in different cities and towns that it is well worth while to secure more than one point of view in facing the future of the lamp income.

Supposing that a one watt per candle commercial lamp capable of meeting the same varied service as the carbon filament and bettering it with respect to life and depreciation, becomes generally adopted, surely an enormous increase in new business is bound to follow the commercial marketing of such a lamp and hundreds of residences in strong "gas cities" are certain to declare for electricity where they knew it not before. Of course, a certain amount of investment must be made for each new house connected, but by bunching the secondary loads on larger transformer units, instead of supplying each house with a separate step-down outfit, a distinct saving can be made. Surely it is the gas man and not the electric-lighting man who will have to sit up o' nights scheming how to meet the new and still-to-be-developed electric illuminants. The larger the connected load in numbers of residences the more probable it is that the maximum peaks will not come at the same time. After all, there is little reason to believe that gas will be driven entirely out any more than has the telegraph by the telephone. The fields of each illuminant will become more clearly defined and, while from an electrical standpoint it is not easy to see that rival illuminants are mutually beneficial, the probabilities are strongly in that direction.

The central-station man who figures his income and expenses on the lighting basis alone overlooks the main tendency of the times in the supply of commercial electric service. The lighting and power developments of a modern company cannot be separated in the total yearly balance sheet. Each department should be self-supporting and as profitable as possible, but co-operation in handling loads at different hours, in economizing by avoiding duplications of duty on the part of employees, and by sharing expenses of outfit and administration, is essential to the best results. Anything which increases the use of electricity in one field tends to increase its use in others. That is a certain result of electrical development in the last decade or two and it bids fair to hold in the field of highly efficient lamps. Heating, motor and sign applications are constantly at hand to help absorb the station output, and at the rate with which new business is being pushed by the lighting companies in both the commercial and the residence fields, one may be reasonably certain that any improvement tending to popularize the sale of central-station energy will, in the long run, be an unmixed good.

Neat Posts for Incandescent Lighting.

A flat and store building on Forty-Seventh Street, Chicago, has adopted a system of special lighting on the street in front of the building which consists of neat iron posts of the type shown in Figs. 1 and 2. These posts carry sand-blasted globes.

FIGS. 1 AND 2.—POSTS FOR INCANDESCENT LAMPS.

In each globe is a 100-cp Gem lamp. This makes a very simple plan for special lighting of business streets in smaller towns and in the outlying districts of larger cities. In order to get good effect, however, it is necessary to place these posts at rather more frequent intervals. To get distinctive effect, they should not be over 20 ft. to 30 ft. apart.

Special Offer for the Wiring of Small Houses at Dayton, Ohio.

The Dayton (Ohio) Lighting Company is making a special effort to secure an entering wedge for the wiring of a list of old residences. To this selected list of residences the following offer has been made:

For $36 the company will equip the house so that electricity may be used in the following rooms: Main hall, one lamp and switch; living room, three-lamp fixture; dining room, two-lamp fixture; kitchen, one lamp; kitchen one receptacle for electric iron.

This price is based on the use of straight electric fixtures in the hall, living room and dining room and kitchen. Should combination gas and electric fixtures be desired, the price will be $42.50. The company has a standard set of fixtures [illegible]

exhibition at the offices. If it is desired to use other designs, the customer can do so by paying the difference in price. The price was arrived at by taking the average cost of wiring 12 types of houses in Dayton. The wiring work is let out to local contractors, and while the cost in different houses varies, the average has come out all right. If more lamps are desired, it is provided that the customer may secure them at approximately proportionate cost.

Electric Cooking Record from a Small Family.

Mr. E. L. Callahan, who is the electric heating specialist of the Chicago office of the General Electric Company, gives us the following record for electric cooking at his home in Oak Park for the year ending June 23, 1906. Mr. Callahan's cooking outfit was described and illustrated in the ELECTRICAL WORLD in the first issue of April, 1907. The table gives the costs and energy consumption for doing absolutely all the cooking and baking by electricity covering a period of 12 months.

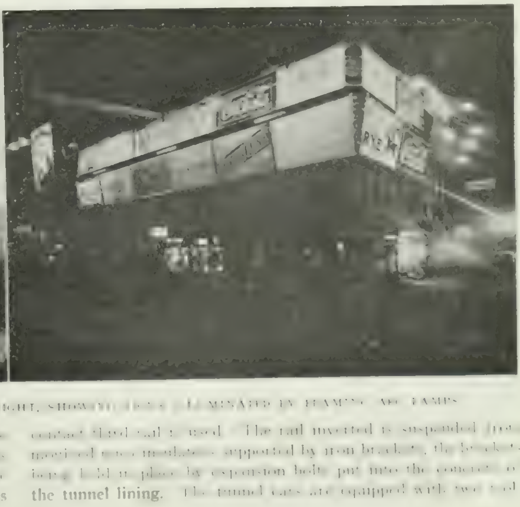
1906-07	Kw-hrs.		No. days 3 meals ea. 2 people	No. days 2 meals ea. 1 person	Equiv. persons per day
June 23-July 24	71	$3.5[illegible]	31	17	2.[illegible]
July 24-Aug. 22	71	3.55	29	18	2.6[illegible]
Aug. 22-Sept. 24	31	[illegible]	17	5	[illegible]
(House closed 2 weeks).					
Sept. 24-Oct. 22	[illegible]	[illegible]	[illegible]	4	2.[illegible]
(House closed 2 weeks).					
Oct. 22-Nov. 22	63	3.1[illegible]	32	28	2.[illegible]
					2.5[illegible]
Nov. 22-Dec. 22	8[illegible]	4.3[illegible]	20	[illegible]	3.[illegible]
Dec. 22-Jan. 22	8[illegible]	4.35	31	25	3.[illegible]
Jan. 22-Feb. 22	97	4.85	31	22	3.7[illegible]
Feb. 22-Mar. 26	88	4.40	32	12	3.3[illegible]
Mar. 26-Apr. 23	55	2.75	31	2	3.06
Apr. 23-May 24	69	3.45	31	8	3.26
May 24-June 23	58	[illegible]	3[illegible]	9	3.3[illegible]
One year	803	$4[illegible]	[illegible]	[illegible]	[illegible]

Total single person days, 1067.
Total single person meals, 3035.
Watt-hours per person, per meal, 264, at 5 cents per kw-hr., or at the rate of 1.32 cents per person per meal.

The utensils used consisted of a 6-qt. vegetable or soup boiler, a 2-qt. vegetable and cereal cooker, a 2-qt. water heater, a 1-qt. water heater, 5-in. frying pan, 7-in. frying pan, 6-in. stove, 12-in. griddle, 12-in. broiler and one oven.

Flaming-Arc Lamps for Billboard Lighting.

It has been generally held that the only satisfactory method of lighting billboards is by incandescent electric lamps spaced



BROADWAY AT THIRTY-FOURTH STREET BY DAY AND BY NIGHT, SHOWING SIGNS ILLUMINATED BY FLAMING-ARC LAMPS.

around the edge of the billboard, or merely across the top of the board, and covered by reflectors. When, however, billboards assume large proportions it becomes difficult to illuminate them properly by means of incandescent electric lamps unless so large a quantity of these be used that the cost of energy consumed becomes quite an item.

In New York City very many, if not most, of the very large signs on house tops or across the front of buildings are illuminated by means of arc lamps hung some distance away from the sign and provided with a reflector so that the source of light is not at all visible from the sidewalk below at night and scarcely visible during the day. A marked economy in energy consumption is thus obtained without any sacrifice in the proper illumination of the sign. As is well known, the sign business is very profitable in New York City because of the large number and size of the signs and the long hours of illumination with electricity at regular rates.

The United Electric Light & Power Company, of New York City, supplies the electricity for a very large group of signs at the corner of Broadway and Thirty-Fourth Street. The sign is maintained and the contract for lighting it made by a local advertising company, to whom the energy is supplied at schedule rates. With the inherent economy of flaming arc lamps and their great value for advertising purposes, these were naturally employed by the advertising company, to whom the space represents so much money. The sign which is shown herewith by day and by night is provided with 14 55-volt Excello flaming-arc lamps, burning two in series and consuming about 12 amperes. The arc lamps burn from sunset to midnight, and the signs are visible for some distance, the location just bordering on Herald Square. The method of suspending the lamps is clearly shown in the engravings, a glance at which also reveals the fact that the signs are also well lighted, as would naturally be expected from so powerful a source of light.

Electric Traction in Belmont Tunnel.

An official trial trip was made through the north tube of the New York & Long Island Railroad Tunnel, better known as the Belmont Tunnel, on Tuesday, Sept. 24. Representatives from the Interborough Rapid Transit Company, the Degnon Contracting Company, the New York & Long Island Railroad Company and officials from the different city boroughs were present.

The trip from Forty-Second Street and Third Avenue (the present Manhattan terminal station) to Van Aulst Avenue, Long Island City, was made in four minutes. The officials were well pleased with this new feeder added to New York's already great electric railway systems.

All steel cars are used in the tunnel service. The overhead contact third rail is used. The rail inverted is suspended from inverted insulators supported by iron brackets, the brackets being held in place by expansion bolts put into the concrete of the tunnel lining. The tunnel cars are equipped with two

ley poles, one at either end, and with an overhead shoe, thus allowing cars to operate by overhead trolley wire when running on the surface lines of Long Island and by overhead third rail when in the tunnel. Cars coming into the tunnel from the surface will have their poles pulled down and hooked fast, letting the shoe make the contact to the rail while passing through the tunnel. Cars can be coupled in trains and operated by a master controller. The car vestibules are fitted with center sliding doors that can be closed for single car service or left open for train service.

There are two tunnel tubes, each having a single track. The cars fit well into the tubes, allowing only necessary clearance for safety. Good ventilation is looked for in this form of tunnel construction, as the car in motion acts like a huge piston crowding the air forward and out to the ventilating shafts and tunnel stations.

Residence Wiring on Installment Payments in Chicago.

The Commonwealth Electric and the Chicago Edison companies have recently begun a special effort to get houses already built, but not wired, to connect to the companies' lines. To this end a proposition has been formulated whereby the company will wire a house for an owner and spread the payment over 24 consecutive months without interest. The payment of the first instalment is made at the time of taking the contract. The first advertisement of this plan, which appeared in the Chicago daily papers Aug. 29, brought in a host of inquiries,

Lamps.	Class "A" Building; two floors with double floors.	Class "B" Building; three floors with double floors.
10	[illegible]	[illegible]
[illegible]	[illegible]	72.00
[illegible]	[illegible]	74.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	83.00
[illegible]	[illegible]	85.00
[illegible]	[illegible]	87.00
[illegible]	[illegible]	89.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
20	73.00	95.00
21	75.00	97.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
29	94.00	118.00
30	96.00	120.00
31	98.00	122.00
32	[illegible]	[illegible]
33	102.00	126.00
34	104.00	128.00
35	[illegible]	[illegible]
36	108.00	136.00
37	[illegible]	143.00
38	[illegible]	146.50
39	[illegible]	150.00
40	[illegible]	[illegible]
41	[illegible]	156.50
42	[illegible]	[illegible]
43	130.50	162.50
44	[illegible]	165.50
45	[illegible]	168.50
46	[illegible]	[illegible]
47	140.50	176.50
48	[illegible]	[illegible]
49	148.00	186.50
50	151.00	190.00
[illegible]	[illegible]	[illegible]
52	[illegible]	[illegible]
53	160.00	200.00
54	163.00	203.00
[illegible]	[illegible]	[illegible]
56	169.00	209.00
[illegible]	[illegible]	[illegible]
58	175.00	215.00
59	178.00	218.00
60	181.00	221.00

so that the man who had been assigned to devote his time exclusively to handling the customers obtained was overwhelmed with work and several more men had to be added at once. The plan is for each solicitor to follow up the customers in his district that would be likely to accept such an offer. The solicitor works in cooperation with the special engineers and estimators appointed for this work. The solicitor quotes prices for the wiring of different classes of buildings according to the schedule given in this article. The price covers only the wiring to the outlets. Switches and fixtures are extra; switches being charged for according to the switch schedule given. The customer is allowed to select his own fixtures with the understanding that the entire cost, including wiring, switches and fixtures, shall be added together and divided into 24 payments. This proposition is offered only to completed residences and not to residences in process of construction or to business establishments. Only residences already connected to the companies' lines will be taken under this offer. The company has selected samples of suitable fixtures for each room in the ordinary residence and placed photographs of them on display, so that the company will not run the risk of having a customer price expensive and exceedingly elaborate fixtures and become discouraged.

The following is a price list for lamp outlets for flats renting at from $25 to $40 per month, and for houses renting at from $20 to $50 per month, of semi-fire-proof construction. Each switch outlet is considered as one for one lamp. Prices of switches and receptacles are added to the list at store-room prices, as given herewith.

PRICE LIST OF SWITCHES AND SOCKETS.

Flush push-button switch, 10-amp. s. p.	$ .97½
10-amp. d. p. switch flush	1.30
Snap switch s. p.	.24
Snap switch d. p.	.50
[illegible]	1.25
[illegible]	[illegible]
Floor receptacle, waterproof	2.92
Three-way flush switch	1.09
Three-way snap switch	.50

The following is a price list for lamp outlets for high-class apartments and medium sized residences renting for more than $50 per month, with hard-wood finish throughout.

Lamps.	Class "C" Building; two floors with double floors.	Class "D" Building; three floors with double floors.
[illegible]	[illegible]	[illegible]
11	78.00	91.00
12	81.00	94.00
13	89.00	99.00
14	92.00	102.00
15	95.00	105.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
18	104.00	114.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
23	119.00	130.50
[illegible]	[illegible]	[illegible]
25	126.00	141.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
29	140.00	157.00
30	143.00	161.00
31	146.00	164.50
32	149.00	168.00
[illegible]	[illegible]	[illegible]
34	155.00	175.00
35	158.00	178.50
[illegible]	[illegible]	[illegible]
37	166.00	189.00
[illegible]	[illegible]	[illegible]
39	173.00	198.00
40	176.50	202.50
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
43	186.00	215.00
44	189.00	219.00
45	192.00	223.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
49	206.00	242.00
50	210.00	246.50
[illegible]	[illegible]	[illegible]
52	218.00	255.50
[illegible]	[illegible]	[illegible]
54	226.00	264.50
[illegible]	[illegible]	[illegible]
56	233.00	272.50
57	236.50	276.50
58	240.00	280.50
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

It should be remembered by central-station men that conditions as regards the cost of wiring in Chicago are radically different from those in the smaller cities and towns. The class of residences for which this schedule is drawn up has brick outside walls and hardwood floors, which in itself makes wiring more expensive than in frame houses. Then, too, the cost of labor is very high in Chicago, and the rigid city wiring rules makes the construction more expensive than is common in smaller towns.

Establishing the Right to a Patent on the Ground of Priority.

By John E. Brady.

It is a fundamental rule of the patent law that patents are issuable only to first and original inventors. The rule as stated is not involved, but an explanation of the meaning of the term "first and original inventor" is essential to a clear understanding of the situation. Where two or more persons, independently of each other, have worked out the same invention, each is an original inventor, and, but for the other or others, would be entitled to the patent. Two patents, however, cannot be granted for the same invention, because an exclusive privilege cannot subsist in distinct individuals and also because the issue of one patent exhausts the power of the government to afford protection to the inventor. Hence, the law is compelled to choose between rival inventors and confer the exclusive privilege upon the one who in reason seems best to deserve it. This it does by providing that the first or earliest in time of these rival inventors shall be regarded as the only true inventor. Robinson on Patents, Sec. 370.

No serious difficulties are presented in regard to the question of priority under the English law, because there the date of the application for a patent is considered the date of the invention, and the first patentee or applicant for a patent is held to be the first inventor. But in this country the courts will go behind a patent already granted or an application for a patent, to ascertain whether the patentee or some rival claimant was in fact the first inventor, and priority is awarded to him who first performed the inventive act.

Where one of two rival inventors has reduced the idea to practice before the other has conceived the idea, the former is unquestionably the first and true inventor. Where their conceptions are simultaneous and one of them precedes the other in putting his idea into practice, his earlier completion of the inventive act renders him the proper patentee. But where the one who first conceives the idea is anticipated in its reduction to practice by another and subsequent originator of the same idea, an additional test of priority must be applied. The rule here is that the first conceiver must show that he has exercised proper and due diligence in rendering his invention available for public use. And if he does this, he will entitle himself to the patent, although a subsequent conceiver was first in putting his idea into practice and in filing his application for a patent.

Suppose that an inventor has been working upon a patentable idea, and has advanced his work to a point where he is about to apply for letters, when he hears for the first time that a patent has already been granted upon substantially the same device, or that an application for such a patent has been filed. Or suppose, on the other hand, that after one has filed an application or secured a patent upon a machine or process which, so far as he is concerned, originated in his mind, he is informed that a rival inventor claims to have been ahead of him in point of time in making the invention, and although he has taken no active steps to secure a patent, announces his intention of claiming such a right. The question of inventorship then becomes an issue, the determination of which depends upon which party is entitled to be considered the first and original inventor. The original inventor is justly entitled to the patent regardless of the time of the filing of his rival's application; but if the other inventor is first in getting in his application, it rests upon the inventor claiming priority to establish his position, and his right to be considered the original inventor. To do this he must show that he was the first to conceive of the invention, and if it appears that the rival inventor was the first to put his invention into practice, then he who claims to be the original inventor must show that he used diligence in carrying his idea to completion. In such a case, if he has been lacking in diligence, then his prior conception will not help him and the patent will go to the rival.

As invention takes place at the date of conception, it is necessary to know what is meant by the term "conception" and when conception, within the meaning of the patent law, takes place. The point of time is neither when the first thought of it was conceived, nor when the practical working machine is completed; but it is when the thought of conception is practically complete; when it has assumed such shape in the mind that it can be described and illustrated; when the inventor is ready to instruct the mechanic in relation to putting the idea into working form; when the embryo has taken some definite form in the mind and seeks deliverance, and when this is evidenced by such description or illustration as to demonstrate its completeness. The true date of the invention is the date when the work of the inventor ceases and the work of the mechanic begins. Up to that point he was inventing, but had not invented, and he must have invented before the law will come to his protection. Cameron & Everett vs. I. R. Brick, 6 C. D., 171.

It follows, then, that the date of the conception is the date when the idea of means, including all the essential attributes of the invention, becomes so clearly defined in the mind of the inventor as to be capable of exterior expression, and it is settled both by practice and express decision that such exterior expression of the mind of the inventor, when relating to machinery, may be by exhibits either in the form of models or drawings, if thereby the invention be made sufficiently plain to enable those skilled in the art to understand it. Webster Loom Company vs. Higgins, 105 U. S., 580.

As has already been said, invention dates from the time of conception. If diligence is used in reducing the invention to practice, an inventor may be granted a patent, although another has filed his application first, or even has been granted a patent; so when an inventor finds that he is in a position where, in order to gain a patent he must prove a prior conception, a question arises as to the nature of the proof to be required of him. Where a patent has already been granted to another, the patent is presumptive evidence that the patentee was the original inventor, and in order to overthrow this presumption, evidence must be given which is free from doubt. Stonenietz Printers' Machinery Company vs. Brown Folding Machine Company, 57 Fed., 601.

The mere uncorroborated word of an individual that the idea for a device, already protected by a patent granted to another, occurred to him before the patentee thought of it, will not suffice to set aside the patent. If he can produce a sufficient number of witnesses in support of his word he may gain his point, but, as it is only natural that the inventor working upon an unperfected device, will refrain from general and open discussion of the idea until he knows that he may do so without fear of someone else jumping in ahead of him and applying for the patent, and that until such time he will keep the matter as close a secret as possible, it follows that, in many cases, he will not be able to produce the necessary corroborative testimony along these lines. The inventor, however, may, as a general rule, make drawings and sketches without rendering his idea public property, and these drawings are liable to be of assistance to him if it later becomes necessary to satisfy a court of law as to his right to a patent.

The fact of conception by an inventor for the purpose of establishing priority cannot be proved by his mere say-so, nor by his unsupported testimony where there has been no disclosure to others, or embodiment of the invention in some clearly perceptible form such as drawings or models with sufficient proof of identity in point of time; for otherwise such facile means of establishing priority of invention would, in many cases, offer great temptation to perjury, and would have the effect of virtually precluding the adverse party from the possibility of rebutting the evidence. Hence, it has been decided in many cases that the mere unsupported evidence of the alleged inventor, on an issue of priority, as to the fact of conception and the time thereof cannot be received as sufficient proof of the fact of prior conception.

It will be remembered that in the first electric railways, in which the [illegible]

above the car, the car maintained contact therewith by means of "overrunning" trolleys connected with the car by a cord or similar means and towed along above the surface of the conductor. These devices were found impracticable for general use because of uncertainty of connection, lack of adaptability to various forms of switches, liability to derailment, and for other reasons. The problem presented was how to make practicable the propulsion of electric railway cars by a continuous contact under all the conditions presented by crowded streets, sharp curves, complicated switches, rough roads, and the necessity of a continuous upward pressure of from 8 lbs. to 15 lbs. The solution was worked out by Chas. J. Van de Poele, who devised the scheme of maintaining contact by the familiar overhead trolley described as "the long, swinging, pivoted, hinged, and upwardly spring-pressed arm extending from a support on the top of the car and equipped with an underrunning contact device." Two patents were issued to the administrator of the inventor after his death and the validity of these patents was made an issue in an action by the Thomson-Houston Electric Company. The action was instituted for the purpose of restraining an infringement of the Van de Poele patents, they having been assigned to the Thomson-Houston Company, and it was offered in defense that Van de Poele was not the original inventor, but a former employee of Van de Poele, named Verstraete. Verstraete testified that the trolley as constructed by Van de Poele was impracticable, and that, as Van de Poele desired to perfect the device in time to exhibit it at the Toronto Exhibition, and had very little time, Verstraete, himself, went down to a shop in that city and constructed a crude form of the patented trolley. Van de Poele, in his application for a patent, had sworn that he was the original and true inventor, and it did not appear that, during his life, any other person claimed the credit of the invention. It was held that such evidence of a former employer given, after years of silence, would not be taken against the oath of the patentee, especially when other evidence in support of the patent was not accessible Thomson-Houston Electric Company vs. Winchester Ave. Ry. Co., 71 Fed. Rep., 192.

Of course, there is no set rule by which to determine all cases where the question of priority of conception is involved, and the determination of each particular case depends upon the facts presented. But, that clear and convincing proof of prior conception must be furnished before a court will award patent rights, is shown in Rudolph vs. Williams, 62 Fed. Rep. 577. The question was one of fact whether Rudolph or Williams was the inventor of an improved method of "feeding the reciprocating blade of a stone sawing machine." Rudolph sued Williams to obtain an adjudication that he (Rudolph) was entitled to the patent. Prior to the making of the invention involved, saws had been constructed so as to cut only during the forward movement of the saw; that is to say, the feeding mechanism of the saw operated only during the forward movement of the blade and was not in operation during the backward movement. The invention, to which each party laid claim, enabled the saw to cut both ways and so accomplished more work with a given amount of power than could have been done before. Williams' statement was to the effect that he conceived the invention in July, 1886, and that he explained it to Rudolph, who was then in his employ as an engineer. He afterwards instructed Rudolph to attach the invention to a saw which he, Williams, owned, giving full directions as to the construction of the device and the method of applying it. He also stated that in October, 1886, he made a pencil drawing and submitted it to his solicitor from which to apply for letters patent. Williams testified positively that he did not obtain the idea from Rudolph and that he received no aid or suggestion from any person as to how the invention ought to be embodied in a working attachment to a stone saw. Other persons also testified in behalf of Williams; among them was one of Williams' relatives, who gave evidence that Williams told him in July, 1886, how to make a stone saw cut both ways instead of one, and an employee of Williams' testified that Williams, after ordering the improvement attached to the saw, had it removed for fear that some outside party would see it, recognize its value and apply for a patent.

Rudolph is the party in whom interest centers at present, for he was attempting to establish his right to a patent by showing that he conceived the idea of the invention prior to the date of Williams' conception. Rudolph, in making out his case, declared that the idea for a stone saw which would cut both ways presented itself to him on the 26th of October, 1879, while he was paying a visit to a stone yard at Mott Haven, and that it was suggested to him by the operation of a diamond stone saw, which was running there at that time. While there, he said, he made a "little sketch" in lead pencil embodying the device, and he explained the method of its working to a friend who was present and testified in his behalf at the trial. The sketch, however, was not preserved, and Rudolph stated that, while he did not believe that the friend, with whom he had discussed the invention, had understood it, it was very clear in his own mind. Rudolph fixed the date of the making of the invention by reference to a freight slip which was dated Oct. 26, 1879. That was the day upon which his furniture was transported to Peekskill, and Rudolph knew that it was upon that same day that he visited the Mott Haven stone yard. But, unfortunately for the force of his contention, it appeared that the date mentioned fell upon a Sunday and that he could not have received the inspiration exactly as set forth for the further reason that there was no stone saw such as he described in the Mott Haven stone yard at the time. On cross-examination he admitted that he forgot all about his invention after it first occurred to him in 1879 and that it did not come back to him until he was caused to think of it by conversation with Williams. Other evidence was given to bolster up the claim of Rudolph, but it was weak and indifferent. No sketches were introduced in evidence nor was any witness produced who could show that Rudolph conceived, not only of the result to be accomplished, but also of the means of accomplishing it. There was little to establish Rudolph's claim to priority, except his own assertion that he was the first inventor, and it is a familiar rule which requires that but slight weight be attached to testimony where it is coincident with the dictations of self-interest. Under the evidence it was held that Rudolph had not sufficiently established his claim and that he was not entitled to the patent.

When drawings are depended upon to make out a case of priority of conception they must be full and complete and such that any person, skilled in the art to which the invention relates, could construct the device upon referring to the drawings. In Uhlman vs. Arnholdt & Schaefer Brewing Company, 53 Fed. Rep. 485, it was attempted on the part of the defendant to establish priority of conception as a defense to an action for infringement of a patent upon a process of filtering beer. The plaintiff had the patent upon the process, but the defendant claimed that he could show that another party had conceived the idea for filtering beer by the process in suit before the date of the plaintiff's invention. The evidence offered consisted of two letters, with enclosures purporting to describe the invention. Referring to the alleged description in the first letter, the court said: "No person, however skilled, could, from these documents, have gleaned the information requisite for the practice of the method of treatment in question." As to the drawings, which were enclosed in the second letter, the court considered that they would be but of little more assistance to an expert who was desirous of acquainting himself with the details of the process which they were intended to describe. The defendant, being thus unable to show a case of prior conception, was held liable for infringement.

An important and long-contested case, which turned upon the question of the sufficiency of certain drawings, was that of Mergenthaler vs. Scudder, 11 App. Cas. (D. C.) 264. Mergenthaler, it appeared, had filed two applications in the Patent Office for patents upon improvements in linotype machines, one in December, 1890, and the other in May, 1891, and about a year and a half later Scudder filed his application for a patent upon a similar improvement. When the right to the patent be-

came an issue Mergenthaler relied upon the fact that he was the earlier in filing his application, and Scudder sought to base his claim upon the ground that he was the first to conceive the invention and was, therefore, the first inventor and the only one entitled to a patent. The question was carried through the offices of the Board of Examiners and the Commissioner of Patents and an appeal was finally taken to the Court of Appeals of the District of Columbia.

Two questions presented were on the trial of the action: I. Whether prior to the application filed by Mergenthaler there was a complete conception of the invention in issue by Scudder, sufficiently shown in proof. II. Whether Scudder had proven that he proceeded with reasonable diligence to reduce the conception to practical form. The linotype machine, which both inventors had sought to improve, even in 1897, represented the thought of many inventors and was the product of no fewer than 1400 separate patents. It was shown that the original linotype machine was the invention of Mergenthaler, he having been granted patents upon such machines as early as 1885. But Scudder laid claim only to certain improvements on those machines, and it seems that he was employed at a liberal salary as superintendent of the Mergenthaler factory in Brooklyn, and was, therefore, in a position to become acquainted with all the details of construction and operation of linotype machines. As Mergenthaler was first in filing application the burden was upon Scudder to establish by clear proof the priority of his invention. It rested upon Scudder to show a completed invention on his part prior to the filing of Mergenthaler's application. Scudder alleged that he conceived the invention in February, 1889, that he made a disclosure thereof at that time, and had the machine in an experimental form in December, 1889; also that he made drawings in May, 1890, which drawings were produced in evidence. And, as there was no very strong evidence of a conception of the invention prior to May, 1890, the case of Scudder necessarily depended largely, if not entirely, upon the sufficiency of the drawings. The work of embodying the invention in the working machine was done after Mergenthaler had filed his applications, and so could not avail Scudder in his attempt to show prior conception.

In order to establish his right to a patent, it was necessary for Scudder to furnish such full and clear drawings of his invention as would enable any person skilled in the art of construction of such machines to reduce his invention to practical form. This he failed to do. Scudder produced a witness who identified the set of drawings which he had made in May, 1890, and upon which depended his claim to priority. But experts were brought forward by Mergenthaler to testify that there were many details which were not represented on the drawings. And after a very lengthy and searching examination it was determined that the drawings were in many essential particulars deficient and wanting in completeness. It was held that the most that the drawings showed was that, at the time of making them, Scudder had the germ of the idea which, at a time subsequent to the applications of Mergenthaler, matured into the machine upon which Scudder sought a patent. Scudder was declared to have failed to establish a prior conception, and, therefore, was held not to be entitled to a patent.

For a number of apparent reasons, every inventor who desires to obtain a patent upon an invention, should make his application therefor as soon as possible after invention. If the inventor requires time in which to bring his invention to maturity, he may prevent the issuing of an interfering patent, in the meantime, by filing a caveat in the Patent Office. A caveat is a document in which an inventor states the function and the distinguishing characteristics of the invention to which it refers, and prays protection until such time as he can complete his work. The caveat is good only for one year, and while in force its only statutory function is to prevent the issuing of any similar patent to another, until the party filing the caveat has had notice and an opportunity to file an application in his own behalf. An omission to file a caveat does not, of course, impair the ultimate rights of the inventor.

Steel Conduits and Steel Conduit Fittings.

A circular has been issued by the Underwriters' Laboratories, 382 Ohio Street, Chicago, presenting certain questions relating to conduit work and requesting detailed replies from manufacturers, contractors and users of steel conduits. This information is desired in connection with a contemplated revision of underwriters' rules relating to the subject. The questions are as follows:

1. In what respect, if, any, does the ordinary form of enamel on rigid conduit prove an unsatisfactory covering for the steel pipe?

2. Does galvanized rigid conduit possess advantages or disadvantages as compared with enameled conduit? If so, what and for what special uses? (The claim has been made that galvanized pipe in the presence of moisture, especially in concrete, suffers from "local action," that is, a corrosion due to electrical action in the presence of the two metals and traces of acid. Well substantiated evidence of such effects is especially desired if the effect is known to have been observed.)

3. Does the enamel ordinarily used on conduit and fittings (junction, outlet and panel boxes) prevent or render difficult strict compliance with the following rule of the National Electrical Code? If so, what commercially practicable means can be found for obtaining better conductivity?

Rule 25f. Must have the metal of the conduit permanently and effectually grounded. It is essential that the metal of conduit systems be joined so as to afford electrical conductivity sufficient to allow the largest fuse or circuit breaker in the circuit to operate before a dangerous rise in temperature in the conduit system can occur. Conduits and gas pipes must be securely fastened in metal outlet boxes so as to secure good electrical connection. Where boxes used for centers of distribution do not afford good electrical connection, the conduits must be joined around them by suitable bond wires. Where sections of metal conduit are installed without being fastened to the metal structure of buildings or grounded metal piping, they must be bonded together and joined to a permanent and efficient ground connection.

(At the meeting of the Underwriters' National Electrical Association in March, 1907, it was suggested that the following be added as a fine print note in Rules 24A, 25d, 25f, of the Code: "It is recommended that galvanized cables, outlet boxes and fittings be used in order to secure a better electrical contact at all points throughout the cable system." It was also suggested that a note be added to Rule 49Ab to read: "It is recommended that the protective coating (of switch and outlet boxes) be of metal such as tin or zinc." These suggestions were referred to a special committee for consideration and report.)

4. Definite information is desired as to the use of conduit in cement or concrete.

(a) Conditions liable to cause deterioration of conduit, either rigid or flexible in cement or concrete. See also inquiry No. 2, above.

(b) Do flexible conduits or armored cables placed in wet concrete admit water to the interior while concrete is setting to a degree sufficient to cause trouble? If so, what precautions should be taken or what limitations should be placed to such use of flexible conduit or armored cables?

5. What injurious effects on exposed conduits are observed from the action of acid fumes and gases. In such cases what may be done to protect the conduits from rapid deterioration?

6. What added specifications for construction and installation of junction boxes should be made? See Code Rule 49A, which treats of switch and outlet boxes, and Rule 25b and g.

7. What defects, if any, are found in present types of

(a) Ordinary conduit outlet boxes?

(b) Junction boxes?

(c) Grounding clamps?

(d) Fittings for use with flexible conduit and armored cables?

(e) Fittings for use with exposed rigid conduit such as "condulets" and similar devices?

8. What other defects, not suggested above, have been noted in present forms of conduit or fittings? What means may be taken to correct such defects and what additions or revisions of the present Code rules on conduit are desirable?

Cost of Generating Electricity by Small Gas Producer Plants.

In the 1907 "Question Box" of the Canadian Electrical Association some interesting figures on the cost of energy from a 100-hp gas producer plant were given by Mr. N. P. Edwards, of Edmonton, Alberta. Anthracite coal with a calorific value of 12,000 B. t. u. was assumed, costing $5 per ton in pea size. The producer efficiency was 78 per cent. The first cost of a 100-hp suction gas producer, engine and compressed air starter, together with erection and foundations, was taken at $7,000. The attendance for a plant of this size is small if the plant is properly equipped, an allowance of four hours per day being ample, according to Mr. Edwards. From the experience of the contributor the following figures were taken:

A 100 b. h. p. consumes 1 lb. of coal per hp-hour, or 1000 lbs. per 10 hours, and the stand-by losses of the other 14 hours will not amount to more than 30 lbs.; hence the fuel was taken at 1030 lbs.

[illegible]

[illegible]	[illegible]
Coal at $5.00 per ton, 154.5 tons	773.00
Oil and waste	[illegible]
Interest on investment at 8 per cent	560.00
Depreciation at 8 per cent	560.00
Insurance, repairs, taxes	250.00
Total	[illegible]
Per hp year	$26.73
Load factor, 100 per cent	

To this must be added the cost of water used to cool the engine and that used in the scrubber, 4.5 gals. per hp-hour; the water used in cooling the cylinder can be used over again if cooling tanks are employed; the allowance for the scrubber and vaporizer is 3 gals. It is inadvisable to use again the water that has passed through the scrubber and been purified, because if there is a large percentage of sulphur in the coal, the sulphurous acid generated in the producer acts on the wrought iron of the scrubber. Repairs to the producer consist of removing the firebrick lining, once a year as a minimum, and sometimes once in three years. The coke in the scrubber requires removal about twice a year.

Mr. J. E. Ashworth, of Moose Jaw, Assiniboia, gave the following figures for a 100-hp plant, not including fixed charges:

Fuel, 125 lbs., per hour (anthracite, $7.00 per ton)	.44
Labor, [illegible] man at $3 per [illegible]	[illegible]
Oil and waste	.05
Operating cost per hour for 100 hp	.79
Operating cost per year, 300 hrs., per hp	$23.70

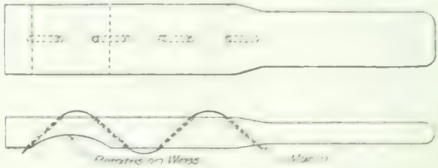
These figures represent brake horse-power and not electrical output.

Switchboard Wire Protection.

By T. W. Poppe.

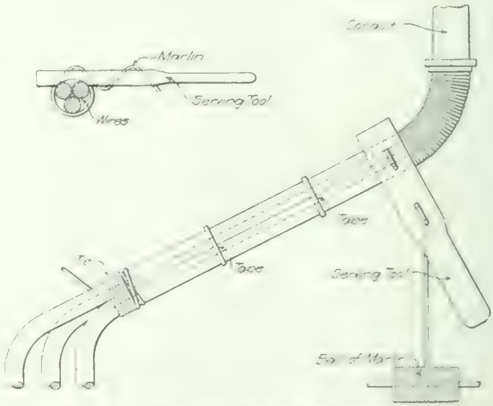
When connecting the feeders and dynamo and service leads to a switchboard, a very neat and durable job can be made by serving the wires with marlin. By serving is meant to tightly wrap the wires of each set (two or three as the system may require) together with marlin. It should be commenced where the wires leave the conduit and continued to within five or six inches of the first lug it will connect with. Here the wires can be separated and continued to their respective lugs. When the serving is complete on one set of wires the marlin should be thoroughly painted with a moisture-resisting compound. The marlin serving will stiffen the wires and they can be bent very neatly to avoid touching the bus-bars of the board. When painted the marlin hardens so that it is difficult to bend the wires after the paint has dried. It then requires a strong pressure to bend them. The marlin acts as an additional insulation and mechanical protection to the wires, and while no harm would result from the wires coming in contact with the bars while thus protected, it looks better to bend them so as to avoid touching the bars.

The sailors when serving a rope or other object use a peculiar serving tool, but a wireman can construct one of wood, using a piece of oak 2 ins. wide, 7/8 in. thick and 14 ins. long Fig. 1 shows a tool similar to one used by the writer. It is made of oak as explained, having four holes drilled through



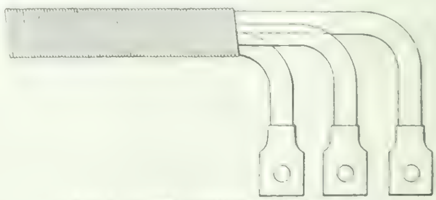
[illegible]

it, as shown. The marlin is passed through the holes, as shown, commencing at the hole nearest the handle. The object of this is to cause a strain on the marlin at the point where it passes around the wire, so that the marlin may be wrapped tightly. The friction caused by the marlin passing through the holes causes the strain. It is necessary to serve the first four



[illegible]

or five inches by hand, pushing the winding into the conduit as far as possible. This acts as an additional protection to the wires where they leave the conduit. This protection should be afforded, as there is more or less wear on the insulation during the process of serving and bending. The serving is continued to within four or five inches of the first lug by means of the serving tool. The wires are then bent in shape, as



[illegible]

shown in Fig. 3, Fig. 2 showing the serving of the wires. While serving it is necessary to pass the ball of marlin around the wires with the serving tool.

To serve the wires properly it is necessary to tie the ends of the wires taut. The wires should be straightened and run together so as to be parallel, being bound with tape at different points to keep them so. As the serving progresses the tape

should be removed, as it will cause a bulky appearance in the marlin if left on. The serving should be continued to a point longer than absolutely necessary at first to avoid a short measurement in it, due to the extra length of wire the bending will require. When it is thus finished the wires can be bent into their permanent position and the marlin removed to the proper point.

The neatest way to bind the serving is to leave three or four windings loose, allow an extra foot of marlin, remove the serving tool and push the end of the marlin under the loose windings, bringing it out between the fourth and fifth winding and rubbing the marlin in the direction of the serving so as to tighten the loose windings; then pull the end of the marlin projecting through the fourth and fifth winding taut. The surplus marlin may be cut off and tucked into the serving by being pushed under the marlin between two wires. This leaves a very neat ending. Each set of wires should be painted as soon as bent into position, as each set finished makes it more difficult to paint the others. The room on a switchboard as a rule is limited and does not admit of much space between the wires. Should some paint drop on the bus-bars during the painting process, it can be removed by using a piece of waste soaked with kerosene oil.

Wiring and Connections for Constant Potential Transformers.

By Geo. A. Burnham

The principal mechanical features on a transformer are embodied in the cores, arrangement of coils, and the transformer case with its various details. Mechanically considered, transformers may be divided into two distinct classes, namely, the core-type and the shell-type. Although the electrical principles involved are the same in the two types, they differ radically in mechanical construction. Fig. 1 is a sketch of a core-type transformer, the magnetic circuit of which consists essentially of two cores *a a*, and two yokes *b b*, which when arranged as shown in the sketch form a complete magnetic circuit. These cores are made, or "built up," of laminated stamping which vary according to different designers, from .012 to .016 of an inch in thickness. It is quite evident that a solid iron or steel core could not be used in an efficient transformer on account of the excessive eddy current loss. To limit the value of eddy currents, the iron is placed in the form of thin sheets laid transverse to the path of the eddy currents, and are insulated from one another by sheets of paper, or a thin coat of varnish. Some makers, however, depend solely upon the oxide which forms upon the surface of the lamina for insulation. The latter arrangement provides a more compact core, and requires less constructive material for given conditions. The insulation of the laminae in the above manner confines small portions of the eddy current to one sheet, which being comparatively thin, offers considerable resistance, and thus the current is practically reduced to zero. As a matter of fact, the loss due to eddy current in a modern transformer is fairly small, indeed.

The iron for "building up" the transformer cores is very carefully selected and is subjected to an annealing process which reduces "aging" to a minimum. This aging of the iron is a phenomenon which takes place in the molecules of the iron, and is attributable to the high temperature to which the core is subjected. The "aging" has a tendency to increase the core losses, and it varies with the length of time through which the transformer has been operated. The magnetic circuit for both the shell-type and core-type transformers is made in such a manner that the joints are broken or interlocked. This mode of construction makes a very efficient and compact core, reduces the reluctance to a minimum and prevents excessive vibration and humming, which otherwise might cause serious injury to the insulation of the wires.

After the cores of small transformers have been assembled they are sometimes covered with a layer of heavy fibrous material much like heavy wrapping paper. After the insulating material has been thoroughly dried, the coils are placed on the cores as shown in Fig. 1. The secondary, which consists of a comparatively few turns of heavy wire, is placed next to the cores as shown in Fig. 1. The secondary, which consists breaking down the insulation to the iron core than there would be if the primary winding, which is subjected to the high voltage, had been placed adjacent to the core. After the secondary winding has been properly insulated, a mica or micanite shield is placed over it; the primary, which consists of a comparatively larger number of turns, is wound over this. In some instances the coils are divided into sections; that is, a secondary coil is between two primary coils arranged alternately along the core. With this method the demagnetizing effects of the secondary coil are split up and the magnetic leakage is much reduced. This method, however, means more space employed for insulation and a complexity of connections, but, on the other hand, the voltage between adjacent layers is considerably less than with the arrangement of coils shown in Fig. 1.

Assume that the primary of the transformer indicated in Fig. 1 has 900 turns, made up of 30 layers, and the primary is to operate at 2000 volts. There will be a difference of potential of 2.2 volts between adjacent convolutions and about 130 volts difference of potential between the ends of adjacent layers. From this it may be seen that some care is necessary in providing for sufficient insulation between the adjacent layers. Oiled silk is generally used for this purpose.

The ends of the primary coils are generally joined to a terminal block, located at the top of the core and thoroughly

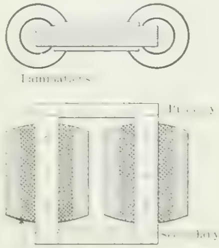


FIG. I.—COILS AND CORE OF A CORE TYPE TRANSFORMER

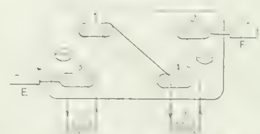


FIG. 2.—TERMINAL BOARD OF A TRANSFORMER HAVING TWO PRIMARY COILS

insulated from the iron structure of the transformer. The block is usually made of porcelain attached to a piece of well-seasoned, especially prepared oak, which, in turn, is fastened to the iron frame which holds the core in place.

Fig. 2 shows a connection block used by one of the large manufacturing companies. One, 2, 3 and 4 are brass terminals to which the ends of the primary coils *a* and *b* are connected. It will be noted that the brass straps *C*, in the position shown, connect the two coils *a* and *b* in series, but should the two straps *c* (one on top of the other) be removed from the terminal 1 and 4 and one be connected between 1 and 2 and one from 3 to 4, the two coils *a* and *b* would be connected in parallel. By this arrangement the primary may be operated at either 1000 or 2000 volts. The leads *E* and *T*, which connect to the line, pass through the transformer case by way of porcelain bushings which are securely fastened into receptacles with an insulating cement; in many instances a form of resinous wax is used.

The secondaries terminals, in many instances, pass to the outside of the case in the same manner as do the primaries, and the series or parallel connections may be made when they are joined to the external circuit.

A complete section of a core-type transformer with the coils immersed in cooling oil is shown in Fig. 3.

SHELL-TYPE TRANSFORMER.

The construction of the shell-type transformer differs widely from that of the core-type. In the core-type there is only one

magnetic circuit, but in the shell-type there are two, as shown by the arrows in Fig. 4. These cores are made or "built up" in the same manner as are those of the core-type. The coils, however, are put on in an entirely different manner. They are form-wound and thoroughly insulated, and then the core is built up around them and then pressed tightly together and held in place by two cast-iron end plates with several through bolts.

Instead of there being few coils and many layers as in the core-type, there are many coils and many layers per coil. The coils are made flaring at the top so that the oil can circulate through

FIG. 3.—[illegible] OF AN OIL-INSULATED TRANSFORMER.

them easily. This method of construction permits the use of deep, narrow coils, with many layers and few turns per layer, consequently the voltage between adjacent layers is low and there is less liability to a short-circuit. The spreading of the coils at the end above the iron core provides a large radiating surface, and allows each coil to radiate its own heat directly. Thus there is uniform heating throughout and consequently no excessive strains are produced on the insulation. The greater part of the iron is placed on the outside where it can easily dispose of its heat and thus reduce in a measure the tendency towards aging.

The sub-division of the windings into many coils allows the full output to be obtained at several different voltages, as the coils may be connected into many different series and parallel arrangements.

Fig. 6 is a diagrammatic sketch of the terminal block indicated in Fig. 5, to which the ends of the various coils are connected. The arrangement shown is used to a great extent in the transformers built by one of the large manufacturing companies.

The primary winding consists of two coils, each having a tap brought out and joined to a post on the terminal block. The number of turns between the tap and the end of the coil is about 5 per cent of the total number of turns per coil. By this arrangement the turns on the primary may be increased by 5 per cent by connecting to the tap instead of to the

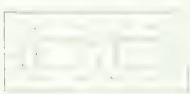


FIG. 4.—MAGNETIC CIRCUITS OF A SHELL-TYPE TRANSFORMER.

end of the coil; by connecting to the two taps instead of to the end of the coils, the turns may be decreased by 10 per cent, thereby producing an increase in the secondary voltage of 5.2 per cent or 11.1 per cent, respectively.

The secondary winding is composed of four coils, the ends of which are joined to the terminal block where various parallel and series connections can be made. The diagram shows two of the sets of coils connected in series; the four coils being connected in series, four times the voltage of one of the coils is available between the two outer terminals. The coils, however, could have been connected in multiple if the strap had been [illegible]

By the latter arrangement c and d would have been connected in parallel and c' and d' in parallel. These pair of coils in turn could have been joined either in parallel or in series by the external connections.

After the connections between the coils and the terminal block have been thoroughly made and soldered to meet the required conditions, the coils assembled on their cores are placed in the transformer case as shown in Fig. 3. These cases are usually of cast iron provided with removable covers held in place by heavy thumb screws. The cases of the larger transformers, however, are frequently made of boiler iron. One of the necessary features of a transformer is that its temperature be main-

FIG. 5.—COILS AND CORE OF A SHELL-TYPE TRANSFORMER.

tained as low as possible. Many of the small transformers are cooled by a natural circulation of air, because comparatively little heat has to be radiated, but in larger transformers the heating becomes an important factor. Self-cooled transformers are those which require no artificial means for dissipating the heat emitted from the apparatus during operation. These transformers may be divided into two types, namely, air-cooled and oil-cooled. The air-cooled or natural draft transformer is one in which air is used to absorb the heat, which is done by designing the transformer so that a draft of air may readily pass through it. Air-cooled transformers, if used out of doors, have the disadvantage that they require specially shaped cases to keep out the rain, and the insulation can readily absorb moisture.

Oil-cooled transformers are those in which the coils and

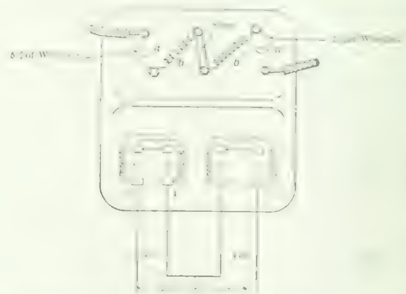


FIG. 6.—TERMINAL BLOCK OF A TRANSFORMER HAVING TWO PRIMARY AND FOUR SECONDARY COILS.

cores are submerged in oil. The oil serves two purposes; it conducts the heat from the coils and cores to the iron case, from which it is radiated, and it serves as an insulator. Frequently lightning discharges rupture the insulation, and the oil flows into the rupture and repairs it, providing the rupture is small.

There is, as a general rule, sufficient space within the case to allow oil to circulate freely, due to connection. The oil on being heated rises to the top, and the warm oil at the top and sides of the case, as it becomes cool, sinks to the bottom. The cases are generally corrugated so as to present a greater surface to dissipate the heat.

In many instances where the transformers are made in such large size that there is not sufficient area to dissipate the heat, artificial means must be resorted to. Generally one of the following methods is adopted: Forced-oil, water, or air circulation.

In the forced-oil circulation type, the oil is pumped from the case and forced to circulate through coils of pipe so that it may dissipate its heat readily, after which it is returned to the case.

In the case of the forced-water circulation, a coil of pipe is submerged in the oil which surrounds the coils and cores. Through this coil of pipe water is pumped. This method has some advantages over the the forced-oil in that it requires less power to force the water than the oil, and, whereas in the forced-oil a cooling arrangement is used, such arrangement is generally dispensed with in this latter type. There is one danger, however, in that the water pipes are liable to break, thereby allowing water to come in contact with the insulation which might cause serious damage.

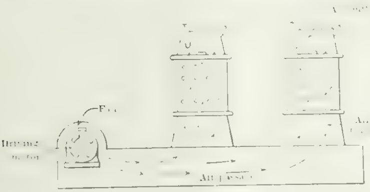


FIG. 7.—AIR-BLAST TRANSFORMERS.

Fig. 7 is a sketch of the air-blast type of transformer, which type is used extensively in moderate sizes. The heat is conducted away by means of a blast of air which is forced through the coils and cores, which are provided with numerous ducts so that the cooling air may reach the interior parts.

ELECTRICAL CONNECTIONS.

The primary and secondary windings of transformers may be variously connected to meet different requirements. Fig. 8 represents the ordinary method of connecting transformers to constant potential mains, the two transformers *a* and *b* consisting simply of a single primary and secondary. The primaries are connected in parallel to a 1000-volt main and, with a transformation ratio of 20 to 1, will produce 50 volts at the secondary terminal. Fig. 9 shows the same transformers with their secondaries so connected as to obtain an e. m. f. of 100 volts.

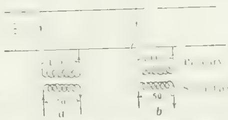


FIG. 8.—INDEPENDENT CONNECTIONS OF TWO TRANSFORMERS.

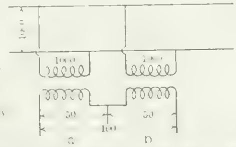


FIG. 9.—THREE-WIRE CONNECTION OF TRANSFORMER SECONDARIES.

In many instances it is necessary to arrange several transformers to feed into the same line, and great care must be taken to get the corresponding terminals of each transformer connected to the same side of the mains. In many instances it is deemed advisable to operate a three-wire circuit from the secondaries of transformers, and thereby reduce the cost of copper for the feeders. By joining the two secondaries in series and connecting the neutral wire to their junction as shown in Fig. 9, the condition can be obtained. This method of connection is used very extensively.

For polyphase distribution ordinary single-phase transformers are used, although special transformers are made for both two-phase and three-phase distribution. Fig. 10 shows the ordinary two-phase distribution using single-phase transformers and delivering two distinct currents from the secondaries. It is sometimes desirable to operate a three-wire, two-phase secondary distribution as shown in Fig. 11. It may be noticed that the voltage across the outside wire on this three-wire system is different from that of Fig. 9, in that here the e. m. f. is 141 volts instead of 200 between the outside wires. This result is due to the difference in time-phase of the e. m. f.s: they differ by 90 time-degrees, so that instead of adding the two secondary voltages numerically, they must be added vectorially.

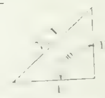


FIG. 12.—VECTOR RELATIONS OF TWO PHASE E. M. F.'S.

Referring to Fig. 12 let E_1 represent the secondary voltage of phase winding *A* and E_2 the secondary voltage, of phase winding *B*, which voltages are displaced by 90 time-degrees. From geometry the third side equals $\sqrt{E_1^2 + E_2^2}$ and since $E_1 = E_2$ the third side, or resultant, equals $\sqrt{2}\,E_1$ or $\sqrt{2}\,E_2$ or $1.41\,E$, E being the voltage of one phase. Transformers in two-phase work are frequently interconnected as shown in Fig. 13, where instead of there being 4000 volts between the two outside wires, the e. m. f. is 2828 volts.

In two-phase combinations, two transformers are required, whereas in three-phase distribution three separate transformers are generally employed. There are in general use two distinct methods of connecting three-phase transformers, namely, the star (or Y) connection and the delta (or △) connection. Fig. 14 shows the star connection for both the secondary and the primary coils.

The combination is made up of three separate single-phase transformers, the primaries of which are represented by the letters *a*, *b* and *c*, and the secondaries are indicated by the letters *a'*, *b'* and *c'*. It is evident from Fig. 14 that one end of each primary is connected to a common point called the "neutral," and the other three ends are connected to the three primary lines. The secondaries are connected in exactly the same manner with respect to the neutral point and the three other ends are connected to the load circuit. The voltage between wires is easily explained by reference to Fig. 15. Let *oa*, *ob* and *oc* represent the secondary e. m. f.s of the three transformers shown in Fig. 15. The point *o* may be considered the neutral and *a*, *b* and *c* the relative e. m. f.s of the three ends of the secondaries which connect to the load circuit. Now the turns of wire in the three legs are equal in number and the e. m. f.s in the three-phase circuit are displaced by 120 time-degrees. From this condition the sides, *ab*, *bc* and *ca* are equal and the time-phase displacement between the e. m. f.s is 120 degs., as shown.

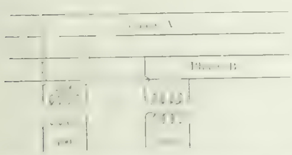


FIG. 10.—INDEPENDENT TWO-PHASE CONNECTIONS.

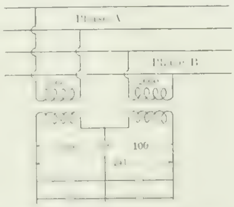


FIG. 11.—THREE-WIRE TWO-PHASE CONNECTIONS.

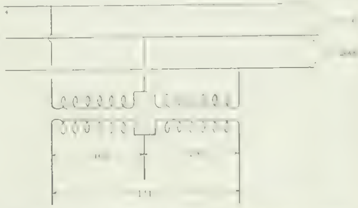


FIG. 13.—THREE-WIRE PRIMARY AND SECONDARY CONNECTIONS, TWO-PHASE.

The delta connection differs radically from the star con-

nection, although both attain the same end. Fig. 16 shows the delta connection; instead of the primary coils having a common neutral the primaries of the three transformers *a*, *b* and *c* are connected in series and a lead is connected at each junction of two coils. The secondaries are connected in a similar manner. The voltages in this type of connection evidently are

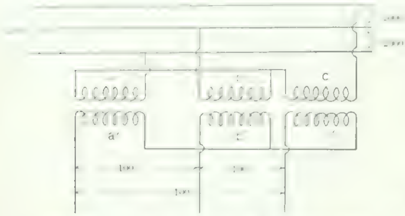


Fig. 14.—Star-Connected Transformers.

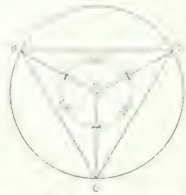


Fig. 15.—Vector Relation of Voltages in Star-Connection.

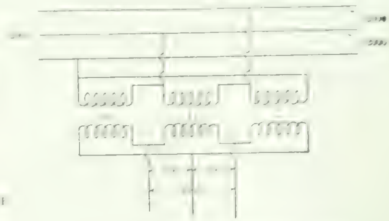


Fig. 16.—Delta-Connected Transformers.

equal, because there is a constant ratio between the primary and the secondary voltage of each transformer.

In the last two cases of three-phase connections arrangements in which the primary and secondary were both connected in the same manner have been considered. The next case to consider is one in which the primary is connected star and the secondary connected delta. Fig. 17 shows this combination, *a*, *b* and *c* are three standard transformers having a ratio of 10: 1. The

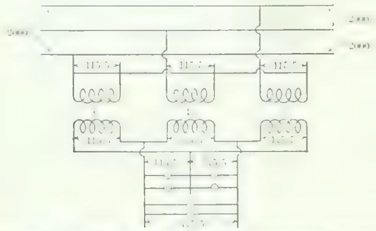


Fig. 17.—Star Primary and Delta Secondary Connections.

primaries are connected in star, and an e. m. f. of 2000 volts is impressed across two legs in series. Thus there is an e. m. f. of 1155 volts impressed on each of the primary coils, as will be seen by referring to Fig. 18. Let *ao* and *oc* represent two of the legs of the star connection having impressed on them 2000 volts, represented by the line *ac*. Now the triangle *aoc* is one having an angle of 120 degs. included between its two equal sides, *ao*

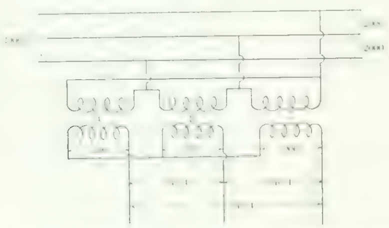


Fig. 19.—Delta Primary and Star Secondary Connections.

and *oc*. Let fall from *oa* a perpendicular *ob* which bisects the line *ac*. Now the lines *ab* and *bc* represent 1000 volts, each. From trigonometry the sine of the angle $boc = \frac{bc}{oc}$, or sine 60 degs. $= \frac{1000}{oc}$, $oc = \frac{2}{\sqrt{3}}\,1000 = 1155$.

Here there is an e. m. f. of 1155 volts impressed on the primary of each transformer. Since the transformer secondaries are connected in delta and have a ratio of 10: 1 the secondary voltage will be 115.5 volts, as indicated in Fig. 19.

Consider now the reverse combination; that is, instead of having a star-connected primary and a delta-connected secondary, consider a delta-connected primary and a star-connected secondary. Fig. 19 illustrates this arrangement. Assume the same type of transformers is used as in the previous case. Now, as the primaries are connected in delta there will be 2000 volts impressed on each primary and since the ratio is 10: 1, there will be 200 volts generated in the secondary of each transformer. The secondary windings are connected in star so that the e. m. f. at the secondary terminals of the transformers will be 346.4 volts. The following is an explanation of the increase in terminal voltage over the individual voltage of the separate secondaries.

The lines *oa*, *ob* and *oc* in Fig. 20 represent the time-phase

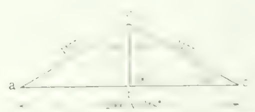


Fig. 18.—Vector Relation of Voltages in Star Connection.

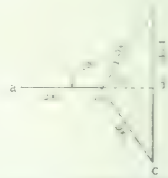


Fig. 20.—Vector Relation of Voltages in Star Connection.

displacement and value of the voltages at the secondaries of the transformers. Now *oc* and *ob* represent 200 volts each, and have included between them an angle of 120 degs. The third side of the triangle *obs* is then formed to be $200\ \sqrt{3} = 346.4$ volts.

Symbols for Wiring Plans.

On the opposite page we reproduce, by the permission of the National Electrical Contractors' Association of the United States, the chart of standard symbols for wiring plans as adopted by that Association, the American Institute of Architects, the U. S. Supervising Architect's office, U. S. Army Quartermaster-General's Office, as well as by several municipal departments, many technical institutions, prominent architects and engineers.

Since the first edition of the chart there has been a change in the symbols for center and bracket outlets, and symbols for indicating "gas only" outlets have been added. Also under the heading "Suggestions," standard heights of wall outlets have been enumerated. These changes and additions were made at the instance of the American Institute of Architects.

Copies of the chart and of sheets for attachment to specifications may be had of the Secretary of the National Electrical Contractors' Association, Utica, N. Y., or the Secretary of the American Institute of Architects, the Octagon, Washington, D. C., at the following cost prices: Wall hangers, 10 cents each. Large quantities, special prices. Specification sheets, lots of 100, $1.25 per hundred. Less than 100, 1½ cents each. There are two specification sheets, one relating to electric light wiring and the other to telephone and bell wiring.

STANDARD SYMBOLS FOR WIRING PLANS

AS ADOPTED AND RECOMMENDED BY

THE NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION OF THE UNITED STATES and THE AMERICAN INSTITUTE OF ARCHITECTS.

Copies may be had on application to the Sec'y of The Nat. Elec. Cont. Assoc'n, Utica, N. Y., and the Sec'y of The American Instit. of Architects, Washington, D. C.

Ceiling Outlet: Electric only. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Ceiling Outlet; Combination. $\frac{4}{2}$ indicates 4-16 C. P. Standard Incandescent Lamps and 2 Gas Burners. If gas only

Bracket Outlet; Electric only. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Bracket Outlet; Combination. $\frac{4}{2}$ indicates 4-16 C. P. Standard Incandescent Lamps and 2 Gas Burners. If gas only

Wall or Baseboard Receptacle Outlet. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Floor Outlet. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Outlet for Outdoor Standard or Pedestal; Electric only. Numeral indicates number of Stand. 16 C. P. Incan. Lamps.

Outlet for Outdoor Standard or Pedestal; Combination. $\frac{6}{6}$ indicates 6-16 C. P. Stand. Incan. Lamps; 6 Gas Burners.

Drop Cord Outlet.

One Light Outlet, for Lamp Receptacle.

Arc Lamp Outlet.

Special Outlet, for Lighting, Heating and Power Current, as described in Specifications.

Ceiling Fan Outlet.

S^1 S. P. Switch Outlet.

S^2 D. P. Switch Outlet.

S^3 3-Way Switch Outlet.

S^4 4-Way Switch Outlet.

S^D Automatic Door Switch Outlet.

S^E Electrolier Switch Outlet.

Show as many Symbols as there are Switches. Or in case of a very large group of Switches, indicate number of Switches by a Roman numeral, thus; S^1 XII; meaning 12 Single Pole Switches.

Describe Type of Switch in Specifications, that is, Flush or Surface, Push Button or Snap.

Meter Outlet.

Distribution Panel.

Junction or Pull Box.

Motor Outlet: Numeral in center indicates Horse Power.

Motor Control Outlet.

Transformer.

Main or Feeder run concealed under Floor.

Main or Feeder run concealed under Floor above.

Main or Feeder run exposed.

Branch Circuit run concealed under Floor.

Branch Circuit run concealed under Floor above.

Branch Circuit run exposed.

Pole Line.

Riser.

Telephone Outlet; Private Service.

Telephone Outlet; Public Service.

Bell Outlet.

Buzzer Outlet.

Push Button Outlet; Numeral indicates number of Pushes.

Annunciator; Numeral indicates number of Points.

Speaking Tube.

Watchman Clock Outlet.

Watchman Station Outlet.

Master Time Clock Outlet.

Secondary Time Clock Outlet.

Door Opener.

Special Outlet; for Signal Systems, as described in Specifications.

Battery Outlet.

Circuit for Clock, Telephone, Bell or other Service, run under Floor, concealed.
Kind of Service wanted ascertained by Symbol to which line connects.

Circuit for Clock, Telephone, Bell or other Service, run under Floor above, concealed.
Kind of Service wanted ascertained by Symbol to which line connects.

SUGGESTIONS IN CONNECTION WITH STANDARD SYMBOLS FOR WIRING PLANS.

It is important that ample space be allowed for the installation of mains, feeders, branches and distribution panels.

It is desirable that a key to the symbols used accompany all plans.

If mains, feeders, branches and distribution panels are shown on the plans, it is desirable that they be designated by letters or numbers.

Heights of Centre of Wall Outlets (unless otherwise specified)

Living Rooms	5′ 6″
Chambers	5′ 0″
Offices	6′ 0″
Corridors	6′ 3″

Height of Switches (unless otherwise specified)

4′ 0″

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NOTE—If other than Standard 16 C. P. Incandescent lamps are desired, Specifications should describe capacity of Lamp to be used.

Boiler Room Economies.

By James Smith

One of the ever-present problems in central-station operation is the delivery of the kw-hour of electrical energy at the bus-bars with the minimum consumption of fuel, and so far as the operating engineer is concerned, this problem is the most difficult of solution, while at the same time yielding a return for any conscientious time expended on it. Before the problem can be dealt with properly, it is necessary to have some record of the units generated, together with the coal and water used, and in most stations these data are easily procurable. The losses that are taking place should then be sought out and an endeavor made to find whether they are due to low boiler efficiency, steam losses, excessive steam consumption, etc. If a station is being operated with very great losses, wonders may be worked in a short time; but not many stations are being thus operated, so that increased economy is obtained gradually and only after a careful study of conditions. Much time is also required for making tests and determining whether a certain performance can be bettered; and, inasmuch as the average engineer has not many leisure moments to devote to such work, it may be weeks before these preliminary matters have been cleared up. The subject may be divided for convenience into the following headings: Fuel analysis, fuel gas analysis, auxiliary apparatus, feed water, firing, superheating, load factor and radiation.

It is essential for obtaining the best results that a straight run of coal should be used, as nothing is so inimical to economical steam generation as the frequent changing of the quality of coal. Firemen, if supplied with a certain line of coal, can in time learn to burn this to the best advantage. A carload of coal from one mine and a carload of coal from an entirely different mine should not be the rule for purchasing fuel. Coal from one mine should be used if good results are to be expected from the average fireman.

The quality of the coal should also be ascertained by repeated tests on carload lots. Not infrequently one finds a station buying the cheapest slack on the market, presumably on the assumption that any deviation in the quality of the fuel will be in its favor. Calorimetric tests of small quantities of coal, while offering some basis of comparison, are not of great commercial value, since the value of bituminous coal, for instance, is augmented by the hydrocarbons contained in it, and a large proportion of this escapes up the chimney without giving up its heat. Evaporative tests under similar conditions yield the best practical results.

In order to make a complete analysis of the gases from a boiler, the temperature, draft and chemical constituents should be known. By means of this information, the chimney losses may be reduced to a minimum, and apparatus for determining these points is available on the market. To obtain the maximum efficiency, the quantity of excess air must be as small as possible, and this quantity can only be determined by individual tests, and depends upon the quality of the fuel and also on the available draft. As much oxygen as possible should be combined with the carbon to produce carbon dioxide. For all practical purposes, the amount of carbon dioxide produced is an index to the state of combustion. Theoretically, without excessive air, 19 per cent of carbon dioxide will be produced; but in everyday work one might with reasonable attention obtain 12 per cent, with an exit stack temperature of 600 degs. F. Many stations are equipped with recording apparatus for ascertaining this percentage, and in most cases satisfactory results are obtained that have justified the original outlay. Without some such apparatus it is not possible to keep a close watch on air-leakages. Many boiler settings are notoriously porous, and being subjected to great changes of temperature, the air-leakage becomes excessive unless constant attention is directed to its restriction. Air leakages, unlike steam leakages, do not show themselves, as the leakage in the first case is from without, whereas the leakage in the latter case is from within.

When boilers are shut down under natural draft, there is always air leakage in the main flue, even though the dampers are closed. The brickwork around damper frames will generally be found to allow considerable air to pass through. This air has a cooling effect on the chimney gases and decreases the draft. If economizers are used, it also means that their efficiency is lowered. Unless all such leaks are stopped, any recording carbon dioxide apparatus is of little use.

The auxiliary apparatus consists of stokers, coil-handling apparatus, feed pumps, condenser equipment, etc., etc. The stokers, coal and ash conveyors, etc., should, as a general rule, be electrically driven, since steam engines for this purpose are inefficient. The question of electrically-driven or steam-driven feed-water pumps is open for discussion. If an electrically-driven pump is installed because of its higher efficiency, a steam-driven pump should be provided as a stand-by in the event of any failure of the electric supply.

Feed-water purification may or may not be essential, but feed-water heating is important. Many engineers have an erroneous opinion as to the detrimental effects of scale in boilers. While scale does not materially reduce the efficiency of a boiler, it may increase the wear and reduce its life. The steam-making power of a boiler-plate depends not on its conducting powers, but on its receiving and transmitting powers. An iron plate can conduct 12 times as much heat as it can absorb from the fire or give up to the water, and it is quite possible that a thin coat of scale on the metal in the water and a deposit of soot on the metal in the heated gases may be a benefit rather than a detriment. The nature of the scale is, of course, important, and unless it is many times as bad a conductor as the iron, the same amount of heat will pass, so that the question resolves itself into its ability of handing over the heat received to the water. A thin scale is preferred by many experienced engineers, who hold that this scale not only stops corrosion and pitting, but makes the boiler steam better. If, however, much scale-forming material is present in the water, this should be removed before the water is fed to the boilers. In every case where water is treated, the treatment should be done external to the boiler, since it is the function of the boiler to raise steam and not to act as a purifier.

When the engineer has checked all the leakages in the brickwork, has affixed gauges to the stack so as to record the amount of carbon dioxide present, and has done all that possibly can be foreseen to effect economy, the problem then must naturally rest with the fireman. The latter should be instructed in the proper method of firing the particular fuel used, and so much has been written on this subject that it would appear that advantage could be taken of the abundant material available.

By means of superheated steam, a saving of from 10 to 20 per cent may be effected in the fuel expense, the greater saving being realized when the engines are working under uneconomical conditions or where the steam pipe lines are very long. While a superheater may reduce the efficiency of a boiler somewhat, the saving in steam more than offsets this loss of efficiency; so that if superheated steam requires 10 per cent additional heat and reduces the engine losses by 20 per cent, a material saving is effected.

The station with a large output and high-load factor naturally shows better economy as to fuel consumption. If the output of a station is below normal, the conditions are not conducive to economy. If the load factor is such as to require banked fires in the boiler room, an effort should be made to improve the load factor. The effect of a bad load factor is more pronounced in the boiler room than in the engine room, since a standing engine does not waste coal, but a banked fire does. The number of boilers under steam should, therefore, be kept down to a minimum and some method of increasing the draft installed to help out at peak loads.

Radiation from all sources should be reduced by covering all heat-radiating surfaces with non-conductors. Nearly all stations have their live steam pipes enclosed in some steam pipe covering, but not all heat-radiating surfaces are covered, so that economy in this direction is only partially obtained.

LETTERS ON PRACTICAL SUBJECTS.

BANDING REPAIRS.

The use of bands on direct-current armatures is always essential where the peripheral speed is much beyond 2500 ft. per minute. In the case of repairs to such armatures, the replacing of bands is the last operation to put them in running shape again, and is usually considered quite a simple matter. This is especially true in the smaller sizes of motors or generators, as the armature may be readily transported to a lathe where this work can be done very speedily; and numerous instances can be cited, where, in the absence of a lathe, the armature was rotated by hand in a set of wooden supports or bearings by fastening a suitable crank on the shaft.

Engine-type generators of 125 and 250 volts often do not require bands when the same generator wound for 550 volts will require them, because the cross-section of the armature copper of the low-voltage generator has sufficient rigidity to give an ample margin to the centrifugal pull, while the other has not. Banding engine-type armatures of large size is always troublesome as the engine can seldom be turned over by steam at the crawling speed required to feed a wire under 300 lbs. or 400 lbs. tension, nice and evenly in place; but in most plants having heavy parts to lift, an electrically operated crane is also available to help out an operation of banding should it be impossible to rotate the armature as slowly as desired by the engine, the crane taking a series of intermittent lifts on the flywheel till all the wire is on.

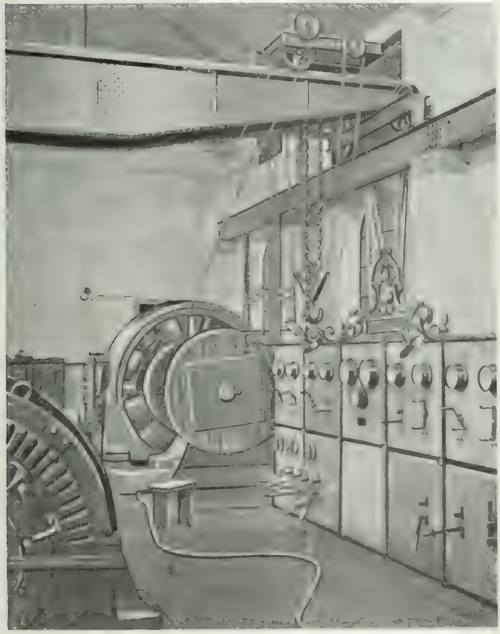


Fig. 1.—Rebanding a Synchronous Motor-Generator Set.

Motor generators of large capacity present possibly the worst phase of this particular kind of repair, as their rotating elements are usually made up of three or four parts, all on one shaft, utilizing every available inch inside and outside of the journals, possessing great weight and, consequently, large inertia, and some outside means has to be used to rotate the armature at a very slow speed. Conditions often do not permit of disassembling a large outfit further than removing one-half of the field frame, as they are frequently placed in already existing steam plants or where the amount of space around them is small, and the floor is none too strong to support the heavy parts deposited upon it. Where there is plenty of room on one side of the armature it is quite possible to drive the armature by a belt around the periphery of the armature, by making use of a fairly good-sized motor and employing a reduction gear in the drive; but in that case it is necessary to remove both halves of the field frame, which makes a particularly hard job when it is a horizontally split frame, as the end bearing has to be removed after jacking up the armature, then the lower half slid out and the bearing put in place again. Vertically split frames permit of this method of drive much more readily as only one side need be removed entirely.

As a rule, the shaft extension is only sufficient to accommodate the starting motor, or exciter, or both, as the design has required, and when either of these is absent the majority of outfits have no extension of the shaft on the opposite end unless an oscillator is provided, and then it does not follow that there will be sufficient area to secure a split pulley of ample size to start the rotating parts should they weigh several tons. To drive such a rotating element by means of a belt around the starting motor or exciting armature is obviously impossible on account of its extremely small radius.

The writer wishes to relate a particular instance illustrating some interesting features in line with the above remarks on large outfits. In a certain South American railway plant of German design and construction, an 850-kw synchronous motor-generator was installed in the best possible location with the ultimate purpose of supplanting the existing steam units, so that they would become reserve power. This outfit's revolving element consisted of three machines on one shaft, as it had an exciter on a smaller diameter of shaft extension at one end, and ran at the remarkable speed of 500 r. p. m. After about six months of almost continuous operation the direct-current armature developed a partial ground just back of the connections to the commutator necks through the edge of an insulated bushing provided to support the front chord of the winding, and immediately under the front band. A close inspection proved that several charred spots were developing large dimensions and immediate repairs were necessary. The cause was also apparent as due to an accumulation of dust and fine particles of carbon at this particular point swept in by the very strong air convection, due to the high speed, and also to the fact that compressed air was not available to clean this generator till after three months of operation.

These repairs seemed quite easy to make, since they were all on the front end of the armature, and the necessity of taking down the generator could be avoided, for this was a great feature of gain both in the time of interrupted service and the trouble of handling by a 20-ton hand crane the 5-ton upper half of this field. By skidding over as far as they would go from the commutator end, both the motor armature and generator field coils, the field coils cleared sufficiently, when the brush holder was removed to give plenty of room to remove the front band, unsolder the commutator necks, bend them to one side, raise the front ends of the armature winding sufficiently to remove the old insulation and replace with a new bushing. The accompanying photographs show the method used to replace the band, also the particular inaccessible location of the outfit, within $3\frac{1}{2}$ ft. of the wall on one side and only 5 ft. removed from an engine and generator on the opposite side. The only location of the driving power left was from above; and when one contemplates the problem of driving at a slow positive speed a revolving element weighing $13\frac{1}{2}$ tons, it means failure if the means are not at hand to get a large purchase. In view of the above objections to taking off the entire field frame, it was certainly gratifying to find on the commutator end of this outfit an extension of the shaft 10 ins. long and a key-way, which had evidently served the purpose of making the factory tests, but was partially hidden when the oscillator was in position.

In looking about for a means to furnish the power to rotate this large mass at a slow positive speed, the gear ratio of 25 to 1 on the hand-drive to the carriage of the overhead crane suggested interesting possibilities. It was apparent that if the carriage were jacked up, then the hand chain would transmit power to the one axle it was geared to, and a rope-drive seemed quite a feasible plan considering the clearance space around this axle. Accordingly a "nigger head" was made of two pieces of hard wood bolted together and turned up true with two grooves, and a hole through the center so as to clamp

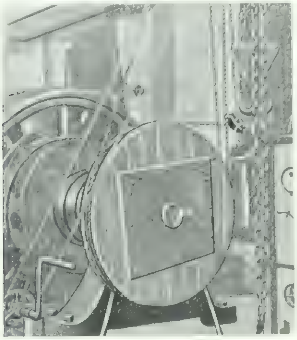


FIG. 2.—DETAILS OF BANDING ARRANGEMENT.

securely around the carriage axle. At each end a plate was securely fastened which engaged in the space between adjacent radial ribs in the wheels on each end of the axle, and prevented any possibility of the "nigger head" slipping. A large wooden sheave was easily improvised from the ends of old cable reels, and two pieces of old boiler plate, cut and filed carefully for a fit around the shaft and key-way, were bolted on securely as the photographs show. This sheave was 62 ins. in diameter and the resulting transmission ratio was approximately 1 to 200 from the hand-drive to the large sheave. A standard 1½-in. rope was passed three times about its circumference and four times in each notch of the "nigger head," and any desired tension was secured on the rope by the snatch block shown, which was fastened to a beam across the outside of the window.

Driving direct by hand to the chain on the upper sprocket would not have given a steady motion. An old chain sprocket was available, and by suitably mounting this on a double crank two men easily turned this armature uniformly, at an average rate of one revolution in 12 minutes. Although these preliminaries cost but little money, it required nearly three days to get them all ready, and the banding part of this repair job only occupied 12 hours after all was ready. These difficulties were foreseen, however, and while the insulating repair was going on these preparations were progressing. This particular band was of .091 in. steel wire and passed 60 times around a circumference of 15 ft. 7 ins., and required a tension of about 500 lbs., but was put in place neatly and very efficiently by this means.

Rio de Janeiro, Brazil. A. F. Rettenmeyer.

APPLICATIONS OF RECORDING PRESSURE GAUGES.

The recording gauge can be applied with good results in many places where its use is at present unknown. The heating system, if equipped occasionally with a recording gauge might tell some interesting facts concerning back pressure. When the exhaust heating system is so arranged that live steam can be turned in to supplement the exhaust when necessary, then the recording gauge might, perhaps, give away some interesting and decidedly expensive using of live steam in a manner hitherto undreamed of by the owner.

A recording gauge connected to the steam chest of a duplex boiler feed-pump would show when, and under what pressures, steam is admitted to the pump in question, and it would prove rather interesting for the owner to know that this piece of apparatus was kept under pressure nineteen-twentieths of the time that the engines are running. Some very interesting calculations of the amount of steam needlessly forced through the pump, could be made for the entertainment of the engineer.

Did you ever connect a recording gauge with the water end of your boiler-feed pump? Probably not, but the writer has, on several occasions, found the record thus obtained to yield very interesting traces of badly working check valves, over-weighted pump springs, and similar things which cost considerable coal to maintain. When it is necessary to maintain 200 lbs. pressure in the pump in order to force water against 125 lbs. steam pressure, then it is time to overhaul something. If one would invest in a recording pressure gauge he would be surprised to find how little time it takes to detect and cut off leaks aggregating more each month than the sum invested in the gauge.

New York City. James Francis.

TOOLS FOR SCRAPING [illegible] BEARINGS.

When a new machine is installed, or when the bearings of an old one must be rebabbitted, the engineer must be alert with tools for scraping the new bearing surface to a good fit. There is not as much of this work necessary now, as there used to be, for machine manufacturers have recognized the necessity for scraped bearing surfaces and do most of that work in the shop. Still a bearing occasionally comes along which needs the scraper and as all newly-babbitted bearings must be scraped, the engineer needs a good scraping kit, as above stated. The usual method is to grind up three or four half round files into something near the desired shape and call the things thus made "scrapers."

For a small sum, a much better set of tools specially made for scraping bearings, can be procured all ready for business. These tools come in a neat box resembling a tap and die box and can be procured either hollow ground or ground in the ordinary manner. A set of 5 cold chisels and a set of packing tools can be procured also if desired. Besides doing sundry repairs about the machinery with these tools, bearings may be quickly scraped to fit the journals.

There is, however, a method of making scrapers in the factory, which will go a long way toward equalling any "store" set of scrapers the writer has ever seen. The ordinary form of scraper looks somewhat like a bent-up half-round file with all the teeth ground off as shown in Fig. 1. In fact, a very good scraper may be made in just that way, provided the file is hardened after it has been ground and bent to shape. If it is hollow ground, so much the better. The shape of the tool along its length is given by the sections, of which there are six shown in the engraving. By using the point of the tool, a small box

FIG. 1.—PLAN VIEW AND SECTIONAL VIEWS OF SCRAPING TOOL.

may be readily worked out, while for larger bearings, that portion is used, several sections toward the handle, which best fits the diameter of the bearing to be scraped.

Fig. 2 shows a form of scraper with which, when properly made and sharpened, one man can remove as much metal in a given time as could three men with the excellent form of scraper shown in Fig. 1. The scraper shown by Fig. 2 is commonly made from a worn-out flat file, which is forged as shown by the engraving. It is not even necessary to grind off the teeth, when this form of scraper is to be made, and the grinding of all the teeth off of a big file, even when worn out, is not an

easy job. The file is bent up as shown, a half-inch or so of the side *a*, being hammered flat—it may be ground if desired, but hammering will answer as well. The cutting edge of the tool is ground up as shown at *b*.

The tool is not ground to an edge until after it has been hardened. The grinding should be done with a very small emery wheel, so as to leave a concave surface at *b*. It is the grinding of this tool, and the shaping of the bend, which determines whether the tool will be a good one or a very bad

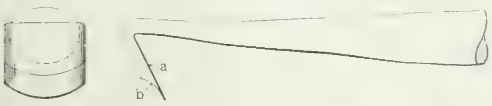


FIG. 2.—END AND SIDE VIEW OF HOME-MADE SCRAPER.

one. If the scraper does not work well at first, the bevel of the grind should be changed, or the angle at which the tool is bent. There is one certain angle for each, at which the cutting is the best. Once those angles are found, the manner in which that scraper will cut will be a revelation.

The ordinary scraper takes a very little cut crosswise of the bearing, while with the new tool, a broad cut can be taken the entire length of the box. The depth of the chip it is possible to remove, depends to a limited extent upon the pressure put upon the tool, and directly as to the manner in which the tool is ground and bent. Much metal may be taken off very quickly with one of these tools and likewise, a very thin, small scraping may be removed when the work is nearly finished and only light chips are desired. A scraping tool which permits the thickness of cut to be varied instantly and at will, from 1/32 in. to 0.001 in., is certainly a very desirable one to possess, and the one shown by Fig. 2, will, if properly made and ground, do all that the writer claims for it.

WILLOUGHBY, OHIO. JAMES F. HOBART.

WATER COOLED RHEOSTAT.

A few years ago I had to install a big hoist, driven by a direct-current, series-wound motor of 150 horse-power from a 100-volt line. There was great need of this hoist, and immediately after installment it had to carry a heavy load. To our great disappointment, a costly and very complicated rheostat with automatically operated controller broke down, and as no satisfactory repair could be done in a short time, I immediately shipped the rheostat back to the factory for repair, and

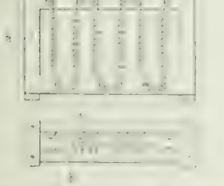


FIG. 1.—WATER COOLED RHEOSTAT.

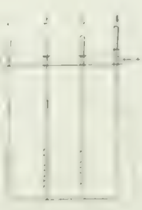


FIG. 2.—RESISTANCE GROUPS IN MULTIPLE.

meanwhile decided to try a water cooled temporary resistance (as I had some experience with that type in other cases). A wooden frame was immediately constructed (Fig. 1), consisting of two parts, *A* and *B*. Porcelain insulators were used to support the resistance wire, wound in spirals, six on each side, making a total of twelve spirals. The total resistance was divided in three groups, four spirals in series in each. The first group contained 30 ft. of No. 8 galvanized iron wire; the second group, 30 ft. double No. 8 wire, and the third group, 40 ft. triple (three in multiple) No. 8 iron wire. By means of four leads these resistances were connected to four switches, mounted on a distant board. The assembled frame with resistance was 12 ins. high, 18 ins. long and 7 ins. wide and was immersed in a water tank (shown by dotted lines in Fig. 1), with inside dimensions of 12 ins. x 22 ins. x 16 ins., with ¾-in. diagram, in and out-going pipe for circulating water.

The top jaws of the switches were connected by means of strap *C* to the line, the motor lead being connected to the bottom jaw of switch 4 (the switch connecting the other motor terminal with the line is not shown on the drawing).

By closing switch 1, switches 2, 3 and 4 being open, the motor has approximately 200 amperes starting current, all resistances being in series. By closing switch 2 the resistance is decreased by short-circuiting the first group, and by closing the other switches, the resistance is further decreased, until the last switch short circuits them all. This rheostat operated satisfactorily as a starting and regulating resistance, although afterwards a fourth group was added to obtain wider regulation.

Fig. 2 represents a modification, where resistance is changed by connecting individual groups in multiple, as it is easy to see

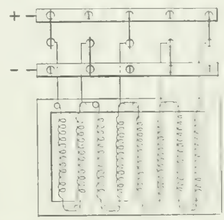


FIG. 3.—ARRANGEMENT FOR VARIOUS COMBINATIONS OF SERIES OR PARALLEL CONTROL.

from the engraving. The widest range of regulation is obtained with connections, as shown on Fig. 3. Here double-throw switches are used, so that all combinations of groups are possible, from all in series to all in parallel. For fine adjustments an ordinary small rheostat may be connected in multiple with the above rheostat.

I have found 15,000 to 18,000 amperes per square inch a fair current density in such rheostats, provided they are immersed in tank with water circulating at a moderate rate. German silver wire admits such a density only for starting resistance; for regulating purposes it is safer to use 12,000 amperes per square inch.

The described rheostats represent a very cheap and convenient form of resistance for testing big generators after they have been installed. The other forms of temporary resistances, such as the ordinary water rheostat or rheostat consisting of iron pipes with water circulating through them, are very bulky, more expensive and less reliable, in addition to possessing some other inconveniences, such as fluctuation of resistance, danger from gases, electrolytic effect, etc.

EAST PITTSBURG, PA. JOHN P. NICKONOW.

PECULIAR BEHAVIOR OF REDUCING VALVE, AND ITS CAUSE.

It seems a very peculiar piece of engineering which requires a reducing valve between boiler and engine, but in some instances it may be good practice, especially when trying to make the best of existing conditions. A steam boiler will not carry as much pressure safely, at the end of ten years, as when it is just out of the shop. There is a certain length of service for any steam boiler, depending upon the manner in which that boiler is used and taken care of. The writer, when at one time engaged in inspecting boilers for an insurance company, came across a boiler which had been in constant service, and was then in use, for 30 years, with no signs of depreciation.

[illegible] best care of any boiler in the world. The water was pure, and the boiler was fired by the waste gases from a blast furnace which was always in blast for months at a time, consequently the boiler never varied in temperature to any extent. It kept just about so hot, week in and week out, an ideal condition for the boiler, and it may be in use yet.

The majority of boilers may be expected to deteriorate at least 5 per cent to 10 per cent each year. This being the case, the boiler must be constructed to carry a much heavier pressure than can be used at first, or that can be carried by the average simple, non-condensing engine.

A Corliss engine of a well-known type will not stand a pressure greater than 125 lbs. and the boiler must stand wear for 10 years and then be able to carry 125 lbs. This means a boiler built for nearly 175 lbs. pressure. It worried the engineer of the plant not to be able to carry 175 lbs. pressure upon the boiler. He claimed that it was economical to generate steam under the higher pressure, even when it could not be used in the engine.

To this end, the steam pipe was cut in two and a pressure reducing valve placed in position. The valve was adjusted to take steam at any pressure above 120 lbs., and to deliver steam at 120 lbs. The valve was adjusted to do that, but whether or not it actually did, was a conundrum which kept the engineer guessing.

A steam gauge was placed in communication with the interior of the steam pipe between the reducing valve and the engine, and it seemed to the observer that the pressure ran sometimes too high, at other times too low; that instead of holding the steam at an even pressure in the engine pipe, the reducing valve allowed the pressure to fluctuate quite a little. It was finally decided to connect a recording gauge with the steam pipe and see what kind of record that instrument would make. This was done and the very first paper taken out of the instrument was a revelation to all who studied it.

While the engine was shut down, the recording gauge registered very closely to 120 lbs., at which the reducing valve was supposed to be adjusted. But as soon as the engine was started, and the pressure reduced in the steam pipe, something happened. The pressure slowly fell until it reached 95 lbs., then it as slowly rose again until 125 lbs. was indicated upon the revolving chart. This fall and rise of pressure was not sudden or abrupt. Instead, it was slow and gradual, and after the rise to the maximum pressure stated, it slowly fell until low-water mark was reached again. One of the by-standers expressed himself very much to the point when he said: "It looks like a tide-chart. There's a regular ebb and flow."

One look was all that was necessary, when the chart from the recording gauge was passed around. The reducing valve was overhauled, and it was found that the stem had become bent a very little, also that some of the parts had worn, making close regulation impossible. The proper repairs being made, the valve was replaced and the steam pressure was found to stay at 120 very closely, proving that the trouble was caused by the sticking of several parts of the reducing valve.

SCRANTON, PA. JOHN SCOTT.

[illegible] SPLICING AND TESTING OF LEAD-COVERED [illegible] CABLES.

Cables are usually left by the pulling-in crew without any reference to their final arrangement, and it should be the jointer's first duty to inspect the cable thoroughly from the edge of the duct to the sealed end in order to ascertain whether any injury has been done the cable while it was being pulled in.

Where there are several cables to be jointed in the same manhole care should be exercised that the corresponding incoming and outgoing sections are spliced. After the protectors have been placed in the mouths of the ducts the cables should be neatly bound and stored around the sides of the manhole and the ends brought in position for splicing. Heat should be applied to the outside of the cable to aid in bending it since this suffices to heat the insulation as well as the lead sheath, so that when the cable is bent the insulation will not break or crack. When bringing the ends into position for splicing care must be exercised that the ends are brought into such position that when the joint is finished the splice will come between the hangers, or whatever supports the cable, so that no strain will be on the joint. If the ends of the cables have been permitted to lie for any length of time in manholes subjected to moisture, any slight imperfection in the soldering will result in more or less moisture finding its way to the insulation. A moisture test should, therefore, be applied before the ends are spliced. This may be made as follows:

The end of the cable should be dipped in a pan of hot paraffin when, if moisture is present, bubbles will appear. The end of the cable should next be cut off with a hack saw and again dipped in hot paraffin when, if moisture be present, bubbles will again appear. If moisture still is evident and it is impossible to cut away any more of the cable, heat should be applied to the outside of the cable.

If there is any suspicion of gas in the manhole a pan should be placed under the cable and hot paraffin poured on the cable, starting at the duct and working down very slowly toward the end. By this means the moisture will be driven out at the open end, the pan catching the drippings. If there is no gas in the manhole a "blow-pot" may be used, care being taken not to burn holes in the lead sheathing. If the cable is covered with saturated fiber and a blow-pot is used, a steel screen must be placed between the latter and the cable, so that the covering will not be ignited. Where there is any doubt as to the freedom from moisture a careful insulation test had better be made before the joint is made up. Both ends of the cable should never be cut before making sure that no moisture is present in the other end, and it not infrequently happens that a splice must be moved because of moisture.

Trouble is frequently experienced owing to the presence of gas in the manhole, and precaution should always be exercised that all gas has been removed before lowering a pan of hot paraffin or a blow-pot into the manhole. This is best done by using an inverted umbrella made especially for this purpose. This is lowered into the manhole in a closed condition, then opened and suddenly withdrawn. The opening of the umbrella and sudden withdrawal forces out the gas. Another method which is widely used consists of placing a cloth screen above the manhole and on the side opposite to the direction from which the wind is blowing. The wind, on striking the screen, is deflected downward, causing an eddy which forces the gas to raise from the manhole.

In [illegible] in the lead sheathing two feet from the end of the cable and two lengthwise cuts separated about 3/4 in. run from the circular score to the end of the cable, care being exercised not to cut into the cable insulation. With some sharp-pointed tool such as a screw-driver the narrow strip of lead sheathing should be pryed up until a pair of pliers can be used; then, with the latter instrument, the strip should be lifted up until it reaches the circular score. It should then be bent backward on the cable and given a gentle tap with a hammer at the bend. [illegible] when it will usually break off.

FIGS. 1, 2, 3 AND 4.—VARIOUS STEPS IN MAKING A SPLICE IN CABLE WIRES.

The wire should now be cleared of the rest of the sheath in a similar manner and twine or wicking wound around the cable at the point where the wires emerge from the sheathing. This winding should extend close to the lead sheathing in order to prevent the paraffin from following along the core of the cable. The paraffin should be heated to about 212 degs. F., and it is an easy matter to determine whether or not the paraffin has the proper temperature by inserting a piece of newspaper in the paraffin when boiling. When the proper temperature has been reached the paper will char. Some hot paraffin should be poured on the cable when the lead is removed in order to stop the paper insulation from unwinding and also to prevent moisture from getting into the cable.

In making the splice the end of the cable should be opened by bending back the conductors layer by layer until the center pair is reached. The center pair from one cable should be brought together with the center pair of the other cable, as shown in Fig. 1, and a paper sleeve slipped over one wire. The ends of both wires should then be brought down and twisted together, as shown in Fig. 2, and then bent back, as shown in Fig. 3, after which the paper sleeve may be drawn over the

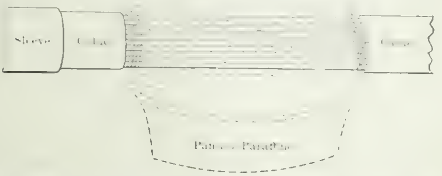


FIG. 5.—CABLE BEFORE WRAPPING IS APPLIED OVER THE JOINTS.

joint, as shown in Fig. 4. When the joints are made in this manner there is no danger of the paper sleeve working away from the splice, as one sleeve holds the other sleeve in place. All of the other conductors should be treated in a similar manner, like colored insulated wire being joined to like colored insulated wire and the joints being broken as much as possible so that when all the splices are made the combined joint will be as small as possible.

After all the joints have been made they should be bunched together and boiled with hot paraffin. A layer of strip muslin one inch wide should then be bound around the joints as tightly as possible and saturated with hot paraffin so as to eliminate moisture. Two other layers similarly treated should be placed over this layer of muslin. Fig. 5 shows how the cable will look after all the joints have been made and before the wrapping has been put on. The wrapping of twine or wicking is shown at *a*. The pan shown under the joint is placed there for the purpose of catching the drippings of paraffin in the boiling-out process.

The lead sleeve which should be slipped over the cable before the latter is opened up for splicing is prepared as follows: The sleeves vary in length for straight joints from 28 to 30 ins. and in diameter from 2 to 3 ins., the thickness likewise varying from 3/32 in. to 1/8 in., depending on the size of the cable. Both ends of the sleeve should be scraped inside and out for a distance of about two inches and the surface so

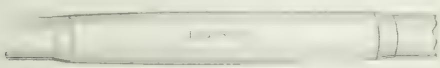


FIG. 6.—LEAD SLEEVE IN PLACE ON [illegible]

cleaned smeared with mutton tallow. The latter material is put on to protect the cleansed surface from tarnishing by contact with air or by contact with the hands of the operator, and also to aid in making the wiped joint. The sleeve thus prepared should be slipped into position over the finished joint so that an equal amount of sleeve will overlap the cable sheathing at both ends. The sleeve may then be beaten down to fit the sheathing by a dressing tool, the place on the sheathing where the joint will come being first brightened and then smeared with tallow. A plumber's joint should then be wiped on each end, as shown by Fig. 6, by a man experienced in making such joints. If properly made bright spots will appear in the joint after it has cooled off.

All the cable sheathing entering the manhole should be bonded together by means of a copper wire to insure that all the cable sheaths are at an equal potential, and also that what ever bonds are run for the protection of one sheath will afford

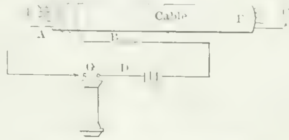


FIG. 7.—INSULATION TEST.

protection for all. The lead should be scraped where the bond is to be made and a No. 10 or larger copper wire wound around each sheath and securely soldered to all.

Fig. 7 shows an insulation test diagram. *A* and *C* are the ends of the cable wire under test; *B* and *D* are wires connected to the battery. In arranging the cable ends for the test the insulation is removed from all the wires and the wire *B* is bound around the lead sheathing and also around the wires shown at *E*. The wires are carefully separated from each other and from the sheathing. After the connections have been made as shown, rapid taps are made with the wire *A* on the binding post *G* of the telephone receiver. The first tap will produce in the receiver a distinct click; if the cable is very long a second faint click may possibly be detected. If the wire under test is well insulated no further sound will be heard in the receiver, but if the wire under test is crossed with any other wire in the cable, or with the sheathing, each tap will be followed by a clear click. If there is moisture in the cable causing a partial connection, clicking sounds will be heard the loudness of which will depend upon the amount of moisture present. All of the wires in the cable should be tested and if any trouble is found it is best to carefully inspect the exposed ends to make certain that they are clear of each other and from the sheathing.

In testing for broken wires the connections are made, as shown in Fig. 8. All of the insulation is removed from the

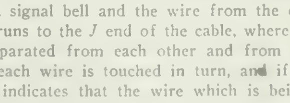


FIG. 8.—CONTINUITY TEST.

F end of the cable wires and a wire wrapped around the ends as shown, the other end of the wire being connected to one side of the battery. The wire *K* runs from the opposite side of the battery to a signal bell and the wire from the other terminal of the bell runs to the *J* end of the cable, where the wires are carefully separated from each other and from the sheathing. In testing, each wire is touched in turn, and if the bell does not ring it indicates that the wire which is being touched is broken.

For aerial work the cables are spliced in the same manner as for underground work only that a stage or platform must be erected at the splice, and a blanket spread over the joint to keep out wind and moisture. In splicing subaqueous cables the armor wires should be bent back on the cable and tied in this position until the joint is completed. After placing a wrapper of jute over and around the joint, the wires may be placed in such manner that they will interlace with those of the other end. They may then be bound down closely by means of steel wire wound closely around the joint for the entire length of the splice. The joint is then washed with soldering acid and the wrappings soldered together carefully, preferably with the aid of a wiping cloth.

DULUTH, MINN. O. F. D[illegible]

QUESTIONS AND ANSWERS.

[illegible]
S. R. S.

D'Arcets' alloy with mercury is said to melt at a temperature of 113 degs. F. Its composition (parts by weight) is as follows: Bismuth, 50 parts; lead, 25 parts; tin, 25 parts, and mercury, 250 parts.

The commutator of a motor has two small holes in the mica segments, which give considerable trouble. We have tried resin, sulphur, cement [illegible]
W. J. L.

Use a mixture of powdered mica and shellac or some insulating varnish. This should only be used as a temporary expedient until new mica sheets can be substituted.

A generator running at 250 r.p.m. will generate 110 volts. What must be the r.p.m. if a potential of 140 volts is desired, the conditions remaining unaltered? [illegible]

If the machine is separately excited with a constant field, the r. p. m. must be $(250 \times 140) \div 110 = 318$. If the machine is self-excited (direct-current) the field strength will be somewhat increased at 140 volts, so that the speed will be somewhat less than 318.

Can alternating-current motors designed for 60-cycle circuits be operated on [illegible]
[illegible]

Yes. The speed will be reduced somewhat, but the permissible output would be practically the same. The iron losses would be greater, so that the efficiency would probably be lessened. See article on "Abnormal Operating Conditions of Electrical Apparatus," by A. E. Buchenberg in the October, 1906, issue.

We have a belt-driven alternator which we wish to run in exact synchronism with another; but we have been unable to get just the proper speed, the speed of one machine being a trifle too small. Can you suggest a method by which we can bring this machine up to the proper speed? [illegible]

Glue thin canvas or strong manila paper onto the driving wheel to which the slower alternator is belted until the exact speed is obtained. The glue should be applied thin and quite hot, and the material should be pressed firmly down upon the pulley. By this means, the diameter of the pulley may be increased to that necessary to give the proper speed.

Is it possible to obtain both alternating and direct current from a bipolar direct-current generator? If so, how can it be done, and what will be the frequency of the alternating current? A. C. E.

A bipolar direct-current generator may be caused to deliver alternating current by connecting a pair of insulated metal collector rings permanently to two commutator bars diametrically opposite each other, and by keeping these rings in continuous connection with an outside circuit by means of a pair of brushes separate and distinct from the direct-current brushes. The frequency of the alternating current in cycles per second will be equal to the revolutions per second of the armature.

How can the presence of water be detected in transformer oil, and if present, how can it be easily removed? W. T. S.

If water be present, it will be found at the bottom of the tank owing to its higher specific gravity. Therefore, pour a quantity of oil, taken from the bottom of the tank, in a bottle and after heating some crystals of copper sulphate until they disintegrate into a white powder, pour the powder into the bottle containing the sample of oil. If the copper sulphate powder resumes its original blue color, or takes on a bluish tinge, water is present. There are many ways of getting rid of this water. The simplest method that we know of was described by R. B Treat in the March number.

Kindly [illegible]
[illegible]

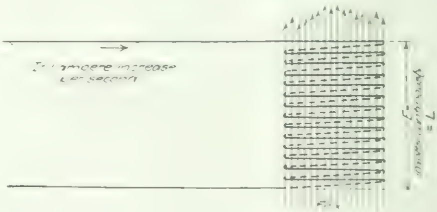
The armatures may be designed with large radiating surfaces so that the heat is rapidly dissipated. Ample duct space may be provided, and this may be supplemented by fan-blade projections which force a current of air through the ducts and armature wires when the dynamo is in operation. The tendency now is to equip the rotating member with large outwardly extending blades and to provide numerous ducts within the rotating and stationary cores so that motors of a given size can carry continuously larger loads than heretofore; the load on machines being largely limited by the facilities for cooling provided. Sometimes motors and generators are placed over openings in air-blast chambers used for cooling transformers or over openings which naturally cause a draft of air to pass through the machine from below.

In a local central station a rotary converter has some sort of a device [illegible]
H. B.

The device is doubtless a magnetic oscillator. A magnet is mounted upon one of the bearing housings in such manner as to attract the end of the shaft. When the circuit is closed, the magnet draws the shaft towards it, and when the circuit opens the armature tends to resume its normal position, which is usually determined by the leveling of the converter. The magnet has in series with it a make and break device called an interrupter, which is controlled by a dashpot to secure the proper frequency of action. The lamp may be used as a signal to indicate from a distance that the device is in working order, or it may be used as a resistance. The object of such a device is to produce periodic motion parallel to the shaft so as to offset the tendency of the armature to run in one position and thus to cause the brushes to wear the commutator and collector in grooves, and not give that smooth, even surface which is conducive to sparkless operation. The bearings also do not work under the most favorable conditions where the shaft has no lengthwise motion.

Can you give a physical explanation of the quantity L, the coefficient of self-induction? One frequently sees the statement "energy is stored in an induction coil." Please explain just what is meant by this statement. J. S.

The coefficient of self-induction of a coil which is designated by the letter L, is expressed in henrys. It is equal numerically to the counter e. m. f. in volts produced in the coil by the changing flux, when the current changes at the rate of 1 ampere per second. If in the accompanying illustration the current changes at the rate of 1 ampere per second, and the



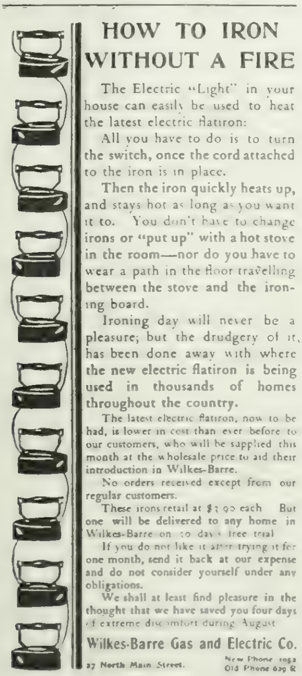
flux varies at such a rate that the counter e. m. f. is 10 volts, then the coefficient of self-induction, L, is 10 henrys. In order to find the value of the stored energy, consider the conditions at the end of 100 seconds. The current will be 100 amperes and the e. m. f. will be 10 volts. The final power will be $10 \times 100 = 1000$ watts. The power initially was 0 watts and it increased uniformly throughout the 100 seconds; hence the average power was 500 watts. The total energy is equal to the product of the average power and the total time. Therefore, the stored energy is $500 \times 100 = 50{,}000$ watt-seconds. Assuming a general case, and letting the current change at the rate of a amperes per second, then the time to reach a value of I amperes will be $(1 \div a)$ seconds. The continuous e. m. f. will be La volts. The final value of power will be ILa watts: the average power having been $(ILa) \div 2$ watts. The total energy for the time $(I \div a)$ seconds will be $(ILa \div 2)(I \div a) = LI^2 \div 2$ watt-seconds. This energy is stored in the magnetic field and not in the coil. The latter serves merely as a means for transferring the energy from the supply system to the magnetic field. The same value of magnetic field represents the same amount of stored energy independent of the coil which may have been used in producing the field or of the time consumed in building up the flux.

CENTRAL STATION SALE OF CURRENT.

A Central Operating Organization.

By Carmelita Beckwith.

The advantages of a central production and marketing management for scattered properties, manufacturing the same or similar commodities, are now thoroughly established. That electricity and gas are to be dealt with much as if they were popular commodities perfectly tangible and material in nature has also been understood fairly well for some time. Still the coupling together of these principles and conditions to make the basis of a widespread and successful business is a development of recent years and one not even now generally understood except to the direct participants. The centralized operating organization handling many entirely independent electric and gas properties in separate territories is well exemplified by the operating department of J. G. White & Company.



[illegible] PA

As the question of consolidation does not enter, the advantages to associates are those eminently fair ones derived from what is in reality a clearing house for the multifarious experiences of many large production and selling companies dealing with a comparatively new product; a clearing house of experience managed by the best talent in the country for the operation of public service properties. The fact that the business in which all are engaged is developing so rapidly and yet is further from complete standardization than any other extensive business makes the form of association particularly valuable. Each company not only learns the experience of all the others, but [illegible] particular needs by mentors of wide reputation.

In every feature of the business [illegible] The engineering operation of the plant proper is but one aspect. Besides there are the auditing and accounting, the statistical, the purchasing, the legal and the business getting aspects, all under the direct influence of the central organization. Probably the business getting end demands, more than any other, the existence of a central operating management. It is very nearly the most important and is certainly at the same time the least systematized and least understood in general of all the departments of the electric power, lighting and railway and gas business.

The production of electricity or gas under any given set of conditions does not vary widely. Ways and means for securing and holding customers are extremely varied, and yet there is always one best way to meet any given situation. That way can generally be discerned at any early stage by the highest business getting talent, but less talent may expend endless time and money discovering it. The central organization can afford to engage this best talent, and through the central organization its high grade service is made available to companies who could not otherwise afford it.

The leading operating organizations of the country are distinguished not only for excellence of personnel, but for their organic simplicity. The head of the operating department of J. G. White & Company is a vice-president of the firm. Next in rank is the operating manager, and under him are the railway manager, gas manager, the electric lighting engineer, operating auditor, operating counsel and publicity manager.

The vice-president in charge attends principally to the financial affairs of operated companies and of the central organization; but all operating policies regularly in vogue or drawn up to meet special problems are subject to his approval. The operating manager supervises all details of operation and plans for the improvement thereof. He is practically the head of the operating administration proper. To each of the three technical specialists all questions in their respective fields are referred for investigation and report. The gas manager is a leading

authority in the construction and operation of gas plants and practically manages all the gas plants operated by the company. The railway manager administers the policies for electric railway operation on the various properties, and the electric lighting engineer looks after matters of electric lighting and power and high tension transmission. At the command of these three technical heads, for the details of matters of engineering construction or reconstruction, there are the extensive facilities of the construction and engineering departments maintained by the company.

A sub-department very essential to the effective carrying out of the operating routine is the statistical division. At the end of each month there is prepared a complete comparative statement of the vital operating figures and ratios on all the properties, and this statement is sent to the resident managers. In addition there is sent to each manager at the same time a special letter from the operating heads pointing out in what respect his particular administration is defective as compared with others and the reasons for inefficiency. These letters are in the form of recommendations, not orders. The aim is to maintain the ultimate responsibility of the resident managers for the successful operation of their properties and to aid them with constructive criticism and a general consulting service. Normally they are free to take what advantage of it their own judgment dictates, and only when there is a really unwise divergence from the approved operating practice of the day does the central office interfere absolutely. It is hardly necessary to point out how this system tends constantly toward the elimination of faulty practices and the establishment of a uniform régime made up of the best methods evolved by experience on all the properties operated.

This same theory works out effectively in handling the accounting and business getting as well as in the management of the strictly engineering features. The operating auditor prepares all operating statements for owners of the respective properties, but his most reliable work, in which he is aided by traveling auditors, lies in systematizing methods of accounting and bookkeeping so that all unnecessary duplication and repetition or other waste of time or money are done away with. The variety of conditions experienced by the accounting head in handling a great many scattered properties enables him to evolve short cuts in routine applicable in general to all properties that could not be developed in the operation of one property.

The department of business getting, because of the infinite possibilities of its work and the fact that many new ones are being discovered constantly, is to-day probably the field of the most interesting developments in this great task of managing grouped public service properties. The publicity manager supervises divisions of business getting which are separately organized, one in the resident management of each property. They all work under directions from headquarters, and these directions are based upon the publicity manager's general experience, his experience afforded in all the properties immediately in hand and the consulting service of an eminent advertising authority.

The problems to be met in the business getting end are the most varied in the whole propaganda and call for the incessant attention of the best business getting brains at headquarters directing the men on the ground and supplying them, not only with working ideas, but where necessary with full plans of business getting campaigns and the printed matter for carrying them out. It is safe to say that nearly every local physical influence in each plant that shapes the internal economy of operation is felt also in the external economy or business getting, but more potent still in the business getting prospect is what may be termed the human element. Communities in the composite vary infinitely more than the physical conditions that govern the operation of plant. In each territory the business getting campaigns conducted through the mails are individualized to meet not only peculiarities of physical environment, but the peculiarities of the residents themselves as determined by careful preliminary study. Then there are the peculiarities of individual consumers or "prospects" that can be dealt with only by personal representation and correspondence on the part of skillful salesmen.

Plainly the business getting directorship at the head office, with intimate knowledge of the experience encountered in operation all over the country and under all sorts of conditions, has as good an equipment as can possibly be achieved for devising new plans to meet new conditions and improving old plans to deal with conditions already analyzed. The assistance of an outside consulting authority, however, is found almost invaluable. From this source comes much of the copy used and all the special printed matter incorporating the latest ideas for interesting and holding the people. Some of the most telling advertisements recently issued by J. G. White & Company in building up the business of a property is reproduced with this article.

Altogether the operation of central stations in groups is a proven success and interesting testimony to that effect is available not only in the operating field, but in the banking business. Large banking houses are coming to depend on these central operating organizations more and more for the management of properties of which they hold the securities and upon the earning powers of which their income depends.

Recently a leading American banking house issued to its district managers and salesmen a folder of instruction for marketing the securities of a certain large property, the organization of which under a central operating management has attracted much attention in financial circles during the present year. From this folder the final paragraph is quoted as follows:

"As an example of what may be accomplished in this direction, a case may be cited of an electric lighting and power property, the management of which was recently assumed by the operating department of J. G. White & Company. This property had been running behind for several years. Within a few months it was earning a substantial surplus, the ratio of operating expenses to gross earnings was reduced about 30 per cent and the gross earnings showed an increase over corresponding months of the previous year of nearly 40 per cent."

New-Business Campaign in Towns of From 3000 to 20,000 People.

Mr. R. W. Hemphill, Jr., of Ann Arbor, gave an interesting talk on this subject at the Michigan Electric Association convention, Aug. 22, outlining the methods used by his company, the Washtenaw Light & Power Company, which gives service in Ypsilanti, Ann Arbor and neighboring villages. One of the most important points is the character or standing of the manager or superintendent in the community in which he lives. Public utility corporations depend much on the confidence the public has in the man who is in charge of the business; his social standing, his business standing and the part he plays in his community. Every citizen owes a duty to his family or to those depending upon him, and also a large duty as a citizen. Public utility managers are not commonly elected to political office. At the same time in every community there are positions and different commissions in connection with the municipal government he is able to fill, and it should be the duty of every man in a position of this kind to play his part and do his work in connection with different enterprises.

The office of the corporation should be centrally located and the business should be conducted with very high efficiency; that is, the public should be able to transact business with the least discomfort and inconvenience. The office should have display windows and exhibition rooms. The displays should be changed once a month or so, to keep up interest in them. The company with which Mr. Hemphill is connected displays fans one month, lamps and glassware another, heaters another, thus making a distinct exhibition in each line. In the exhibition rooms there are connected all articles that the company advertises. Motors and flatirons are connected up ready to run. In

cold weather on payment days, coffee percolators are kept in operation, so the ladies who come to the office are served with a cup of coffee and various eatables. Such attention makes a pleasant impression. Last spring his company sent out two men in a house to house canvass. If electric service is being employed in the house the representative would say that he just called to see if everything was satisfactory. This attention creates a pleasant feeling between the customers and the company. If electric service is not used he puts in a word or two about some neighbor who has it and is satisfied with it. The representative makes a record on an index system having a card for each resident in the town, stating concisely what electric equipment is in the house and such remarks as the solicitor is able to secure. The representatives visited 3000 residences in six weeks. From the data thus gathered, cards were arranged by streets, and the company knows how many houses are using gas, kerosene and electricity. The number of kerosene lamps is surprising. In a city of 3100 houses with a very efficient gas company of 50 years' standing and an electric company doing business for 12 years, there are 850 homes using electric, 1400 gas and 300 using kerosene lamps.

The company enters into a yearly contract with each daily paper for advertising for an amount not more than that paid by the printing company for motor service and light. Mail advertising is used for gas, and some bulletins are also sent to the company's electric customers. A visit is made to each business man periodically by a solicitor, and as each month passes many gas arcs are superseded by electric lamps. The company during this spring, in a town of 8000 population, obtained an increase of from 40 to 48 per cent each month, compared with the corresponding month of the year before. In another town an increase of 38 per cent was obtained. In any town in Michigan at least 25 per cent increase can be made by a systematic business-getting campaign.

A Franchise Campaign at Grand Rapids, Mich.

BY LEWIS W. BAILEY.

A unique campaign of education is being conducted in Grand Rapids, Mich., by the Grand Rapids-Muskegon Power Company, and it should prove most effective.

The company has just completed its second dam at Croton on the Muskegon River, 17 miles below the first dam, known as the Rogers Dam. It now has one line to Grand Rapids and Muskegon at 70,000 volts and is erecting a second line, which will operate at 100,000 volts.

The company is seeking a franchise in Grand Rapids and has agreed with the City Council on power and lighting rates far below those prevailing in any other city of the size in the country. However, the franchise is to be submitted to a vote of the people and the company is determined to make sure of its passage. Three excursions have been run from the city to Croton, a distance of 35 miles. In each case the company chartered a special train of the Pere Marquette Railroad Company. The first excursion carried city officials and some of their friends; the second carried merchants of the city, and the third the manufacturers. In each case there were about 250 in the party. The start was made from the city in time to permit of a short look around at the dam and power house before dinner. En route plenty of cigars were provided to keep the crowd good natured, and local manager H. W. Hillman, general manager George Erwin and vice-president Foote and others of the company saw to it in person that each of the crowd was well cared for. Just before the company's property was reached the officials of the company distributed cards bearing the following information:

"Croton Dam foundation about 3000 oak piles and two rows heavy interlocking steel sheet piling, 30 ft. to 36 ft. long, driven 6 ft. below the bed of the river. Concrete piers, 42 ft. high. Concrete apron extends 200 ft. below dam, 4½ ft. to 2½ ft. thick, heavily reinforced with steel. Eight steel flood gates 13 ft. x 20 ft. each. Bear trap, 40 ft. long. Power house building, fireproof; protected from backwater by heavy concrete walls. All concrete work heavily reinforced with steel. Thirty thousand barrels cement and 1250 tons steel used in construction work. Concrete core wall about 300 ft. long and 42 ft. high set on a foundation of interlocking steel sheet piling driven 30 ft. to 36 ft. below bed of river. Two generators that will develop 7000 horse-power each. Wheel shafts 12-in. steel, 110 ft. long, 8 waterwheels on each. Current at generator 6600 volts. Will be transformed to 100,000 volts. Pond 1600 acres, 9 miles long."

After viewing the plant, the visitors were invited to the company's house where on the lawn tables were spread under a great canopy and the entire party was seated at once. A farmer dinner was served that would make glad the heart of any man with a healthy stomach. After dinner the party broke up to pursue its own pleasures. Baseball games were organized, some returned to the power house to examine the plant more closely; others, with whom the officials desired to talk, lent a willing ear in such surroundings, while small parties were made up for launch rides on the company's lake in the company's launch, which makes 16 miles an hour. The departure each day was made in time to get the crowds home for 6 o'clock dinner.

These excursions were supplemented by six-column reports in the local papers written by the company's press agent and illustrated by cuts and maps. The leading local papers are also giving the company support in their editorial columns and the campaign is certainly creating sentiment in favor of the franchise.

GRAND RAPIDS-MUSKEGON POWER COMPANY'S WORKS AT CROTON.

A page article in a recent Sunday paper entitled "The House Without a Chimney," described the electric house, which was built by Mr. Hillman, when with the General Electric Company, at Schenectady. The article pictured the many uses for electricity in the home and was gotten up as a news feature.

A feature which perhaps most pleased the visitors of the com-

[illegible] was the sluicing in of about 150,000 cu. yds. of earth from a bluff to fill the old bed of the river and turn the water over [illegible] and the core wall the sand was washed in with a hose, the water being pumped by two 100-hp motors. The operation required about 60 days, but with only three or four men engaged, all the electricity was, of course, generated at the upper dam.

The company is now building a new steel tower line to Grand Rapids for the 100,000-volt transmission line. The towers are set 500 ft. apart. The wires are suspended by a new style of insulation. The insulators, which are of porcelain, instead of being set on the poles are suspended beneath the cross-arms, five disks for each insulator, and these carry the transmission cable.

The power company, in its efforts to convince the people of the fairness of the new franchise, used an argument which touched the pocketbook last month. To each of its customers it sent with the monthly bill made out according to the rates under the old franchise of the Grand Rapids Edison Company, under which it is now operating, a bill showing what the amount would be under the new franchise. In every case it was lower than under the existing franchise and, consequently, was most convincing.

Electric Signs in Portland, Ore.

In an address recently delivered before the Sacramento convention of the Pacific Coast Advertising Men's Association, Mr. Bury I. Dasent, advertising manager of the Portland Railway, Light & Power Company, entered a strong plea for the use of electricity in advertising. Referring to the use of the electric sign in Portland, Ore., he said that this means of advertising has assumed such importance in the business-getting plans of progressive merchants that even staid and conservative concerns such as banks have been brought to a realization of its value. A prominent banking institution of Portland last winter broke away from its hide-bound traditions of conservatism and installed an electric sign of the "flasher and chaser" variety, bearing the legend, "We Pay Four Per Cent." It was something unique for an establishment so dignified, but what was the result? The day after its installation a stranger entered the bank and depositing $10,000, remarked, "I don't reside in your city—but I happened to see your electric sign last night, and was so impressed that I decided to open an account with you." This sign is a large and expensive one, but an officer of the bank has stated that the profits traced directly to its influence paid for the sign within eight days after its installation.

In many cities throughout the country, enterprising merchants have combined to secure the effective advertising of particular sections and streets by the adoption and installation of an especially efficient scheme of special street illumination, using incandescent lamps of high candle-power. Experience has shown that where a street, formerly dark and unattractive, has been so illuminated, a business reanimation has speedily followed. The city of Portland is now experiencing this renaissance of street illumination. The transitional movement in streets and sections so lighted is characterized by an unquestioned business revival, and as a result the Portland Railway, Light & Power Company is now engaged in the installation of these lamps in various sections of the city for business men who are interested in the stimulation of trade and the improving of the lighting in the vicinity of their places of business, and for the further purpose of beautifying and advertising the streets in which their stores are situated. It has been realized by the enterprising business men of Portland that this plan of special illumination forms an advertising feature of tremendous value, and one that is absolutely necessary if they would keep abreast of the times.

It is due to the electric sign that the business thoroughfares of Portland have advanced more than 200 per cent in brilliancy within the last year. To it the city owes its brilliant thoroughfares, and its air of metropolitan gaiety throughout the hours [illegible] ablaze with electric light many more people venture out at night, and if anything, the throngs are now greater after nightfall than in the daytime.

The electric illumination of Portland's shopping district constitutes a spectacle that is free for the enjoyment of all, and the great public loves spectacular effects, and will go a long way to see and enjoy them. Until this electric era began, the merchant put up his shutters or pulled down his shades when he closed the doors of his store. His expenses—rent, salaries, insurance, all went on, but his business stopped. That was the ancient way. With the modern way—the electric way—business no longer slumbers, for the store keeps glittering eyes open for trade throughout the lingering hours of the night, and whets the desires of the multitude by tempting displays under the glittering rays of the electric lamps.

Electricity in Amusement Halls.

By William H. [illegible]

All through the East, during the past year, there has sprung up like mushrooms over night, a lot of amusement enterprises. These are of the moving picture, penny-in-the-slot and the small vaudeville show variety, and all use electricity to a great extent for illumination, for advertising and for the operation of the different machines.

Their outside appearance varies with the ideas and tastes of the proprietors and the amount of money to be spent in their construction and range from the gorgeous electrical palace to the small store with its kalsomined walls and sand-covered floor.

The better ones have a ceiling studded with a great number of incandescent lamps, with the walls set off with plaster art groups containing many small candle-power lamps, frosted or colored, according to the nature of the design. Here and there placed on the floor will be found in some, unique and novel electrical devices to amuse. On the outside of the building, signs of all sorts and arc lamps, as a rule, of the flaming arc type, blaze out in the darkness of the night. The cheaper

NIGHT ILLUMINATION OF AMUSEMENT HALLS.

ones are lighted by clusters or single incandescent lamps run across the ceiling. Outside will be found installed a panel sign, or one or two arc lamps, or outline lighting. The large and the small depend upon their electrical display to attract attention, and the brighter their premises look the better is their business prospect.

Their burning hours average about six every day, being from dusk until 12 to 1 a. m. There are a great many which operate through the day from 1 p. m. on, and use all their lighting equipment except that outside. This is desirable business, as they use every unit, comparatively none of the equipment lying idle. A great many companies encourage this class of business and offer a great many inducements to them, such as lower rates, equipment and service.

In the smaller ones the proprietors find that they cannot, on

account of the cost, model their establishments after the larger ones. Their thought turns to anything that will set out in as much light as possible, with the least expense, their premises. Naturally, to begin with, the place is painted white, and where any other coloring is added, pink or light blue is used, nothing darker. In some cities where panel signs were furnished by the lighting company, these were hung over the sidewalk about the center of the store, with an arc lamp each side of it. Later the panel signs were removed and a painted steel or iron sign substituted. They considered that the electrical panel sign used energy unnecessarily when the arc lamps were burning. In the hall proper Gem or Nernst lamps have taken the place of the clusters and incandescent lamps to a great extent.

The manager of an amusement company which controls the larger ones in a great many cities throughout the United States said that his company was always on the lookout to install another one anywhere the situation warranted it. They used one general style of architecture, shown in the accompanying illustration. Their difficulty, he said, was on the rate question, for to make any kind of display they had to have a low rate. In some cities this ran as low as 5 cents and in others as high as 9 cents per kw hour. In the matter of lamp renewals, as a general thing frosted lamps were not renewed for them. To have the incandescent lamps conform with the general design it was necessary to have frosted lamps, a few colored and some special ones, and they had to frost and color the clear glass lamps that were exchanged free of charge.

In a city of 200,000 the average monthly consumption of one of this concern's amusement places was 1850 kw-hours, the equipment was 100 16-cp equivalents. The matter of the electrical equipment was carefully gone over and the size of the installation kept down to the minimum, as they were on the [illegible] kw-hour demand rate with a low second-hour rate. In the same city an independent concern was constructed along the same lines, but of smaller dimensions with a larger equipment, 175 16-cp equivalents, whose average monthly consumption reached only 1250 kw-hours. The smaller ones in the same city, with an equipment of 75 16-cp equivalent on the regular rates, have a consumption of [illegible] kw-hours.

Scattered all through New York City are a great number of these small amusement halls, some blocks having as many as five of them. All through the cities lighted by the Public Service Corporation in New Jersey there are groups of from five to 20 of them. The commercial department of the Public Service Corporation considers them one of the best business propositions they have when compared with the ordinary installation of 100 16 candle-power. The advertising the company gets from such installations is, moreover, considered to be of greater value than that received from the average store.

Electric Signs in Seattle.

By H. Cole Estep.

It is claimed that there are more electric signs in the city of Seattle, per capita of population, than in any other city in the United States. One of the striking features of the city, always noticed by newcomers, is the brilliancy of the illumination of the business district at night, due largely to the profuse use of the electric signs. The electricity for most of these signs is furnished by the Seattle Electric Company, and a short account of how this department of the company's business was developed follows.

NIGHT SCENE ON FIRST AVENUE, SEATTLE.

The distinctive feature of the sign business-getting policy of the Seattle Electric Company is that this department has paid a reasonable profit from the start. While many central station companies are at first forced to conduct their sign business at a loss and are required to rent signs, give them away, install them for nothing, or offer thirty-day free trial in order to build up a paying sign load, this company has been able, by virtue both of local conditions and of the method of business-getting pursued, to conduct the sign department on a paying basis from the beginning

The campaign was started two and a half years ago. In the beginning a reasonably cheap and efficient design of sign—namely, the Chris-Wallin porcelain trough type—was adopted as a standard. This type was selected because its comparatively low first cost and the low cost of operation made it easy to introduce. [illegible]

[illegible] introduced.

With a good sign to start with, the next step was to employ an expert, an experienced sign-business solicitor. This solicitor selected one progressive merchant in each line of business and concentrated on him until he agreed to take an electric sign. Once he was secured, his competitors followed suit, as a matter of course. In securing the first customer the electric sign was presented to him from the standpoint of a profitable advertising proposition that he could not afford to be without. This main point was emphasized, hammered on and illustrated by experiences and testimonials from merchants in his particular line in other cities. No special rates for his sign energy were offered, nor were the signs offered to him at less than cost; he was induced to buy them outright at a fair price. In short, the electric sign was presented, not as a new venture that needed special low rates and other inducements to make it acceptable, but as a standard, paying business proposition both for the merchant and the electric company. This line of attack met with eminent success and resulted in the conditions noted in the first paragraph of this article.

As is seen from the accompanying illustration, a night scene on First or Second Avenue in Seattle compares very favorably with one on Broadway, above Twenty-Third Street, in New York. The City Council has passed an ordinance which requires all electric sign owners to take out a permit and compels them to burn the lamps every night until 1 a. m. This insures a full illumination of the business district throughout the evening and gives steadiness and dependability to the sign load.

Under the stimulus of the sign department of the Seattle Electric Company many large sky line signs, visible for miles across the sound, have been erected. The most notable of these is that of the Seattle Hardware Company, which is 6 ft. high and 300 ft. long. It cost $1,000. This example, together with the fact that there are 50,000 lamps in electric signs in Seattle—one sign lamp for every five inhabitants—indicates the intensiveness and success with which this field has been cultivated in the Queen City of Puget Sound.

Electrical Decorations at San Jose, Cal.

By E. E. Pomeroy.

San Jose having been selected as the headquarters for the recent "Native Son's" celebration, the city decided to use electricity for decorative effect at night, and the electric light tower,

FIG. 1.—ELECTRIC TOWER AT SAN JOSE, CAL.

standing in the heart of the city, was utilized in carrying out part of the plan. This tower, which is about twenty-five years old and something over 200 ft. in height, is built mostly of iron pipe and braced with heavy wire; it is used ordinarily for street lighting purposes [illegible]

As will be seen by Fig. 1, the tower was strung with incandescent lamps, 1300 16-cp lamps being used. The wiring was

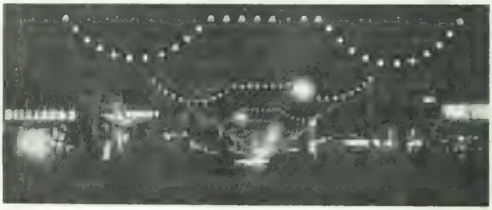


FIG. 2.—STREET SCENE AT SAN JOSE, CAL.

divided into sixteen circuits of No. 12 wire and arranged for 110 volts, the primary potential being 2200 volts. Six men were engaged about four days on the work.

Fig. 2 shows the method of lighting the main streets.

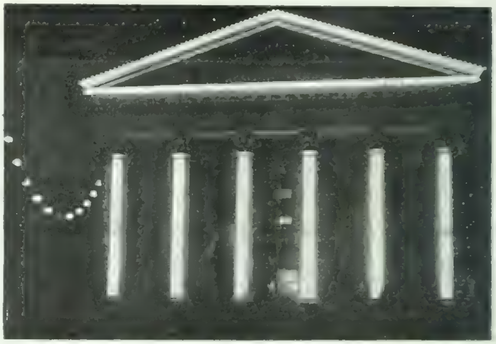


FIG. 3.—COURT HOUSE ILLUMINATION.

Lamps of 16 cp were strung in festoons of thirty each and covered with red paper lanterns; in all about 3500 lamps were used. Fig. 3 shows the electrical decoration of the court house. The electrical decorations were designed and installed under the supervision of city electrician John Guilbert, with the assistance of Frank Fall, as foreman.

Electric Street Decorations for Holidays.

The Boardman River Electric Light & Power Company, of Traverse City, Mich., has issued this summer as postal cards two interesting views of its lighting decorations made specially for July 4. We reproduce [illegible] herewith, thinking that

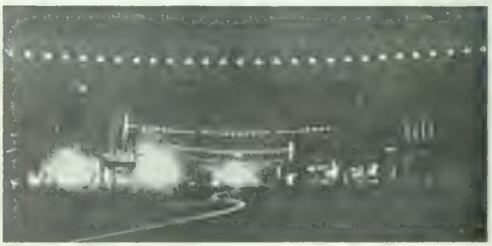


FIG. 1.—STREET SCENE AT TRAVERSE CITY, MICH.

possibly some of our other central station readers might also find the idea effective in business-getting.

These streamers were put up for the National holiday, and it was intended to take them down again promptly; but their

brilliant appearance made them quite popular, and a subscription was taken up to cover the expense of letting them remain in position during the summer months.

The company informs us that it used for this work bare No. 10 copper wire. The circuits carried 8-cp Shelby lamps with the "9171" receptacle, and the lamps were placed 24 ins. apart. The streamers were installed about 200 ft. apart, and this spacing made the street seem a blaze of light. Altogether, the company had up 1000 lamps of 8 candle-power, distributed

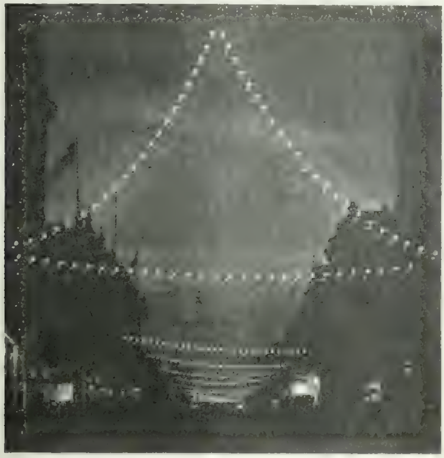


FIG. 2.—DECORATIVE STREET ILLUMINATION AT TRAVERSE CITY, MICH.

through the main streets of the town. The people were very much pleased with the effect, and photographs were in brisk sale, while there has been a great call for the postal cards. The zigzag streak of light down the middle of one of the postal views was caused by an automobile coming along the street toward the camera at the time of the exposure. The two views are taken from opposite ends of the street.

Point System of Paying Solicitors at Dayton, Ohio.

The Dayton Lighting Company, at present writing, is about to adopt the point system of paying its solicitors a commission. The system is a modification of that used by the Denver Gas & Electric Company, and described by Mr. C. N. Stannard, secretary of that company, in the ELECTICAL WORLD of April, 1906. At Denver, 5 per cent of the increase in gross revenue for each month of the year, as compared with the corresponding month of the previous year, is divided among the solicitors as commission, the division being in proportion to the number of points each solicitor has secured. The same plan is to be followed in Denver, except that the percentage of increased gross receipts to be divided among the solicitors has not yet been fixed.

Under the point system when a solicitor brings in a new contract, he is credited with a certain number of points, based upon the estimated gross revenue which the new business will bring in. The business which is most profitable to the company counts more points, however, than the class of business yielding the same gross revenue which is not so profitable to the company. Long-hour business, calling for the smallest investment per dollar of income, is credited with the highest number of points. The classification or schedule adopted at Dayton for crediting the solicitors is as follows:

CLASSIFICATION.

A.—Signs, outlining, motors, irons and cooking appliances, 10 points per $1 of yearly gross revenue.

B.—Windows operated according to the company schedule, also fans or any additional business secured on present installation, not otherwise classified, 9 points per $1.

C.—Dead service revived; must have been out of commission at least three months, 7 points per $1.

D.—Residence lighting and new contracts of any kind requiring an extension of service, 5 points per $1.

E.—Where meters are installed within three months from date of removal, 1 point per $1.

Successions or transfers secured by the representative, personally, are counted as 100 points, but no points are given on the revenue, unless added business is obtained; then such additional business is estimated according to the above schedule.

RULES FOR ESTIMATES ON REVENUE.

All flat rate contracts are estimated according to the contract price less the cost of the wiring, etc.

For meter customers the revenue is estimated as follows:

All-night lighting, 80 kw-hours per 16-cp lamp or equivalent per year.

Midnight lighting, 60 kw-hours per 16-cp lamp or equivalent per year.

Ordinary store lighting, 30 kw-hours per 16-cp lamp or equivalent per year.

Residence lighting, 20 kw-hours per 16-cp lamp per year.

Electric irons in residences, $10 per year, and according to consumption for other uses.

Motors, fans, etc., are to be estimated according to the place at which they are installed, and the length of time during which they are operated. All motor estimates must be approved by the motor specialist.

OUTLINE LIGHTING REVENUE ESTIMATES.

For 4-cp lamps when wiring is paid for by the consumer, $2 per lamp per year. The company is to furnish the first installation of lamps, free renewals, attention and switching service. When the company does all the wiring the price will be $2.75 per lamp per year. Outline lighting will be used as follows:

March 1 to Oct. 15, from dusk to 11 o'clock.

Oct. 16 to Feb. 28, from 5:30 to 11 o'clock.

Total hours per year	1625		
Net kw-hour rate	5	cents	
Switching charge	10	"	
Renewal charge	5	"	per kw-hour
Wiring charge	75	"	per lamp per year
First lamp installation	10	"	based on a 2 year contract

SIGNS, REVENUE ESTIMATES.

Assuming all sign lamps to be of 2 candle-power, the necessary connections to the present wiring to be made by the consumer, and the company furnishes the first installation of clear or frosted globes, free renewals, attention and switching service, the revenue will be estimated at 40 cents per lamp per year. The sign lighting is assumed to be operated during the same hours as the outline lighting noted above.

WINDOW LIGHTING REVENUE.

Where the consumer places the switch outside of the building subject to the approval of the company and it furnishes the switching service to him free of charge, agreeing to turn on the window lamps every evening at dusk and to switch them off at 11 p. m., the rate will be $.0635 per kw-hour with a discount of 5 per cent.

A Help in Explaining Equitable Rates for Electrical Energy.

Mr. D. W. Low, general manager of the Alliance (Ohio) Gas & Electric Company, in order to explain to some of his customers the reason for the necessity for charging more for electric energy when the use is only one or two hours per day than when it is used many hours per day, got up the following estimate on a door factory intended to produce a certain number of doors per year. This estimate shows the fixed and running expenses of such an establishment and the cost per door with the different rates of production per day. This example is one designed to be more easily understood by ordinary power

[illegible] paratus and involves the use of terms about which the average consumer knows little.

The expense of running this door factory is divided into fixed and running expenses, and Mr. Low's figures show that the cost of producing doors may be anything between \$2 and \$14.62 per door, depending on the number that is being produced. These figures are such as might well be used by the commercial departments of some other companies in handling complaints as to rates and explaining the reason for high rates to short-hour consumers.

[illegible] PER YEAR.

Items.	Standing.	Running.	Total.
[illegible]			
Depreciation, 5 per cent	750.00	000.00	750.00
Insurance, 4 per cent	600.00	000.00	600.00
Management and sales	3,000.00	000.00	3,000.00
[illegible]	[illegible]	[illegible]	[illegible]
Coal	000.00	\$400.00	400.00
Engineer	600.00	000.00	600.00
Oil, waste and supplies	000.00	75.00	75.00
Water	000.00	25.00	25.00
[illegible]	[illegible]	[illegible]	[illegible]
Repairs	150.00	50.00	200.00
[illegible]	[illegible]	[illegible]	[illegible]
Factory labor	000.00	4,050.00	4,050.00
Three men at \$1.50	000.00	000.00	000.00
Three men at \$3.00	000.00	000.00	000.00
Freight	000.00	750.00	750.00
Total cost, 15,000 doors	\$6,530.00	\$23,470.00	\$30,000.00

[illegible] PER DOOR [illegible] OUTPUTS PER DAY [illegible] ON ABOVE.

Per Day.	Output, Per Year.	Standing.	Cost, Running.	Total.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

LETTERS TO THE EDITORS.

Hopkinson Method of Charging for Electricity.

To the Editors of Electrical World:

Sirs:—Referring to the letter of Mr. Arthur Williams in your issue for Sept. 7, I would say that I believe that the Philadelphia Edison Company was the first to practically use the "Hopkinson" method in the United States, although the writer had never seen it.

On page 251 "Finances of Gas and Electric Light and Power Enterprises," is given a table first published in the proceedings of the Association of Edison Illuminating Companies, 1891. The closing paragraph of this letter to his board of directors (page 252) shows that the writer had been using this method successfully for a year before Feb. 17, 1891, and was anxious that the profitable results of putting electricity at 15 cents per kw-hour, and giving discounts as high as 47 per cent for long hours of use, as well as motors used all day at 5 cents per hp-hour, should not be lost to his company upon his retiring from its service. In 1896 the matter of minimum charges was treated algebraically (see "Finances," page 162), although the problem was privately solved by the writer in 1890. On page 134 of "Finances" is given another presentation of the "Hopkinson" method, published Oct. 15, 1900.

New York. Wm. D. Marks.

To the Editors of Electrical World:

Sirs:—Mr. Arthur Williams, writing in your issue of Sept. 7, in regard to the "Hopkinson Method of Charging for Electricity," states that "the Hopkinson or any similar method under which a minimum charge is placed upon the installation places a premium on the use of the service in other than the most necessary manner, and to that extent retards the development of the industry."

It seems hardly fair to Dr. Hopkinson to assume that he advocated the inequitable and inexpedient charge based on the customer's installation. The following quotations from his presidential address of 1892 show very plainly that the maximum demand of the customer and not the installation was in his opinion the proper basis of charge.

"The ideal method of charge, then, is a fixed charge per quarter proportional to the greatest rate of supply the consumer will ever take, and a charge by meter for the actual consumption. Such a method I urged in 1883, and obtained the introduction into certain Provisional Orders of a clause sanctioning a charge which is calculated partly by the quantity of energy contained in the supply and partly by a yearly or other rental depending upon the maximum strength of the current to be supplied."

"In certain recent cases in which I am acting as engineer, the Board of Trade have sanctioned on my application, for each unit per hour in the maximum power demanded, a charge not exceeding £3 per quarter, and in addition for each unit supplied, a charge not exceeding two-pence."

Boston, Mass. J. S. Codman.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Efficiency and Voltage Drop.—The Oerlikon Company recommends the defining of efficiency and voltage drop as follows: The efficiency of a machine or of a transformer which is built for a normal rating of A kilovolt-amperes, with a power factor $\phi = \cos \phi$, is defined as the ratio of $A \cos \phi$ to $A \cos \phi + v + i_1^2 r_1 + i_2^2 r_2 + i_2 c$, where v is the no-load loss in kilowatts at normal voltage, frequency and speed, after deducting all copper losses due to the no-load current and no-load excitation in the windings; $i_1^2 r_1$ is the copper loss in the primary winding which has the total resistance of r_1 and carries the current i_1 at the load A; $i_2^2 r_2$ is the corresponding value for the secondary winding, r_2 being its total resistance without transition resistance of the brushes. Finally $i_2 c$ is the loss which occurs in machines with commutators or slip-rings and represents the loss due to the transition resistance; for carbon brushes the mean value $c = 0.002$ is to be selected. r_1 and r_2 are the resistances for 60 degs. C. The losses $i_1^2 r_1$ and $i_2^2 r_2$ are determined by simple resistance measurements. The exciting current i_1, which corresponds to the load current i_2, is found from the characteristic curve of the machine. For a generator the no-load loss is best determined by driving it as a motor and measuring the power consumption. The efficiency of motor-generators is also to be determined according to the above definitions. The efficiency as defined above has a higher value than the real efficiency, since the above definition excludes all so-called additional losses due to armature reaction, etc. The exact measurement and calculation of these losses is generally impossible, and for modern machines this loss is small and is within the limits of errors in every efficiency test. The voltage drop e of a machine or of a transformer which is built for a normal rating of A kilovolt-amperes, a power-factor $\cos \phi$ and a normal voltage, E, is the difference between E and voltage $E + e$ at no-load for that excitation and speed which are required to produce the normal voltage at full load with the required power factor. For transformers the voltage drop at unity power factor is very nearly equal to the voltage drop in the ohmic resistance of the windings; $e = (i_1^2 r_1 + i_2^2 r_2) \div i_1$. The voltage drop of transformers for $\cos \phi = O$ is determined by the voltage e at the terminals which is required to produce the normal current i_1 in the primary winding at normal frequency, if the secondary winding is short-circuited. With poly-

phase and single-phase generators it is in general difficult to provide a full load at exactly the required power factor, but by making use of a slightly excited unloaded synchronous motor it is often easy to load a generator with full-load current at normal voltage, whereby, of course, cos ϕ is approximately zero. In stations with two or more generators this test is very easily carried out. If a voltage drop c_3 has been found for a certain excitation from the no-load characteristic curve with a current i at $\cos \phi = O$, experience has shown that it is permitted to find the voltage drop for the same current and for a different power factor, by means of the Kapp diagram. This diagram is reproduced and the method of using it is described. For testing the insulation of high-tension windings the Oerlikon Company recommends, whenever possible, to generate the testing voltage in the windings themselves and to connect successively each of the terminals of the windings with the frame and a terminal of the low-tension winding. In this way the insulation of the winding itself, the insulation from the frame and the insulation from the low-tension winding are obtained. The testing voltage is applied in the form of alternating e. m. f. for 30 minutes. If it is not possible to generate the high-tension in the machine or transformer itself: a special testing transformer must be used, one terminal of which is connected with the frame and the low-tension winding, and the other terminal with the high-tension winding which is being tested. It is advisable to insert a resistance or an inductance coil between the high-tension winding and the testing transformer to avoid dangerous arc or short-circuits on the machine under test. In any case, it is necessary to measure the testing voltage at the electrodes by means of a spark-gap which has been calibrated with an alternating voltage of pure sine wave. The arrangement recommended in the standardization rules of the American Institute of Electrical Engineers (1902-3), using a spark-gap between two needle points, has been found very satisfactory in practice.—*Elek. u. Masch.*, Sept. 1. ,

Determining the Losses in Motors.—C. F. SMITH.—A paper illustrated by diagrams in which the author deals with the methods in use for obtaining a separate determination of the iron and friction losses in direct-current and alternating-current motors. The advantages and disadvantages of the various methods are described. Special attention is devoted to the testing of alternating-current motors.—Lond. *Electrician*, Aug. 30.

Lamps and Lighting.

Helion Lamp.—W. G. CLARK AND H. C. PARKER.—Some notes on their helion lamp. Most of the information given is already known. It is stated that conclusive life tests have not been completed upon the low-candle-power filaments of small cross-section, but life tests made upon filaments of greater cross-section for higher-candle-power filaments at one watt per candle operated up to, in one case as high as 1270 hours, and on a number of filaments upward of 700 hours, and in each case the drop in candle-power was very small—only about 3 per cent. In each case the lamp failed at, or near, the joint where the filament was united to the platinum leading-in wires. The cement used for uniting the filament to the platinum acts upon the filament. For this reason the authors are at present engaged in the development of a cement for making a joint which will not act on the filament.—*School of Mines Quarterly*, July.

Metallic-Filament Lamps.—Notes on two recent British patents. According to a patent granted to the German Welsbach Company, the common refractory metals, such as molybdenum, tungsten, vanadium or tantalum, in the form of filaments pressed from the powdered metal with an addition of organic binding materials, are heated in an atmosphere containing both nitrogen and hydrogen, but no oxygen. This serves to remove the carbon in a gaseous form while retaining the metals in a metallic state. A patent granted to Siemens & Halske relates to the production of ductile tungsten from powdered tungsten. The powdered metal is stamped into an iron tube, the tube is closed and subjected to a drawing or rolling process. The shell of iron is then removed chemically, and the rod of tungsten heated electrically in an indifferent atmosphere until it becomes sufficiently ductile. —Lond. *Elec. Engineering*, Aug. [illegible]

Twin-Carbon Arc Lamp.—An illustrated description of a new twin-carbon arc lamp of the British Thomson-Houston Company with long burning hours and specially constructed for use in places where corrosive fumes are present, such as foundries, etc. The lamp has two arcs in series within the enclosed globe and consumes about the same power as the 5-amp. series multiple lamp. It gives a perfectly steady white light. The carbons are placed close together, and to the observer the effect is the same as if the light emanated from a single arc. The negative carbon holder is so arranged that no shadows are caused. The carbons used are 10 mm in diameter and with 12-in. upper and 5-in. lower, the lamp will burn approximately 100 hours. The lamp is designed to operate singly on from 200 to 250 volts direct-current circuits and can be adjusted from 2.75 to 3.5 amperes.—Lond. *Elec. Engineering*, Aug. 15.

Public Arc Lighting.—F. TEAGUE.—Tables giving details on public arc lighting in various British cities, especially concerning the number of lamps used, the type, the method of trimming etc. The notes on trimming are especially complete.—Lond. *Elec. Engineering*, Aug. 23.

Test of Three-Phase Plant.—A description of the official tests of three steam alternators just constructed for the Great Cobar Copper Mines in Australia. The sets were tested on the specified power factor of 0.85. For the official tests two of the sets were connected as shown in Fig. 1. One set was run under steam as

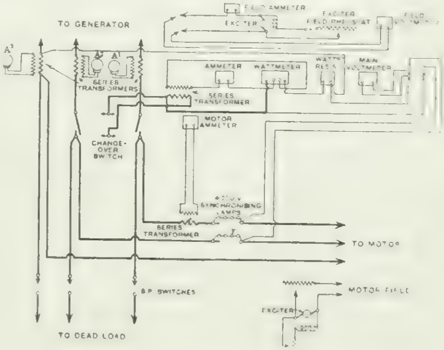


FIG. 1.—TEST OF THREE-PHASE PLANT.

a generator, and the other acted as a synchronous motor working in parallel with a balanced water load. The pistons belonging to the engine of the second set were removed and the set run up to speed, to allow of its being synchronized with the generator by means of a 30-hp direct-current motor belted to the flywheel of the engine. The necessary current for this was supplied from the works power plant. The arrangement proved very flexible, as by varying the field on the synchronous motor it was possible to obtain any power factor on the generator from zero lagging to about 0.85 leading. The actual power-factor during the official tests was 0.85 lagging, for which the generators were designed. In cases where two generators of a similar type are to be tested the adoption of this arrangement has the advantage over the use of choking coils that, once the connections are made, no time is lost in making adjustments to get the right power factor, since the only alteration required is to the series regulator in the field of the machine used as synchronous motor. The following is a summary of the results of this test, the readings showing the great advantage of using variable expansion gear on the high-pressure cylinder, there being only a difference of ¾ lb. per kilowatt between 20 per cent overload and half load. The steam consumption per kw-hour, condensing, was 22.4 lbs. at full load, 22.7 lbs. at three-quarter load, 24.0 lbs. at half load and 23.25 lbs. at 20 per cent overload. The governing results showed a rise of only 2½ per cent permanent and [illegible] per cent momentary variation.—Lond. *Electrician*, Sept. 6.

Oil Engines.—An illustrated account of an exhaustive test which has been recently carried out to determine the oil-consumption of a 500-hp Diesel oil engine by M. Longridge, chief [illegible] British Engine, Boiler & Electrical Insurance Company. The guaranteed consumption was 0.45 lb. of 18,000 B. T. U. oil per hp-hour, and the test figures came out at 0.348 lb. for full load, 0.303 lb. for half load and 0.304 lb for quarter load. The half-load figure is equivalent to a thermal efficiency of 47 per cent.—Lond. *Elec. Eng'ing,* Sept. 5.

Electric Cranes.—H. H. Broughton.—The first of a series of articles on electric cranes. The author summarizes the advantages of electrically driven cranes and points out their superiority over the hydraulic system. A summary is given of comparative tests of hydraulic and electric cranes, the results of these tests being given in great detail in form of tables.—Lond. *Electrician,* Sept. 6.

Traction.

Tramways and Motor Omnibuses.—H. M. Sayers.—An article in which the author discusses the relative advantages of tramways and motor omnibuses for public passenger service on the basis of cost of service. It is shown that, as the cost of a motor-omnibus service is nearly proportional to the car miles run, while the cost of a tramway service is partly made up of charges dependent upon the cost of equipping the route, irrespective of the service run upon it, there must be some density of service for any particular case at which the route charges make up the difference between the car mileage costs of the two vehicles. For a denser service the tramway is the more economical. Working out this principle with figures derived from experience, the result is generally that, wherever the traffic promises to make a tramway remunerative, it is more economical than the motor omnibus. It is also pointed out that, where traffic fluctuates widely during the day, or over a year, omnibuses may give a better result than tramways, owing to the route charges of the latter having to be put against a too small car mileage. Attention is drawn to certain costs due to the use of the roads, which fall upon the rate-payers in the case of the omnibus, while tramways contribute directly to the rates, being assessed upon their tracks; tramways also maintain a considerable part of the road surface, and these items must be taken into account in ascertaining the true total cost of each service. It is finally suggested that the much better utilization of the street area by vehicles running upon rails must be taken into account where street congestion renders the best use of the streets an important economic consideration.—Lond. *Elec. Eng'ing,* Sept. 5.

Accidents.—A report of the British Board of Trade on the number of persons killed and injured on the railways of the United Kingdom during 1906. The totals upon electric railways, through contact with the "live" rail, are four killed and twenty one injured. In addition, sixteen employees and one person on business were injured by shock and burn, not caused by direct contact with the "live" rail, and four were injured (one fatally) in generating stations.—Lond. *Elec. Eng'ing,* Aug. 29.

Installations, Systems and Appliances.

Tariffs of Charging for Electrical Energy.—An editorial summary of the various tariffs employed by British supply stations. The maximum demand system of charging is favored very considerably, the upper limit being frequently 14 cents and the lower limit 4 cents, although there is a good deal of variety. For example, there are the limits 14 and 6 cents, 12 and 6 cents, 14 and 8 cents, 12 and 5 cents, 14 and 3 cents, and so on. This variety, of course, is natural enough, because the stand-by charges and running charges must both vary considerably with the size of the undertaking and with local conditions. The maximum-demand system is undoubtedly correct in principle, but it is generally inadvisable to give this system without any alternative, and consequently any number of systems more or less simple are found in addition. Thus Buxton, besides having a rate of 14 cents for the first hour and 6 cents after the first, has rates of 12, 8, 6 and 5 cents. Some towns have simply a flat rate, others having a sliding scale with limits. Hornsey gives a rate of 10 cents with rebates, and Hertford includes free wiring if 16 cents and 4 cents are paid in place of 14 and 4 cents. A difference of price according to the voltage of supply is noticeable in one or two instances. Thus Hove gives a supply of 220 volts for 14 cents and 8 cents, but for a supply of 110 volts the charge is 16 and 8 cents. Similarly, Kensington gives a supply at 200 volts for 10 and 6 cents, but charges 12 cents for a 100-volt supply. Halls are charged at 7 cents and churches at 6 cents at Govan. At Horsham churches have to pay 10 cents, while at Hackney a 6-cent rate is allowed. At Whitehaven the charge is based on $40 per kw-year and 4 cents per kw-hour, whereas at Norwich a yearly charge is made of 12 per cent on the net assessment, and a further charge of 2 cents per kw-hour. Flat rates, in addition to being subject to rebates, are frequently quite complicated. Thus at Westminster the first 1000 kw-hours are charged at 11 cents and the next 3000 at 9 cents, and after 4000 the charge is 7 cents. St. Pancras, again, has a number of different charges. The flat rate with or without discounts is unfair. In addition to the different tariffs for lamps, there are further rates for motors. Generally speaking, the published rate for motors is a flat rate of from 2 cents to 4 cents per kw-hour; though, as a matter of fact, large consumers are always consid red on their merits and prices are arranged in accordance with load factor and quantity. In addition to a flat rate, some supply authorities graduate the charge according to quantity: thus Woolwich supplies 10,000 kw-hours at 4 cents and 40,000 kw-hours at 2.5 cents. Some authorities make the more rational charge of a certain sum per kilowatt of demand per year and a low rate per kw-hour. In the case of a small demand for motors, as well as for lamps, the complications may arise that a consumer desired the charges of the maximum-demand system for his lighting load, and also requires a certain amount of energy for motors and heaters. If he wishes to take advantage of the maximum-demand rate for lighting and of the lower rate for heaters and motors, he must pay for two meters and put in duplicate wiring. On the other hand, if he avoids duplicate wiring and has only one meter, it is practically impossible for him to make use of the maximum-demand system. Finally, the advantages of the use of a time-switch are pointed out. If two meters were installed and a time-switch to change over from one meter to the other during times of peak load, or the equivalent arrangement of a single meter with a shunt, then all the energy used during the greater part of the day and registered by one of the meters might be charged for at quite a low rate, and that used during the time of peak could be charged at a comparatively high rate. It is quite immaterial to the suppliers of electrical energy for what purposes the electrical energy is used during times of light load. Such a system has the disadvantage that it takes no account of load factor, but it has the advantage of simplicity, and the further advantage that it would tend to encourage the small user of electricity for motors.—Lond. *Electrician,* Aug. 30.

British Central-Station Account.—An abstract of last year's report of the Borough of Stepney electric station. The general tendency of British electricity supply authorities to reduce their rates, especially to power consumers, has in some cases led to disastrous results. In the case of Stepney, however, a substantial reduction in price per kw-hour for both motors and lamps has actually resulted in a larger surplus than last year. This has been effected by a reduction of the works cost of generating electrical energy, this reduction amounting to about 10 per cent and having been accomplished by economies in the use of coal. The total coal used during the year was 9360 tons, of which 4000 tons were best smokeless Welsh, costing $18,000, and used principally for carrying the heavy load during the few hours each evening, while the balance of more than 5000 tons consisted of cheap bituminous slack, costing $15,000, and was used throughout the greater part of the 24 hours. The total expenses, including capital charges, etc., per kw-hour were 3.54 cents, while the corresponding total revenue from all sources was 3.74 cents.—Lond. *Elec.,* Aug. 30.

Manchester.—The conclusion of the illustrated description of the three-phase power supply of the Manchester municipal station. The present installment deals especially with sub-stations In certain installations both alternating-current and direct-cur-

rent are needed from the three-phase mains, and both stationary transformers and rotary converters are required in one sub-station. The number of power consumers on the three-phase mains at present is 10, and the rating of the sub-station plant installed is 7160 kilowatts. Some 3800 kilowatts of this total is in motor-converters and the balance in static transformers. The combined consumption of the 10 firms is over 12,000,000 kw-hours per year. Among the present three-phase customers are two spinning mills, a wire works, a locomotive works, armor-plate works, chain works, electric-motor makers, machine-tool makers and chemical works. The motors installed in these works range in size from 7.5 to 150 horse-power.—Lond. *Electrician*, Aug. 30.

Transformers for Adjustable Resistances.—G. BENISCHKE.—Voltage regulation in alternating-current circuits is preferably carried out by means of adjustable inductance coils, but they cannot always be used. For instance, for charging mains when a long cable containing considerable capacity is to be gradually switched on to a high-voltage supply, the use of an inductance coil would be dangerous, since the variation of the inductance from a high to a low value would probably lead to resonance conditions at some point. For this purpose, therefore, non-inductive regulation must be employed, and, if the handling of apparatus in the high-tension circuit is to be avoided, a transformer connected as in Fig. 2 and whose secondary is gradually

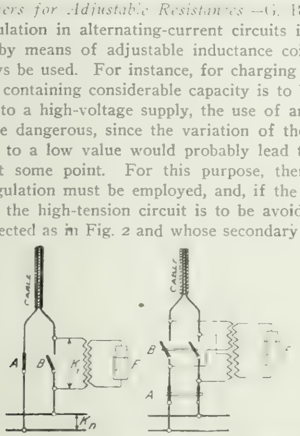


FIG. 2.—TRANSFORMERS FOR ADJUSTABLE RESISTANCES.

short-circuited by a liquid or other resistance F may advantageously be employed. For double-pole charging—such as is necessary in the case of concentric mains—the modification shown in the right-hand diagram is suitable. The action of such apparatus depends on the fact that the primary of a transformer behaves like a choking coil, with an impedance which decreases as the secondary load is increased, so that more current is allowed to pass to the mains. The maximum choking action occurs when the secondary is on open circuit, and the minimum when the secondary is short-circuited; the voltage across the primary in the latter case being the short-circuited voltage of the transformer, which is only a small fraction of the open-circuit primary voltage. The distinct advantage of this method over choking-coil regulation lies in the fact that, whereas with the latter the ohmic resistance remains constant and only the inductive resistance varies, with the transformer both resistances vary simultaneously, and it is possible to alter the amount of variation of each by altering the nature of the secondary load. Further, the ohmic resistance of a choking coil is comparatively small, while the corresponding equivalent ohmic resistance of the transformer, both on open circuit and with a non-inductive secondary load, is large compared with its inductive resistance. By never actually opening the secondary circuit, and by using the correct maximum secondary resistance, it is possible to insure that the resonance conditions cannot occur.—Lond. *Elec. Engineer*, Aug. 16.

Electricity on Farms.—D. S. PAXTON.—A profusely illustrated account of the numerous applications of electricity for industrial purposes at a farm in Saxony. A system of high-and-low-tension wires has been erected, and portable transformers and motors can be connected to it at numerous points. Electric motive power is employed for threshing, saws, pumping and distributing manure, etc.—Lond. *Elec. Eng'ing*, Aug. 29.

Electric Equipment of an Asylum.—A description of the equipment for light and power purposes of extension of the lunatic asylum of the London County Council.—Lond. *Electrical Engineering*, Aug. 29.

Switchboard.—O. S[illegible]

the new switchboard in the station of the International Electric Company in Vienna. Use is made of the system of Klingenberg, in which the different instrument panels are not firmly fixed on the main frame but are movable. All instruments and apparatus which belong to one machine or to one cable are placed on a car running on rails in a closed chamber of the main board. This enables one to disconnect single groups of instruments from the switchboard by simply running the corresponding car out of the board so that revisions and repairs are not made in the high-tension room, but in front of the switchboard.—*Elek. u. Masch.*, Sept. 1.

Starting Switch.—Details of construction with illustrations of a recently patented motor-starting switch of E. F. Moy, which is of the hand-operated, magnetic-clutch variety.—Lond. *Elec. Eng'ing*, Aug. 29.

Rules.—A full reprint of the complete set of regulations of the German Association of Electrical Engineers for erection of electric installations for light, power, etc., with a notation which is recommended for electrical drawings.—*Elek. Zeit.*, Sept. 5.

Regulations.—Extracts from the new sets of safety regulations of the German Association of Electrical Engineers.—Lond. *Elec. Eng'ing*, Aug. 29.

Wires, Wiring and Conduits.

Soldering.—A. LIPPMANN.—The conclusion of his article on the rôle which acid plays in solders. He shows that it is possible to make solders which contain much less organic acids and are more suitable for soldering than rosin, so that the recommendations of the latter material by the German Association rules is not warranted. To compare the advantages of different solders, tests of the acid content, of the attack on metals, mechanical tests, etc., are recommended. Electrical tests (for instance, resistance measurements) may also give information concerning the quality of the solder, but they require too much time.—*Elec. Zeit.*, Sept. 5.

Fuses.—G. J. MEYER.—An abstract with illustrations of his recent German paper on the phenomena during the blowing of a fuse, and on the German regulations as to fuses.—Lond. *Electrician*, Aug. 30.

Electrochemistry and Batteries.

Purification of Water.—H. LEFFMANN.—A Franklin Institute paper on direct and indirect methods of electric purification of water. In direct methods electrolysis is applied with aluminum electrodes. Aluminum hydroxide is formed which has the effect of combining with the organic matter and entangling the suspended substances, so that the water after treatment can be subjected to a rapid filtration and will show material improvement in microbic content, especially if the amount of suspended matter and microbic content were previously high. For waters containing but little suspended impurity, the purifying action is relatively low. The consumption of the aluminum electrode is a serious item of expense. As an indirect electrical method, he mentions the sterilization of water by means of electrically produced ozone, and gives some data on the experimental plant which was in use with the Vosmaer process in Philadelphia. Many tests of the bacteriocidal efficiency of the ozone plant have shown that the water as discharged from the ozonizer was practically sterile, exact figures being given in formulas and tables.—*Jour. Franklin Inst.*, Aug. and Sept.

Charging Plant for Storage Batteries.—An illustrated description of a charging plant for electric automobiles. The switchboard measures 11 ft. by 3 ft. and has mounted at the back of it a field rheostat for the dynamo, with hand-wheel in front. A reverse cut-out is fitted to prevent the accumulators discharging through the dynamo in the event of the latter accidentally stopping. The main ammeter and voltmeter are 9 in. in diameter and of the dead-beat, moving-coil type, reading up to 175 amperes and 75 volts respectively, while there are 20 ammeters of 6 in. diameter for the charging circuit. The resistances are fitted in separate porcelain units for each step, and may be easily replaced. There are double-pole main switches and fuses, with a safety fuse to each circuit. The dynamo is capable of a normal output at 70 volts of 160 amperes. It is pos-

[illegible] 4 volts, the normal rate being 7 amperes, with a possible maximum of 10 amperes if necessary. The dynamo runs at 960 revolutions per minute.—Lond. *Electrician*, Sept. 6.

Units, Measurements and Instruments.

Current Meter.—W. W. Lackie.—A description of a device for measuring electric currents. As shown in Fig. 3, a maximum-current indicator comprises a pivoted lever, *C*, connected to the core of a fixed solenoid, *A*, so as to be tilted when a certain current passes. The tilting connects a wheel, *F*, carried by the lever, with a wheel of the counting train of a watt-hour or other meter, so as to move a weight along the lever till the latter is tilted back. The position of the weight indicates the

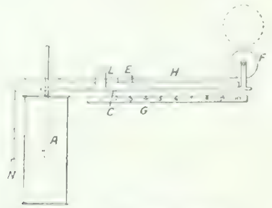


FIG. 3.—[illegible]

current strength. The time taken to tilt the lever back is approximately the same for all currents, and depends on which wheel is used as driving wheel. According to the specification the lever is trough-shaped, and the driving wheel may belong to a clockwork, driven electrically or by a spring so as to make the apparatus complete in itself. In the arrangement shown the wheel, *F*, winds in a cord *H*, which passes through the weight, *E*, and moves it by a stop, *L*. When the lever tilts back the cord is unwound by a weight, *N*, leaving the weight, *E*, for its position to be read from a scale, *G*, on or separate from the lever. The cord may be fixed to the weight, *E*, the part to the left being omitted, but in that case a further increase of current would be recorded in a shorter time than the original current. Several modifications of this meter are also described.—Lond. *Elec. Engineer*, Aug. 23.

Optical Pyrometry.—L. Holborn.—A (British) Association paper in which the author first summarizes the fundamental laws of black-body radiation, namely, the Stefan-Boltzmann law for the total radiation, Wien's displacement law, and Planck's law for the radiation at a single wave length. Measurements of temperature can be based on any equations, but the most important one is the third law, especially in the simpler (and older) form of Wien. The fundamental constant in Wien's law has been determined with an accuracy which may amount to about 1 per cent so that temperature measurements (if the melting point of gold, 1064 degrees, is taken as the starting point) is accurate to 6 degrees at 1500 degrees C, to 16 degrees at 2000 degrees C and to 48 degrees at 3000 degrees C. Several types of optical pyrometers are briefly described. If an optical pyrometer which has been standardized by means of a black body, is employed on a body of smaller radiating power, not the true temperature is obtained but a smaller value which in distinction from the true temperature is called the "black temperature." For the noble metals such as silver, gold and platinum, special measurements of the emissivity have furnished a simple result. The emissive power (relative to that of a black body, at the same temperature) for those metals for a given wave-length in the visible region is independent of the temperature within the accuracy of the measurements of temperature. Thus platinum emits red light of about one-third, gold of one-eighth, and silver of one-fourteenth of the brightness of a black body at the same temperature. The law is valid down to low temperatures where we can determine the emissive power from the absorption of good metallic mirrors.—Lond. *Electrician*, Aug. 30.

[illegible] are suspended side by side and joined and weighed at the bottom. They are surrounded by a conducting vessel, which is charged to a certain potential. The fibres diverge even when earthed, since each fibre is in an electrostatic field formed by, say, the positive charge of the nearest wall, and the negative charge on the other fibre, due to induction. This arrangement has the advantage that positive and negative charges have an opposite effect upon the divergence. The scale of the instrument is quite independent of the potential to which the outer vessel happens to be charged. The deflection is simply proportional to the difference of potential between the fibres and the conducting vessel, which behaves like Faraday's ice pail. Very high potentials can be measured with the instrument, so long as a proper auxiliary potential is available. On the other hand, the sensitiveness of the scale is preserved down below one volt, so that even fractions of a volt can be measured. Herein the instrument is distinctly superior to the gold-leaf, which ceases to act below some 70 volts.—*Phys. Zeit.*, Aug. 15; abstracted in Lond. *Electrical Engineering*, Sept. 5.

String Galvanometer.—G. Zemplen.—A note on the observation of alternating currents with a string galvanometer.—Lond. *Electrician*, Sept. 6.

Testing Machine.—C. E. Larard.—An illustrated paper describing in detail the construction of a new testing machine which is capable of great precision of control with respect to the time rate of straining and loading, either slowly or very quickly over a large range. The control obtained in this machine for torsion as well as the more usual tests of tension, compression, and bending, is due to the use of two electric motors with wide-speed range, the high range in the rate of straining by hydraulic pressure, and the fact that the handle and other adjustments are controlled from one position.—Lond. *Electrical Engineering*, Aug. 15.

Testing Dry Cells.—F. Stahli.—An illustrated description of a simple switchboard for measuring simultaneously by means of a single galvanometer and a single ammeter the voltage and amp-hour rating of dry cells.—*Elek. Zeit.*, Sept. 5.

Electric Welding.—An illustrated article on the Thomson process of electric welding and various modifications of it which have recently been developed. A new method of uniting the surfaces to be joined as in the left-hand diagram of Fig. 4. These projections set up local heating, and when they are at the right temperature they are welded together by pressure. A method of forming joints in thin material is as follows. The strips are butted in the clamps of the welder in such a way that when heated and pressed together the edges are turned up against each other, as shown in the right-hand diagram. An automatic hammer is then used to force the upturned edges down against the strip, and to press the heated metal to about the same thickness as the original strip. An extremely strong and satisfactory joint is the result. A Thomson electric-welding machine, specially adapted for the manufacture of hollow handled table cutlery, and a method of electrically welding wire

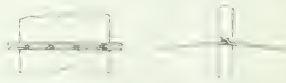


FIG. 4.—ELECTRIC WELDING.

netting, also the manufacture of square and hexagon-headed bolts by electric welding, etc., are described. Finally, a transformer specially designed for welding purposes by Berry and Wallis Jones is noticed and illustrated.—Lond. *Electrical Times* Sept. 5.

Telegraphy, Telephony and Signals.

[illegible] Italian Electrical Association describing his new system of wireless telephony, which is based on the use of a spark gap. For generating the spark a special rotating arrangement is used by which it is claimed 10,000 single sparks per second can be obtained. In wireless telephony there is required a microphone that can be used with high-tension currents. It must be capable of withstanding a pressure of several thousand [illegible]

gave rise to the Majorana hydraulic microphone, which depends on the capillary properties of fluid jets. A stream of liquid flowing from a suitably constructed opening divides itself into drops which follow each other at practically constant intervals. The frequency may be noticed acoustically by allowing the drops to fall on an elastic membrane which then gives out a sound of corresponding frequency. When mechanical oscillations are superimposed on the fluid jet periodical constrictions may be noticed which are of very nearly the same frequency as the superimposed oscillations. The drops thus force the membrane on which they impinge to give out sounds of a corresponding frequency. If the drops fall on a level surface at right angles to their direction, a covering of thickness, varying with the frequency of the drops, is formed. Prof. Majorana has constructed a microphone on this principle and has thus obtained telephonic currents of extraordinary clearness and strength. This microphone consists of the usual mouthpiece and of a membrane fixed to a glass tube which moves freely under the oscillations of the membrane and through which slightly acidulated water flows. The liquid passes out of a special opening in the glass tube and strikes the upper surface of a "collector," consisting of two cylindrical pieces of platinum insulated from each other. On striking the middle of the "collector" the fluid spreads itself over the surface and puts the two halves in permanent connection. Thus a battery whose poles are connected in circuit with a telephone and this "collector" will send a constant current through it so long as the membrane is not affected by sound waves. When the membrane vibrates the aperture begins to oscillate, and varies the flow of the drops so that the fluid on the "collector" is continually altering in thickness. If this circuit is connected in a suitable way with the spark-gap mentioned above, the intensity of the spark will correspond with the sound waves and will transmit to the receiving station the appropriate words and sounds. Prof. Majorana obtained good results with this experimental arrangement, but found it advantageous to use a Poulsen arc in nitrogen instead of the spark-gap.—Lond. *Electrician*, Aug. 30.

Miscellaneous.

Effect of Electricity on Plants.—J. H. PRIESTLEY.—A paper read before the British Naturalists' Society in which the author gives results of the experiments with the overhead discharge system of electrification. This method has a distinct effect, usually favorable in character, upon the growth of plants. Experiments with earth currents showed occasionally an increase in the rate of plant growth, but often there was no definite effect.—Lond. *Electrician*, Sept. 6.

Meter Calibrating Equipment.

BY WILLIAM BRADSHAW

The watt-hour meter being the apparatus which definitely determines the revenue on which the success or failure of the operating company depends, it is highly important that it be kept permanently in correct calibration. To accomplish successfully and economically this purpose requires two lines of standard instruments, which are usually designated as primary standards and secondary standards.

The primary standard may have a great many useful features, but the essential one must be permanence of calibration. With this feature obtained, the standard should in addition be unaffected by uniform external magnetic fields, accurate on either alternating or direct-current circuits, astatic, cover a wide range of currents and voltages, convenient to use and of a semi-portable type.

The primary standard may contain all of these features and still be of little value to the central station if it will not stand shipment when properly packed without destroying its calibration. The central station must from time to time verify the calibration of the standard, and not having the means at hand for this work, it must ship its meter to some standard laboratory or Government bureau of standards. Rarely can the instrument be delivered to the standardizing laboratory by messenger, hence must, to be of any value, be so constructed as to be shipped by express without mechanical injury or damage of calibration.

A line of primary standards, or precision instruments, have been in use for a number of years, and through the medium of a free calibration service for a period of five years, the manufacturer has been able to keep accurate and reliable records of the permanence of each instrument's calibration and general performance of the meter. The number of instruments in constant use, record of whose performance has been kept, runs into the hundreds, and every one has made one or more round trips between the customer and the manufacturer's laboratory without a single failure due to shipment. The average performance of permanence of calibration has been a change not exceeding .1 to .2 of 1 per cent.

From the above it will be seen that the central station has available a line of primary standards with all the essential or important features of a laboratory standard; but which, regardless of frequent shipment by express and movement from place to place by the user, is just as permanent in calibration, retains its zero setting equally well and has greater inherent range of current and voltage than the average laboratory standard.

A precision meter which has the preceding characteristics and qualifications is illustrated by Fig. 1. This particular meter

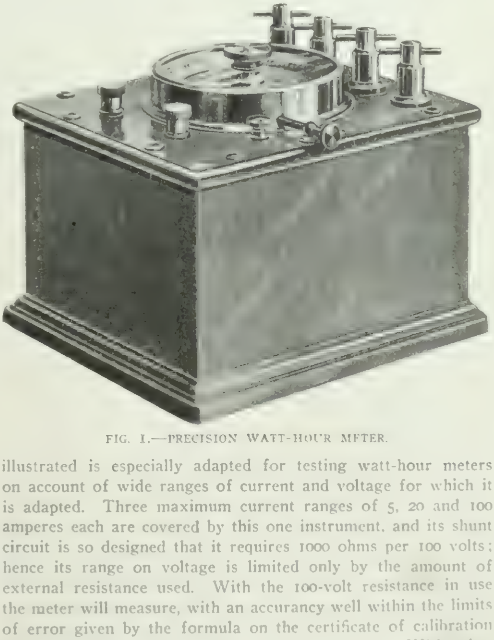


FIG. 1.—PRECISION WATT-HOUR METER.

illustrated is especially adapted for testing watt-hour meters on account of wide ranges of current and voltage for which it is adapted. Three maximum current ranges of 5, 20 and 100 amperes each are covered by this one instrument, and its shunt circuit is so designed that it requires 1000 ohms per 100 volts; hence its range on voltage is limited only by the amount of external resistance used. With the 100-volt resistance in use the meter will measure, with an accurancy well within the limits of error given by the formula on the certificate of calibration shown in Fig. 2, values from 10 to 10,000 watts. With other resistances the range of watts measured will be in proportion to the resistance used.

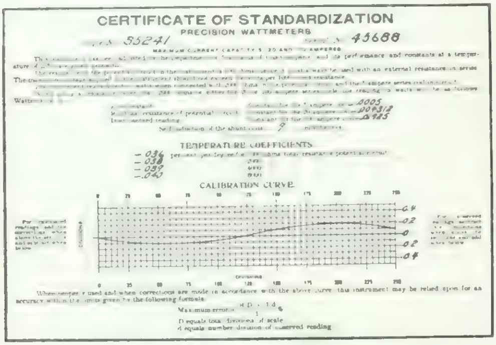
The coil system consists of two movable and four fixed coils. Each movable coil is placed between two fixed coils and the connections of the coil system so arranged that each movable coil is attracted by one and repelled by the other of these fixed coils. This arrangement prevents any mutual induction between the two sets of coils.

The instruments are zero reading; that is, the movable system is deflected from its position of rest when current passes through the coils, and the indications are read from the deflection required of a spiral spring to return the movable system to the zero position. By this construction it is possible to place the coils close together and make them of [illegible]

ture of energy in the coils; also with this form a minimum of disturbing influences enters.

The scale covers an entire circle approximately 5 ins. in diameter, and this is again virtually multiplied in length ten times by providing the deflecting pointer with a vernier which permits reading to 1/10 of each of the 200 main scale divisions or 1 in 2000 parts.

The certificate of calibration illustrated in Fig. 2 gives a representative calibration curve for one of these meters. This curve shows the variable relations between the deflection of a


CERTIFICATE OF STANDARDIZATION

PRECISION WATTMETERS

35241 45688

TEMPERATURE COEFFICIENTS

−.036

−.038

−.039

−.040

CALIBRATION CURVE

D equals total divisions of scale

d equals number division of observed reading

by the use of two controlling springs is it possible to keep this variation down to a negligible value or 1/10 of 1 per cent. With the best possible single spring this variation will usually exceed 1 per cent for some point of the 360-degree scale.

The secondary standard used should furnish an accurate, convenient and economic method of line calibration of service meters. Secondary standards, with which the line test can be easily and accurately made, are now available in the form of special watt-hour meters variously known as test meters, master meters or preferably portable watt-hour meters. The method of this line test consists in comparing the speeds of the moving element of the service meter and the portable watt-hour meter. The difference in revolutions between what the standard meter should make if the service meter were correct and what it actually does make for a given number of revolutions of the service meter, divided by the number of revolutions the standard makes for correct registration of the service meter, gives in per cent the accuracy of the service meter; that is, the per cent registration of the service meter.

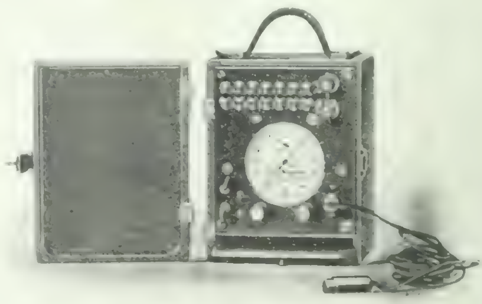
When the full-load speeds of the discs of the service meter and the standard meter are the same, these data are obtained direct by taking the difference between the two speeds for a given time and dividing this difference by the speed of the service meter for the time taken. If the speeds of the two meters under full load are different it is necessary to use a constant.

Fig. 3 shows a portable watt-hour meter arranged for this class of service. It has four current capacities of 5, 10, 20 and 40 amperes and two voltage capacities, namely, 100 and 200 volts. The meter may be arranged for any one of the series capacities by a simple plug board on the face plate of the meter and for either of the voltage capacities by changing the leads on the face plate to the left of the voltage connections. The meter is arranged to record on its dial the revolutions of the disc and also an additional index indicates 1 revolution to 25 of the disc. The special features in this design are series coils made up of sections which are connected in series-parallel groups for the various capacities, thus giving the same load characteristic for any one of the four capacities and a high torque for light weight of moving element.

In making a test using this meter as a standard, the standard meter is connected in series with the service meter under test, care being taken to place the series connection for the standard meter on the load side of the service meter and the voltage connection of the standard meter on the line side of the service meter, this connection preventing either meter measuring the shunt energy of the other. When thus connected a load approximating full load or 4 per cent of full load is connected and a comparison made of the speeds of the two meters, the standard meter being started and stopped as desired by a small snap switch in the shunt circuit of the same.

This method of testing service meters is very simple and one man alone can test a large number of service meters per day, as compared with any other method. When used with discretion this method gives very accurate and reliable results, but there are a few limitations to the meter which should be borne in mind when using it for test purposes. To obtain the best results it is advisable, although not absolutely necessary, that the load and voltage characteristics of the service meters being tested be known. If these characteristics do not agree in general with those obtained from standard makes of watt-hour meters, there is a possibility of considerable error being introduced in the calibration of the service meter. If the different capacities of the series coil are not obtained by a series-parallel arrangement of sections of the coil, there will be considerable difference at various points on the load characteristic in the per cent registration of the various capacities. An allowance for this difference in per cent registration must be made in calibrating the service meter if a standard is used having this type of series coil. It is recommended that tests be made on the service meter at loads approximating full and 4 per cent of load. If calibration is made for the light load at 10 per cent of full load or over a calibration which will be within 2 per cent at this point might be 5 or 6 per cent, or even more, plus or minus at 2 per cent of full load. The error in setting in some instances may even cause the instrument to creep on shunt alone. For this reason it is advisable to calibrate at the lower rating, as stated above.

Many central stations will take all of the precautions cited and make the serious error of considering the portable watt-hour meter as a primary instead of a secondary standard; that is, assume that the portable watt-hour meter is sufficiently permanent in calibration that it does not need any primary standard to which it is compared to keep it in calibration, or at least it is only compared at very rare intervals with such a standard. Many instances are known in which this type of meter has



shown remarkable performance, the calibration remaining practically constant over a long period, but the severe service to which this type of meter is subject in transporting it from one installation to another and installing it for test together with the liability to accident, such as short circuit, sudden jar, etc., makes it a very hazardous policy to rely solely on the calibration of the secondary standard, the only safe method being to have at hand a reliable primary standard of a type which will stand shipment and consequently can be sent to some bureau of standards for calibration at regular intervals

or secondary standard meter at very frequent intervals to prevent the changing of the calibration of service meters when they are correct and the standard is out of calibration.

It is the practice of some large central stations to check the secondary standard against the primary standard every day previous to starting out for a series of line tests on service meters. Others make this calibration check every three days, others at longer intervals, while a few are willing to take the chance and make no calibration whatever.

Arc Lamps for Use with Locomotives.

Fig. 1, herewith, which shows a lamp mechanism from which all complications have been eliminated, represents the results of a series of experiments conducted by Mr. B. B. Lacy for the Galveston, Harrisburg & San Antonio Railway Company with a view to simplifying the usual lamp construction and rendering its operation sufficiently reliable to justify the general adoption of the device for locomotives. The bracket which supports the frame permits adjustment laterally as well as forward and back so as to bring the arc at the focal point of the reflector. The lower electrode of the lamp is made of copper ½ in. in diameter, while the upper is of carbon ⅝ in. in diameter. It is stated that the lower electrode does not waste away appreciably, and that the arc is maintained at the same vertical point at the focus of the reflector. Direct current of from 12 to 17 amperes at a potential of 35 volts is furnished by an enclosed generator directly connected to a 2-hp rotary engine controlled by a governor which throttles the supply of steam and maintains the speed at 800 r. p. m.

FIG. 1.—LAMP MECHANISM

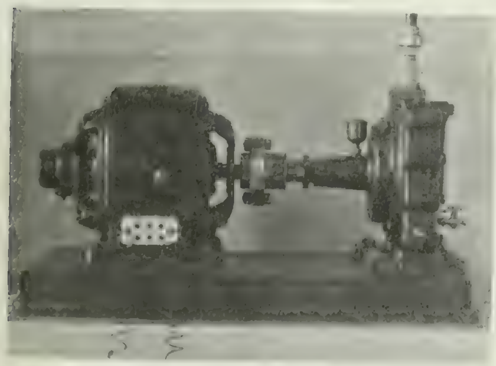


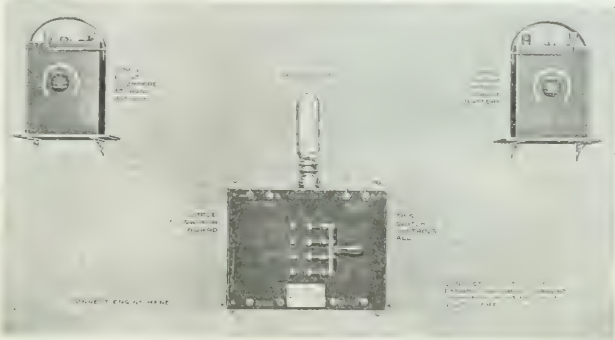
FIG. 2.—ROTARY ENGINE AND ARC LIGHTING GENERATOR

Ignition Switchboard Outfit.

The Dayton Electrical Manufacturing Company, Dayton, Ohio, has placed on the market a new switchboard outfit, known as "Apple 8-s," for igniting gas engines used to drive direct-current lighting or power dynamos. The outfit is applicable wherever *direct current* (110 or 220 volts) is available, and is particularly suitable for use with stationary gas engines used to drive lighting or power dynamos (direct-connected and belted gas engine-generator sets); large marine gas engines with which a lighting dynamo is used, and gas engines located where a direct-current city lighting or power circuit is available.

The switchboard provides a means of charging two ignition storage batteries alternately from any 110-volt or 220-volt direct-current circuit, taken through a lamp of proper resistance, one battery being charged from the lighting or power circuit while the other is being used for igniting and vice versa.

As an e. m. f. of 110 or 220 volts is too high to be used for recharging a low-voltage battery, it is necessary to take current through a resistance lamp to reduce it to the proper amount for recharging work. The resistance lamp used for thus cutting down the current is shown at the top of the switchboard in the accompanying illustration. The four-pole double throw switch mounted on the face of the switchboard breaks and makes all connections for transposing the charging and ignition currents from one battery to the other and does so positively, quickly and without the slightest complication. The entire operation consists simply of throwing the switch handle from one side of the board to the other.



IGNITION SWITCHBOARD OUTFIT

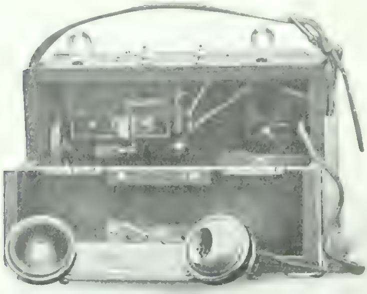
Storage batteries unquestionably furnish the best current for ignition work, giving off the "fat," hot sparks so much desired for igniting the mixture of gas and air in the combustion chamber of the engine, and the switchboard shown provides a ready and inexpensive means for properly charging small storage batteries, thus keeping them at the highest point of efficiency at all times.

The outfit is easily mounted on a post or wall. The wires from both batteries are connected to the binding posts marked "Battery," wires from the engine to the terminals marked "Engine," and wires from the dynamo to the terminal marked "Dynamo," these being all the connections necessary. The one switch does the rest. Any touch- or jump-spark coils, timers and plugs of standard make can be used with the outfit. Its use lengthens the life of the points in a touch-spark engine, for the reason that when the switch handle is thrown on one side the current for ignition flows through the electrodes in the engine in one direction, and then when the switch handle is thrown on the other side, the current flows in the opposite direction. This distributes the platinum evenly between the two points in the engine or those in the coil and gives long life to the points which is a very important feature.

Testing Set for Telephone Lines.

The lineman's testing telephone shown in the accompanying illustration has been designed for testing long-distance telephone lines, or any other form of circuits that do not carry high-voltage currents. It is especially intended for rough outdoor service. The apparatus is compactly aranged in a well-constructed, heavy oak box, reinforced at all corners by heavy cast-brass trunk corners.

The prominent feature is a one-half m. f. condenser in the receiver circuit to eliminate an exposed switch hook, for the



[illegible] WITH CASE OPEN.

purpose of breaking the line circuit. With this arrangement the instrument may be rung any time when on the line. The long type buzzer or ringer is not across the line when ringing out, and the generator shunts out the bell, putting the full voltage on the line when ringing with the generator.

The all-metal combination telephone forming a part of this equipment consists of a seamless brass tubing frame or handle and a transmitter and receiver containing the same size parts as are used in the regular long-distance equipment. All exterior sides and edges are carefully protected, and are enclosed as

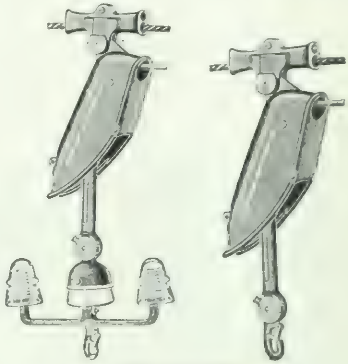
[illegible] TESTING SET, CASE CLOSED.

much as is practicable. A transmitter cut-out button is arranged just opposite the receiver for preventing the annoyance of side tones taken up by the transmitter when listening in on the line in a noisy place. This button also cuts in the battery when necessary, or only when talking. In other forms of instruments not provided with button-switches as long as the receiver is off the hook, the battery is being consumed, which is unnecessary. All parts are thoroughly finished and well insulated. The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., is the manufacturer of these instruments.

Ajax Safety Pulleys.

Four sterling qualities are claimed for the new safety pulley designed by Albert Scheible and marketed by the Ajax Line Material Company, of Chicago. It is simple, the only movable parts being the sheave and the knob to which the lamp is fastened. It is weatherproof, being housed as shown in the illustration. It is lamp-supporting, as guideways inside the casing guide the knob to and from a seat automatically, where it is supported independent of the rope.

It is smooth in action, avoiding sudden jars which would shake the carbons out of adjustment. This latter feature is attained



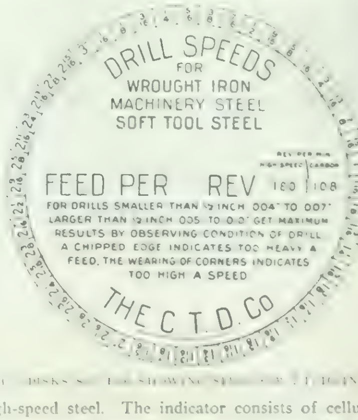
SAFETY PULLEYS.

by having the knob ride up an inclined guide when it first enters the pulley; then as the casing tilts, the angle between the knob and the guide soon becomes too steep for the knob to continue, thus stopping the knob without jarring it. Slackening the rope allows the knob to seat itself in the safety position, from which another pull on the rope releases it automatically.

The knob itself has the familiar Ajax snaphook for the lamp, and a clamp which readily grips either cotton or wire rope. For series circuits, the Ajax "Volta Arm" design for 10,000-volt work is fitted direct to the knob, as also pictured herewith. Both cuts show the Ajax safety pulley with a clamp for suspension strand, but it is also made with other styles of clamps for use on piping, beams or ceilings.

Speed Indicator for Drills.

The accompanying illustrations show a convenient device for determining the proper feed and speed of drills for both carbon



[illegible] DISKS SET FOR SHOWING SPEEDS [illegible]

and high-speed steel. The indicator consists of celluloid disks which are movable around a common center, the method of

use being self-evident from the illustrations. There are three disks, the combination of one side of the center disk and the corresponding outer disk indicating the proper speed for drills and the combination of the other side of the center disk and the corresponding outer disk showing decimal equivalents of

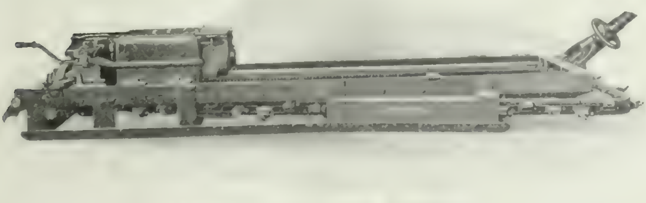
FIG. 2.—DISKS SET FOR SHOWING DECIMAL EQUIVALENT OF 1 TO

certain fractions. This device has been prepared by the Cleveland Twist Drill Company, Cleveland, Ohio, for free distribution to applicants.

Enclosed Mining Machine Motor.

The electric mining machine illustrated herewith has been designed for use in mines where explosive gases are encountered. The motor is of the enclosed type, and although it is given the same rating as that of the open type formerly used, it occupies no more space than the open-type motor.

It will be appreciated at once that the service to which mining motors are subjected is extremely severe. The equipment must withstand both oil and moisture, as well as heat and dirt, and yet it receives almost no attention. The motor here illustrated is provided with automatic ring-oiling bearings, which are so arranged that the oil hermetically seals the motor housing, and gas which may accumulate about the motor cannot be ignited by any spark within the motor. Over the commutator of the motor there is placed a plate-glass door,



[illegible]

protected by a heavy malleable-iron lid; the brushes may be observed through the glass door without exposing the motor to the mine gases. The starting switch is equally as well protected as the motor itself, all contacts being hermetically sealed in flame-tight metal casings.

The electric mining machine described above has been placed on the market by the Jeffrey Manufacturing Company, Columbus, Ohio. It not only conforms to the rigid rules and requirements of the British Government, but it requires the lowest possible expense for operation and maintenance.

Metallic Shield Blow-Out Controllers.

The arc-rupturing device in the controllers illustrated herewith differs from the ordinary magnetic blow-out device in two important particulars. The blow-out coil is constructed without any magnetic material in the flux circuit, and hence there

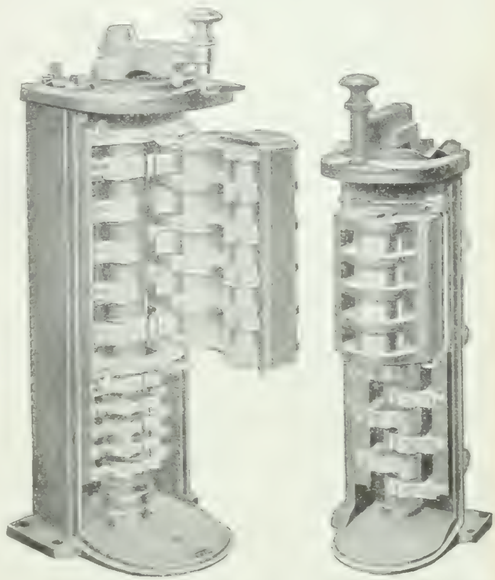


FIG. 1.—CONTROLLER WITH BLOW-OUT SWUNG OPEN. FIG. 2.—BLOW-OUT IN PLACE ON CONTROLLER.

is no "point of saturation" beyond which the controller refuses to operate satisfactorily. The blow-out effect increases in direct proportion to the current, and consequently the more powerful is the arc the greater is the magnetic field for rupturing it.

The second distinctive feature of the controller resides in the use of a copper shield which is brought directly in the sweep of the arc. The external magnetic field created around the shield attracts the arc to the shield and divides it into two, one arc going from one contact finger to the shield and the other from the shield to the other contact finger. These two arcs travel rapidly in opposite directions and finally become united again in the air, but around the shield; the arc at this time has become drawn out to such an extent as to rupture. Under operating conditions the arc is swept around the shield with great rapidity, and it does not affect the metal in the slightest degree. Moreover, the arc travels in the center of the shield and the insulating partitions are not subjected to any injury from the flame.

Fig. 1 illustrates a metallic-shield controller designed especially for heavy, intermittent work, such as electrically operating rolling mills, wharf cranes and other machinery. This type has a rating of 200 amperes on continual service.

In Fig. 2 there is shown a 100-ampere controller with the blow-out in place. This type is intended for use with cranes, hoists, locomotives, etc., or for service where a light, compact and efficient controller is required.

The metallic-shield blow-out type of controller is manufac [illegible] Broad Street, New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The lower temperature favored the distribution of seasonable merchandise, and collections were more prompt; but agricultural prospects were not so bright in a few sections, where killing frosts were experienced. Reports of retail trade are favorable with scarcely an exception, the fall demand equalling sanguine expectations, and jobbers in all leading lines of wearing apparel report the season's results equal to last year's. Manufacturing returns are more irregular, but most plants are well occupied and have orders covering production for some months. Purchases for more remote delivery are restricted by the financial uncertainty, which tends to cause conservatism, especially in the East. Scarcity of labor retards work at many points, while other delays are due to strikes, of which several are in progress. There is also much complaint of car shortage, but not more than is customary at this season. Railway earnings in September thus far exceed last year's by 7.5 per cent, and foreign commerce at the port of New York for the week showed a gain of $1,890,283 in exports and a loss of $2,889,491 in imports, as compared with 1906. In the iron and steel trade, the quiet tone as regards new business is still the leading feature, though mills, furnaces and factories are still busy on old orders. New orders are reported by leading interests as running 25 per cent behind a year ago at this date. There is apparently more competition for new business offering in finished products. Business in structural material is dull, but contracts on long-delayed work are again being figured on. The tightness of money makes it difficult to close pending contracts. The decline in building activity has made lumber dull, and yellow pine and hemlock are easier at the West. Other materials are also easy, and hardware manufacturers are seeking orders, whereas a year ago deliveries could not be promised short of five months' delay. Copper is again lower, lake copper for future delivery being quoted at 14⅞ to 15 cents, while for electrolytic grades 14¼ to 14⅝ cents has been named. At the lower prices domestic demand for spot copper has improved slightly, while Europe has bought moderately for October and November delivery, but business, on the whole, is disappointingly dull and competition for orders is more in evidence. The closing quotations of the previous week were 14⅞c. for Lake, 14⅝c. for electrolytic and 14¼c. for casting stock. On Sept. 20 Lake closed at 15¼ cents, electrolytic 14⅞ cents and casting 14⅝ cents. *Bradstreet's* reports 166 business failures during the week ending Sept. 26, against 179 in the week previous and 165 in the corresponding week of last year.

PLANS FOR UNIVERSITY.—U. S. Consul L. E. Dudley, in the following report from Vancouver, tells of the plans for a new provincial university in that part of Canada: "The last session of the provincial Parliament incorporated the Royal British Columbia University, and appropriated 2,000,000 acres of government land, the proceeds from which are to be used in the construction of the necessary buildings and for the endowment of the university. According to the plans for the building to be erected on the university site at Point Grey, the specifications call for a two-story structure, 150 ft. long by 62 ft. in width. The competing architects will have to figure on accommodation for at least 300 pupils, administration offices, general lecture rooms and apartments for the special scientific subjects required for the two years' course in engineering, which includes chemistry, physical and biological laboratories. The design for the building will be chosen from those submitted in the competitive examination, for which $850 is being offered to architects. This amount will be divided into three amounts—$500 for first prize, $250 for the second prize, and $100 for third. It is proposed to expend about $100,000 on the first part of the construction, and, as conditions warrant, to double this amount. The competitive plans must be handed in by October, and are to serve as ideas upon which the definite building may be erected. The present plan for location calls for a building about 300 ft. from the water front, and equidistant between the boundaries of the university grounds. This will afford ample opportunity for the construction of wings and additions. It is understood that building will begin in the spring. The actual location of the university grounds is on the east side of the naval reserve, covering nearly 32 acres, with a water frontage of 800 ft., having a depth of 1600 ft."

PLATINUM IN COLOMBIA.—Writing from Cartagena, U. S. Consul I. A. Manning states that the platinum industry in Colombia seems to be attracting considerable attention from abroad, which causes him to supply the following report: "Recently a French company, headed by Albert L. de Lantreppe, of London, has made some heavy purchases of mining properties in the platina district. They are soon to send competent engineers to make a complete study of the region from which platina is taken at present, and especially of their properties. Other capitalists and companies have also recently secured large holdings, which they expect to develop more scientifically than has been usual in working the mines. It is said that these companies will make an effort to find whether platina is found in quartz deposits as well as in placer ground, the latter being the only source of the present supply. The platina of Colombia has been found only on the headwaters of the Atrato River and the Rio San Juan in the State of Cauca and near the Pacific coast of Colombia. Most of these deposits are also gold bearing and they have been worked for a good many years, principally for the latter metal, as only during recent years has platina assumed a value sufficiently great as to give this metal an important place in the market. There is still no doubt a very great expanse of country rich in minerals of all kinds and where platina must exist, which has never yet been prospected in a scientific manner. While a great deal of platina is exported through Cartagena and Barranquilla, the export from Buenaventura must be considerable."

PLANT AT SEATTLE.—It is now stated that the extensions to the municipal lighting plant will not be completed until next June, according to the present calculations of the city officials. A new 4000-kw generator is to be installed, however, by January, and this will enlarge the present capacity of the plant, which has reached its limit. "Work is in progress now on the pipe line from the lake down to the station," Superintendent Youngs says. "This line will be three miles long and we are starting on the rock work now. In a short time we will have a camp and boarding house installed to take care of the crew on the pipe line. One of the 4000-kw generators will be installed in January, if the contract is fulfilled. This will relieve the present congestion of business. The other generator will follow shortly. The new waterwheel should be in place shortly after the generators. By June we should have the pipe line finished and we can then run the new waterwheel and both generators. If we had not been held up for a year and a half in getting the money from the $600,000 bonds, our extensions would be completed. Both of the private companies have all of the business that they can handle and extensions to their plants have been delayed." The present municipal lighting plant has a capacity of 3500 kilowatts. The extensions will give it 8000 additional kilowatts. For the past few weeks applications for light have had to be refused by the lighting department, as the present plant can handle no more business.

PRICE OF COPPER.—The prices quoted on copper are still weak and low, and a good deal of satisfaction is felt in electrical industries that have suffered with a price pushed unduly up to 25 cents or more. The United Metals Selling Company and other large producers continue to quote copper at 15 cents a pound, although sales are reported a shade below that price. No large transactions have been made. The big consumers are still holding aloof from the market, and signify their intention of remaining out until they feel that the bottom has been reached. A large producing company says that in view of the fact that cost of production is now within a few cents of the selling price, a further heavy recession in prices would be unnatural.

NERNST LAMP COMPANY, Pittsburg, Pa., has closed a number of large contracts lately and has issued a special request for an early filing of orders, so that customers may not be disappointed as to deliveries.

CONTRACT FOR SUBMARINES.—The United States Navy Department has awarded the contracts for building $3,000,000 worth of submarines, which amount was appropriated by the last Congress. The final arrangement stipulates that the Electric Boat Company shall build four boats of the Octopus type at $285,000 each, three boats of the same type, but of larger displacement, at $360,000 each, that $230,000 shall be retained by the Department to pay for improvements on these boats and that $550,000 shall be withheld, to permit the Department to construct one or even two boats of a type other than the Octopus. This makes the way open for the Lake submarine boat to have another chance. It is generally felt that the decision amounts to giving the entire contract to the Electric Boat Company, as was the Department's intention when the board of construction and the board on competitive trials of submarine and subsurface boats unanimously recommended the Octopus or so-called Holland type. The long delay has served only to bring about a semblance of competition, as the government cannot leagally build any boat other than the Octopus type without further competitive tests or without an act of Congress. This statement was given out when the contracts were awarded: "In view of the explicit provisions of the act of March 2, 1907, the opinion of the attorney-general, the unanimous opinion of the board on comparative trials of submarine and subsurface boats and the unanimous recommendation of the board on construction, the department has decided to award a contract for four submarine boats of the Octopus type and three additional submarine boats, of the same type, though of greater displacement, to the Electric Boat Company, under the conditions as to reduced prices and guarantees for superior speed recommended by the board on construction, but has reserved from the total authorized appropriation of $3,000,000 a sum sufficient to permit the construction of one or even two boats of a type other than that reported favorably by the trial board, should it subsequently prove advisable to build such a vessel or vessels, the law leaving it entirely discretionary with the department as to how much of the total authorized amount of $3,000,000 should be obligated at this time."

AMERICAN STORAGE BATTERY COMPANY is a promising newcomer in the storage battery field. It is at present occupying the old electric light plant of the Cambridge Electric Light Company, Cambridge, Mass. The company was organized this year to manufacture a new type of storage battery, of which E. C. Eckstromer is the inventor. Mr. Eckstromer has devoted his life to this line of work, spending most of the time in Germany, and after years of study he perfected a type of storage battery which can be applied to any vehicle, and which, it is claimed, practically doubles the radius of action. The new company expects to apply its batteries to the new submarine boats now building at Quincy. They are also in demand for the automobile trade, as it is found that an automobile equipped with one of these batteries can go over 100 miles without recharging. The company has an automobile and a motor boat of its own for demonstration purposes. The president of the new company is Joseph C. Kent, of J. C. Kent & Company, bankers and brokers, Boston. The consulting engineer is Prof. William L. Hooper, of Tufts College. The old electric light plant is being equipped for the temporary occupation of the company, the experimental laboratory alone costing $25,000, but it is expected that within a year it will be in occupation of a factory of its own, to cover some 10 acres of ground. The location for this has not been definitely picked, but it will doubtless be in Cambridge, near the company's present location. Before long the company expects to have from 100 to 150 men at work on the manufacture of the batteries in its present plant. Very full tests and reports in regard to the battery have been made by Prof. Hooper and by Prof. John Stone, who has gone over the Hooper results. The battery is of the lead-lead pasted grid type, but by a special process the active material is rendered unusually porous and permeable by the electrolyte.

AN IMMENSE SWITCHBOARD.—The Westinghouse Electric & Manufacturing Company is now shipping the largest switchboard equipment that has ever been turned out, it is said. The cost alone is over $150,000. It has 100 panels. The various appliances, such as switches, voltmeters, ammeters, circuit breakers, lightning arresters and other apparatus connected with it, will be shipped in 200 boxes, each box measuring 3 ft. x 9 ft., and the entire load will fill four freight cars. This switchboard was made by the Westinghouse Company for the Rio de Janeiro Tramway & Power Company, of Rio de Janeiro, Brazil, which firm operates a water power plant known as the Brazilian Niagara, and which has a capacity of 40,000 horse-power. The energy is generated about 40 miles from Rio de Janeiro, to which city it is transmitted for light and power. The power house machinery for this plant was all constructed at the East Pittsburg works, and the shipment of the switchboard about completes the installation.

SUBMARINE SIGNAL.—The Submarine Signal Company, of Boston, has called attention to the fact that vessels equipped to receive submarine signals frequently save one or more days in making port, which means a day or more saving of interest on bankers' letters of credit, from 75 per cent to 90 per cent of such business being done on this class of credit. The North German Lloyd Company, which has 23 of its vessels equipped with submarine receiving apparatus, has arranged to have its vessels sailing to United States ports equipped. The Argo line, sailing between London, Bremen and Hull, is having three vessels equipped. The Panama Railroad Steamship line has arranged to have the receiving apparatus installed on its five steamships sailing between New York and Colon. To allow vessels to test the submarine signal apparatus, the Sandy Hook lightship is ringing its submarine bell continuously day and night, during September. The new *Lusitania*, of the Cunard line, is equipped to receive submarine signals.

UNLAWFUL TELEPHONES.—The Central District & Printing Telegraph Company, operating the Bell telephone system in Pittsburg and vicinity, has begun a campaign against agents who have been engaged in selling telephones and other appliances for use in connection with its lines. The officials of the company say that if some action is not taken to prevent the introduction of such apparatus, conditions in Pittsburg soon will be as bad as those in Paris, where each subscriber furnishes his own instrument and usually pays more attention to the ornamental effects on the outside of the set than to the value of the instrument for telephone purposes. It appears that at least one agent has made it his practice to represent to prospective customers that his apparatus is approved by the telephone company for use on its lines. The officials of the company point to a clause in the subscribers' contracts which directly prohibits the use of such apparatus.

ALLIS-CHALMERS.—The annual meeting of the Allis-Chalmers Company to have been held last week was postponed. This caused some criticism and a slight decline in the stock. Representatives of the company state that too much importance has been attached to the adjournment of the annual meeting. The postponement was not the result of any unsatisfactory development. It is generally known that some plan for strengthening the financial position of the company is being worked out, and other matters which have an important bearing upon the company, and which the management desires to make public at the annual meeting, are in course of settlement. It is understood that the earnings of the company for the first quarter of the present fiscal year will show that the turning point for the better has been reached. Some details of this were given in our columns last week.

NORTHERN CRANES.—The new power stations of the North Shore Electric Company, at Waukeegan and Blue Island, near Chicago, are furnished with alternating-current electric cranes furnished by the Northern Engineering Works, of Detroit, Mich. These cranes are 30 tons and 25 tons capacity, respectively, 58 ft. and 39 ft. span. The larger crane is equipped with an auxiliary high-speed alternating-current hoist. The Black Hills Traction Company has recently installed an 8-ton, 32-ft. span Northern traveling crane at Spearfish, S. D.

FOREIGN ORDERS.—It is stated that among contracts for the other side is one obtained by the Westinghouse interests for the electrification of the Rise Carr rolling mills, at Darlington, Yorkshire, operated by Sir Theodore Fry & Company, Limited —one of the oldest established concerns of its description in Great Britain. The contract includes a number of motors ranging from 400 horse-power to 5 horse-power. The complete plant will cost nearly $1,000,000.

THE BRISTOL COMPANY, Waterbury, Conn., is about to build another new addition to its present plant. It will be 53 ft. x 170 ft., three stories high. This further space is made necessary by the increased demand for Bristol recorders and Bristol patent steel belt lacing. With the amount of business in sight, it looks as though it would not be long before even this addition will be crowded.

ACTIVITY OF ELECTRICAL INDUSTRIES.—A special dispatch from Boston gives some of the facts as to the extent of the sustained activity in electrical manufacturing industries and says: "The reduction in working forces made by the three large electrical manufacturing companies during the last six or eight months has been far less than might be gathered from the somewhat disturbing reports circulated from time to time. The Western Electric alone of the three companies has made an extensive curtailment in the number of its employees, but the public has only a minority interest in the securities of the Western Electric Company. At the close of their last fiscal years, the General Electric, Westinghouse Electric and Western Electric companies employed upwards of 73,300 men. At present the names on the payrolls aggregate 63,200, a decrease of 10,200, or, say, 13 per cent, since the early part of the year. Fully 60 per cent of this decline, however, is contributed by the Western Electric Company, which sold in 1906 nearly $70,000,000 of telephone and general electrical apparatus, and has been obliged to restrict its output of electrical supplies on account of the very marked let-up in telephone construction and expansion this year. Below are shown comparatively the employees of each of the three companies at the end of the last fiscal year, the number now, the decrease and percentage of decrease:

	Employed Last Fiscal Year	Employed Now	Decrease	Percentage Decrease
General Electric	[illegible]	[illegible]	[illegible]	[illegible]
Westinghouse	18,386	17,200	1,200	6.5
Western Electric	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]

In spite of the reduction in employees the three companies have actually been able to turn out as much, and in the case of the General Electric and the Westinghouse companies, more gross business during the first six months of the current fiscal year than they did in the corresponding period of 1906. For instance, during the six months ended July 31 the General Electric billed a total of $35,406,878 of gross business, against $25,915,762 in the same portion of 1906. Comparison of the gross business of the General Electric and the Western Electric companies during the six months ended July 31 and June 30, respectively, 1907 and 1906, follows:

	Six Months, 1907	Six Months, 1906	Increase
General Electric	$35,406,878	$25,915,762	$9,491,116
Western Electric	30,000,000	31,000,000	*1,000,000

*Decrease.

The Westinghouse Company reports net income for five months of $3,548,886, or at the rate of about $8,500,000 a year. This indicates figures at least up to those of last year.

ALLIS-CHALMERS BUSINESS.—"Business may be falling off somewhere, but not here," said W. S. Heger, assistant to President Whiteside, of Allis-Chalmers, to a representative of the *Wall Street Journal,* whom he showed through the great plant at West Allis. "Our books are as far ahead as they were a year ago. One day within a fortnight we booked orders for $800,000 worth of work. Some departments are ahead an entire year. Orders are coming in better than last year." Inspection of plant fully confirms what Mr. Heger says. The only apparent difficulty is lack of working room, as the business has outgrown the capacity of the eight large buildings. The company owns 110 acres at West Allis, 34½ acres being under roof. Plant capacity is 11,000 horse-power. There are 102 traveling cranes, with combined capacity of 2010 tons. So many extra tools have been set on the floors to keep up with business that the workmen are crowded. There is plenty of room for expansion when the problem of working capital is solved.

TELEPHONE EQUIPMENT.—(1) Bids will be received until Oct. 23 by the Postmaster-General's Department, Sydney, New South Wales, Australia, to supply 11 tons galvanized iron wire (400 pounds per mile); 1600 best white porcelain insulators; 500 wall telephones. (2) Bids will be received until Oct. 30 to supply 55½ tons hard-drawn copper wire (300 lbs. per mile); 400 lbs. 3/16-in. wide copper binding tape (200 lbs. per mile); 3500 large, best white porcelain insulators; 1000 tallow-wood cross-arms, 3 ft. 10 ins., with end bolts and straps, complete; 2500 of the same 5 ft. 2 ins. (3) Bids will be received until Dec. 11 to supply 1000 common battery wall telephones, 100 table telephones. Address for particulars, Commonwealth Offices, 72 Victoria Street, Westminster, S. W., London, England.

BECK FLAMING ARC.—The selling organization for the Beck flaming arc, under the name of the New York Beck Lamp Company, is no longer in existence. The entire business, inclusive of manufacturing and selling, is conducted by and in the name of the Beck Flaming Lamp Company, 30 Greenwich Avenue, New York City. Mr. J. H. Hallberg, the electrical expert and inventor, is now taking a prominent part in the management. The Beck Company has a fine exhibit at the Electrical Show this week, and its lamp has been adopted exclusively by the New York Edison Company for the interior and exterior illumination of Madison Square Garden. It can also be seen in the booths of the New York Edison, United Electric Light & Power and Driver-Harris Wire Companies.

THE STANDARD ROLLER BEARING COMPANY, of Philadelphia, Pa., has increased its capital of $3,500,000 to $5,000,000. Large additions are now being made to the plant and equipment for the purpose of enlarging its department for the manufacture of roller bearings for shafting hangers and also for the establishment of an entirely new department for the manufacture of roller bearings for trolley cars. The saving by the use of roller bearings on trolley cars amounts to about $300 a year per car, and the demand is so great that a large addition to the plant is required to take care of the business that is now rapidly increasing.

LOOMIS PETTIBONE CO., 2 Rector Street, New York, announces the incorporation of its new company, in which the partners are Messrs. Burdett Loomis, Hawley Pettibone, H. A. Kimber and C. Lee Straub will be engaged exclusively hereafter as consulting engineers. They will continue in the work followed during the past 20 years and will specialize in the design, construction and operation of power, fuel and illuminating gas plants, and their application to industrial, mining and central power station work.

AUTOMATIC TELEPHONE.—It is stated from Chicago that the Automatic Electric Company has laid off two-thirds of its forces, or about 400 men. There are plenty of contracts, but they cannot be financed owing to tight money.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and stagnant, the principal feature being the renewed bearish activity by traders, resulting in a heavy tone and moderate declines. The receivership of the New York City Railway had no general effect upon the market, which is also true of the immunity granted to the Alton road in the Standard Oil rebate case. The announcement of an issue of some $30,000,000 of New York, New Haven & Hartford stock, for which the stockholders will receive rights to subscribe at 125, was far from favorable in its effect on the security in question, which showed a decline of some 15 points. The further decline in copper prices, bringing the metal down squarely to a 15-cent basis, caused, naturally, a great deal of irregularity in Amalgamated, although that issue continued to act as if it had measurably discounted the adverse conditions. The United States Steel stocks were subjected to more or less pressure from the bears, accompanied by vague reports about a further decline in the activity of the trade. Electric and traction stocks were ex-

NEW YORK.

	Sept. 24	Oct. 1		Sept. 24	Oct. 1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Allis-Chalmers Co. pfd.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Am. Dist. Tel.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
American Locomotive	[illegible]	[illegible]	Interborough Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
American Tel. & Cable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
American Tel. & Tel.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	47	Metropolitan St. Ry.	—	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electric Boat pfd.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electric Vehicle pfd.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

BOSTON.

	Sept. 24	Oct. 1		Sept. 24	Oct. 1
American Tel. & Tel.	107[illegible]	105[illegible]	Mass. Elec. Ry. pfd.	49[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mass. Elec. Ry.	—	—	[illegible]	[illegible]	[illegible]

PHILADELPHIA.

	Sept. 24	Oct. 1		Sept. 24	Oct. 1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Sept. 24	Oct. 1		Sept. 24	Oct. 1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			

tremely dull and weak, the latter in most cases suffering heavy declines. Metropolitan Street Railway closed with a net decline of 7⅞ points, and Brooklyn Rapid Transit lost 5½ points. The curb market, in the main, followed the lead of the Stock Exchange list, net losses being scored by the active issues. The closing quotations of Oct. 1 are given in the table.

ISSUES OF SECURITIES.—During the first nine months of the current year American corporations have obtained slightly over $750,000,000 of new money by the authorization and issuance of securities. Of this amount about 82 per cent went to the railroads and about 18 per cent to industrial corporations. Of it about 74 per cent was raised by means of bonds and notes and the balance through the sale of stock. The railroads issued about four and one-half times as much bonds and notes as stock, while the industrial companies issued about one and three-quarter times more stock than bonds.

Issues of less than $1,000,000 have not been taken into consideration in these figures, which do not include refunding schemes. Bonds and notes issued by industrial concerns read as follows. It will be noted that electrical and telephone companies are responsible for $35,500,000, the greater part of the total.

Bonds issued by industrials	[illegible]
Stock issued by industrials	86,640,000
General Electric	[illegible]
Western Bell Telephone	8,000,000
Westinghouse Electric & Manufacturing	6,000,000
Tampa Gas Company	5,000,000
North American Company	5,000,000
Pacific Telephone & Telegraph	3,000,000
Atlanta Telephone & Telegraph Company	2,000,000
Bell Telephone of Missouri	2,000,000
Niagara Falls Power Company	1,500,000
Seattle Electric	1,500,000
Boomer Coal & Coke	1,100,000

The industrial stock issues appear as follows:

American Telephone & Telegraph	$22,000,000
California Gas & Electric	15,000,000
San Francisco Bonded Mortgage	10,000,000
Duquesne Light	10,000,000
Pittsburg Oil & Gas	5,000,000
Westinghouse Electric & Manufacturing	5,000,000
Canadian General Electric	3,000,000
St. Louis Car Company	3,000,000
La Belle Iron Works	2,500,000
Mexican Light & Power	2,400,000
J. G. White & Co.	1,500,000
Bell Telephone of Buffalo	1,500,000

Traction and trolley companies stand for some large amounts, such as Ohio Electric, $24,000,000; Buffalo & Lake Erie Traction, $1,000,000; Int. Rapid Transit, $10,000,000; New Orleans Railway & Light, $5,000,000; Pacific Traction Company, $2,000,000; United Railways Investment, $2,400,000; Joliet & Southern Traction, $1,700,000; Springfield & New England Traction, $1,500,000; Detroit United Railways, $2,000,000; United Railways of St. Louis, $1,200,000. Some of the large steam railroad issues have also included money for electrification.

PRICE OF CABLE SHARES.—Advices from London last week state that the general belief on the Stock Exchange that the Marconi system of wireless telegraphy is at last likely to enter into serious competition with the transatlantic cable companies has caused a depreciation in the price of shares of the latter. To meet the wireless company's competition the submarine cable companies would have to make reductions in their tariffs. Representatives of the various companies interviewed maintained that they had no fear of effective competition from the Marconi system. It is pointed out, however, that this seventeenth "cable," assuming its successful working, will be taking messages at less than half the rates charged by the submarine companies, and that therefore it will always be fully occupied. It was declared by the Marconi Company in London that under the new system, with merely two stations, the company would be able to handle as much business as eight ordinary lines. To this argument the submarine companies vouchsafed no response other than a reiteration of the declaration that no reduction of their rates would be found necessary; whereupon Mr. Marconi's London representative intimated that the rates with which the wireless service would be started were susceptible of reduction. While it is universally recognized that the cable companies are justified in their present refusal to consider the question of a reduction in rates, some criticism is heard of their cocksure attitude under the circumstances.

TELEPHONE CONSOLIDATION.—Note was made last week of the consolidation of the Bell telephone interests south of New York and northern New Jersey. The new company will operate in southern New Jersey, eastern Pennsylvania, Delaware, Maryland, District of Columbia, and northern Virginia and West Virginia, will have nearly 300,000 subscribers' stations, control property assets of $40,000,000, have yearly gross earnings of about $10,000,000, with net earnings for dividends of between $2,000,000 and $2,500,000. The consolidation, which is to be followed by others, will result in substantial economies of administration and operation, and will make possible the standardizing of telephone rates in the entire territory. At present the Chesapeake & Potomac has upward of $7,000,000 of floating debt borrowed from the parent company, which debt is to be capitalized into stock paying 6 per cent. In addition the $2,650,000 of Chesapeake & Potomac stock on which no dividends are now being paid, will be exchanged for about $1,800,000 stock of the new company, on which 6 per cent dividends will be paid. From this source the parent company through its 57 per cent ownership will derive an additional $50,000 or $60,000 annually. The new company will assume the bonded debt of the three operating companies, which is, however, relatively small, amounting to but $1,961,000. An idea of just what the consolidation comprehends may be gleaned from the following statistics of the three companies at the end of their last fiscal year, Dec. 31:

	Bell Phil.	Ches. & Pot.	Penn.	Total
Stations	164,211	70,167	46,170	280,548
Increase in 1906	[illegible]	17,547	8,327	65,295
Percentage increase	[illegible]	33.3	[illegible]	[illegible]
Plant investment	$24,316,938	[illegible]	$4,564,244	$38,554,914
Capital stock	22,878,433	2,650,000	4,609,350	30,137,783
[illegible]		1,344,000	617,000	[illegible]
Floating debt	1,555,000	7,024,000	.	[illegible]
[illegible]	[illegible]	2,452,076	1,243,195	9,196,584
Balance for dividend	1,668,674	75,681	285,443	2,029,798
Gross per station	44	39	[illegible]	[illegible]

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph's report for August and eight months compares as follows:

	1907.	1906.	1905.	1904.
August gross	$486,264	$435,298	$385,102	[illegible]
Expenses	307,110	283,823	241,859	209,533
August net	[illegible]	$151,475	$143,243	[illegible]
Interest and taxes	37,887	33,947	24,819	22,707
August surplus	$141,267	[illegible]	[illegible]	$101,569
Eight months gross	$3,848,067	[illegible]	[illegible]	$2,607,362
Expenses	2,415,774	[illegible]	1,859,575	[illegible]
Eight months net	[illegible]	[illegible]	$1,146,116	[illegible]
Interest and taxes	[illegible]	[illegible]	178,255	[illegible]
Eight months sur.	$1,145,77	[illegible]	$967,861	[illegible]

MONTGOMERY EARNINGS.—The report of the Montgomery (Ala.) Light & Power Company for the 12 months ended June 30, 1907, compares with the year ended Feb. 28, 1907, and the 12 months ended June 30, 1906, as follows:

	June 30, 1907.	Feb. 28, 1907.	June 30, 1906.
Gross	. . . .	$282,688	
Expenses	. . . .	123,714	. . .
Net	[illegible]	$158,974	$134,500
Charges	[illegible]	100,801	100,350
Surplus	[illegible]	[illegible]	[illegible]

The surplus after charges is equal to 2.95 per cent on the $2,000,000 capital stock outstanding.

SCRANTON ELECTRIC BONDS.—N. W. Harris & Co. are offering $1,000,000 Scranton, Pa., Electric Co.'s first and refunding mortgage 5 per cent gold bonds due July 1, 1937, optional on any interest date after July 1, 1912, at 110 and accrued interest. The company is in control of the entire electric light and power business of Scranton. It has a capitalization of $500,000 preferred stock and $2,500,000 common stock and authorized bond issue of $10,000,000. The gross earnings for the year ended July 31, 1907, were $361,165 and net earnings $134,170 and surplus $59,170.

WESTINGHOUSE EARNINGS.—The Westinghouse Electric & Manufacturing Company continues to make a favorable showing of surplus and net earnings. The total income for the five months ended August 31, aggregated $3,548,886, or at the rate of $709,775 a month, or $8,517,300 a year. The surplus for the five months aggregate $1,704,341, which was at the rate of $340,870 a month, or $4,090,440 a year. The surplus in the five months was at the rate of 16 per cent a year on the total capitalization of the company, including all classes of stock.

TRACTION MORTGAGE.—The Indianapolis & Louisville Traction Company has filed a mortgage in favor of the Colonial Trust Company, of Pittsburg, and F. F. Brooks, as trustees, to secure $400,000 mortgage and collateral trust 6 per cent five-year convertible gold notes dated July 1, 1907, and payable July 1, 1912, subject to call at any time at 102½ and interest.

GENERAL NEWS

Construction News.

[illegible] soon commence on the construction of an electric railway from Geneva to [illegible]. It is the intention of the promoters to eventually extend the line to Union Springs, Troy, Eufaula, Clayton and Montgomery. Richard Tullis, of Montgomery, is interested in the enterprise.

TROY, ALA.—Fox Henderson, L. M. Bashinsky and W. Chaney are interested in a project to build an electric railway from Troy to Orion, a [illegible].

FAIRBANKS, ALASKA.—Extensive improvements and additions are being made to the plant of the Tanana Electric Company which will greatly increase the capacity of the plant. A large turbo-generator set is now being installed in the power house. The company has ordered a large number of motors and other equipment from Seattle, and promises to extend its transmission lines to any section of the Tanana where operations are being conducted on a large enough scale to give promise of [illegible] to the company.

ALAMEDA, CAL.—At an election held Sept. 21 the proposition to issue $305,000 in bonds for public improvements was carried by a large majority. Among the improvements contemplated is included the erection of an addition to the power house of the municipal electric light plant, the installation of additional machinery and the construction of a reservoir.

LOS ANGELES, CAL.—The Edison Electric Company is planning to begin work shortly on its Kern River No. 2 power plant. This station will be located on the Kern River just above the dam and intake of its present No. 1 plant. There will be five stations in all on the river, with an aggregate output of 90,000 horse-power.

LOS ANGELES, CAL.—The Los Angeles Aqueduct Commission of the Board of Public Works is advertising for tenders for the necessary hydraulic and electrical machinery and apparatus for its proposed Cottonwood Creek hydro-electric power plant in Inyo County. The tenders call for a 750-kw, three-phase alternator to be driven by a 1400-hp tangential water wheel at 600 r. p. m. under 1200 ft. head. There will be 90 miles of 30,000-volt transmission line with cedar poles and the necessary step-up and step-down transformers, switchboard and line material. Bids must be filed before October 7.

OAKLAND, CAL.—The Oakland Gas Light & Heat Company suffered a loss by fire on Sept. 18, the damage amounting to over $100,000. The fire was caused by a guy wire falling across the main wires causing a short circuit that was carried to a steel oil tank at some distance. The oil was ignited and 6000 barrels destroyed. A 4000-kw Crocker-Wheeler alternator, recently received, was practically ruined. The transformers, overhead circuits, etc., were also considerably damaged.

OROVILLE, CAL.—Preparations are being made by the Orovillle Light & Power Company for the construction of a power plant in Humbug Valley.

REDDING, CAL.—The Northern California Power Company, which has in operation three power houses, two at Volta and one at Kilarc, and which has begun the erection of a fourth at the junction of the north and south forks of Battle Creek, is now contemplating the erection of a fifth power house on South Battle Creek. The company has acquired possession of the old George Hagen place with its large and famous springs of water. A party of surveyors is now making the preliminary surveys in the South Battle Creek country.

REDWOOD CITY, CAL.—On petition from W. J. Martin the Board of Supervisors has advertised for sale an electric light and power franchise in the First township of San Mateo County.

SAN DIEGO, CAL.—Arrangements have been made for the installation of a power plant for the electrical operation of the Los Angeles & San Diego Beach Railway. The plant of the Los Angeles-Pacific Railroad Company located at Sherman has been purchased and will be moved to San Diego. E. S. Babcock has charge of the work.

SAN FRANCISCO, CAL.—A special meeting of stockholders of the Pacific Gas & Electric Company will be held Nov 20 to consider and vote upon the proposition to increase the bonded indebtedness of the company [illegible].

SAN FRANCISCO, CAL.—The Northwestern Pacific Railway is planning improvements to its North Shore Electric branch, from Sausalito to points in Marion County, involving an expenditure of $150,000. New electric generating equipment will be installed immediately at San Anselmo, and it is reported that the road will be electrically equipped to Point Reyes. At San Anselmo a sub-station will be established, to contain two 500-kw motor-generators, leaving space for four more motor-generators to provide for the extension of the electric service to Point Reyes.

SAN FRANCISCO, CAL.—Contracts have recently been closed aggre[illegible] power station of the Southern Pacific Company, which will furnish electricity for operating its tramway lines east of San Francisco. The con[illegible] New York, N. Y., [illegible] engineer of the company, as follows: Boilers, to the Parker Boiler Company, of Philadelphia, Pa.; H. R. Worthington & Company, for con[illegible] bines and generators, and to the General Electric Company, for motors and other car equipment.

SAN JOSE, CAL.—The citizens are considering the question of establishing a municipal electric light plant in San Jose. At present the United Gas & Electric Company holds the contract for lighting the streets. The contract expired June 30, and Mayor H. D. Matthews has sent to the Council a message urging that body to make appropriations for a municipal plant. The Mayor calls attention to the fact that the street lighting last year cost the city over $12,000, and the cost next year promises to reach $14,000. This cost, the Mayor claims, could be materially lessened under a system of municipal ownership. An electrical engineer is to be appointed to investigate the cost of the proposed plant.

VENTURA, CAL.—F. M. Packard and J. P. Jones, of Los Angeles, have applied to the board of supervisors for a franchise to construct an electric railway from Ventura to Nordhoff.

BRECKENRIDGE, COL.—The Summit County Power Company is installing a large power plant at Dillon for the purpose of supplying electricity for mines and mills at Breckenridge, Kokomo, Frisco, Como, Argentine, Montezuma and adjacent territory. The officers of the company are: Henry L. Dougherty, chairman of board of directors; William J. Barker, president; William S. Stearns, vice-president; E. N. Stannard, secretary; Frank W. Frueauff, treasurer. The offices of the company will be in New York, N. Y., and Denver, Col.

DENVER, COL.—The Denver & South Platte Railway Company, which is to build and operate an electric railway between Denver and Littleton and other cities in Colorado, has filed a notice of a $1,000,000 mortgage with the Continental Trust Company, of Denver, the proceeds of which will be used for the completion and improvement of the road. Thomas B. Dean is president of the railway company.

TRINIDAD, COL.—The Trinidad Electric Railway Company is contemplating extensive improvements to its system, and within a year proposes to connect Cokedale, Segundo, Hastings and the interlying coal camps with Trinidad.

BRIDGEPORT, CONN.—The Union Typewriter Company has awarded the contract for the construction of its new power house in the West End.

ESSEX, CONN.—The plant and holdings of the Essex Light & Power Company have been purchased by George L. Cheney, and Mrs. William G. Seeley, of Essex; William A. Brothwell, of Chester, and G. L. Sleeper, of Deep River. The following officers have been elected: George L. Cheney, president; G. L. Sleeper, secretary and treasurer, and E. N. Frary, superintendent. The company is capitalized at $50,000, and contemplates extending its lines to Deep River, Chester and possibly to Saybrook and Westbrook.

NORWICH, CONN.—Four transformers have been received at the municipal electric light plant to be installed in the addition recently constructed, which will be used in connection with the power plant of the Uncas Power Company in Scotland, which will furnish electricity for operating the municipal electric plant as soon as it is completed.

NORWICH, CONN.—The third annual report of the Board of Gas and Electric Commissioners shows that the income from the municipal electric light plant exceeded the cost of manufacture and distribution by $36,215, and after charging off for depreciation $13,582 leaves a net profit of $22,632. The profit this year is the largest in the three years the city has had the plant by over $3,000. The total profit on gas was $7,215, while the profit on electricity was $14,463. The cost of lighting the city streets and buildings amounted during the year to $21,731, being an increase in the incandescent lighting, as the lamps are burned all night, instead of until 1 o'clock in the previous year. Because of the contract with the Uncas Power Company, it is expected that during the ensuing year the prices in electricity can be reduced. The demands on the plant for power and light are such that had the commissioners not been able [illegible] necessary to have greatly added to the plant.

LAUREL, DEL.—[illegible] tric Company was destroyed by fire on Sept. 21, owing to which the towns of Bridgeville, Seaford and Delmar, in addition to Laurel, are in darkness. Charles C. Stephenson is manager.

WASHINGTON, [illegible]

WASHINGTON, D. C.—[illegible] plies and Accounts, Navy Department, Washington, D. C., until Oct. 8, to furnish at the navy yards and naval stations the following supplies: New York, N. Y., schedules 311 and 344, wireless telegraph apparatus, [illegible] Pa., schedule 340, electric and air drills, etc.; Naval Academy, Annapolis, Md., schedule 347, material for two steel towers; schedule 348, electrical [illegible]

wire, cabinet and panel board, electric chandeliers, etc., globes and reflectors, electric fittings; Pensacola, Fla., schedule 334, motors, waterproof cable, etc.; schedule 335, copper pipe. Applications for proposals should designate the schedules desired by number. E. B. Rogers, paymaster-general, U. S. N.

SOUTH JACKSONVILLE, FLA.—The new electric light plant of the East Coast Railway Company has been placed in operation, and arc lamps have been installed from the depot to the river front. The establishment of a municipal electric lighting plant in the near future is said to be under consideration.

ATLANTA, GA.—The Atlanta Telephone & Telegraph Company has applied to the State Railroad Commission for permission to issue $2,000,000. The application states that the company desires to issue $1,000,000 at once and to sell others at a later date as required. The purpose of the bond issue is to improve its property in this city and to extend its lines. C. Jerome Simmons is president of the company.

CANTON, GA.—At an election held Sept. [illegible] the citizens voted in favor of issuing bonds for the establishment of an electric light, water works and sewerage systems in the town.

COLUMBUS, GA.—The citizens are considering the question of establishing a municipal electric light plant and are advocating issuing bonds for $100,000 to erect the plant.

CANTON, ILL.—The People's Gas & Electric Light Company has recently contracted for a steam heating plant, and is contemplating extending its lines to St. David, five miles distant, to furnish electricity for lighting the town.

CHICAGO, ILL.—The contract between the Northwestern Elevated Railroad Company and the St. Paul Railroad contemplates all switching north of Wilson Avenue to be done by electric power as soon as the electrical equipment of the road is completed. The Northwestern Company has awarded the contract for all the overhead work in the electrical equipment of the St. Paul tracks north of Wilson Avenue to the Brennan Construction Company for $100,000.

GREENVIEW, ILL.—Frank Marbold has purchased the stock of the Middletown Mutual Telephone Company, and will install a telephone system in the east side of the county.

JOLIET, ILL.—The Joliet & Southern Traction Company has issued a mortgage to the American Trust & Savings Bank, of Chicago, as trustee, to secure an issue of $1,500,000 in bonds. The proceeds will be used chiefly to finance the construction and equipment of new lines, including those for which the Fisher Construction Company has the contract.

MANITO, ILL.—Smith & Miller, of Bloomington, have been granted a 24-year franchise to operate an electric light plant in Manito.

WAUKEGAN, ILL.—The new power stations of the North Shore Electric Company at Waukegan and Blue Island have been equipped with alternating-current electric cranes furnished by the Northern Engineering Works, of Detroit, Mich. The larger crane is equipped with an auxiliary high-speed electric hoist.

BOONVILLE, IND.—The City Council has ordered the Cumberland Telephone & Telegraph Company to remove its poles and wires from the city limits within 30 days.

CRAWFORDSVILLE, IND.—Announcement has been made that the Crawfordsville division of the Indianapolis & Northwestern Traction Company will be extended west from Crawfordsville to Danville, Ill., next spring. C. C. Reynolds is general manager of the lines in Indiana.

GARY, IND.—The Gary & Interurban Railway Company has filed amendments to its charter increasing its capital stock to $1,000,000. C. B. Murdock is secretary of the company.

GOSHEN, IND.—The Goshen Telephone Company has ordered plans for the erection of a new exchange building in which it is proposed to install a new common battery switchboard with an ultimate capacity of 3000 lines and a present equipment of 1200.

NEW CASTLE, IND.—The New Castle Telephone Company has decided to extend its lines not only in and about the city, but toll lines to Memeie, Anderson and Middletown. R. R. Faulkner is general manager.

CLINTON, IA.—The City Council is considering the question of requiring all telephone wires in the city placed underground.

[illegible] remodelling and extending its plant.

MT. PLEASANT, IA.—Messrs. Jackson & Ruggles, of Centerville, are contemplating the erection of an electric light plant in Mt. Pleasant.

NEWTON, KAN.—The Electric Light & Power Company has added to its plant a new dynamo, two switchboards and other new equipment.

ROSEDALE, KAN.—The Kansas City & Olathe Electric Railway [illegible] Merriman. Another engine of the same type will be installed in the [illegible]

LOUISVILLE, KY.—The Cumberland Telephone & Telegraph Com- [illegible]

BIDDEFORD, ME.—The city of Biddeford has entered into a con- [illegible] of the contract the company agrees to operate and maintain the electric lighting system now in force, which consists of 86 arc lamps and 58 in- [illegible] amount as the old contract; in addition the company agrees to furnish 20 additional series enclosed alternating-current arc lamps and 25 additional series incandescent lamps free of charge, which gives the city 106 arc lamps and 83 incandescent lamps at the same cost previously paid for 86 arc lamps and 58 incandescent lamps. For each additional arc lamp furnished the price will be $82.50 per year, and for incandescent lamps $25 each per year.

SKOWHEGAN, ME.—The Skowhegan Electric Light Company is installing a 200-hp boiler in its plant, which with the boilers now installed will give its steam plant a total capacity of 600 horse-power.

WESTBROOK, ME.—Owing to the rising of the water of the Presumpscot River, caused by a heavy rainfall, the cofferdam in connection with the water-power plant to operate the new electric light station for the Westbrook Electric Light & Power Company was carried away. The damage will be very heavy, as a large part of the work done on a canal being built as a part of the improvement has been washed out.

ADAMS, MASS.—The selectmen have granted the Adams Gas & Electric Light Company permission to extend its lines to Siggsville.

MILFORD, MASS.—The electric and compressed air plant of the Webb Granite Company was destroyed by fire, caused by an explosion, Sept. 29, entailing a loss of about $8,000.

QUINCY, MASS.—The Quincy Electric Light & Power Company has recently installed a 20-hp motor at the plant of the Quincy Avenue Granite Company to operate the air compressor for the pneumatic tools, and has also installed a motor of 10 horse-power in the plant of Cook & Company for the same purpose.

TURNERS FALLS, MASS.—The Franklin Electric Light Company has completed a new schedule of prices for electricity for lighting, which gives a reduction of 33 1/3 per cent in the maximum price. The scale of prices is as follows: For 50 kw-hours per month, 12 cents per kw-hour; from 50 to 100 kw-hours, 11 cents; from 100 to 200 kw-hours, 10 cents; from 200 to 300 kw-hours, 9 cents, and for 300 kw-hours and over, 8 cents.

BAY CITY, MICH.—The City Council has instructed William H. Fitzhugh, superintendent of the municipal electric light plant, to prepare specifications for rebuilding the plant, and has also directed the comptroller to advertise for bids for its construction. It is expected that about $100,000 will be spent on the equipment.

COLDWATER, MICH.—The power house of the Branch County Poorhouse is reported to have been destroyed by fire.

MANCHESTER, MICH.—The construction of an electric light plant is under consideration, for which estimates are being made. For further information address Fred Weidmeyer.

PAW PAW, MICH.—The Falkenau Electric Construction Company, of Chicago, Ill., has been awarded the contract for installing a complete hydro-electric plant for the city of Paw Paw. The electrical equipment consists of a 150-kw and an 80-kw Allis-Chalmers water-wheel-type generators for direct connection to water wheels, two 9-kw belted exciters and a number of Allis-Chalmers motors ranging from 15 to 40 horse-power. One of the latter is to be used to drive a triplex power pump.

CALEDONIA, MINN.—An election will soon be held to vote on the proposition of issuing $6,000 in bonds, the proceeds of which will be used to improve the light and water plant.

NORTHOME, MINN.—The Village Council has granted a franchise to E. E. Bigham, of Minneapolis, to construct, maintain and operate an electric light system within the limits of the village of Northome for a period of 30 years. The ordinance granting the franchise provides that the plant shall be completed and in operation by Jan. 1, 1908.

COLLINS, MISS.—At an election held Sept. 24, the proposition to issue $5,000 in bonds for improvements to the electric light and water system was defeated.

HATTIESBURG, MISS.—The Hattiesburg Traction Company will install another large boiler to increase the capacity of the present plant to meet the requirements of the system until the new plant is ready for operation, work on which will soon commence.

UNIVERSITY, MISS.—D. S. Ross, secretary of the University of Mississippi, writes that bids will probably be received in the spring for rebuilding the power plant, which was recently burned. The cost is estimated at from $10,000 to $15,000.

JEFFERSON CITY, MO.—Contracts have been awarded by the warden and board of prison inspectors of the Missouri State penitentiary for the ventilating, heating and lighting plant for the penitentiary as follows: Boiler-house building, to John Short, Jefferson City, for $5,950; steam boilers to Heine Safety Boiler Company, St. Louis, $20,400; dynamos, to Western Electric Company, Kansas City, for $24,064; engines, to St. Louis Iron & Machine Works, St. Louis, for $20,400; motors, to Westinghouse Electric & Manufacturing Company, St. Louis, for $12,350; conduit and cable work, to F. E. Newberry & Company, St. Louis, for $10,252.

GARDINER, MONT.—The Forestry Service has appropriated $2,800 toward the construction of a telephone line from Gardiner to Cooke.

EXETER, NEB.—C. C. Smith has been granted a franchise to erect an electric light plant in this town.

YERINGTON, NEV.—The Truckee General Electric Company has completed its transmission line to this place and is now furnishing electricity to mines of the Nevada Douglas Copper Company.

ATLANTIC CITY, N. J.—The city council on Sept. 23 authorized a bond issue of $35,000, the proceeds to be used to install the electric lighting system planned for Atlantic Avenue.

[illegible] treets of the city. The company offers to furnish arc lamps for $97.50 per lamp per year on a yearly contract, and $75 per lamp per year on a five-year contract. The city is now paying the company $97.50 per lamp on a five-year contract, which will expire Nov. 30.

[illegible] for $25,000 for the erection of a municipal electric light plant has been introduced in the City Council. The city is now paying the Public Service Corporation $95 per lamp per year under a five year contract, which will expire at the end of this year. The citizens voted some time [illegible]

BROOKLYN, N. Y.—The Sutepec Electric Light & Power Company has increased its capital stock from $200,000 to $300,000.

BUFFALO, N. Y.—The Public Service Commission, Second District, has approved the application of the Crosstown Street Railway Company to construct an extension of its electric railway in Cheektowaga from the city line to the Pine Hill Road.

NEWBURGH, N. Y.—It is reported that plans for utilizing the Plattekill stream for power for a large electric plant at a cost of $500,000 are almost completed. The plan is to divert the waters of the Plattekill and the Orange Lake stream into a new channel and construct three reservoirs and erect power houses with a total capacity of 1500 horse-power. Nearly all water rights have been secured, and financing of the project is said to be assured.

FAYETTEVILLE, N. C.—The Carolina Telephone & Telegraph Company is contemplating the erection of a new building in the near future.

FAYETTEVILLE, N. C.—The county commissioners have granted permission to W. M. Morgan to erect poles and wires for the transmission and distribution of electricity from the plant of the Cape Fear Electric Power Company.

AKRON, OHIO.—The city council has passed an ordinance requiring all electric wires on Main and Howard Streets, between Federal and Jackson Streets, to be placed in underground conduits.

ASHTABULA, OHIO.—The Village Council has adopted an ordinance providing for a franchise for an electric railway from Main Street to Ashtabula Harbor by the way of Swedetown, to be awarded to the company agreeing to carry passengers at the lowest rate of fare.

CANAL DOVER, OHIO.—The question of issuing $35,000 in bonds for the purpose of erecting a municipal electric light plant will be submitted to a vote of the people at the November election. The present contract expires on Jan. 1.

DAYTON, OHIO.—The Dayton Street Railway Company has been granted a franchise from Southwest Dayton to Dayton View and Northwest Dayton. It has been announced that construction work will commence at once.

NORWOOD, OHIO.—E. A. Hafner, representing the Southern Ohio & Tri-State Telephone Company, of Cincinnati, has made application to the Village Council, for a franchise to build and operate an automatic system. The company was incorporated recently with a capital stock of $50,000.

SPRINGFIELD, OHIO.—A 400-hp rotary converter is being installed at the Medway power plant of the Ohio Electric Railway Company.

URBANA, OHIO.—It is announced that the American Automatic Telephone Company will move its plant from Rochester to Urbana after Jan. 1. It is stated with the change of location will be consummated by the absorption of the Select Telephone Manufacturing Company, of Springfield. The officers of the company will be James S. Brailey, Jr., of Toledo, president; J. W. Lattig, of Rochester, N. Y., vice-president and general manager; B. J. Williams, of Rochester, N. Y., secretary and treasurer, and S. B. Grove, of Toledo, assistant treasurer.

ENID, OKLA.—R. G. Webber and A. B. Hulit, of Kansas City, have made application to the City Council for a 20-year franchise for an electric light plant. The company promises to erect a plant costing between $75,000 and $100,000, and will commence the construction immediately upon the granting of the franchise.

OKLAHOMA CITY, OKLA.—The Oklahoma City Street Railway Company has filed amendments to its articles of incorporation providing for extensions to Guthrie, south to Norman, and west to Yukon, a total distance of 125 miles. The capital stock of the company is $3,000,000, and the incorporators are John W. Shartel, Anton Classen, George H. Brauer, Charles Edward, W. F. Cooke and J. M. Owens.

GOLD HILL, ORE.—The Gold Hill Canal Company has purchased the Condor Water Power Company of Gold Ray and has made an initial payment of $350,000. This insures the completion of the Gold Hill Canal, as this company now controls the electrical situation of Rogue River. Headquarters of the company will remain in Gold Hill.

INDEPENDENCE, ORE.—The City Council has unanimously passed the water and light ordinance by which the Willamette Valley Company agrees to install 12 or more arc lamps of 1200 cp. each and furnish current for same; ten 16-cp. incandescent lamps in the city hall and jail buildings and five more fire hydrants.

PORTLAND, ORE.—The Mount Hood Railway and Power Company has begun work on its $2,000,000 power plant on the Sandy and Bull Run rivers. The company is to operate into Portland over a private right-of-way.

BENTLEYVILLE, PA.—Application has been made for a charter for the Finleyville Southern Street Railway, which plans to construct an electric railway from Finleyville to Bentleyville, a distance of 14 miles. The incorporators are M. J. Hayes, T. M. Hughes, H. B. [illegible] and S. C. Wilson.

DRAVOSBURG, PA.—The Council has passed an ordinance granting a franchise to the Dravosburg Heights Street Railway Company over the veto of Burgess Simpson.

HANOVER, PA.—The Hanover & McSherrystown Street Railway Company has secured franchises from the McSherrystown Council for the extension of its line through the town, and proposes to extend its line to Robert's Mill and Littlestown, a distance of about five miles, work on which will commence in a few weeks.

LANCASTER, PA.—The Conestoga Traction Company has purchased a site on which it will erect a new car barn and power house to take the place of the one on North Queen Street. It is expected that work will commence on the construction of the new plant within 30 days.

PHILADELPHIA, PA.—Bids will be received by George R. Stearns, director department of public works, until Oct. 22, for equipment and materials for improvement, extension and filtration of the water supply as follows: Contract No. 109, electric equipment for Torresdale filters; contract No. 126, pumping engines for Lardner's Point pumping station; contract No. 127, boilers, Torresdale pumping station; contract No. 128, centrifugal pumping engine for Torresdale pumping station; contract No. 134, magnesia covering and painting at Lardner's Point pumping station. Specifications, drawings and blank forms upon which bids must be made can be obtained from the chief engineer of the bureau of filtration, room 712, City Hall, to whom all communications should be addressed.

PHILADELPHIA, PA.—Arrangements have been completed by which the Bell Telephone Company of Philadelphia and the Pennsylvania Telephone Company, the Chesapeake & Potomac Telephone Company and all licenses of the Commercial Bell Telephone Company now occupying contiguous territory in South New Jersey, Eastern Pennsylvania, Delaware, Maryland, Northern Virginia and West Virginia are merged into one company. The companies named are operating over 300,000 telephones and are in no way competitors. The object of the consolidation is to secure better service, greater economy and efficiency in the operating and management of the various departments and to finance extensions and enlargements. The authorized capital of the combined companies will be $60,000,000; this will retire all the old stock, discharge floating indebtedness of all companies and provide for several years' growth.

PITTSBURG, PA.—The corporation committee of the council has approved the ordinance granting a franchise to the Diamond Light & Power Company after adopting some amendments. The compensation to the city was fixed at 1½ per cent of the gross receipts, instead of 5 per cent of the net receipts; the city auditors are given the right to examine the books of the company, and the company must furnish arc lamps to the city at a price not exceeding $70 per lamp per year.

WASHINGTON, PA.—Negotiations have been closed by the State Mutual Telephone & Telegraph Company whereby it comes into possession of the property of the Federal Telephone Company, operating in Canonsburg, South Canonsburg and Houston.

WINDBER, PA.—It is reported that the Berwind-White Coal Mining Company is contemplating the construction of an electric railway to connect Central Windber with the various mines of the company.

PROVIDENCE, R. I.—Announcement has been made by the Narragansett Electric Lighting Company of its intention to construct a waterproof conduit from a point near South Street to the easterly shore of the Providence River. The dimensions of the tunnel contemplated are about 8 ft. in diameter and 400 ft. long, the cost of which is estimated at $40,000.

ABERDEEN, S. D.—The Broton-Ferney Telephone Company, it is said, has accepted the conditions of the city council for building a telephone into the city.

LAWRENCEBURG, TENN.—[illegible] the contract for the construction of the concrete dam for the municipal electric light plant, and Howard Neely, of Chattanooga, the contract for the tunnel. The turbines and dynamo will be purchased by W. G. Kirkpatrick, of Jackson, Miss., the engineer in charge of the plant.

MEMPHIS, TENN.—The machinery in the new plant of the Conley Frog & Switch Company, which has just been completed, will be operated by electricity. J. E. Conley is president of the company.

NEWPORT, TENN.—[illegible] system.

EL PASO, TEX.—The Bell Telephone Company has decided to make improvements to its system in this city, which will involve an expenditure of about $100,000.

HOUSTON, TEX.—M. Moss & Miller, of [illegible] awarded the contract to install the new automatic telephone in the city.

McKINNEY, TEX.—A committee has been appointed by the City Council to investigate the question of issuing additional bonds for the [illegible]

PROCTOR, VT.—We are informed that the Vermont Marble Company has decided not to install a plant at Pittsford this season, at least, and may not do anything with it another year, as it is a very expensive proposition to develop, and it is questioned whether it will be a paying investment.

AMHERST, VA.—It is reported that a company will soon be organized for the purpose of installing an electric lighting plant in Amherst.

BOYDTON, VA.—R. W. Lassiter, of Oxford, N. C., has been in town recently negotiating with parties owning land on the Roanoke River, with a view of securing water rights on the river for the purpose of establishing an electric light plant at Eagle Point Falls.

BRISTOL, VA.-TENN.—John H. Gose, city clerk, writes that J. D. Mitchell, Harry Roberts and Theodore Swann, all of Bristol, have secured a franchise to erect an electric power plant in Bristol.

WAYNESBORO, VA.—The electric light plant and pumping station were completely destroyed by fire Sept. 25, which leaves the town without water and light. The plants were owned by W. A. Rife.

BELLINGHAM, WASH.—Albert A. Haug is interested in a project to build an electric railway to connect Bellingham with the Mt. Baker mining district.

CASTLE ROCK, WASH.—The St. Helens (Ore.) Mill & Power Company is preparing to install a large power plant on the Toutle River with a head of 860 feet, which will generate ultimately approximately 20,000 horse-power. The water flowing from Spirit Lake will be utilized.

CHEHALIS, WASH.—C. L. MacKenzie, [illegible] and Edward Rees, of Portland, Ore., have closed negotiations with Harry West for the purchase of the electric light plant in this city. Mr. West has a lease on the city's business, which will not expire for 13 years. The plant is located on Coal Creek, east of the city, at the mouth of a coal mine, where there is an ample supply of fuel within a few hundred feet of the plant.

RENTON, WASH.—The City Council on Sept. 18 voted to take preliminary steps toward the installation of a municipal electric lighting plant to cost about $25,000. A committee was appointed to investigate and report plans to the Council. The Snoqualmie Light & Power Company is now lighting the city.

SEATTLE, WASH.—The Seattle Electric Company has closed a contract with the Washington Coal Briquette Company which will result in the erection of a factory at Renton for the manufacture of briquettes from waste coal. The site has been secured, and plant will have capacity of 125 tons a day.

TACOMA, WASH.—L. H. Pearson, clerk for Commissioner of Public Works, writes that the proposition in regard to the proposed municipal power plant is at present in the hands of a committee of the City Council, with a view to purchasing the water rights and site on the Upper Nisqually River.

TOPPENISH, WASH.—The City Council has granted a franchise to E. F. Bohannon, of Toppenish, to construct and operate an electric lighting plant.

WHEELING, W. VA.—Senator S. B. Elkins, Col. Richard O. Kerns and Henry Gasaway Davis, of New York, N. Y., have secured a charter for an electric railway through the counties of Taylor, Barbour and Randolph in West Virginia, to be connected with the Morgantown, Fairmont and Mannington line, which is to be extended to Wheeling and [illegible] Pittsburg. [illegible] Elkins Light & Power Company, and the main office will be at Elkins.

OSHKOSH, WIS.—The Winnebago Traction Company, which some time ago was placed into the hands of a receiver, has taken steps for reorganization. This plan contemplates improvements in Oshkosh and vicinity amounting to $300,000. It is proposed to spend $100,000 on the Oshkosh plant and for cars, and to build an extension to Berlin, on [illegible]

CHEYENNE, WYO.—The city council has granted a franchise to W. J. Parker, president of the Northern Colorado Power Company, for a street railway system, which is to be completed within six months.

CALGARY, ALB.—The municipal electric light plant at Calgary, after paying all interest and expenses, has a surplus for the first seven months [illegible]

[illegible] purchase the electric street railway system now being built by the city. Address Mayor May.

[illegible] line and a considerable amount will be expended on the Chilliwack line. [illegible]

[illegible]

[illegible] Orrin F. [illegible]

WINNIPEG, MAN.—[illegible]

building of conduits on the principal streets. Address F. E. Cambridge, city electrician.

EAST TORONTO, ONT.—Contracts have been awarded by the corporation of East Toronto for building the power plant and furnishing its equipment, which consists of 150-kw, 2200-volt, three-phase, 60-cycle generator of the revolving field type made by the Allis-Chalmers-Bullock Company, Montreal. The exciter is a 15-kw, 125-volt machine. The plant will also furnish electricity for operating the water works system. John P. Galt, of Toronto, is consulting engineer.

KENORA, ONT.—A company is being formed here for the purpose of building an electric railway from this town to Keewatin and from thence along the Winnipeg River to connect with the Grand Trunk Pacific Railroad. A charter is now being applied for.

OTTAWA, ONT.—The W. C. Edwards Company is planning to operate its new factories by electricity, which will be developed partly by steam and partly by water power from the Rideau River.

ST. CATHERINES, ONT.—The Falls Power Company has applied to the city council for a franchise to erect poles and wires for the distribution of electricity for lighting and power purposes in the city. The request is made in view of the fact that the Stark Company will not be able to begin the lighting of the city by Nov. 1, in accordance with the extension of time granted in May, and the Falls Company is willing to take over the franchise and supply arc lamps at $39.50 each for a period of years. The Lincoln Electric Light & Power Company is now lighting the city at the price of $72.50 per arc lamp, upon a temporary extension of the old contract.

PUEBLA, MEX.—Announcement has been made that the control of the Puebla Tramway, Light & Power Company has been purchased by a syndicate in London, Eng., of which Sir Westman Pearson is head. The transaction, it is said, involves the consolidation of the Anglo-Mexican Electric Company, Ltd., with the Puebla.

Company Elections.

CŒUR D'ALENE, IDAHO.—At a meeting of the stockholders of the Idaho Water & Electric Power Company, held Sept. 10, the following officers were elected: J. L. McClear, president; P. J. Scanlon, vice-president; Maude Thornton, secretary; Charles G. Dawes, treasurer. This company was organized recently for the purpose of developing the power of the St. Joe River, by the construction of many dams, to generate power to operate the trains of the Chicago, Milwaukee & St. Paul Railway across the mountains.

BENTON, ILL.—At a meeting of the stockholders of the Tri-County Telephone Company held recently the following directors were elected: O. S. Martel, W. S. Means, Felix Dillon, J. E. Dixon, J. J. Pierce and George W. Young.

New Industrial Companies.

THE W. F. BOSSERT MANUFACTURING COMPANY, of Utica, N. Y., has filed articles of incorporation with a capital of $50,000. The directors are William F. Bossert, Hiram C. Williams and Charles G. Bennett, all of Utica. The company proposes to manufacture railway signals.

THE IMPROVED ELECTRIC MOLDING COMPANY, of New York, N. Y., has been chartered with a capital stock of $500, and the following directors: Adolph Muller, John F. Sherlock, of New York City, and Chester Martin, of Brooklyn.

THE INTERNATIONAL ENGINEERING COMPANY, of Fort Wayne, Ind., has filed articles of incorporation with the Secretary of State, with a capital stock of $200,000. The object of the corporation is the manufacture and sale of machinery and mechanical and electrical appliances. The directors are: George H. Loesch, Charles H. Doebler and F. L. Jones.

THE INTERNATIONAL [illegible] COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture telephone instruments. The directors are Charles G. Van Gilder, Morristown, N. J.; George H. Opdyke, New York; Thomas Lincoln, Brooklyn.

THE LENSED ELECTRIC SHADE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $5,000. The directors are Charles Wheeler and Joseph B. Hall, of Chicago, Ill.; Joseph O. Stillson, of Indianapolis, Ind.; D. M. Gilbert, of New York, N. Y.

THE LOOMIS-PETTIBONE COMPANY, of Hartford, Conn., has [illegible] West Hartford; Hawley Pettibone, of New Rochelle, N. Y., and Harrison P. Freeman, Jr., of Hartford. The company proposes to manufacture mechanical apparatus and railroad equipment and to construct and operate railways and telegraph lines.

THE [illegible] COMPANY, of [illegible] Conn., has filed a certificate of organization with a capital stock of $25,000 for the purpose of manufacturing and dealing in electrical supplies. The incorporators are Elizabeth Sanderson, Edith S. Childs and Walter San[illegible]

THE NEW YORK [illegible] CHAIN COMPANY, of New York, N. Y., has been incorporated with a capital stock of $200,000. The directors are [illegible] Clouser, Brooklyn.

New Incorporations.

[illegible]

NAPA, CAL.—Articles of incorporation have been filed for the Napa Valley Electric Company. The capital stock of the company is placed at $200,000. Percy S. King is one of the directors.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Northern Electric Railway Company with a capital stock of $25,000,000. This company has been formed to acquire the Northern Electric Company and the Shasta Southern, besides constructing new roads to the northern part of the state. The petition states that it proposes to build a railway from Chico to Redding, a distance of 76 miles; from Sacramento to Folsom, 26 miles; from Sacramento to Hamilton, via Woodlands, with a branch to Colusa, 108 miles, and from Sacramento to Yuba City, 48 miles. The directors are Alan W. Maginnis, Curtis Hillyer, Francis C. Van Deinse, Martin L. Washburn, Harry C. Mack, Charles Elsey and [illegible]

DENVER, COL.—The Eaton Electric Company has been incorporated with a capital stock of $35,000 by W. J. Farr and others.

CHAMPAIGN, ILL.—Articles of incorporation have been filed for the Danville & Southern Railway Company with a capital stock of $10,000 by W. H. Carnahan, B. E. Bramble and others. It is proposed to construct an interurban railway from Danville to Georgetown.

HINSDALE, ILL.—The Hinsdale Electric Company has been incorporated with a capital stock of $2,500 by Arthur Marrow and others.

CLAY CITY, IND.—The Clay City Lighting Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. The company was organized to build an electric light and power plant in Clay City. J. M. Long, H. R. Vandivier, B. M. and W. H. Guirl are the incorporators.

EVANSVILLE, IND.—The Evansville, Pittsburg & Vincennes Railroad Company has been chartered with a capital stock of $10,000 by F. W. Cook, T. N. Honeywell, J. M. Fenke, L. J. Herman, H. E. Meyer and others. The company proposes to construct an electric railway from Evansville to Petersburg and intermediate towns.

LEBANON, IND.—The Citizens' Electric Light & Power Company has been incorporated to operate an electric light plant here. The capital stock is $25,000. Richard A. Edwards, George R. Chamberlain and M. A. Edwards are the directors.

TULSA, I. T.—The Tulsa Electric Light Company has been incorporated, with a capital of $15,000, by R. D. Campbell and D. M. Martindale, of Tulsa, and H. F. Burt, of Oklahoma City, Okla.

PELLA, IA.—Articles of incorporation have been filed for the Waterloo Southwestern Railway Company with the secretary of state for the purpose of constructing and operating an electric railway by either steam or electricity from Waterloo via Pella to Charlton, a distance of about 130 miles. The capital stock of the company is placed at $150,000, and the directors are E. A. Harris, P. H. Van Gorp, P. H. Bousquet, U. L. Hendrichs, A. N. Kuyper and others, all of Pella and vicinity.

PORTLAND, ME.—The Bromfield Electric Company has been organized for the purpose of generating electricity or gas for light, heat and power purposes. The company is capitalized at $500,000 and the incorporators are Charles M. Drummond, of Portland, president, and Wadleugh B. Drummond, treasurer.

PORTLAND, ME.—The Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company has been organized in Portland, Me., for the purpose of constructing and operating an electric railway in Minnesota and Iowa. The capital stock of the company is $25,000,000, and the officers are Eben Winthrop Freeman, of Portland, president, and M. H. Boutelle, of Minneapolis, Minn., secretary.

TRAVERSE CITY, MICH.—Articles of association have been filed for the Traverse City Street Railway Company with a capital stock of $25,000. The company will operate a street railway in the city.

TRAVERSE CITY, MICH.—The Grand Traverse Railway Company has filed articles of association with a capital stock of $450,000. The company proposes to build an electric railway from Traverse City to Elk Rapids and thence to Charlevoix.

WINONA, MINN.—Articles of incorporation have been filed for the Homer Rural Telephone Company with a capital stock of $5,000 by Lloyd Barber, O. S. Bundy and J. H. Johnson.

HELENA, MONT.—The Capital City Power Company, of New Jersey, has been incorporated with a capital stock of $2,000,000 by B. R. Higgins, S. Hartman and H. S. Leonard, of New Jersey. A. P. Thatcher, of Helena, is named as state agent. This is the corporation which has been formed for the purpose of building the third dam across the Missouri, near Helena.

[illegible] others.

Legal.

[illegible] Heaton, of the Superior Court, has decided against the city in the suit to restrain the Home Telephone Company from interfering with the city's purpose to use the top cross-arms of the telephone company's poles on which to string electric light wires. The city's plan for the building of a municipal light plant included use of the company's poles for high tension wires, under the clause in the franchise which purports to give the city the right to string wires for police or fire alarm purposes. The court held that the franchise reserved no rights to the city to string wires of a dangerous and disturbing character on such poles for the conveyances of energy for lighting. The decision will greatly increase the cost of the city's plant, and will delay the completion of the work.

THE AMERICAN TRUST & SAVINGS BANK COMPANY and Frank H. Jones, both of Chicago, have filed foreclosure proceedings in the United States Circuit Court at Cincinnati against the People's Gas & Electric Company, of Xenia, Ohio. The Western Gas & Investment Company, with headquarters in Chicago, is made a party defendant. The petition charges that the company is wholly insolvent and unable to pay its debts and that the plant is shut down. Last March, in a suit brought by Evelyn Bird, the Union Savings Bank & Trust Company, of Cincinnati, was appointed receiver by the United States Circuit Court and is still acting in that capacity. Notwithstanding this action, the American Trust & Savings Bank Company asks for the appointment of a receiver. The two suits are very similar in their nature, with the exception that the last one asks for a foreclosure of its mortgage and that the plant be sold as a going concern. Its being closed down, it is averred, will result in a damage to the business that the plant might secure.

LIABILITY OF ELECTRIC COMPANY FOR INJURIES TO LINEMAN UNDER EMPLOYER'S LIABILITY ACT.—In a recent action for damages the plaintiff was an employee of defendant as one of a gang trimming trees so as to admit the stringing of defendant's electric wires. The gang's foreman pointed out a tree for trimming, and plaintiff, with another, climbed the same, attached a rope to a limb, and then cast it over a crotch of the tree above the limb, so that the loose end of the rope dropped to the ground. They then sawed off this limb, which fell on a lower limb. The lower limb was then sawed off, but when it fell the foreman held the rope taut, so that the limb to which it was attached did not fall with the lower limb, but remained suspended in the air and swung it toward plaintiff, who, in attempting to avoid it, fell to the ground. It was held that the foreman in holding the rope was not engaged in an act of superintendence, within the employer's liability act, making an employer liable for injuries to an employee resulting from the negligence of any person in the service of the employer entrusted with and exercising superintendence. Lowery vs. Huntington Light & Power Company, New York Supreme Court, Appellate Division, 105 N. Y. Supp. 852.

DE FOREST LITIGATION.—Suit asking for the rescinding of contract, for the recovery of wireless patents and for an injunction has been instituted in the Supreme Court of the District of Columbia by Lee De Forest against Benjamin F. Cole. The petitioner sets forth that he is the inventor of wireless telephony and wireless telegraphy discoveries, apparatus and methods covered by twelve United States patents, and that there are eight patents applied for, including one for aerophones. These patents are listed as beginning with Dec. 12, 1905. It is alleged that De Forest and Cole on Nov. 9, 1906, entered an agreement that De Forest give his exclusive time to the development of wireless telephony for a certain time and that he should receive from Cole a salary of $250 a month. De Forest was to apply for patents and to assign them to Cole, it appears, while Cole was to furnish money to secure patents in England, France, Russia, Denmark and Sweden and to pay other necessary expenses. The whole amount to be paid was not to exceed $8,000 a month for three months. De Forest was to adjust all outstanding claims and contentions between himself and Abraham White and the American De Forest Wireless Telegraph Company, so that De Forest should be able to deliver a clear title to absolute ownership and possession of practically all outstanding patents granted him, and that Cole agreed to incorporate a company with a capital of $100,000, to which was to be assigned all of the De Forest patents. According to the alleged agreement 25 per cent of the stock was to go to De Forest, and the other 75 per cent to Cole and his associates. It is stated that Cole agreed to pay in $60,000 to the company before its incorporation. It is set forth that on Feb. 7, 1907, De Forest filed with the Patent Office a written conveyance of his patents to Cole; that De Forest has carried out his share of the agreement; that he succeeded in obtaining a final adjustment of his contentions with Abraham White and the American De Forest Wireless Telephone Company; that De Forest has incurred an expense of $6,000 under the agreement and that Cole has failed to advance more than $1,000 under the agreement. De Forest tells the court he [illegible] ask for orders rescinding the agreement and revoking the assignment of the patents to Cole.

Educational.

[illegible]

Jack has been appointed instructor in this course for both day and evening classes.

INSTRUCTION IN TURBINES.—The first public school course in the practical handling of a turbine engine will be offered this winter as part of the industrial training at the new Stuyvesant High School, in East Fifteenth Street, New York City. A 250-hp turbine has just been erected in the school building, to serve a double purpose of generating current and for laboratory work by the students. In the same room is a 350-hp tandem compound engine of the latest type of cylinder-driven machines. This generates its share of the 400 kw of power needed to drive the shop machinery and light the buildings. The students, therefore, will have an opportunity to test and compare the working of the two latest types of generators. The question of instruction in operating steam engines of various types is being investigated by the National Society for the Promotion of Industrial Education for discussion at its annual meeting in Chicago on Dec. 5. Thus far, however, the Stuyvesant High School is the only municipal trade school found in which turbine instruction is contemplated.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Some changes in the electrical engineering course are proposed after a consultation with a special advisory committee of engineers which was appointed by the corporation over a year ago to confer with the teachers of the department. This committee consists of Prof. Elihu Thomson, Mr. C. L. Edgar, Mr. H. V. Hayes, Mr. Chas. F. Scott and Mr. L. A. Ferguson. There is also a visiting committee consisting of Prof. Thomson, Mr. Francis Blake, Mr. F. P. Fish, Mr. Chas. A. Stone, Prof. Percival Lowell and Mr. Chas. T. Main. In the new arrangement the student is expected to take one foreign language for a year and a half instead of two languages each for a year. The study of applied mechanics will be started at the opening of the second term of the second year. Another feature is a series of six lectures in the second year by the professor of electrical engineering. These will relate to power and its applications, power in industrial life and in its influence on civilization. Effort will be made to overcome the tendency of students to slight work which is not distinctively electrical in character. The work in hydraulics, steam engineering and the design of stationary structures will be improved, and thesis work will probably be begun at the beginning of the senior year. Some general studies will probably be included in the senior year for the breadth which they give.

Obituary.

MR. JAMES LANG, founder of the J. Lang Electric Company, Chicago, died Sept. 10 at the age of 84. Mr. Lang founded the company which bears his name about 25 years ago, but disposed of his interest and retired from business about five years ago.

Personal.

[illegible]

MR. PERCY H. THOMAS left the Westinghouse interests on Oct. 1 to join with [illegible] Neall, consulting engineer, of Boston, to form the firm of Thomas & Neall, electrical engineers, with offices in New York and Boston. [illegible] do general consulting work in [illegible] special attention to high-tension transmission design, to the investigation of the difficulties in operation on high-voltage plants, [illegible] high-tension practice. While connected with the Westinghouse Electric & Manufacturing Company, Mr. Thomas and Mr. [illegible] vestigation work on high-tension problems, both experimentally and in commercial systems. Mr. Thomas graduated from the Massachusetts Institute of Technology and entered the Westinghouse employ as a "student." His early work was on insulation of apparatus and on transformers, followed by a residence in Brazil in 1896-7 in connection with one of the early transmission plants. Later he spent some years in the investigation of static disturbances and lightning, with special reference to the protection of commercial systems. More recently, as chief electrician of the Cooper Hewitt Electric Company, he carried on the practical development of its well-known mercury vapor apparatus, in which and other fields he has made several inventions. Mr. [illegible] actively interested in the American Institute of Electrical Engineers, be- [illegible] graduate of the Massachusetts Institute of Technology, has made a [illegible] successfully in Boston, where he opened his office in the spring of 1906.

MR. J. T. BURKE, connected with the Southern Pacific Company, has been elected president of the Peninsular Electric Railway Company, of San Jose, Cal.

DR. W. M. HABIRSHAW, of insulated wire and cable fame, has recently returned to New York, after a long sojourn on the other side of the Atlantic in search of health.

MR. J. T. DAY, chief electrician of the New Hampshire Electric Railways, at Haverhill, Mass., has resigned to accept a position as chief electrician with the Malden Electric Company, of Malden, Mass.

MR. FRANK STOUT, who for the past nine years has been associated with the I. P. Frink concern, now occupies a position of similar character with the Bryant Electric Company, and will represent it in the territory east of Pittsburg and Buffalo.

MR. ARTHUR E. PAIGE, patent attorney, announced that on Oct. 1 his offices were removed from the Land Title Building, Philadelphia, to 714 Walnut Street, where he has maintained an office and laboratory for more than 21 years.

MR. ALBERT CARR has resigned his position as chief engineer of the United Railroads of San Francisco to take the position of superintendent of construction on the water power developments of the Central Colorado Power Company, with headquarters at Colorado Springs.

MR. CARL D. MURALT, who was recently elected an additional professor of electrical engineering at the University of Michigan, has been granted a month's leave of absence to act as consulting engineer for the Austrian Government in the electrical equipping of the Alberg tunnel.

MR. J. E. HAM, who has had a very long connection in the East with the insulated wire industry and was more recently with the Hazard Manufacturing Company, has been appointed representative of the Waterbury Company for the introduction of its insulated wires and cables. His headquarters will be the Waterbury branch office at 108 La Salle Street (Stock Exchange Building), Chicago.

MR. J. E. FRIES, who has been connected for some time past with the Allis-Chalmers Company at Milwaukee, has joined the Power Improvement Company of that city, a comparatively young concern engaged in the consulting field of engineering. Among the industries employing the power company is the Schlitz Brewing Company, which will build a large central station at Lake Michigan and transmit electrical energy to the brewery at Milwaukee and the New Majestic Theatre. It is proposed by the company also to take up electric railway work. This is a branch to which Mr. Fries devoted much of his time while with the Allis-Chalmers interests. Mr. Fries is a Swedish engineer of high technical training and wide experience in the electrical field.

Trade Publications.

CIRCUIT BREAKERS.—In its bulletin No. 4516, the General Electric Company illustrates and describes direct-current circuit breakers especially designed for electric railway equipments.

ARC LAMPS.—Enclosed alternating-current, constant-potential arc lamps for 104 volts and 6 amperes are well illustrated and discussed in detail in Bulletin No. 1095 of the Fort Wayne Electric Works, Fort Wayne, Ind.

AIR COMPRESSORS.—Bulletin No. 1513 of the Allis-Chalmers Company, Milwaukee, Wis., is devoted to Christensen portable air compressors, which are designed for 11, 16, 20 or 25 cu. ft. of free air per minute, for driving pneumatic tools.

H. W. JOHNS-MANVILLE COMPANY has issued a small, neat brochure with gray cover printed in red and black, devoted to the Morris metallic packing for which it is sole selling agent. This packing is standard for Corliss valve stems and all piston rods, steam turbines, hydraulic air, gas, ammonia and vacuum uses.

KEYSTONE TRAVELER.—The September number of the Keystone Traveler, which is published by the Electric Service Supplies Company, is full of bright sayings about the many articles handled by this company. "Supplies for every electric service" is what the company carries in stock. The more serious reading matter is lightened and brightened by an occasional funny story.

FORT WAYNE GENERATORS AND MOTORS.—Two recent bulletins of the Fort Wayne Electrical Works relate respectively to direct current belted generators for lighting and power and small direct current motors. In both cases every detail of the apparatus is illustrated by well-executed cuts, and in the motor catalogue are included illustrations showing the application of the motor described to driving a radial drill and a [illegible]

PRINGLE CATALOGUE.—The Pringle Electrical Manufacturing Company, of 1906-8 North Sixth Street, Philadelphia, has just issued a new edition of its catalogue. The catalogue is very complete, giving illustrations, descriptions and price lists of goods of Pringle manufacture, showing a large variety of high-grade switches, panel boards, iron and wood cabinets, switchboards and accessories, wall and floor receptacles and other specialties. Copies of this new catalogue are now available to the trade.

LIGHTING AND POWER SUPPLIES.—Catalogue No. [illegible] of the Commercial Electrical Supply Company, of St. Louis, Mo., is a [illegible]

[illegible] supplies. This supplements the other catalogues of the same house on Telegraph Apparatus and Supplies, Street Railway and Mining Supplies and "New Idea" Fixtures. The material is listed in such a way that, so far as possible, all articles having relation to each other are grouped together. The general index is supplied with a marginal thumb index.

APPLE IGNITION OUTFIT.—The Dayton Electrical Manufacturing Company, of Dayton, Ohio, has just issued Bulletin No. 7, describing its 8-s switchboard gas engine ignition outfit. The outfit consists of the 8-s switchboard and two storage batteries, and is for use with stationary gas engines, which are used to drive direct current lighting or power dynamos. The switchboard provides for charging two storage batteries alternately from the lighting or power dynamo. This bulletin describes and illustrates fully this outfit and will be sent upon request to all who are interested.

HOLOPHANE.—[illegible] Holophane Company, 227 Fulton Street, New York, have issued the first number of a monthly publication entitled "Holophane," devoted to the system of illumination with which this name is associated. A brief history is given of the work of the Greek engineer, Psaroudaki, and Prof. Blondel, of Paris, in producing a globe of clear glass, with prisms upon its surface so disposed as to break up the glare of the intense light with very little loss by absorption. The monthly will endeavor to give those interested in the science of illumination a more exact appreciation of the practical application of that science.

WELDED PIPE.—The National Tube Company, Pittsburg, Pa., has issued an illustrated book by Mr. F. N. Speller, describing in detail the manufacture of welded pipe from ore to finished product. Mr. Speller says: "In writing and illustrating this work I have endeavored to treat the subject in a popular style as far as possible, the object being to familiarize all users of pipe with the properties of the materials involved and their treatment in the course of manufacture. This is a branch of the iron and steel industry the elements of which have been little understood by engineers, architects and consumers in general. It has been our object in this short treatise to meet this need, believing that the result will be beneficial to all concerned. Any of your readers who are directly interested may obtain copies by writing to the nearest office of the company, either in New York, Pittsburg, Chicago, St. Louis or San Francisco."

Business Notes.

JNO. H. COWLES & CO., 44 Fifth Street, Louisville, Ky., have succeeded to the business of Haight & Co., brass founders, silver, nickel and copper platers, etc., and will develop along the lines followed during the [illegible]

FRINK REFLECTORS.—Frink's special patent window reflector, made by I. P. Frink, 551 Pearl Street, New York City, has been installed in all the newest of the large stores opened recently in this vicinity, viz., Greenhut & Company, Oppenheim, Collins & Company, John Forsythe, Sheppard Knapp & Company and The Berlin, Brooklyn, N. Y.

BLAKE SIGNAL & MANUFACTURING COMPANY, Boston, Mass., will be represented at the American Street & Interurban Railway Convention, at Atlantic City, Oct. 14 to 18, inclusive, by E. J. Burke, C. C. Blake and George S. Hastings. It will have a complete working exhibit of standard signal apparatus, together with a trained and competent train dispatcher, various types of railway telephones and standard blanks, etc., for telephone-train dispatching.

[illegible] Chalmers Company are the following: A 200-kw, direct-connected Corliss engine and direct-current generator to the Hudson Company store, Detroit: a 550-kw Corliss engine and direct-current generator to the Wisconsin Steel Company, Chicago; an electric motor equipment for the works of the B. J. Johnson Soap Company, Milwaukee; fifteen three-phase induction motors ranging from 10 to 75 hp to the Montezuma Copper Company, Sonora, Mexico; turbines, electrical generating and motor machinery for the city of Paw Paw, Mich.; 150-kw, three-phase alternator and exciter to the corporation of East Toronto, Ont.

THE BERKSHIRE ELECTRIC COMPANY, of Pittsfield, Mass., carried on for many years by C. G. Tompkins, is being reorganized by A. E. Truesdale and G. H. French. The new corporation will retain the name of the Berkshire Electric Company, and it is the intention of the new owners to enlarge the territory and the scope of its business. The company will be prepared to furnish designs and estimates for electrical installations of all descriptions, as well as power plants, telephone systems and the entire mechanical equipment of buildings. The manufacture of electric and gas fixtures will be continued and enlarged and the sale of electrical materials will be carried on as in the past. Mr. Tompkins will still be associated with the company.

EUGENE MUNSELL & COMPANY, the well-known dealers in mica, and the Mica Insulater Company, manufacturers of micanite and other high-grade electrical insulators, for many years located at No. 218 Water Street, New York, have removed to No. 68 Church Street, corner of Vesey Street. Owing to the increase in their business, they were compelled to seek more commodious quarters, and their new location is one of the most central in the downtown business district, being only one block west of Broadway, and within five minutes' walks of the principal railways and ferries. They occupy four floors at their new location, the second floor being devoted entirely to their offices, while the other three are used for stock and shipping departments, for the preparation and sorting of mica and for the manufacture of mica specialties.

THE ELECTRIC STORAGE BATTERY COMPANY of Philadelphia will have an interesting exhibit at the convention of the American Street and Interurban Railway and Manufacturers' Association at Atlantic City, Oct. 14, and among other materials will show one element of type 71-R in a containing tank sufficiently large to hold 83 plates of this type, the tank showing the standard method of re-enforcement used on cells at the end of rows. A 12-pole carbon regulator, recording hydrometer, recording and signaling hydrometer, automatic cell filler and compensating hydrometer will be shown, with examples of positive and negative plates of the different types. The representatives who will be present are Messrs. Charles Blizard, third vice-president; Albert Taylor, manager New York office; G. H. Atkin, manager Chicago office; E. L. Reynolds, manager Pennsylvania sales office; H. B. Gay, manager Cleveland office and Robert C. Hull, district engineer.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

AMERICAN ELECTRO-THERAPEUTICAL ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, [illegible]

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, fourth Friday of each month.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, Walter S. Mower, London, Ont.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, Tillson, Municipal Building, Brooklyn, N. Y.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Montreal, Que., June 24, 25 [illegible]

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Montreal, September 11, 12 and 13, 1907.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Mulholland, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, [illegible]

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November [illegible]

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

[illegible] of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. [illegible]

EMPIRE STATE GAS & ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, [illegible] St., New York.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New England, Philadelphia, Pittsburg and Chicago. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles West.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., Oct. 16, 1907.

KENTUCKY INDEPENDENT ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Charles W. Ford, Oklahoma City, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 24, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

866,618. ELECTRIC WATER FILTER; Melvin A. Brannon, Grand Forks, N. D. App. filed April 11, 1906. An electric filter for drinking water adapted for household use and which provides both a porous filtering medium and electrolytic plates which act upon the water.

866,639. AUTOMATIC TELEPHONE RELEASE; F. W. Dales, Chicago, Ill. App. filed Feb. 9, 1907. In a telephone exchange system, a plurality of selectors and a connector, each connector provided with a release relay, said connector provided with a net, and a trunk-release circuit, including said magnet and relays in series with each other, together with a source of current for energizing said magnet and relays.

866,645. ANTI-HUMMER FOR TELEPHONE AND TELEGRAPH LINES; Nels O. Hagen, Pekin, N. D. App. filed May 4, 1907. A device for absorbing the mechanical vibrations of a telephone wire at the point of its entrance to a dwelling, especially a wooden frame house, which vibrations are stated to be the cause of a loud humming noise in windy weather.

866,646. CONTACT DEVICE; Clarence J. Hester, [illegible], N. Y. App. filed Dec. 3, 1906. Contact device by means of which electric currents may be taken from a trolley wire or other overhead cable at intervals and conducted to operate an indicator in the car.

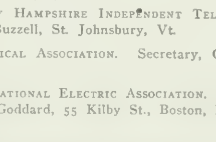
866,667. MEANS FOR FASTENING COLLECTOR LEADS; [illegible] Mattman, Norwood, Ohio. App. filed Jan. 31, 1907. A dynamo electric machine having a collector ring with an inclined or cone-shaped seat and a collector lead having a wedge-shaped terminal held between the ring and its seat.

866,709. SUPPORT FOR ELECTRIC CONDUCTORS; William W. Benson, Philadelphia, Pa. App. filed [illegible]. A supporting device for an electric conductor [illegible] ing having the usual open channel with side corrugations to hold the conductor.

866,714. TELEPHONE SYSTEM; H. P. [illegible], Chicago, Ill. App. filed Oct. 27, 1902. A telephone system comprising a subscriber's line consisting of two metallic limbs, suitable sub-station apparatus, suitable central-station apparatus, a normally open, low-resistance connection across the terminals of the two limbs at the central station, and a relay for closing said connection, said connection when closed operating to short-circuit the said sub-station apparatus.

866,716. MANUFACTURE OF INCLOSED FUSES; Robert C. Cole, Hartford, Conn. App. filed June 23, 1906. An inclosed fuse comprising an enclosing case, an indicator wire associated therewith and a metallic holder fastening the end of said wire to the wall of the case and an end closure for the case covering said metallic holder.

866,729. TROLLEY; William Moeckel, Jersey City, N. J. App. filed June [illegible], 1907. The trolley harp has U-shaped extensions on each



[illegible] Support for Electric Conductors.

side, to the arms of which are swiveled grooved rollers which receive the trolley conductor between them.

866,735. CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed Jan. 2, 1902. Relates to circuit protectors for protecting low-tension instruments and circuits from unduly strong currents; includes an ordinary fuse cartridge and a thermal-circuit breaker [illegible]

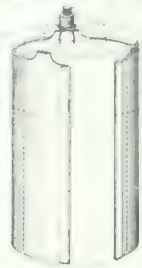
[illegible] BATTERY ZINC; Henry C. [illegible], Boston, Mass. App. filed Dec. [illegible]. A [illegible] battery zinc provided at its upper edges with a lip or lips turned back toward and either touching or almost touching upon the main body of the zinc.

[illegible] METHOD OF EXHAUSTING INCANDESCENT LAMP BULBS; [illegible] O. Wo[illegible], Pittsburg, Pa. App. filed Feb. [illegible]. A method of exhausting incandescent lamp bulbs consisting in employing the flow of a fluid to control the successive steps or operations during the process of exhaustion.

[illegible] held by the cores of the electromagnet.

[illegible] conductor moldings employed in buildings and other structures for the purpose of supporting the electrical conductor wires. Designed to exert a resilient gripping action on the wires.

[illegible]



[illegible]

alarm boxes designed to be applied to boxes in ordinary use and so constructed that the main alarm mechanism will be set in motion when a member located upon the exterior of the box is actuated.

[illegible],781. TROLLEY; George R. Forster, Fithian, Ill. App. filed April 27, 1907. A retrieving device for a trolley pole including a pneumatic cylinder having a piston normally spring impelled in one direction.

[illegible]794. INTERCOMMUNICATING TELEPHONE; Chas. E. Lee, Chicago, Ill. App. filed Feb. 28, 1906. In intercommunicating telephone devices the combination with the pivot telephone-hook, of an extension thereof beyond the pivot forming a latch thereon, a circuit connecting mechanism controllable by said latch, a push button controlling the relations of said latch with the circuit-connecting mechanism aforesaid, and a circuit-connecting mechanism or switch for connecting with any desired number of terminal points; substantially as described and shown.

[illegible],810. ELECTRIC LAUNDRY IRON; Earl H. Richardson, Ontario, Cal. App. filed Oct. 10, 1906. Construction of flat-iron having an interior hollow chamber with a pair of heating coils.

[illegible],820. ELEVATOR MACHINE; George L. Smith, Chicago, Ill. App. filed Aug. 11, 1906. An electric motor for elevators having special arrangement of gears by which different speeds are secured.

[illegible],846. ELECTRIC LOCOMOTIVE CONTROLLER; Charles O. Dayton, Washington, Iowa. App. filed Oct. 8, 1906. Block-signaling system for single-track trolley roads having a register by means of which the number of cars which enter a block in either direction is taken account of.

[illegible],849. METHOD AND PROCESS FOR THE RECOVERY OF COPPER AND OTHER METALS FROM THEIR ORES; Charles H. Ehrenfeld and Jacob R. Grove, York, Pa. App. filed Sept. 7, 1906. Relates to a method of the recovery of metals from their ores in which the metal is dissolved out of the ore into a solution of a suitable solvent agent by the aid of electricity and thereupon electrically deposited out of such solution.

[illegible],858. APPARATUS FOR DEPOSITING METALS; Wilbur A. Hendryx, Denver, Col. App. filed June 30, 1905. A depositing cell comprising an open frame, a filtering medium carried thereby, and metal-depositing means within said frame.

[illegible],859. APPARATUS FOR DEPOSITING METALS; Wilbur A. Hendryx, Denver, Col. App. filed June 30, 1905. An apparatus for depositing gold, silver and copper from cyanide solutions; comprises an anode, a cathode surrounding the same, and a filtering envelope applied to the exterior surface of said cathode.

[illegible] 945. ELECTRIC SIGNALING ON RAILWAYS; William J. MacKenzie, Dunmurry, Eng. App. filed Dec. 13, 1905. Railway system for signaling between rails. Includes special trolleys between the track rails which complete circuits to the engine cab by means of rollers depending therefrom.

[illegible] ELECTROPLATING APPARATUS; Lo[illegible]otthoff, Flushing, N. Y. App. filed May 1, 1906. An apparatus f[illegible]ectroplating small articles, such as nails, etc. Includes a tank with a feeding device for impelling the objects through said tank.

[illegible],977. CUT-OUT; Joseph G. Swallow, New York, N. Y. App. filed April 4, 1907. Cut-out box in which all the electrically live parts are so covered that access from the outside is impossible. Has means for sealing the covering plate so that it cannot be removed by unauthorized persons.

[illegible],983. RAILWAY SWITCH; Guy M. Thompson, Seattle, Wash. App. filed Nov. 26, 1906. The switch-point has a pair of connections with separate iron cores which are acted upon by solenoids in separate circuits.

[illegible],990. ELECTRICAL MEASURING INSTRUMENT; Thomas W. Varley, New York, N. Y. App. filed Sept. 7, 1905. Electrical measuring instrument having a substantially constant magnetic field in combination with stationary and movable coils so disposed that a current passing through the stationary coil will shift or distort the lines of force of the constant magnetic field so as to cause a torque on the movable coil.

[illegible],014. TELEPHONE EXCHANGE SYSTEM; Edward E. Clement, Washington, D. C. App. filed Dec. 10, 1904. In a telephone system, a line, a line relay, a cut-off relay, and means whereby each relay controls the operative connection of the other.

[illegible] ELECTRIC CONTACT RAIL AND SHOE; George Drawert [illegible] collector shoe from all [illegible]

867,[illegible] ELECTROLYTIC [illegible] PROCESS FOR EXTRACTING COPPER FROM ITS ORES; [illegible] App. filed Dec. 29, 1905. An electro[illegible] ing copper from its ores consisting [illegible] ammonical leaching process.

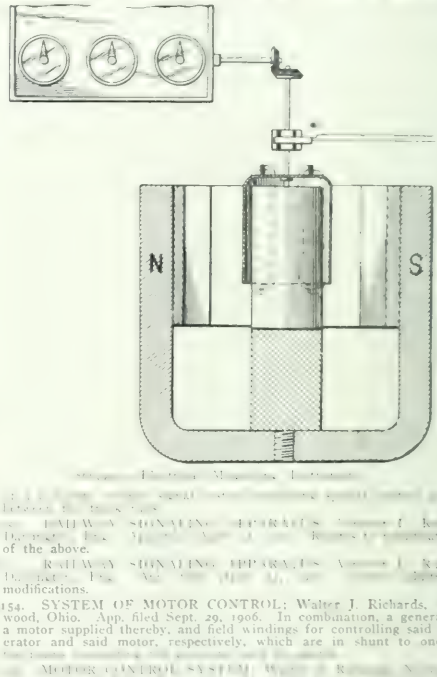
[illegible] burg, Norwood, Ohio. App. filed Aug. 30, 1905. In a system of dis[illegible] having a plurality of low-tension windings, means for connecting the generator or generators to one of said low-tension windings, one or more converters, and means of connecting a converter to another low-tension winding.

[illegible],125. TROLLEY WHEEL SUPPORT; George W. Grisdale, Jr., Philadelphia, Pa. App. filed March 5, 1906. The trolley harp is swiveled on a vertical axis at the end of the trolley pole and the swivel bearing is capable of movement out of its vertical plane.

[illegible],140. MOLDING FOR ELECTRIC WIRING; William H. G. Kirkpatrick, Philadelphia, Pa. App. filed April 27, 1906. A molding having a member provided with longitudinal grooves with an intermediate mortised partition and an interlocking keeper whose length is considerably less than the width of the molding.

[illegible] N. Y. App. filed Jan. 5, 1907. A specially constructed magnet is suspended by links between the wheels of the truck so as to exert a magnetic breaking action on said wheels and on the track rail.

[illegible],150. RAILWAY SIGNALING APPARTUS; Vincent L. Raven, [illegible]



[illegible] of the above.

[illegible] modifications.

[illegible]154. SYSTEM OF MOTOR CONTROL; Walter J. Richards, Norwood, Ohio. App. filed Sept. 29, 1906. In combination, a generator, a motor supplied thereby, and field windings for controlling said generator and said motor, respectively, which are in shunt to one of [illegible]

[illegible] MOTOR CONTROL SYSTEM; [illegible] Ohio [illegible] other direction.

[illegible] CONTROLLER REGULATOR; [illegible] In combination, a controller handle, [illegible] carried by said handle and arranged to be moved by the same force to engage the notches of said member to stop the handle as the latter is moved forward, and to be released therefrom subsequently.

867,192. FLOATING POWER PLANT; James W. Dawson, San Fran[illegible] each side geared to a dynamo, and mechanism is provided for lifting them out of the water in accordance with the current needs of the [illegible]

[illegible] BLOCK SIGNAL SYSTEM FOR ELECTRIC RAILWAYS; [illegible] railway signal of the block type used in connection with the single-track electric railways having turn-outs at frequent intervals to permit the passage of cars in opposite directions. [illegible] mechanism for registering the number of cars [illegible] tions.

[illegible] CIRCUIT MAKING AND BREAKING DEVICE; [illegible] Riker, Bridgeport, Conn. App. filed Jan. 18, [illegible] an induction coil having a contact member an[illegible]pact [illegible] ated by the core magentization for enforcing the making of the [illegible]

867,212. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Rochester, N. Y. App. filed Sept. 18, 1905. A thermal protector for telephone systems of the type having spring blades enclosing cartridge [illegible]

[illegible] CIRCUIT CLOSER FOR DOOR ALARMS; [illegible] Themke, Strathcona Alberta, Canada. App. filed March 14, 1907. A circuit closer adapted to be applied to an ordinary door-knob within the interior of the door so as to close an alarm circuit when the knob is turned.

Electrical World

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NEW YORK, SATURDAY, OCTOBER 12, 1907.

CONTENTS.

INTERNATIONAL SCIENTIFIC NOTATION.

As pointed out recently in a letter in our columns, there is a great need for a scientific notation brought down to date, and we are glad to state that this is a subject which has been taken up for study by the International Electrotechnical Commission. As our readers will recall, this commission is the outcome of the St. Louis International Electrical Congress, which recommended the organization of two commissions to take cognizance of matters previously considered by the Chamber of Delegates at International Electrical Congresses—it having become apparent that this body had survived its usefulness of earlier days. One of these was an international commission to consist of two members appointed by the government of each country to be represented. Under the name of a "Conference" and with only semi-official character, several meetings have been held of a commission such as that recommended. The other recommendation was for the appointment by the various technical societies of the world of a representative commission to consider the question of "the nomenclature and ratings of electrical apparatus and machinery," and it was suggested that this commission should have a permanent secretary. About two years ago this recommendation was also put into effect by the organization of the International Electrotechnical Commission, and an arrangement was made whereby a number of the national electrical engineering organizations provide the funds for the maintenance in London of a Central Office, in charge of a permanent secretary. To return to our subject, each of the several national societies subscribing to the maintenance of the commission was requested some months ago to appoint a committee to study the subject of an international system of electrical nomenclature and symbols. The British committee entered on its work some time ago, and we understand that shortly the appointment of an American committee by the American Institute of Electrical Engineers will be announced.

It is now more than 20 years since the late Prof. Hospitalier commenced the ardent advocacy of an international system of symbols for physical quantities and abbreviations for units. After futile appeals before several international electrical congresses, he finally secured, at Chicago, in 1893, a recommendation from the Chamber of Delegates in favor of the system which he had compiled. This table of notations, while now somewhat incomplete through the advance of technical science, contains little that is radical, being based largely upon the notation of the earlier authoritative writers upon physical science; and as it has been very generally followed by writers in this country and in France, it is to be hoped that the commission will introduce few, if any, changes in the table. As the work which the commission has entered upon can scarcely escape extending into the general field of scientific notation, the question arises whether it would not be advisable, and even absolutely necessary for best results, to seek the cooperation of non-electrical professional and scientific bodies throughout the world in the preparation of a system that all can use in

common. Indeed, one can think of but few scientific terms that are exclusively encountered in electrical literature. Such cooperation would not be difficult with respect to this country and Germany, Austria and Switzerland, where there are bodies already organized for the purpose of establishing a system of notation that will be acceptable to all branches of physical science and its various technical applications.

The American body was organized in 1904 by appointment of members by the American Institute of Electrical Engineers, the American Chemical Society, the American Physical Society, the American Electrochemical Society, and the National Bureau of Standards, and has for secretary Prof. W. F. Magie, of Princeton University. In February of the present year, a commission representing a large number of professional and scientific societies in Germany, Austria and Switzerland, having an aggregate membership of more than 40,000, was organized for the study of, and report on, a system of standard scientific and technical notation for German-speaking countries, and is now engaged on its work, with headquarters in Berlin. As this body is highly representative not only of the electrical, mechanical and civil engineering professions of the countries named, but also of the chemical, electrochemical and "physical" branches of science, the desirability of entering into cooperation with it is obvious, if the aim is a system of notation for international usage. In the absence of any announcement of the scope of the present plans of the International Electrotechnical Commission in this connection, we can only hope that they will not conflict with cooperation with the other essential factors in the establishment of a truly international system of scientific and technical notation, and one which will meet with recognition in every branch of science dealing with the terms and quantities involved.

Unbalanced Loads in Two-Phase to Three-Phase Transformation.

An article by Mr. Bernh. F. Jakobsen on page 717 of this issue records an interesting general solution of a problem in phase transformation. The problem relates to the relative unbalance in the load on the three-phase primary side when the load on the two-phase secondary side is unbalanced. The extreme simplicity of the solution of the problem in a specific case will be appreciated if one considers first the maximum possible unbalance on the two-phase side; that is, with a certain load on one phase and no load whatsoever on the other phase. Evidently the load current on the three-phase side will be unbalanced; either the load currents in two lead wires will be equal in value and that in the third lead wire will be zero, or the load current in the latter lead will have a value equal numerically to the sum of the two currents in the other two leads, which two currents will be directly in time-phase with each other and with the load current in the third lead.

It is well known that if the load on the two-phase side is balanced, that on the three-phase side is balanced also, neglecting the small distorting effect of the local magnetic impedances of the several transformer coils. When the load on the two-phase side is only partially unbalanced, it may be considered as two loads, one in complete balance and the other in complete unbalance, and the effect of each on the primary quantities may be separately determined and then added (in proper time-phase relation) to obtain the resultant effect. In any event, and without any reference to the relative unbalance of the two-phase load or the relative time-phase position of the currents in the two secondary phases, the load current in one of the three-phase primary leads is equal in magnetomotive force and opposite in time-direction to one of the two-phase load currents; the current in one of the other leads is equal to the vector sum of one-half of this load current and a current equal in magnetomotive force and opposite in time-direction to the other of the two-phase load currents; while the current in the third lead is equal in magnetromotive force to the vector difference between the latter load current and one-half of the former secondary load currents. Only in case of exact equality in numerical value, and exact time-quadrature in phase position, of the two secondary currents are the three primary currents equal in value and displaced in phase by 120 electrical time-degrees. These facts are treated fully by Mr. Jakobsen in this issue.

The Measurement of Electrolytic Resistance Without the Use of Electrodes.

It is well known that the resistance of an electrolytic conductor, such as a tank of copper-sulphate solution, follows the same laws as that of a solid conductor. That is to say, it increases in proportion to the length, and inversely as the cross-sectional area; but the measurements of the resistance offered by an electrolyte are more or less influenced and interfered with by the polarization of the electrodes. If we try to measure carefully the resistance of a copper-sulphate tank between copper electrode plates, we find that there is a certain disturbing e. m. f., or at least a c. e. m. f., of polarization which affects the measurement, and makes the resistance appear either greater or less than its real value. For this reason alternating currents are commonly employed in the measurement of electrolytic resistances. Another method, which has been tried at different times, is to avoid the use of electrodes altogether, by employing closed ring glass tubes, filled with the solution under test, and determining the alternating-current strength which can be induced by an alternating magnetic field in such a ring. A series of measurements of electrolytic resistance without the use of electrodes, by Messrs. W. S. Franklin and L. A. Freudenberger, appears in the last number of *The Physical Review.* The electrolytic solutions under test were contained in a glass ring tube enclosing the core of a small transformer. The electrolytic conductor thus formed a secondary winding of a single turn. The effect of this closed secondary circuit of fairly high resistance was to alter the apparent impedance of the primary winding by a certain small amount. A similar transformer with an adjustable resistance in the secondary circuit was balanced against the electrolytically loaded transformer with the aid of a special alternating-current galvanometer in a Wheatstone bridge arrangement. The method forms an interesting check upon the usual method of measurement with electrodes, but does not seem to have possessed a high degree of sensitiveness in the case reported.

Comparisons of National Light Standards.

In the early days of electric lighting, the desirability of an international standard of candle-power or luminous intensity was soon manifest. The standards of light employed in 1880 by different countries were diverse and indefinite. For example, Great Britain held to her parliamentary candle of spermaceti

⅞ in. in diameter or six to the pound, and burning away at the rate of 120 grains per hour. Occasional variations in the horizontal intensity of this standard candle reached 30 per cent. In 1884, the International Conference of Electricians in Paris adopted an international unit of light, which was named the violle, and which was defined to be the light emitted perpendicularly from 1 sq. cm. of platinum at the temperature of its solidification. As this unit was rather large, the International Electric Congress of 1889 adopted the "bougie décimale," or decimal candle, as an international standard, and which was defined as the one-twentieth of the violle. The intentions of the International Conference of 1884, and of the International Congress of 1889, in regard to a uniform light standard were excellent; but, unfortunately, the art of photometry had not reached the state of development necessary for the execution of the project. The various delegates went home rejoicing in the supposed possession of an international decimal candle defined in terms of the violle. When, however, they tried to reproduce the violle, each in his own laboratory, the variations discovered were serious and disconcerting. Molten platinum is not an easy substance to work with, and very small degrees of impurity effect appreciable changes in the luminous emission from its glowing surface. The result was that the attempt to bring about a uniform international candle was a failure. France alone of all the countries represented has clung faithfully to the bougie décimale, and still retains it; but even France has not claimed to perpetuate this decimal candle through the instrumentality of the fundamental standard violle and its square centimeter of glowing freezing platinum. She has maintained the bougie décimale through the medium of her standard carcel lamp burning 42 grams of pure rape-seed oil per hour. It is claimed by carcel-lamp experts that under proper conditions this flame standard of light can be relied upon to be reproduced within about 1 per cent. The normal carcel has been accepted in France as the lighting equivalent of 9.6 bougie décimales.

The other countries represented in the congress seemed to have been so discouraged with the non-success of the violle primary standard that they gave up for the time all hope of adhering to an international candle, decimal or otherwise. They set to work to find a standard of light that would be reproducible to a satisfactory degree of accuracy. In England, the pentane flame standard was produced, in Germany the amyl-acetate flame standard, and in France the colza-oil flame standard, as already mentioned. Each standard has its advantages and disadvantages. Experts trained exclusively to the use of one frequentaly extol its particular praises and sigh doubtfully over the precision of the others. It is now generally admitted that the best of these three flame standards is likely to vary at different times with one and the same observer to the extent of 1 per cent, and with different observers more. It is also generally agreed that suitably selected and aged incandescent lamps are much more reliable standards for reproducing a given candle-power than any flame standard can be. Consequently, any one laboratory can maintain an assigned candle-power once established through comparison of such secondary incandescent lamp standards. It is only necessary to re-establish the terminal voltage on the lamp with the aid of an accurate voltmeter and the candle-power in a given direction becomes re-established, if the lamp is not worked too long.

About the year 1893, the incandescent lamps of American manufacture became commercially standardized in terms of the nominal British parliamentary candles of that date through measurements at Charlottenburg, which established a mean ratio of one hefner amyl-acetate standard equal to 88 per cent of the British parliamentary candle. This ratio has since been accepted both by the American Institute of Electrical Engineers and by the national Bureau of Standards. In England, however, the British parliamentary candle has been allowed to burn out, and it is now accepted as the tenth part of the Vernon-Harcourt 10-candle pentane flame standard. According to measurements made both at Kew and at Charlottenburg, this new concrete standard of the British candle is nearly 4 per cent feebler than the original representative in spermaceti as determined in Charlottenburg. The gas photometric standards in America are also Vernon-Harcourt pentane standards, and it would seem that the unit of candle-power maintained in the best gas photometric laboratories of the United States is a few per cent less than that maintained by the electric lamp manufacturers. In other words, an incandescent lamp of 16 mean horizontal candle-power in the United States is said to correspond to what the gas industry would rate at 16.5 candles, or thereabouts.

An international congress on photometry met this year in Zurich, as already mentioned in our editorial and digest columns of the issue of Sept. 21. This congress adopted a ratio of one hefner equal to 91.3 per cent of the new British candle and equal to 93 per cent of the carcel. This means that the United States standard candle-power is a couple of per cent more than the French bougie décimale and nearly 4 per cent more than the new English candle or than the United States gas candle if the latter conforms to Vernon-Harcourt pentane standard. These discrepancies would be quite immaterial if incandescent lamps were not under comparison, because comparison tests of flame standards or of glow-lamps against flame standards might readily vary within those limits. Incandescent lamps of the same specific consumption can, however, be calibrated and compared to less than one per cent, so that it becomes desirable to restore, if possible, the international bougie décimale. This seems to be about midway between the British and American candles, and only a couple of per cent of change would have to be made by any of the three countries, England, France and America, in order to secure uniformity. The uniformity could only be reached through international action, and could only be maintained through the regular interchange of standard incandescent lamps between the national laboratories as suggested recently in an excellent paper by Dr. Hyde. Instead of having four different units of candle-power in the four countries mentioned, this international adjustment would leave only two outstanding, namely the hefner and the bougie. It would be very desirable to have only one instead of two; but the difficulties in the way of a readjustment to that effect would be much greater and perhaps irremovable. It would mean more than 5 per cent all round, a distinct commercial disturbance, particularly for Germany, which would be placed at a disadvantage, because a 21-hefner lamp would become reduced below 20 candles. On the other hand, the readjustment to the bougie between England, France and America would probably be too small to be commercially objectionable.

Annual Meeting Empire State Gas & Electric Association.

The annual meeting of the Empire State Gas & Electric Association was held on Oct. 2, at the Edison Auditorium, New York City, Vice-President Carleton Macy in the chair, the president, Mr. E. H. Palmer, being absent from serious illness. An interesting message was read from him, however, dealing with the work of the association. The reports presented during the day by Mr. C. H. B. Chapin, the secretary, showed that the association had increased from 48 members to 69 at the present meeting.

Mr. H. H. Curran, of Curran & Mead, presented a very interesting report as to the publicity work done for the association during the year, and a number of examples were submitted of the work done in sending out articles to the press as to the work of the association—municipal ownership failures, electrical advances and other cognate matters. Quite an interesting discussion followed as to this work and its real value to the members.

Mr. W. W. Freeman, of Brooklyn, then presented the report of the public utilities committee and its work in watching the action of the new Public Service Commission. One of the cases to which the committee was giving attention was that of the Watertown Light & Power Company, which is now appealing from a decision of the old commission limiting securities to a point considerably below the actual investment of the company. The case is expected to go before the courts in November, when it will be seen what they have to say to the power of the commission to enforce such a limitation. Reference was also made to the order of the former commission fixing 15 cents as the maximum kw-hour charge to be made by the Rockland Light & Power Company in Orangetown. It was shown that this order was a restraint of trade and a suppression of the natural law of supply and demand. Out of 112 customers served at a loss, 75 would receive service at a greater loss, and out of 26 served at a profit, 19 must be served at an increased profit to make good the increased losses. It is hoped and believed that under the new commission such orders will not be issued. The case was also referred to of the Newburgh Light, Heat & Power Company, where an application for an issue of $250,000 preferred cumulative 8 per cent stock had been denied. Mr. Beal, of that company, explained that the object had been to strengthen the character of the issue, making it more attractive to the stockholders. The attitude taken appeared to be one broadly of objection to such a kind of issue because, not in this case, but in others it might settle on the community a definite future obligation which would require the raising of that dividend through higher prices for gas and electricity, working a hardship on the community. If the cumulative feature had been left out it would have gone through. The application will be renewed.

Mr. Freeman referred also to the situation at Saratoga, where Senator Brackett, representing the company, had raised the contention that the Legislature had not the right to delegate such powers as fixing rates to these commissions; and if this was sustained it would do away with the present law and the commissions. Mr. Searle and others made the point that the idea could not be too strongly fought that companies should be limited to 6 or 8, or even 10 per cent if they could earn it by good management and give good service.

Mr. Freeman emphasized the importance of setting aside a certain sum for depreciation regularly, as an item of cost, and paying dividends only out of what was left over. The Brooklyn Edison Company this year is charging up a sum equal to one-half of 1 cent on each kw-hour sold, as an element of replacement and depreciation. It is now replacing a feed-water plant, charged against the account, and when it comes before the commission it will be recognized that the $350,000 or $400,000 item was an expense, and not in any sense part of the profit.

Mr. R. A. Davidson presented a report from the committee on insurance, which said it was not able at the present juncture to present any scheme of mutual insurance. The report said:

"In connection with the handling of insurance for various corporations' interests, it has been deemed desirable by the insurance companies to perfect an organization for the following purposes:

"First.—For inspection of properties in a thorough manner by engineers competent to pass upon desirable improvements.

"Second.—To negotiate with the assured to secure the improvements, and where necessary to take actual oversight of such improvements.

"Third.—To secure uniform rules and submit definite assurances of rate for the improvement affected.

"Fourth.—To bring about closer relations between the organizations representing the assured and the insurance companies, and to co-operate with such organizations in the development of standards for construction and elimination of fire hazards which will be satisfactory to all interests.

"Fifth.—To secure uniform rulings on forms, and to assist the assured in placing their accounts in desirable companies not crippled by conflagration losses or affected by wilful violations of state laws or doubtful foreign ownership.

"Sixth.—The magnitude of the entire subject, and its growing importance renders immediate action and careful consideration of the entire subject necessary by organizations as vitally interested as are electric and gas lighting combinations.

"Seventh.—Detailed advice on all improvements and new construction should be furnished these interests without the same ownership having to consult through a dozen different channels; in other words, it is earnestly recommended that some one source of information be supplied them through which they can discuss the various items suggested above."

Mr. Davidson added: "We have also received propositions from insurance brokers looking toward a uniform inspection and rerating of risks. We believe that without doubt some general scheme for placing insurance through a central source can be worked out which will greatly benefit the members of this association, and looking toward that end, we ask that this committee be continued and permission be given to obtain from the members of the association the necessary confidential information to enable us to work out the details properly."

Mr. Cole criticized the chaotic conditions among the companies themselves in that they are sending out independent inspectors, often incompetent, in addition to the regular state inspectors; and instances were cited at Elmira and elsewhere of such work.

The presentation of the treasurer's report brought up a discussion as to the value and heavy cost of the publicity work, on which $4,500 was expended. The other work of the association took about $1,700. It was pointed out that unjust publicity had cost members very large sums of money, and it was argued that good publicity checked all that. Mr. T. C. Martin pointed to the extraordinary subsidence of the municipal ownership agitation as one proof that the publicity work had had desired effect. Mr. W. H. Gardiner confirmed this.

The afternoon session was mainly devoted to papers and written reports, among them one by Mr. A. E. Forstall on "Gas Standards." Mr. L. C. Palmer presented a paper on the methods that public utility corporations should advocate as a basis for taxation. He said:

"At present we are taxed by the state on our gross earnings, one-half of 1 per cent. This is purely a state tax. If this plan of assessment is fair, equitable and desirable for the state to base its claims for its share of our tax, why should it not be equally fair, equitable and desirable as a basis on which to assess general utility corporations in the municipalities and counties? In addition to this we are again taxed by our city, school and county, and the valuation for these latter taxes is fixed by the tax commissioners regardless of the rate of taxation. In some cities the rate closely approximates 3 per cent, and utility companies are compelled to pay this rate upon whatever valuation the tax commission places upon the franchises and tangible property in the streets and alleys, besides

paying their regular real estate tax upon their plants proper, making the load very burdensome to carry. There is no question about the constitutionality of the state right to tax special franchises, which include the main and wire systems of gas and electric companies, that are in the streets, alleys or public places, but there should be some unit of value as a basis. At present there is none. If in the city above quoted as having the $40,000 assessed valuation, its property was in just proportion to that in the city that was assessed at $140,000, it would be all right, but such is not the case—and here comes in the trouble, for the franchise valuation in the city of the $40,000 assessed valuation is much more valuable than in the one whose assessed valuation is $140,000. In the writer's opinion, if we could pay our taxes upon our gross earnings, then each company would stand its just proportion of the taxes. The company selling $100,000 worth of its product would then pay taxes upon that basis, and another, selling only one-half as much of its commodity, would be taxed only one-half as much; while under our present system of assessments the earnings of a company make but little difference in the amount it is compelled to pay in taxes, as some very valuable properties are assessed much less than others not nearly so valuable. A property's value is its earning capacity, or what it can be made to earn, hence it should be taxed upon what it actually does earn and not upon what a few disinterested commissioners may think it advisable to place upon it, whether it can afford the amount or not, These commissioners do not know the circumstances under which each plant is laboring, but they can know how much our earnings are, and if I earn $100,000 per year, I should pay taxes upon that amount, and my neighbor earning $50,000 should pay taxes upon that amount only, then we would have a uniform taxation, and each general utility corporation would bear its just proportion of the public expenses."

Mr. Gardiner discussed this briefly as a member of the public policy committee of the National Electric Light Association, which combated the belief that a special tax should be paid for the use of the streets, as unfair to the consumer of service as against the non-consumer. "The use of the streets is practically free to every one. The modern gas or electric company transports energy equivalent to thousands of tons of coal over or under the public streets without wear and tear on these streets, without maintenance expense to the city, without interference with other traffic, without noise and nuisance to the public living along the streets, and with less detrimental incumbrance to the streets than could be done in any other way. If anybody is entitled to special consideration and advantage it seems to us that the user of this service should receive some advantage over the user of other forms of energy which require transportation in a manner that encumbers the public thoroughfares and subjects other people to interference, noise and nuisance, and also subjects the streets to unnecessary and expensive wear.

"In street railway service the same thing is true, but in a lesser degree. The taxes imposed upon quasi-public corporations are simply shifted to their consumers, as the company's ability to lessen the cost of its service is lessened to that extent, and in the case of street railway service it means that the users of the cars are paying more than their fair proportion for the maintenance of the public highways. If the public cars hold on an average 30 people, it means less interference with traffic than would 30 individual conveyances.

"We believe that the theory of franchise taxation is in error, is against the interests of public policy, imposes burdens where they do not belong, and in the street railway business imposes burdens on the poorer class of people, whom, as a rule, the public wishes to protect and favor in all other methods of taxation."

It was voted, after further discussion, that the chair appoint a standing committee of three on taxation, and to investigate the subject of the taxation of franchises.

Mr. R. M. Searle presented the report of the meter committee detailing the work done to secure data as to meters used by companies and the nature of testing. The committee approved the following recommendations:

1. That it be recommended to the commission the acceptance of certain or all types of meters, and all new types to be submitted to the commission.

2. That it be recommended to the commission that they continue to deal with the inspection of individual meters as they now do until a practical manner of carrying out the feature of the law can be evolved.

3. That the commission be requested to fix on as small a charge as possible for the services of their representative to supervise the test of all meters complained of by consumers on consumers' premises.

4. That the following section of the law be printed at the top or on the back of each billhead, together with the resolution of the commission fixing the charge for the services of the commission's representative, and an example of the blank billhead and the manner of charging for services be submitted to the commission for their information and approval:

"If any consumer to whom a meter has been furnished shall request the commission in writing to inspect such meter, the commission shall have the same inspected and tested; if the same on being so tested shall be found to be 4 per cent if an electric meter, or 2 per cent if a gas meter, defective or incorrect to the prejudice of the consumer, the inspector shall order the gas or electrical corporation forthwith to remove the same and to place instead thereof a correct meter, and the expense of such inspection and test shall be borne by the consumer. A uniform reasonable charge shall be fixed by the commission for this service."

5. It is suggested that companies send to the commission a statement once a month of tests on complaint of meters.

6. That a sub-committee of three report to the general committee at its next meeting upon a feasible method of supervising company's standards and tests of consumers' meters; the committee to consist of the chairman and such others as he may select to be associated with him.

7. It is suggested that a sub-committee be appointed to answer the only question asked by the commission at the meeting on Aug. 29, 1907, and which was not completely answered at that time, that is: "The number, the causes, the kinds, the number discovered on complaint as well as discovered by company, of meters running fast." The committee to consist of Mr. Arthur Williams, of Yonkers, chairman; Mr. R. M. Searle, of Rochester, and Mr. C. W. Cunningham, of Elmira, and that this sub-committee report at the next meeting of the general committee.

Mr. W. W. Cole presented a brief paper on the agitation for underground distribution in place of overhead, an abstract of which will be printed in a subsequent issue. Mr. E. L. Elliott then read an excellent paper on "Buying and Selling Illumination," in which he advocated the utility of illuminating engineering. The discussion in the paper was directed chiefly to street lighting. An abstract of Mr. Elliott's paper will be printed in a later issue.

The next paper on the programme, "Municipal Ownership in New York State," was read by Mr. Glenn Marston, and was a very forceful treatment of the subject, advocating vigilance and activity against the movement.

Messrs. T. R. Beal, L. C. Palmer and S. C. Bradley, Jr., were appointed a standing committee. The following officers were then elected unanimously: Mr. S. C. Bradley, Jr., president; Mr. P. J. Glidden, vice-president; Mr. T. C. Horton, treasurer. There were added to the executive committee Messrs. A. Williams, W. T. Morris and R. M. Searle.

Manufacture of Metallic and Other High-Efficiency Filament Lamps.

Two patents have recently been issued in Great Britain to the British Thomson-Houston Company, the representative in Great Britain of the General Electric Company, on the manufacture of metallic and other high-efficiency filament incandescent lamps. The more general patent states that the process described is applicable to a great variety of refractory metals and materials,

such as tungsten, molybdenum, boron, zirconium, titanium and compounds or alloys of any of these, or of other materials of the same general refractory nature. These materials are impregnated with less refractory metals or alloys, such as copper, cadmium, gold, silver, mercury, bismuth, tin, and various other of the well-known metals having vaporizing compounds approximating to these, and the alloys of these metals may also be used. In general, the less refractory metals are introduced in the pores of the refractory material and serve to give the body ductility and strength, and in some cases to increase its electrical conductivity. The ductile or alloy melting metal is retained in this condition until the body has been worked or formed into the desired shape, and it is then driven out by heat treatment, leaving behind a refractory wire rod or filament.

The specification then proceeds to describe the process which involves the use of an electric furnace for effecting the impregnating process. A rod of pure tungsten pressed into shape under heavy pressure passes through an airtight joint into a chamber at the bottom of which is placed a quantity of the ductile metal amalgam or alloy with which the tungsten is to be impregnated. In utilizing the apparatus the air is first exhausted from the chamber and then the tungsten rod lowered until its end makes contact with the liquid metal, after which it is elevated and an arc established between the rod and the vaporizing metal at the bottom of the tube. Excluded air and other gases given off during the process are then exhausted from the chamber so that after some minutes of operation the tungsten rod is in a clean and porous condition, and then the rod is suddenly lowered into the liquid metal, which percolates through the pores and completely fills up all the minute spaces in the rod. The impregnated rod is then withdrawn from the liquid and, after cooling, is smooth and strong and has a fine, even fracture and can readily be polished. Tungsten impregnated with silver or cadmium is white; while tungsten and the other refractory metals become yellow or salmon-colored when impregnated with copper. The impregnated rod may then be subjected, without further treatment, to the consolidating action of a high current, and if the current is properly applied, the resultant rod is much stronger and better suited for use as glowers than the original pressed or untreated material. Moreover, the impregnated rod may be rolled, drawn or extruded, much like pure metals of pure ductility, and can be converted into filaments of essentially the size now used in incandescent lamps. In the latter case, the filament is treated with electric current, as in the case of the rod.

The claims of the patent are on the process of impregnating the material, of forming it into a body of a required shape, and subsequently passing an electric current through the body to eliminate the fusible components.

The second patent relates to a method of producing pure boron, suitable for the production of rods for lamps and furnaces, which consists in heating a boron compound, such as nitride, in an inert environment to a temperature sufficient to decompose the compound and yield pure boron. In the process the apparatus described in the first-mentioned patent is in part utilized. The claims relate to the production of conductive boron by the decomposition of a boron compound, such as nitride, by heating to a temperature of about 15 degs. C. in a vacuum furnace.

The Street Railway Convention at Atlantic City.

[illegible] Monday, Oct. 14, the American Street & Inter-[illegible] Association, with its allied societies, will [illegible] ual convention at Atlantic City, and the [illegible] spread [illegible] over the week until the [illegible] patent [illegible] and [illegible] be held in the sun parlor near [illegible] h which, also, the fine customary [illegible] made. The accountants will have [illegible] onte Hotel, and the claim agents will be in session at the St. Charles. During the week there will as usual be various entertainments, but it is understood that owing to the local conditions pertaining at a seaside resort at this season of the year, the banquet will be omitted. A very large attendance is expected, and the hotel reservations have been extremely heavy. Secretary Swenson announces the following programmes for the various societies:

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

Wednesday, Oct. 16, 1907—9:30 a. m. to 1 p. m.; convention called to order; address of welcome, president's address, report of executive committee, report of secretary and treasurer, addresses by presidents of affiliated and allied associations, announcements, new business. Reports of committees: (a) membership, (b) compensation for carrying mail, (c) subjects, (d) car wiring, (e) standardization of equipment. Paper—"The Technically Trained Man and the Electric Railway Profession," by Prof. H. H. Norris, Cornell University, Ithaca, N. Y.; paper—"The National Fire Protection Association and Its Work in the Street and Interurban Railway Field," by Ralph Sweetland, Boston, Mass.; paper—"The influence of the Design of Railway Structures on Economy of Operation," by H. J. Campion and William McClellan, consulting engineers, New York, N. Y.

Thursday, Oct. 17, 1907—9:30 a. m. to 1 p. m. Appointment of nominating committee; reports of committees: promotion of traffic, rules, heavy electric traction. Paper—"Light Freight Handling by Electric Lines," by P. P. Crafts, general manager Iowa & Illinois Railway Company, Clinton, Iowa; paper—"Freight Service on Electric Railroads," by H. H. Polk, president Interurban Railway Company, Des Moines, Ia.; paper—"A Department of Publicity," by J. Harvey White, advertising manager Boston Elevated Railway Company, Boston, Mass.; paper—"Advertising from the Street Railway Standpoint," by A. W. Warnock, general passenger agent, Twin City Rapid Transit Company, Minneapolis, Minn.; paper—"The Problems of a Small Road," by H. S. Cooper, Manager Galveston Electric Company, Galveston, Tex.; paper—"The Use of T-Rails in Cities," by C. Gordon Reel, Vice-President Kingston Consolidated Railway Company, Kingston, N. Y.

Friday, Oct. 18, 1907—9:30 a. m. to 1 p. m. Reports of committees: (a) insurance, (b) rules for the construction of modern car houses, (c) municipal ownership, (d) public relations; paper—"Public Policies of the Past and Future," by C. Loomis Allen, Vice-President Utica & Mohawk Valley Railway Company, Utica, N. Y.; paper—"Interurban Railway Fares," by Theodore Stebbins, J. G. White & Company, New York, N. Y.; discussion—"Reduced Fare Agitation;" discussion—"Depreciation from the Financial and Managerial Standpoints;" report of nominating committee and election of officers. During this session, also, Mr. W. J. Clark, of the General Electric Company is to present a paper on "Municipal Ownership in Great Britain and the United States."

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION.

Tuesday, Oct. 15, 1907—10 a. m. to 1:30 p. m. Convention called to order; address—John I. Beggs, president American Street & Interurban Railway Association; annual address of president, annual report of executive committee, annual report of secretary-treasurer; paper—"Park Accounting," by Frank J. Pryor, Jr., comptroller the American Railways Company, Philadelphia, Pa.; question box, edited by Frank R. Henry, auditor, United Railways Company of St. Louis, St. Louis, Mo.; appointment of convention committees; new business. Two p. m. to 5 p. m., luncheon and social afternoon.

Wednesday, Oct. 16, 1907—9:30 a. m. to 1 p. m.; joint meeting with "American" association (on Steel Pier); 3 p. m. to 6 p. m.; paper—"Mechanical Devices for Office Use," by F. E. Smith, auditor Chicago Union Traction Company, Chicago, Ill.; report of committee on "Standard Classification of Accounts and Form of Report;" report of committee on "International Standard Form of Report."

Thursday, Oct. 17, 1907—10 a. m. to 2 p. m.; paper—"Where Maintenance Ends and Depreciation Begins," by J. H. Neal, auditor of disbursements, Boston Elevated Railway Company, Boston, Mass.; reports of convention committees; election of officers; installation of officers.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

Monday, Oct. 14, 1907—9:30 a. m. to 12:30 p. m., registration at Steel Pier; 2 p. m. to 5 p. m., convention called to order; address—John I. Beggs, president American Street & Interurban Railway Association; reading of the minutes of last meeting; address of the president; annual report of the executive committee; annual report of the secretary-treasurer; appointment of convention committees; reports of special committees; report of committee on "Control Apparatus;" report of committee on "Maintenance and Inspection of Electrical Equipment."

Tuesday, Oct. 15, 1907—9:30 a. m. to 12:30 p. m.; report of committee on "Way Matters;" paper—"Care of Electric Railway Tracks," by George L. Wilson, Engineer Twin City Rapid Transit Company, Minneapolis, Minn.; paper—"Rails and Joints as Affected by Traffic in New York City," by W. Boardman Reed, engineer, New York City; report of way committee on "Rails Corrugation Investigation;" report of committee on "Concrete Tie Investigation;" report of sub-committee on "Rail and Rail Matters."

Tuesday, Oct. 15, 1907—2 p. m. to 5 p. m.; report of "Committee on Standardization;" report of committee on "Open vs. Closed Terminals for Car Storage;" report of committee on "Operating and Storage Car House Designs;" question box.

Wednesday, Oct. 16, 1907—9:30 a. m. to 1 p. m.; joint meeting of American Association and Allied Associations.

Paper—"Gas Engines," by Paul Winsor, chief engineer motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass.; paper—"Gas Engine Operation," by W. W. Cole, general manager Elmira Water, Light & Railway Company, Elmira, N. Y.; paper—"Steam Turbines," by St. John Chilton, engineer, Allis-Chalmers Company, Milwaukee, Wis.; paper—"Steam Turbines," by August H. Kreusi, engineer, General Electric Company, Schenectady, N. Y.; paper—"Recent Developments in Steam Turbine Power Station Work," by J. R. Bibbins, engineer, Westinghouse Machine Company, East Pittsburg, Pa.; general business; election of officers.

The claim agents' association will have its meetings on Monday, Tuesday and Wednesday.

Test of a 7500-kw Steam Turbine.

An eight-hour economy test was made Sept. 1 by the New York Edison Company, through its chief engineer, Mr. J. P. Sparrow, of a 7500-kw Westinghouse-Parsons steam turbine in Waterside Station No. 2. While rated at 7500 kilowatts, the turbine has a maximum output of 11,250 kilowatts. Under 175 lbs. of steam pressure, 28 ins. vacuum, and 100 deg. superheat, the turbine unit was guaranteed to have a minimum steam consumption of 15.9 lbs. per kw-hour at the generator terminals, with a normal speed of 750 r. p. m. The electrical efficiency of the generator was guaranteed to be 97.8 per cent, exclusive of friction and windage at the test load. The results of the tests showed a consumption about 7.5 per cent less than the guarantee.

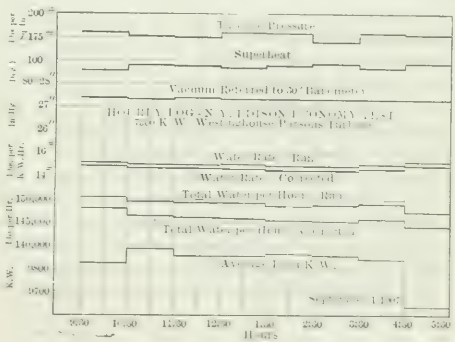
During the tests the turbine carried practically 70 per cent of the 25-cycle load of the station. The load on the turbine was maintained as constant as possible by remote control of the turbine governor by the switchboard operator, the maximum variation of the load being held within 4 per cent above and below mean, except during the last hour, when the load decreased somewhat. Previous to the test, the turbine unit had been running on a load of 7000 kilowatts, which was increased to the test load 10 minutes before the start.

The electrical load was measured by the two-wattmeter method, using instruments of the standard laboratory type, which were calibrated at the New York Electrical Testing Laboratories immediately before and after the tests. The power-factor was maintained substantially at unity, and the electrical readings were taken at one minute intervals. All water of condensation was weighed at intervals of five minutes. The circulating pump drew salt water taken from the East River, and condenser leakage was determined entirely by chemical analysis, employing the silver nitrate test with a suitable color indicator. This method is stated to have proved extremely sensitive, and had the advantage of making it possible to discover any change in the rate of condenser leakage taking place during the tests, whereas the method of weighing the leakage accumulated during a definite period, when the condenser is idle and under full load, provides only an average result during the period. The water level in the hot well was maintained at a practically constant point. Steam pressures and temperatures were determined close to the turbine throttle and the degree of superheat was obtained in the usual manner.

The following data represent the results of the tests, calculated for instrumental errors only:

Duration of test	9:30 a. m. to 5:30 p. m.
Average steam pressure at throttle, lbs. per sq. in. gauge	177.5
Average superheat at throttle, degrees F.	95.74
Average vacuum (referred to 30 ins. barom.), ins. mercury	27.31
Average load on generator, kilowatts	9830.48
Average steam consumption, as tested, lbs. per kw-hour.	15.15

Owing to the departure during the test from specific operat-



CONSUMPTION TEST OF STEAM TURBINE.

ing conditions upon which guarantees were based, it was necessary to correct the observed results by the following amounts:

Pressure (2.5 lbs. high) correction, 0.25 per cent; vacuum (0.69 in. low) correction, 1.84 per cent; superheat (4.25 deg. low) correction, .29 per cent. These corrections when applied to the observed steam consumption given above gave the following results, representing contract conditions:

Average corrected water rate during eight-hour tests, 14.85 lbs. per kw-hour. The guaranteed water rate was 15.9 lbs. per kw-hour.

The accompanying chart represents the results segregated into hourly periods. It will be noted that the load was considerably lower during the first and last hour than during the main part of the test. Neglecting these two hours and considering only the six hours' period from 10:30 a. m. to 4:30 p. m., the results are as follows:

Average corrected water rate, 14.8 lbs. per kw-hour.

Equivalent water rate, 10.65 lbs. per brake hp-hour.

Equivalent water rate, 9.8 lbs. per indicated hp-hour.

The two latter quantities are determined by applying conversion factors for generator efficiency and for internal losses.

Compared with the results previously obtained from tests of machines of similar design installed in the Manhattan Station of the Interborough Rapid Transit Company, New York, and the Long Island City Station of the Pennsylvania Railroad, at the same loads and with equivalent operating conditions, the several performances are almost identical.

CURRENT NEWS AND NOTES.

AMERICAN ELECTROCHEMICAL.—The American Electrochemical Society will hold its meeting in New York City Oct. 17 to 19, as already announced, full details of the programme having been given in these pages last week.

OHIO TELEPHONE INDEPENDENTS.—The executive committee of the Ohio Independent Telephone Association, at a meeting a few days ago, decided upon the following places and dates for the district meetings: District No. 1, Cleveland, Nov. 8; No. 2, Canton, Nov. 19; No. 3, Zanesville, Nov. 20; No. 4, Newark, Nov. 21; No. 5, Washington C. H., Nov. 22; No. 6, Toledo, Dec. 3; No. 7, Lima, Dec. 4; No. 8, Dayton, Dec. 5; No. 9, Hamilton, Dec. 6. District officers will be chosen at these meetings and delegates elected to attend the meeting of the International Independent Telephone Association. While it was announced some days previous to this meeting that the proposed negotiations between the Bell and the Independent people relative to Bell competing exchanges would be taken up, nothing furthur than a discussion of the subject took place. It is said that the question will be taken up at some future meeting of the committee.

A SWINDLER ABROAD.—It has been brought to our attention that a man who some time ago defrauded a number of members of the electrical and mechanical industries in this country has recommenced operations, and we therefore deem it advisable to republish his description and warn our readers against him. He is a very plausible Englishman, about 30 years of age, 5 ft. 7 or 8 ins. in height, of slight build, light complexion, has crooked teeth, and generally represents himself as the son of some large manufacturer or other important man in England. He is very well informed as to the names of products and manufacturers on both sides of the Atlantic, and as a rule, after gaining the confidence of the man upon whom he calls, tells a story about having been robbed and asks for a loan to tide him over until he can get money from his father, to whom he has cabled. There are any number of concerns in the country which have been victimized by this plausible swindler.

LONG DISTANCE WIRELESS.—A despatch from Sydney, N. S., dated Oct. 7, states that while Marconi experts there were testing new receiving cones at the top of the tower at Morien station an operator in the room below picked up the wireless station at Manila in the South Pacific. A message was received saying that the American cruiser *Philadelphia* had arrived at that point all safe. The Marconi people account for the strange happening on the theory that the cone at Morien must have been in perfect tune with that at Manila. The authorities at Washington state that the old cruiser *Philadelphia* is at the Bremerton Navy Yard, near Seattle, and has been out of commission for several years. They scout the theory that a message could be sent from Manila or Bremerton to Sydney. Mr. John Bottomley, secretary of the Marconi Wireless Telegraph Company of America, said that he didn't put any faith in the story. In the first place, he never heard of a Marconi wireless station at Morien. The Marconi station in Nova Scotia is at Cape Breton, some distance away. He also said that there is no Marconi wireless plant at Manila.

WIRELESS TELEPHONY.—A Norfolk, Va., despatch states that wireless telephone communication was had on Oct. 5 by Mr. De Forest between the battleship *Virginia,* at the Norfolk Navy Yard, and the office in Norfolk, a distance of two miles. According to advices from Boston, the battleship *Connecticut* has also been equipped with wireless telephone apparatus, and that in recent tests it was demonstrated that ships equipped with the wireless telegraph, but not with the wireless telephone, could distinctly hear through ordinary telephone receivers what was said in the transmitter of the telephone aboard another ship. Mr. De Forest, on the *Connecticut,* talked into the transmitter of the wireless telephone, and the operators on the *Kentucky* and *Illinois*, although those ships were not equipped with wireless telephones, attached telephone receivers to the wireless telegraph instrument and heard distinctly conversational tones of Mr. De Forest. The *Kentucky* and *Illinois* were 11 miles away from the *Connecticut.* It is stated that in one test spoken words were received on a battleship 22 miles distant from the *Connecticut.*

TELEPHONY IN ALBERTA.—The provincial government's telephone lines have been completed in several parts of Alberta, and work is proceeding briskly on the unfinished sections. The Calgary-Hudson's Bay line is now complete and instruments will be installed very shortly. The line from McLeod to Blairmore and Franklin is practically complete, and will be in operation very shortly, and the same applies to the line from Wetaskiwin to Hardisty and the one from Lacombe to Stettler. The section from Edmonton to Lloydminster is completed as far as Vegreville, and will be in opration before the snow flies. Instruments have been distributed northward from Edmonton for about 30 miles along the line to Athabasca Landing, and the rest of the apparatus will be distributed and the wires strung on the government telegraph lines this fall. If it is not completed, the system will be in such shape that it will be finished early in the spring. When completed this line will have the distinction of being the most northerly telephone line in the world, except the system in operation at Dawson City. When the Alberta government promised to have 500 miles of government line in operation before the end of 1907 there were a number of scoffers, but from the progress made by the various gangs, it is evident that some 600 miles will be in use this year.

VISITORS TO THE SHOW.—The success of the Electrical Show at Madison Square Garden with the public is well known, but it is not realized that a great many central station men have also been attracted. Mr. M. S. Seelman, of the Brooklyn Edison Company, sends us this as a very imperfect list of the visitors to their "seven-room flat in heaven" last week: C. L. Edgar, president, Edison Electric Illuminating Company, of Boston; I. E. Moultrop, superintendent, construction bureau; La Rue Vredenburgh, superintendent, exhibition department; L. D. Gibbs, special agent; T. R. Beal, secretary Poughkeepsie Light, Heat & Power Company; E. O. Richards, superintendent, Newburgh Light, Heat & Power Company; P. T. Glidden, vice-president, Binghamton Light, Heat & Power Company; Jos. B. McCall, president, Philadelphia Electric Company; Alexander Dow, president, Association of Edison Illumination Companies; L. A. Ferguson, vice-president, Chicago Edison Company; F. M. Tait, general manager, Dayton Lighting Company, Dayton, Ohio; C. R. Huntley, vice-president, Buffalo General Electric Company; W. C. L. Eglin, chief electrical engineer, Philadelphia Electric Company; Henry L. Doherty, president, Denver Gas & Electric Company; W. W. Cole, manager, Binghamton Company; Homer E. Niesz, assistant to vice-president, Chicago Edison Company; Walton Clark, vice-president, Public Service Corporation of New Jersey; J. H. Whittlesey, chief engineer; Dudley Farrand, general manager, Percy Ingalls, treasurer, Gen. G. H. Harries, vice-president, E. S. Marlow, treasurer, Public Service Corporation of New Jersey; L. E. St. Clair, general superintendent, Washington Railroad & Electric Company; Gen. F. E. Greene, vice-president, Ontario Power Company; E. L. Davenport, general agent, Narragansett Electric Lighting Company, Providence, R. I.; A. B. Tenney, general manager, H. T. Sands, manager, Haverhill Electric Company; C. G. M. Thomas, vice-president, New York & Queens Electric Light & Power Company; H. E. McGowan, general manager, Flatbush Gas & Electric Company; Geo. Bullock, president, E. E. Witherbee, manager, United Gas Improvement Company, Philadelphia, Pa.; Jos. D. Israel, secretary and manager, P. H. Bartlett, B. J. Lochart, H. M. Haffligh, special agents, Edison Electric Light Company, Philadelphia, Pa.

COLUMBIA UNIVERSITY.—The first meeting of the Electrical Engineering Society of Columbia University, New York City, will be held on Oct. 18, at 8.15 p. m., in room 301, Engineering Building. Professor F. R. Hutton will deliver a lecture on "Gas Engine Units." All who are interested in this subject are invited to attend.

TITANIUM COMPOSITE ARC ELECTRODE.—A patent issued Oct. 1, to Mr. William S. Weedon, of Schenectady, N. Y., describes a luminous arc-light electrode for use with a positive copper electrode, in which titanium sub-oxide is the luminous element. Seven parts of titanium oxide are mixed with one part of carbon and exposed to a temperature of 1500 deg. to 2000 deg. before or after the electrode is formed, thus converting the oxide to a sub-oxide.

MODERNIZING OXFORD it said to be the worthy ambition of Lord Curzon, its chancellor, who as a preliminary step is raising a fund of $1,250,000. He regards an electrical laboratory as a primary need. It will be remembered that Prof. Bell was made a doctor of science at the last commencement, and it is also understood that Mr. Edison was invited to receive a similar honor, but found it impossible to go over to England at the time.

DAY SERVICE AND HEATING DEVICES.—The Boone Electric Company, of Boone, Ia., started a daylight service Oct. 1. Boone is a town of about 9000 population, so that there should be plenty of day load in the course of a year or two. Among other things, a special effort will be made to sell electric heating and cooking appliances. These will be distributed through Mr. H. L. Tillson, an electrical contractor who makes his headquarters at the company's offices.

VICTORIA FALLS POWER.—A special cable dispatch from London, of Oct. 5, says: "Ralph D. Mershon, of New York, one of the consulting engineers of the Victoria Falls Power Company, has just returned to England from South Africa, where he studied the long-discussed problem of transmitting electric energy generated by the Victoria Falls to the mines operated in the Rand. Mr. Mershon boldly declares that there is not the slightest doubt in his mind that the transmission could be profitably effected." It is said, however, that scepticism is entertained in London on the subject.

AERIAL ASSOCIATION.—An announcement has been made of the organization of the Aerial Experimenting Association, with a membership including Prof. Alexander Graham Bell. The association was organized recently at Halifax, Nova Scotia, at a dinner given by Professor Bell to Captain Baldwin, who made a successful airship flight there. The new association will be incorporated in the United States and will carry on the aerial experiments which Prof. Bell has been conducting at Beinn Breagh, N. S. Headquarters will be established at Washington, for the winter, and in the summer will be transferred to Baddeck, C. B.

SWISS TUNNEL ROADS.—The introduction of electric traction on railroads that have long tunnels appears to have had an extraordinary effect in the development of short and long tunnel schemes in Switzerland. Some of the plans for inter-canton and international routes are very ambitious, involving sums as large as $55,000,000 in individual instances. Including local trolley enterprises, there are already in Switzerland 111 projects for which concessions have been granted. It is obvious that the execution of even a small number of these projects would not only require a very large sum of money, but would call for large quantities of hydraulic and electrical apparatus.

WIRELESS REVENUE.—A special cable dispatch from London, of Oct. 5, says: "Intimations more or less authoritative that Signor Marconi has succeeded in establishing wireless service across the Atlantic are followed by forecasts that the public will prefer this method of communication, because it is new, and that the cable companies will suffer. *The Economist* has a carefully reasoned article to-day showing that the wireless system, even if successfully operated, cannot handle more than 3,000,000 paying words annually, and that it will only be equivalent at the most to the laying of the thirteenth cable across the Atlantic with the kingdom as a base, or the seventeenth between Europe and America. The position of the cable companies consequently is not insecure, even if Signor Marconi's expectations are carried out."

RAILROAD TELEGRAPHERS.—By the requirements of the new eight-hour law for railroad telegraphers, which went into effect recently, the number of operators employed by the roads in New York and nine other states should be increased by one-third. Hundreds of station agents, who have been acting as both ticket agent and telegraph operator, will also come under this law, making it necessary to employ two men. The New York Central will not at once comply with the law, being unable to secure 1000 new operators. The New Haven has men enough. The strikers claim that the new law means employment for 8000 more men. The New York Central Railroad, like the Pennsylvania, has established its own telegraph schools at various points to train men for the work. There will doubtless be a larger resort to the telephone.

NATIONAL WASTE.—According to advices from Washington, as the result of an extensive investigation of the country's natural resources, conducted in the West, at the instance of the Government, Prof. J. A. Holmes, Chief of the Technologic Bureau of the Geological Survey, who has just returned, has made an official statement warning the American people that the present prodigious waste of these resources must stop at once if the country is to continue to prosper. Prof. Holmes made the investigation to determine how serious the situation is. He declares that in the mining operations of the present time nearly one-half of the total coal supply is being left underground; that water as a source of power is being wasted day after day and year after year to the extent of millions of horsepower, and that forest fires have burned more lumber than has been used in the building of homes or in the industries. Prof. Holmes says that the waste of coal is appalling. Every possible means should be adopted, he declares, for reducing this waste to an absolute minimum, in order that the country's fuel resources may suffice for the future, as for the present needs of the Nation. At present rates of waste and consumption, he sees an end of the coal supply by the year 2000. And yet the attempt to utilize Niagara is treated as a crime!

TITANIUM is the subject of a report by Mr. F. L. Hess, for the U. S. Geological Survey. Although generally spoken of as one of the rare elements, it is really one of the more common ones. According to Dr. F. W. Clarke, chemist of the Survey, it forms 0.43 per cent of the surface rocks of the globe and is much more plentiful than lead, zinc, copper and other metals classed as "common." A great many schists and gneisses carry titanium, and it is found in appreciable quantities in clays—not only surface clays but also those that have been dredged from the sea bottom. After noting the use of titanium in steels the report says: "Several firms are now experimenting with titanium filaments in incandescent electric lamps, but the reduction of titanium to a metal is so difficult that the lamps have not yet been extensively placed on the market. Titaniferous magnetite and titanium carbide, the titanium of which is derived from rutile, are used as electrodes in arc lamps. When one electrode is made of these substances a block of carbon is used for the other. The best known rutile deposit in this country, the one which produced the greater part of the titanium output in 1906, is at Roseland, Nelson County, Va. A few pounds were produced in Chester County, Pa., where the product is said to occur in comparatively large crystals and to be very pure."

WIRELESS TELEGRAPH PATENTS.—The number of United States patents issued relating to wireless telegraphy (class 178, sub-class 319), up to and including the issue of June 25, 1907, is no less than 463. A complete set of the printed specifications of these patents may be obtained for $13.89 from the Patent Office.

EIGHT-HOUR LAWS.—The Circuit Court of Cass County, Missouri, has held that the new eight-hour statute is unconstitutional and savors of class legislation. This decision follows the attempt of a telegraph operator in the employ of the Missouri Pacific Railway to have the company indicted for compelling him to work more than the prescribed eight hours.

ENCLOSED FUSE FILLING.—A patent issued to Mr. Frederick H. Weston, of Schenectady, N. Y., describes a filler for enclosed fuses consisting of granules formed of slaked lime by the use of a binder. Such granules are stated to be hard, infusible and porous, incapable of being rendered conductive by heat and providing proper interstices for the distribution of the fusing gases for absorption.

CANADIAN TELEGRAPHS.—Owing to the great advance in wages and material the Canadian Pacific Railway Company is increasing telegraph rates by from 100 to 200 per cent. The preparation of a suit before the railway commission has been commenced by newspaper publishers from the head of the lakes to the Pacific coast. The case will be carried before parliament at the coming session. Litigation, based on charges of restraint of trade, is also threatened.

TELEPHONE INDICTMENTS.—At Dallas, Tex., on Oct. 5, Judge Scott, of the Fifty-Fourth District Court at Waco, set the cases against Vice-President and General Manager J. E. Farnsworth and Superintendent C. A. Gales of the Southwestern Telephone Company for Nov. 25. President H. J. Pettingill is also indicted. All are charged with unlawful discrimination in the telephone rates in violation of the anti-trust and anti-pass laws of Texas. In case of conviction the lowest penalty is $200 fine and six months in the penitentiary and the highest $1,000 fine and two years in the penitentiary.

CLEVELAND ELECTRIC CLUB.—On Oct. 2, Mr. C. C. Badeau read a paper before the Electric Club of Cleveland on "Circuit Breakers and Their Relation to Electric Machinery." At the next meeting on Nov. 6 it is proposed to discuss Nernst lamps. The officers for the year ending September, 1908, are: President, Mr. E. E. Ranney, superintendent exchanges, the Cleveland Telephone Company; first vice-president, Mr. George B. Dusinberre, consulting engineer; second vice-president, Mr. C. G. Beckwith, superintendent, Collinwood Municipal Light Plant; secretary, Mr. George L. Crosby; treasurer, Mr. D. M. Hosford; board of managers, Prof. H. B. Dates, electrical engineering department, Case School of Applied Science; Mr. C. E. F. Ahlm, consulting engineer.

TELEGRAPH MONOPOLY.—As the result of application made by Attorney-General Jackson of New York, the Hearst-Socialistic candidate elected at the last election, Justice Ford, of the New York Supreme Court, has issued an order directing the Western Union and Postal Telegraph Cable Companies to show cause before Justice Seabury, this week, why the attorney-general should not get leave to begin an action to vacate their charters and annul their corporate existence. The ground for Mr. Jackson's petition was that the companies had violated the statutes of the State prohibiting monopolies and unlawful restraint of trade and competition. Mr. Jackson charged that a combination was made on Jan. 1, of this year, and that a new and increased schedule of rates was put into effect. The companies, he contended, had agreed to maintain joint offices and divide the profits of business received therein. He alleged, for example, that the companies had agreed to divide hotel business on a basis contrary to the Penal Code of the State.

ORGANIZED LABOR.—Cardinal Gibbons has a forceful article in *Putnam's Monthly* on organized labor, in which he insists that unions have sacred obligations and must be warned against serious dangers. He objects strongly to the boycott, and says that "experience has shown that strikes are a drastic, and, at best, a very questionable remedy for the redress of grievances." As to the "open shop" and intimidation, he says: "Every American citizen has the right to be protected in his efforts to earn an honest livelihood. No man or combination of men should have the power to prevent him from following his vocation, even by intimidation, for he may have not only himself but a wife and children for whom to provide. It is my opinion that the honest laborer who is willing to do work which is proper and in no way conflicts with the interests of the community should be given the opportunity to perform it, and to have the same protection from the authorities which is extended to any peaceful citizen, no matter how powerful or influential may be the person or society which opposes him."

TELEGRAPH CONTRACTS.—The telegraph war between the Pennsylvania Railroad and the Western Union Telegraph Company, begun under the Cassatt régime because of the efforts of the Wabash Railroad to reach the Atlantic seaboard, has ceased, and 25-year contracts have been made. The fight between the Goulds and the Pennsylvania over the former's efforts to reach the seaboard and to gain an entrance into Pittsburg was marked by protracted litigation as well as by numerous physical efforts on the part of the Pennsylvania to oust the Western Union from the Pennsylvania's right of way. The telegraph company's poles were cut down repeatedly, and for a long time there was open warfare between the two interests. The Goulds lost the telegraph business on the lines east of Pittsburg, but after much struggling they gained a railroad entrance into Pittsburg. Their line to the Atlantic seaboard is not yet completed, but unfavorable money market conditions rather than objections on the part of other railroad interests have been held responsible for the work being delayed. The Postal Company made a contract with the Pennsylvania, but it is understood that the renewed Western Union contract will not deprive the Postal of any office of importance.

CANADIAN POWER.—A recent conference was held at Toronto in the Parliament Buildings on the subject of the acquisition of a supply of electric power for distribution by the Hydro-Electric Power Commission. The parties to the consultation were Mr. H. H. McCrae, of the Electrical Development Company, of Ontario; Mr. Geo. Tate Blackstock, K. C., special counsel for that company; Hon. Mr. Whitney, prime minister of Ontario; W. K. McNaught, M. P. P., of the Hydro-Electric Power Commission, and Mr. A. F. Lobb, counsel for the commission. Although no official statement as to the discussion was given out, it is understood that the Electrical Development Company is now desirous to share in the business of supplying the Hydro-Electric Commission with electric energy. The Ontario Power Company has agreed to sell energy to the provincial commission at the rate of $10.40 per horse-power per annum, for 25,000 hp or less, or $10 per hp-year for more than that quantity. It is understood that when the problem was first broached the Electrical Development Company was not willing to meet these rates. Now it is said that the concern wishes to secure equal rights with the Ontario Company, and has submitted a proposition to the Government. This is said to include a provision that it shall serve a certain prescribed area of the province. The Electrical Development Company is allied with the Toronto & Niagara Power Company, which has transmission lines from Niagara Falls to Toronto and to Brantford. By means of these, power could be furnished to municipalities on these routes.

Hydro-Electric Power and Transmission Plant at West Buxton, Maine.

THE supply of electricity for municipal and private use in Portland, Maine, has recently been largely increased and improved by the operation of the new station of the Portland Electric Company. This is a hydro-electric development on the Saco River at West Buxton, about 20 miles from the city, and will amount to 4000 horse-power, produced by four units, of which three are now installed. The electrical energy is transmitted at a potential of 22,000 volts, to the main transformer station in the suburbs of Portland.. The development has been carried out by J. G. White & Company, and several interesting features have been introduced in both the design and construction.

While of moderate size the plant at West Buxton represents the best and latest practice in water-power development and utilizes the energy of the river at the point of location practically to its full extent. The accompanying illustrations convey an excellent idea of principal points of the design. In the construction the most notable feature, considering climatic conditions and the handicap of exceptionally rigorous winter weather, has been the rapid rate of work. Construction was begun on Aug. 3, 1906, and the plant was complete and ready for operation Aug. 12, 1907.

A review of the electric light and power situation at Portland is interesting in connection with the new installation. The development of the city in recent years has been steady and substantial, and the population has grown at the rate of about 40 per cent per decade. Portland is now one of the most important manufacturing centers of New England, having about 250 well-established manufactories. The total capitalization of these is $7,000,000, and nearly 5000 operatives are employed. Portland is, besides, the winter terminal of the Grand Trunk Railroad, the general business activity of the city and the demand for electricity being materially augmented by this fact. The large demand for power, coupled with the high cost of coal, has stimulated water-power development and made necessary the installation at West Buxton.

At the present time there are two principal companies doing the electric lighting and power business of Portland, namely, the Portland Lighting & Power Company, and the Consolidated Electric Light Company of Maine. The Portland Lighting & Power Company is supplied with electricity generated by a hydro-electric plant of 2500 hp, located at Great Falls on the Presumpscot River, 20 miles from Portland. This company has the city lighting contract and also furnishes electricity for commercial purposes, particularly in the suburban territory. The Consolidated Electric Light Company operates a modern and efficient steam plant of about 2800 horse-power in Portland, and supplies most of the general commercial demand of the city, where its distribution system is extensive. A considerable portion of the distribution system is underground. Both of these companies have been running their plants at full capacity for some time.

The West Buxton development, with the transmission lines and the sub-station in Portland, is owned by the Portland Electric Company, and the Consolidated Electric Light Company has contracted for the entire output. It will thereby be enabled to take care of the great influx of new lighting and power contracts signed and in prospect. By the combined operation of the three plants described, Portland is placed in a unique position. Its residents now pay lower rates for electricity than is charged in any other city in New England.

The design of the West Buxton plant, and in particular the transmission system, is based on the purpose of ultimately uniting the service with that of the Great Falls water-power plant at a main transformer station in Portland. The transmission lines from the Great Falls plant are to be carried direct to the new station. This will permit the abandonment of several sub-stations and auxiliary plants. The high-tension current from both West Buxton and Great Falls will be reduced to

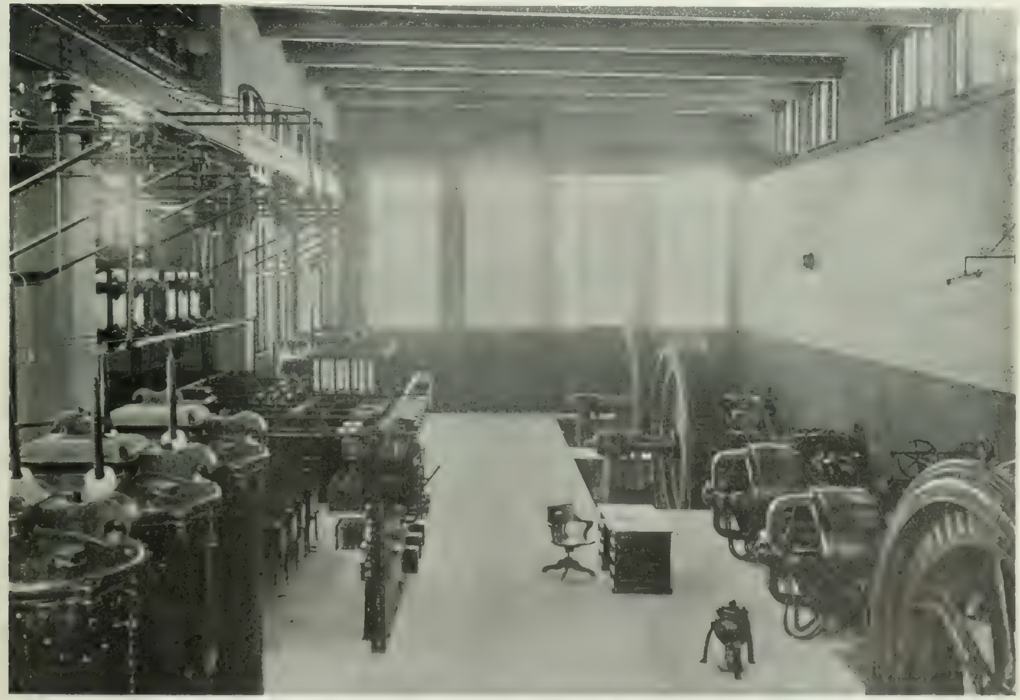


FIG. 1.—INTERIOR VIEW OF THE WEST BUXTON POWER HOUSE OF THE PORTLAND ELECTRIC COMPANY

[illegible] Consolidated Electric Light Company's plant. There, motor-generator sets are placed for converting the united output to direct current at 250 volts, which is distributed by a three-wire system throughout the business section of the city. At present there are installed at the main transformer station mentioned, [illegible]

[illegible]

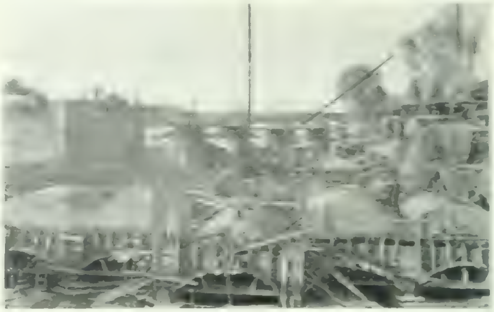
further transformer equipment to handle the Great Falls output.

The transmission line from the West Buxton plant to Portland consists of two three-phase circuits of No. 2 wire, a metallic telephone circuit of No. 12 copper wire, and a ground circuit of No. 12 phono-electric wire. The main line insulators are triple petticoated, glazed porcelain, and are mounted on hard maple pins. The circuits are carried one on either side of the pole on two cross-arms and the triangles are inverted. The wires are placed 36 ins. apart. The telephone wires are carried on brackets below the lower arm, while the ground wire is run over the tops of the poles and grounded at every sixth pole through a No. 4 B. & S. copper wire, connected by a brass screw-plug with a galvanized-iron pipe driven 6 ft. in the ground. The cross-arms are of long-leaf yellow pine, and are doubled at points of curvature on [illegible]

[illegible]

[illegible]

At West Buxton the principal structures of the plant proper [illegible] crete and brick. The power house is located on the east bank of the river, with the dam abutting against it and the water is [illegible] long, 30 ft. high and 29 ft. thick at the base. It consists essentially of monolithic sections 40 ft. long, keyed together and also into the rock foundation. The entire plant is founded on bed rock. The intake and head works are protected by a reinforced concrete wing wall and boom 140 ft. long running from the abutment of the dam at an angle of 45 deg. to the [illegible]



[illegible]

surface of the water at all stages of the river so that floating débris will be skimmed off and carried along its face to a chute in the adjacent end of the dam. Six concrete piers support the boom.

The construction, including the placement of the major part of the concrete in both dam and power house, was carried on without interruption throughout last winter, which was exceptionally cold. The cement was mixed with hot water and the rock and sand were thoroughly heated before mixing. Special appliances were devised to carry out the heating process

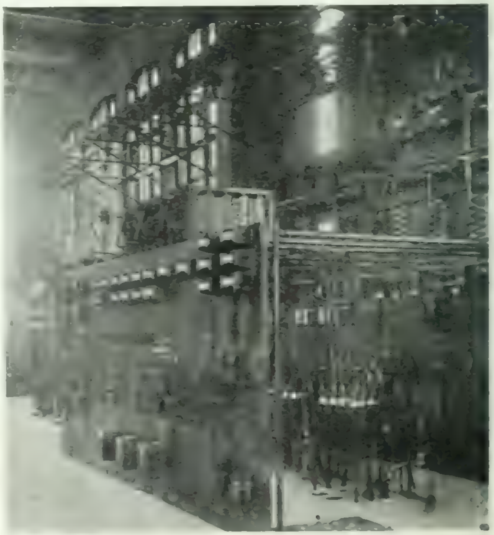


FIG. 5.—[illegible]

rapidly and economically. Though much of the concrete was placed in a surrounding temperature of 30 deg. below zero, and nearly all of it under freezing conditions, none was injured by freezing and the finished work has proved exceptionally [illegible] ably by the expedition with which the mixed material was placed after heating and by the heat stored in the solid con-

stituents which was sufficient to allow the mass to set before it was reduced to a freezing temperature.

The control of the river during construction involved some special problems. Use was made in part of an old timber mill dam conveniently located just above the new dam site. The old dam was raised for a part of its length and an area including the situation of the new power house and about 200 ft. of the

FIG. 6.—DAM AND POWER HOUSE OF THE [illegible]

new dam was surrounded by a cofferdam built down stream from the old dam and then in to the east bank of the river. During the construction of these coffers the west abutment and the end section of the dam were being built. When the cofferdam was completed the original timber dam was opened west of the point where it was joined to the cofferdam and the entire flow of the river was sent through that channel. Then the power-house foundations and the adjacent 200-ft. section of the dam were [illegible]

The next step was to bloc[illegible] the channel, cut through the old dam, thereby [illegible] the flow of the river through the power house and exposing the foundations for the final dam section. The aperture in the old dam was first narrowed as much as possible by constructing cofferdams from each side toward the center. The projecting ends were finished square and parallel, and were provided with shoulders running from top to bottom. Across the narrow remaining opening, heavy joists were laid and upon these joists a massive timber gate was built in position to be dropped into the opening. The supporting joists were then sawed through to the safe limit and dynamite charges were inserted at each sawed section. All the charges were connected on the same circuit. They were then simultaneously exploded: the supporting timbers parted and the gate fell solidly into place, resting against the shoulders of the cofferdam. The river then flowed through the power-house draft tubes and over the completed section of the dam, permitting the last section to be built very easily.

The arrangement of the machinery in the West [illegible] plant

FIG. 7.—[illegible]

is unusually logical and conduces to simplicity of operation. The main and exciter turbines are of the horizontal immersed type and each unit is placed in a separate wheel chamber, with the shaft projecting through the chamber wall into the generating room [illegible]. The

[illegible] units running at 360 r. p. m.

Each of the main turbines is made up of two wheels, having a diameter of 48 ins. and each is designed to develop 1340 horse-power under a 25-ft. head. The wheel chambers in which the turbines are placed are 12 ft. deep and the draft tubes are 13 ft. long. Water is admitted at the ends of the turbine, and the gates [illegible]

FIG. 8.—DAM, INTAKE AND HEADGATES AT WEST BUXTON.

driven from the main shaft. The gate shaft is parallel with the main shaft and controls the gates by means of reach rods. The gates are 48 ins. in diameter and 22 ins. wide. The common discharge from the two wheels of each machine is into a heavy cast-iron box at the center. Below the draft boxes are the draft tubes, which are conical, 10 ft. in diameter at the upper

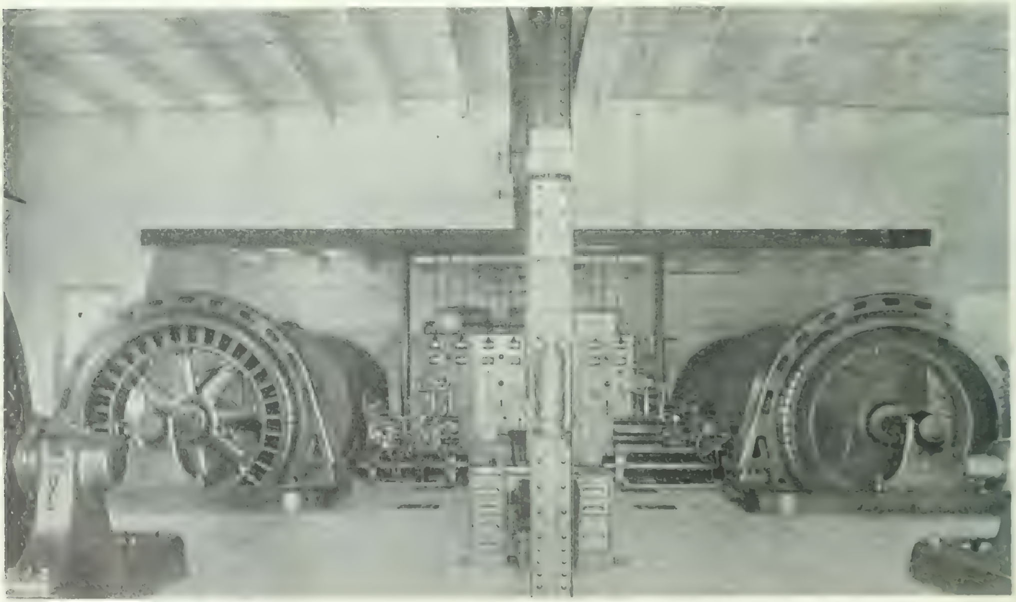


FIG. 9.—INTERIOR OF THE GREAT FALLS PLANT OF THE PORTLAND LIGHTING & POWER COMPANY.

end and 12 ft. at the lower and 13 ft. long as above noted. These tubes are designed to give a velocity of 5 ft. per second at the lower end with eight-tenths water. They discharge into concrete channels which run beneath the generating room to the tail-race.

The over-all length of the main generating units is 41 ft., and each has six shaft bearings, two at the generator and three in the turbine, with an intermediate thrust bearing. The turbine bearings are located one at each end and one at the center in a yoke bolted to the draft box, and are of lignum-vitæ. The thrust bearing is three feet long and is provided with four collars. The shaft is 9 ins. in diameter at the bearings.

The flow to the wheel chamber of each of the main generat-

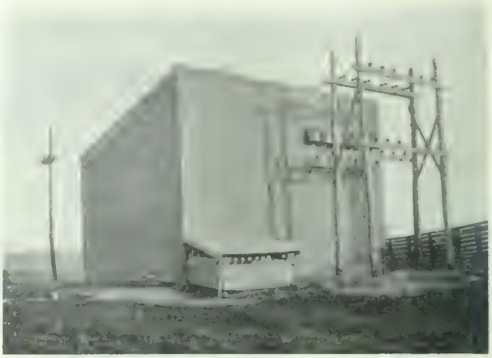


FIG. 10.—MAIN TRANSFORMER HOUSE IN SUBURBS OF PORTLAND.

ing sets is controlled by three independently operated head gates. There are two main gates and a filler gate for each wheel, all constructed of yellow pine. The main gates are 7 ft. 9 ins. wide and 13 ft. high, and they differ from each other only in controlling mechanism. One may be manipulated under full head and the other only under a comparatively small head when the wheel chamber is nearly full. However, to facilitate the movement of the main gate in starting up a set, a filler gate is provided to be used ordinarily for filling the wheel chamber. All the gates are operated by hand mechanism of the standard worm gear, pinion and rack design, allowing a lift of 13 ft. The exciter turbines have a rating of 100 horse-power, and are of

single wicket gate design, 21 ins. in diameter. They are controlled by individual head gates.

The main generators are of the revolving-field type and are designed to carry an overload of 25 per cent for two hours without excessive overheating. They have a full load efficiency of 94 per cent and an efficiency of 91 per cent at half load.

The switchboard and transformers in two banks of three each, are arranged in a row opposite the generating machinery. The transformers are rated at 500 kilowatts, and are oil-insulated and water-cooled. The cooling water is circulated through a coil in the upper part of the transformer tank over the core and surrounding the ends of the windings. The water is taken from the forebay, near the exciter turbines, and carried beneath the floor in two 3-in. pipes, which are connected by a third 3-in. pipe running crosswise under the transformers. This cross pipe is connected with another lateral pipe lying close to the transformers, by risers in which are placed suitable screens. One-inch pipes lead directly to the respective transformers from the secondary lateral pipe. A glass is provided in the water circuit of each transformer so that the circulation is always under observation. From the transformers the discharge pipes lead downward into the tail-race.

The switchboard and apparatus is designed for a current capacity commensurate with the 22,000-volt transmission pressure, and automatically operated oil switches are used on the outgoing lines. There are nine principal panels as follows: One exciter panel, one regulator panel, four three-phase generator panels, one transformer panel and two outgoing line panels.

The entire electrical equipment of the West Buxton plant has been provided by the General Electric Company. All the turbines are of the S. Morgan Smith manufacture, as well as the hoists of the main head gates. The Dayton Globe Iron Works provided the hoists for the smaller gates. The construction of the plant and transmission system has been very

FIG. 11.—INTERIOR VIEW OF MAIN [illegible] PORTLAND.

materially simplified and expedited through the fact that J. G. White & Company, besides being contractors for the installation, are also the operating mana[illegible] three of the public service properties in Portland, effected by the development. Naturally, decisions as to plans for co-ordinating the new construction with the plants already in use have been reached with little or no unnecessary delay.

Unbalanced Loads in Two-Phase to Three-Phase Transformation.

BERNH. F. JAKOBSEN.

In the two-phase to three-phase transformer arrangement of Fig. 1 there are two independent magnetic circuits, and on the two-phase or secondary side two coils with N_1 turns each. Taking the ratio as 1 to 1 the coil AA' has also N_1 turns, the coil BC has $N_2 = \frac{2}{\sqrt{3}} N_1$ turns. It is well known that when the load on the two-phase side is balanced, the load on the three-phase side is balanced also. The present article deals

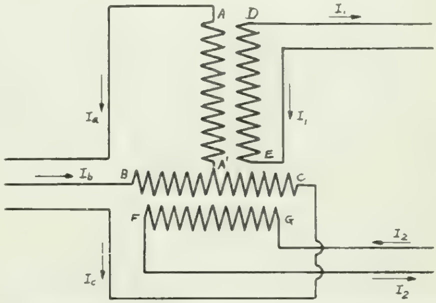


FIG. 1.—CIRCUIT DIAGRAM IN TWO-PHASE TO THREE-PHASE TRANSFORMATION.

with the determination of the effect of different loads taken under different time-phase-angles on the two-phase side.

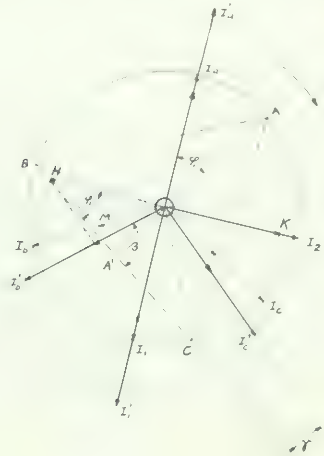
Let the transformer coils be so interconnected that a current flowing from A' to A results in a current flowing from E to D, and let all currents flowing towards A' be called negative, and let the current produced by a positive current be called negative if it exists in coil $A'A$ and DE, and let a positive current in BA' and a negative current in $A'C$ be considered as producing a negative current in FG, flowing from G to F.

In order to draw up the vector diagram one has only to remember that, neglecting all losses: (1) The ampere turns of corresponding coils must be equal but oppositely directed, or $\Sigma (N \times I) = 0$. (2) The algebraic sum of the three-phase currents must be equal to zero, or $\Sigma (I) = 0$. (3) The input must equal the output.

It should be noted that if the current I_b and I_c are equal and in time-phase—that is, both flow simultaneously either away from A' or towards A'—the resultant m. m. f. is zero. If they are equal, but opposite in time-phase ($I_b = -I_c$) the m. m. f. in ampere-turns is $N_2 I_b$. In the first case I_b and I_c taken together represent no power; in the last case the power is $P = I_b E_m \cos \phi$.

Fig. 2 shows the diagram for a balanced load. $I_a = I_b = I_c = I_1 = I_2$, and the phase angles are alike. If N_2 is represented as unity $N_1 = \frac{\sqrt{3}}{2}$, and the ampere turns of I_2 are represented to scale by $OK = N_1 I_2 = \frac{\sqrt{3}}{2} I_2$, the ampere turns of I_b is represented to scale by $OM = I_b \times \frac{1}{2} = \frac{1}{2} I_b$, etc. The currents I_1 and I_a must always be equal but opposite in time phase. The ampere turns in FG are $N_1 I_2$ and must be equal to those in coil BC. The ampere turns of BC may be represented as $-(I_b + I_c) \cos 30° = \frac{2 N_1}{\sqrt{3}\ 2} - 2 I_b \tfrac{1}{2}\sqrt{3} = I_b N_1 = I_2 N_1$ as should be.

[illegible] 50 per cent, then I_1 also increases 50 per cent. I'_a enters coil BC at A' and must go through that coil without changing the resultant m. m. f., which is possible only when the increment current, $\Delta I_a = I_a I'_a$, divides itself into two equal parts, each of which magnetically counteracts the other. The current ΔI_a is added to the current



[illegible] AD [illegible] PHASE I

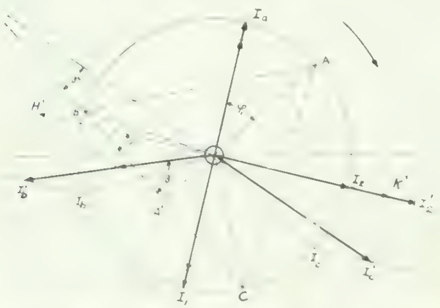
I_a and the current $-\frac{1}{2}\Delta I_a$ is added to I_b and I_c. The increment of current in BA' $(-\frac{1}{2}\Delta I_a)$ is equal and in time-phase with that in $A'C$ so that they neutralize each other magnetically. BC represents the line voltage on the three-phase side, and its time-direction is parallel to the voltage in the coil FG. The time-phase angle for I_1, I_2 and I_a is ϕ_1, for I'_b it is β, and for I'_c it is γ. Since $\beta = \gamma + 2\phi_1$, the power in BA' and $A'C$ (Fig. 1) are not equal unless $\phi_1 = 0$.

The power in the coil BC is unchanged as the increments of currents ΔI_b and ΔI_c are in time-phase. The currents corresponding to I'_a (in Fig. 2) are I'_b and I'_c and, therefore,

$$I'_c = I'_b = \sqrt{I_b^2 + (\tfrac{1}{2}\Delta I_a)^2 - 2 I_b \times \tfrac{1}{2}\Delta I \cdot \mathrm{Cos}\,120^\circ}$$

$$I'_c = I'_b = \sqrt{I_b^2 + (\tfrac{1}{2}\Delta I_a)^2 + I_b \Delta I_a}$$

II. In Fig. 3 I_1 retains its normal value, but I_2 has been in-



[illegible]

creased by 50 per cent to I'_2. OK' is now the ampere turns of the coil FG and OH', which ampere turns the coil BC must produce. In order not to affect I_a, two currents equal in value, but opposite in time-phase, must be added, one to I_b and the other to I_c, for only then will $I_a + I_b + I_c$ remain zero. The increase of the ampere turns in coil FG is $I_2 I'_2 N_2 = \Delta I_2 N_2$. This must equal the increase in BC, and consequently there must be added to I_b and I_c two equal but opposite currents, $I_b I'_b = \Delta I_b$ and $I_c I'_c = \Delta I_c$, the vector being parallel to I_2. Thus

$$N_2 \Delta I_2 = N_1 (\Delta I_b + \Delta I_c)$$

$$N_2 \times \Delta I_2 = [illegible] \frac{2}{\sqrt{3}} N_2 \times 2\Delta I_b$$

$$\Delta I_b = \frac{\sqrt{3}}{2} \Delta I_2$$

The resulting currents are then:

$$I'_b = I'_c = \sqrt{I_b^2 + \Delta I_b^2 - 2 I_b \Delta I_b \cos 150^\circ}$$

$$= \sqrt{I_b^2 + (\Delta I_b)^2 + [illegible] I_b \Delta I_b}$$

If ϕ be the time-angle between ΔI_b and the voltage BC, the increase of power in coil BC would be:

$$\Delta P_b = \Delta I_b E_{bc} \cos \phi$$

ϕ is also the time-angle between I_2 and the voltage FG and the increase of power therefore is,

$$\Delta P_2 = \Delta I_2 E_{fg} \cos \phi$$

Since $\Delta I_b = \frac{\sqrt{3}}{2} \Delta I_2$ and $E_{ab} = \frac{2}{\sqrt{3}} E_{fg}$, therefore

$$\Delta P_b = \Delta P_2$$

If in case I, $I_a = I_b = I_c = 10$ amp. and $\Delta I_1 = \Delta I_a = 5$, then $I'_1 = 15$ and $I'_b = I'_c = 11.47$ amp. and the line loss on the three-phase side is in watts $P_1 = R\,(15^2 + 2 \times 11.47^2) = 487.5\,R$.

If in case II, $I_a = I_1 = 10$, and $\Delta I_2 = 5$, then $I'_2 = 15$ and $I'_b = I'_c = 13.9$ amp. and the line loss is, in watts, $P_2 = R\,(10^2 + 2 \times 13.9^2) = 487.5\,R$.

The power transmitted was the same in the two cases and such was true also of the copper loss of the line.

III. Assume the same conditions as under I with the exception that the time-phase angles in the two-phase circuits are not

[illegible]

alike. Since the voltages in the coils DE and FG are in electrical time quadrature, the currents are not in quadrature. In Fig. 4 I'_1, I_2, ϕ_1 and ϕ_2 are given. The vector-diagram is con-

structed with ϕ_1 as the time-phase angle for each current and the currents I'_b and I'_c are obtained as before in Fig. 2. OK' is then the ampere-turns in the coil FG, and OH' is the ampere-turns in BC. $OK = N_1 I_2$ is, however, the ampere turns in FG with the time-phase angle ϕ_2 and OH is the ampere turns required in BC. The difference between OH' and OH is $H'H$ and these ampere turns must be supplied by I'_b and I'_c. In order not to disturb the equilibrium on the three-phase side, equal but oppositely-directed currents must be added to I'_b and I'_c and in order to compensate for $H'H$ a current $I'_b I''_b = H'H$ must be added to I'_b and a current $I'_c I''_c = -HH'$ must be added to I'_c. The resultant currents I''_b and I''_c are then obtained, where $I''_b > I''_c$.

General Solution: The vector-diagram for any conditions can be constructed in a much easier, though less instructive manner, as shown below. Referring to Fig. 5 where I_1, I_2, ϕ_1 and ϕ_2 are secondary quantities, and assuming that the three-phase voltage has not been distorted, $I_a = -I_1$. $OK = I_2 N_1$ is the value of the ampere-turns produced by I_2 and $OH = -OK$ is the ampere-turns to be produced in the coil BC. Let $HH' = OH$, then OH' equals twice the m. m. f. in coil BC. The problem is

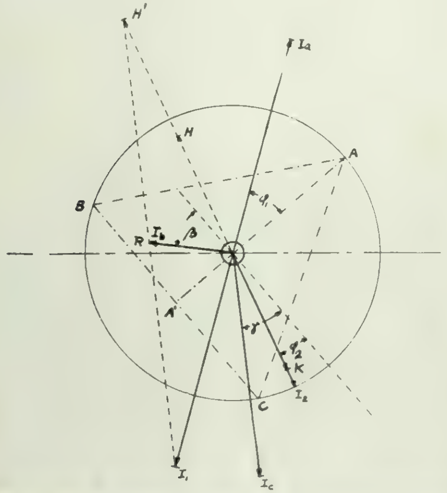


FIG. 5.—VECTOR DIAGRAM OF CURRENT RELATIONS; GENERAL SOLUTION.

then to find the value of the two currents I_b and I_c whose resultants are OH', and, at the same time, OI_1; that is to say, $H'R = RI_1$ and $OR = I_b$, $RI_1 = I_c$. It is seen from the construction of Figs. 4 and 5 that when angle $I_1 O I_2 \gtrless 90°$, then $I_b \gtrless I_c$.

The vectors I_b and I_c in all of the diagrams represent the currents in BA' and $A'C$ and also twice the ampere turns in their respective coils. In Fig. 5, ϕ_1 is positive and ϕ_2 negative, β is positive and γ negative.

The vectors OA, OB and OC in Figs. 2, 3 and 4 represent the phase-voltages of a star-connected generator feeding the three-phase side of the transformer.

When $I_1 = O$ then $I_a = O$ (neglecting the magnetizing current) and $I_b = -I_c$, that is, they are 180 deg. out of time-phase with each other and producing m. m. f. opposite in time-phase to that of I_2, so that $I_2 = \frac{2}{\sqrt{3}} I_c$.

When $I_2 = 0$, $I_1 = I_a$ and $I_b = I_c = \frac{I_a}{2}$ or I_b is in time phase with I_c and the resultant m. m. f. is zero. They are both 180 deg. out of time phase with I_a.

Single-Phase Equipment of the Rochester Division of the Erie Railroad.

As has been noted in our columns from time to time, and as discussed in our issue for Jan. 29, 1907, the first American steam railroad to substitute single-phase motors for steam locomotives in the propulsion of its trains was the Erie, on its Rochester Division. We are able to give below a description of the numerous details embodied in the electrical equipment of the above division.

The section of track equipped is 34 miles long, extending from Rochester, over the main line of the Rochester Division, to Avon, a distance of about 19 miles, thence 15 miles over the Mt. Morris Branch. The railroad is entirely single-track, with sidings at way stations, averaging 3 to 4 miles apart. The grades are light, and the curvature for the most part quite easy, the line being relatively quite straight.

The electric service is devoted solely to passenger traffic, which is of the local interurban type. There are in use six motor-cars, each of which is equipped with four conductively-compensated series-connected single-phase motors of Westinghouse manufacture. These motors are operated with 25-cycle current taken from auto-transformers, which receive their supply at 11,000 volts from an overhead catenary trolley wire. Electrically considered, the motors are similar in every respect to those in use on the New York, New Haven & Hartford

FIG. 1.—CATENARY LINE CONSTRUCTION IN THE AVON YARD.

locomotives, being provided with compensating field coils for neutralizing the armature reactance, and thereby improving the power-factor, and being equipped with "preventive resistance leads" between the commutator segments and the armature winding to minimize sparking at the brushes. The auto-transformer on each car is rated at 200 kilowatts, and is of the oil-insulated, self-cooling type. It has three high-potential and eight low-potential taps, the e. m. f.'s of the latter varying from 300 to 110 volts.

All of the switches connected with the trolley mechanism, the auto-transformer, and the motors themselves are operated by compressed air, the valves for which are controlled electro-magnetically. The car equipment, therefore, includes three distinct electrical circuits, the high-potential 11,000-volt trolley circuit, the low-potential motor circuit, the e. m. f. of which does not exceed 300 volts, and the control circuit, the e. m. f. of which is 15 volts.

The high-tension wiring of the car consists mainly of varnished cambric cable, drawn through loricated iron conduit. A small amount of high-grade rubber cable is used, but it is thoroughly protected with varnished cambric tape wherever there is danger of a brush discharge to ground breaking down the insulation. The high-potential circuit passes from the pantograph trolley through the line switch to the 11,000-volt tap on the auto-transformer. The trolley mechanism is operated by a pair of springs and by an air cylinder. The trolley is

raised and held against the wire by means of springs, and it is lowered by the application of air pressure to pistons working in cylinders that form part of its base. When down, it is automatically locked, and the latch of this lock can be withdrawn only by applying air pressure to another small piston, which then unlocks the pantograph, allowing the springs to raise it. The trolley mechanism is so connected with the control circuit through the line relay that any interruption in the supply of high-tension current immediately causes the trolley to be lowered by applying the air to the main cylinder in the trolley base.

The line switch is equivalent to a main high-tension circuit breaker. It is opened and closed by air pressure, admitted by electrically operated valves. In case the supply of air is exhausted, as when the car has stood for some time unusued, the line switch must first be held in mechanically by means of a handle provided for the purpose until the air pump, which can then be placed in operation, has compressed air to a pressure of about 50 lbs. per sq. in., which is sufficient to actuate the control system. For the purpose of raising the trolley when there is no air pressure, there is provided a small automobile tire pump placed underneath one of the car seats, which is connected by a three-way cock into the trolley air piping system, and enables the air-operated trolley latch to be withdrawn and power obtained that will start the air compressor and set going the motor generator set, which is used for charging the storage battery and supplying energy to the control circuit.

FIG. 2.—ELECTRIC TRAIN AT AVON.

In the main low-potential circuit are the switch-group, the reverser, and the "preventive coils." All of the switches of the group are provided with interlocks, which automatically govern the connections in such a way that each switch of the group acts only when the current in the motors has decreased to a predetermined value, thus making the acceleration automatic. The "preventive coils" are small auxiliary auto-transformers used in connection with the main transformer in order to prevent the short-circuiting of the intervening turns when the motor connections are changed from one tap to another on the main auto-transformer.

The control circuit includes a master controller, in each vestibule, the train line wires and their connections to the valve magnets and interlocks, a storage battery supplying energy for these wires, and a motor generator set, which is used either to charge the batteries or to actuate the control system. The master controller makes the proper connections by means of which energy from the storage battery actuates the valve magnets which control the action of the air-operated main contracters in the switch group, and the reversers. The controller handle is normally held in a vertical central position by springs, unless it is moved to one of the running points by the motorman. When released from the grasp of the hand, it flies to the vertical position, opening the circuit, and enabling the emergency application of the brakes by means of brake relay valve alongside of it. There are two holes in the face of the master controller, directly under the handle, and attached to the handle by means of a chain is a plug which may be inserted into either of these holes. The master controller is not operative unless this plug is pushed all the way into the lower hole, which closes the line switch, connects the generator and battery, and puts the brake relay valve into circuit. This is the ordinary running position of the plug. In case the line switch is opened by an overload, which generally causes the trolley to be lowered, the plug is taken out of the lower hole and placed in the upper, which action immediately closes the line switch, releases the trolley, and allows it to spring up against the wire. As soon as contact is made with the main circuit, the plug is taken out of the upper hole and replaced in the lower one.

There is a push button upon each side of the bottom of the master controller case. That on the right-hand side is used for lowering the trolley and opening the line switch. When the button on the left-hand side is pressed the switch group connection is stepped up to the last or high-speed notch and remains in that position until the handle of the controller has been returned to the off position.

There are four distinct notches on each side of the controller, the first corresponding to the coasting position with the main circuit open, the others enabling such gradations of speed as may be desired. Reversal is effected by moving the controller handle to the opposite side of the center or dead point. If the controller stops on the dead point, as it will if released by the hand, the brakes will be applied immediately.

The motor generator set is a compact machine of about ⅛ kilowatt, the motor being of the self-starting induction type,

wound for 110 volts, the generator delivering normally about 23 volts. It is placed under one of the seats in the car and is covered by a box with removable lid, so that it can easily be reached for such small attention as it requires. It is mounted upon rubber bushings, and runs so quietly that its presence in the car can hardly be detected.

The storage battery consists of seven cells contained in a wooden box with handles, carried in an enclosed box underneath the car. No other auxiliary lines for any purpose are connected to the control circuit, in order to prevent it from being disabled by accidental grounds.

In one vestibule there is located in an asbestos-lined compartment enclosed with steel doors a slate switchboard panel upon which are carried all the switches and fuses for the control of the battery and motor generator set, the lighting circuits and heaters, and also the main connection from the low-tension side of the main autotransformer to the auxiliaries.

The control circuit is fitted with junction boxes, branches running to receptacles at each of the four corners of the car directly under the end sills. The jumpers for connecting the cars and the receptacles are of the 12-point type, there being 12 wires in the main control circuit.

All of the low-tension wiring between the transformer and switch group and motors is enclosed in a boxing of "Transite," to insure its protection against mechanical injury, as the in-

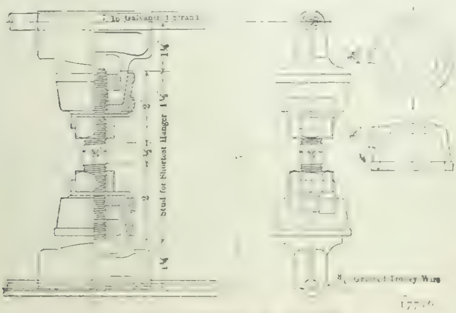


FIG. 3.—DETAILS OF HANGER.

ductive effect of heavy currents renders the use of iron conduits impossible for this part of the wiring.

The air brake and electrical equipment were placed upon the cars by the engineers at the Buffalo car shops of the Erie Railroad.

CATENARY TROLLEY CONSTRUCTION.

The overhead trolley construction being the first of all catenary installations to operate regularly at 11,000 volts, almost all of the details had to be designed especially for the equipment. Nearly all of the construction is of the side-pole and bracket type, exceptions being found at sidings and railroad yards. A No. 4—0 grooved copper contact wire is supported at intervals of 10 ft. by hangers suspended from a seven-strand 7/16-in. steel "messenger" cable supported by the brackets. Each bracket consists of a 3-in. x 2.5-in. tee 10 ft. long, the heel of which is fastened to the wooden pole by a pair of bent straps, the outer end being supported from the pole-top by two 5/8-in. steel truss rods, instead of the single rod commonly used in bracket work. The insulator used at each bracket is of Thomas manufacture, 6 7/8 ins. in diameter, and 6 in. high. It [illegible] together by a quick-setting cement of litharge and glycerine.

On straight track the poles are placed at intervals of 120 ft., but on curves the intervals are somewhat shorter. The maximum deflection from the center line of the track, on curves, is 7 ins. each way. The catenary hangers are of the Electric Railway Company's drop-forged type, being modified by the engineers to suit the requirements. The messenger clip and the trolley clip are of the same type but grooved differently to accommodate their respective wires. They are joined by a 5/8-in. iron hanger rod, [illegible] end, the longer rods being flattened in the middle to admit of bending them slightly, so as to conform to the divergence of the messenger and trolley wire near the ends of the spans. Both

FIG. 4.—OVERHEAD CONSTRUCTION AT MT. MORRIS TERMINAL.

the trolley and the messenger ears are secured in position by jam nuts. This type of suspension was developed especially for this installation, and is so constructed that there is no possibility of parts coming loose and falling apart on account of vibration. It is also very quickly and easily adjustable on the trolley wires.

The steady-strain rods, which are of treated wood, are mounted at one side of the bracket instead of directly underneath, in order to give sufficient clearance for the pantograph trolley on curves, where the super-elevation results in the tilting of the shoe from the horizontal. Each steady-strain

FIG. 5.—[illegible] CONSTRUCTION, [illegible] TOWER, [illegible] AND SWITCH POLE.

rod is hinged to a spool-type Thomas porcelain strain insulator, which is clamped to one side of the bracket in such a manner that the hinged end of the rod is almost at the elevation of the top of the tee bracket. The method of attaching the steady-strain insulators to the bracket is such that they can readily be shifted along the bracket to follow up any change in alignment of the trolley wire that may be required by curvature or for any other reason. The clamps holding the

[illegible] spool-type insulators are cemented on to pieces of ¾-in. pipe, through which passes the ⅝-in. eyebolt by means of which they are attached to the bent irons. Steady strains are used only on curves and turnouts; they were not found necessary on tangent track.

The span constructed is as nearly as possible similar to the bracket construction, the same type of pin and insulator being used. A 3 in. x 2½ in. tee about 30 ins. long is suspended from the span wire by hangers of galvanized strand cable, adjustable in length, and fastened to the span wire cable by specially designed clips, the construction forming a sort of stirrup upon which the pin and insulator are carried. The messenger wire rests upon the insulator just as in the case of regular bracket construction. This form is used, not only for spans where there is only one track, but also in the yards at Avon, and Rochester, where three or four parallel tracks are electrically equipped. Span construction, in general, was used only where conditions absolutely required it.

For the extra long spans required in the Rochester yard, where it was impossible to use guys of the ordinary type, it became necessary to employ a self-supporting span construction. and this was accomplished by installing the "Tripartite" type of steel pole, set in concrete. This pole is constructed of re-rolled Bessemer steel rails, and it is less subject to rust, and consequently is more durable than any other available type of metal pole; moreover, all of its surfaces are always open and are easily inspected. On account of the great tenstile strength of the material, there is considerable saving in weight, and the fact that it was a standardized product, enabled quicker delivery to be made than though special riveted poles of structural steel shapes had been especially designed for these locations. The span wires consist of the regular messenger cable fitted with cable sockets sweated on at each end, the same being fastened to turnbuckles and pole collars at the tops of the poles. There are two span cables at each pair of poles, the upper one being used to carry the weight, the lower one acting to steady the arrangement and also serving as a relay in case of an accident to the upper span. Similar construction was also used at Avon, where guying of the side poles was not always possible.

[illegible]

A very simple type of pull-off was devised for the curves in the span construction, and it so happened that both the Rochester and the Mt. Morris yards have considerable curvature. The pull-off consists simply of a spool-type insulator, with a pipe cemented through the center; the pipe is slipped over the hanger spacing-rod joining the messenger and trolley clips, thus giving an insulating connection through which an ordinary pull-off cable can be attached to both the messenger and the trolley w[illegible] the messenger and the trolley wire is easily adjusted to suit the conditions, by shifting the spool-type insulator up and down the spacing rod, by inserting longer or shorter nipples of pipe underneath it. In general, where it is near a span wire, the messenger cable is supported rigidly on its insulator and the trolley wire needs all the side pull; but in the middle of a span the pull must be equally divided between the messenger and the trolley wire.

The presence of several through-truss bridges over streams, and two low bridges over the Erie right of way, necessitated the employment of special construction at these points, particularly at the bridge at Clarissa Street, on the outskirts of Rochester. The original clearances here were so low that the road-bed had to be excavated out and the track lowered about 2 ft., the minimum clearance between the rails and the trolley wire being finally 18 ft. The messenger is fastened to a horizontal spool-type insulator mounted at the center of a substantial piece of turned oak, which is long enough to carry two more similar insulators, one on either side of the center one.

The steel hangers reaching down from the overhead bridge structure carry the two side insulators, so that there are always two insulators in series between the 11,000-volt messenger cable and the steel parts of the bridge. These insulated supports are suspended at short intervals from the under side of the bridge, and are further supplemented by the use of steady strains which prevent any side displacement of the trolley wire. The sortest sizes of hanger spacing rods are used in such places. Where the bridge trusses are high enough to permit it, an iron stirrup is employed like that used in span work, which carries the standard form of straight-line insulator, and the regular type of catenary suspension is employed.

TELEGRAPH SYSTEM.

As is well known, the single-phase trolley system causes interference with telegraph lines along the right of way, and unless both the electrostatic and electromagnetic induction are properly compensated there is always danger of telegraphic communication being seriously affected. The electrostatic effect is particularly annoying, as it is absolutely continuous as long as the trolley line is charged, whether or not there are any cars moving. Various means were proposed and tried by the Western Union Telegraph Company for the elimination of the "static," which always causes the telegraphic relays to chatter, but the most successful thus far known is that due to E. W. Applegate, quadruplex expert for the Western Union Telegraph Company, who has developed a very simple means for overcoming static interference. Mr. Applegate worked upon the theory that it is useless to try to compensate for the electrostatic influence, and that it is best to "pacify" the instrument by additional devices.

The Applegate "static pickup," for which a patent has been applied, comprises a back contact relay and a high resistance shunt. The current enters the relay 1 and 2 through a 150-ohm magnet coil attracting the armature *C*. When the line opens by any operator opening his key the armature *C* falls back and through the back contact connects point *C* and *D* by the aid of a spring *S*.

The shunt *A* consists of 350 ohms of carbon stick, and provides a better path for the static electricity than do the magnets, pacifying the magnets to a certain extent. When the line opens and the armature connects with the back stop *C* and *D*, both the *A* and *B* shunts are in with the main line and pick up the static electricity which escapes through shunt *A* to the ground, relieving the agitation of the armature so that it can respond to the closing of the line.

The shunt *A* robs the relay of main line battery current very materially, so that it responds to the home key sluggishly. Consequently the auxiliary battery *F* is inserted in shunt 2. When the armature *C* falls back this battery acts upon the magnets and assists their prompt response to the home key or to any other operator to such an extent that the shunt *A* does not cause noticetble drag. No matter what the line "static" may be these shunts "pacify" the instruments and the "static" is not felt.

The armature spring is adjusted high enough to overcome the wave of "static" that escapes *A* and *B* shunts. The aid of the 7-volt battery overcomes this adjustment and leaves the relay very prompt and satisfactory.

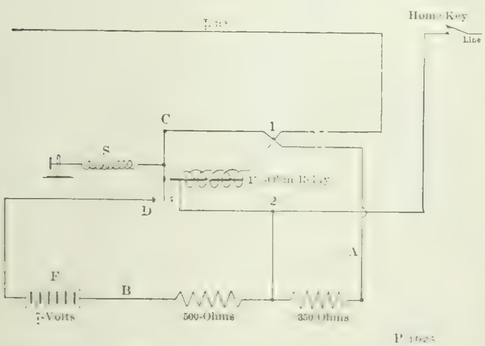


FIG. 7.—CIRCUITS OF BACK CONTACT TELEGRAPH RELAY

The arrangement has proved so successful that all telegraph wires are now operated "single," with ground return, instead of in "metallic circuit," as it was at first feared would be necessary. The telegraph department of the railroad company, in connection with the signal department, constructed a private telephone line of two copper wires between Rochester and Avon, with instruments at all signal towers and stations in the dispatcher's office, and at the substations, and car shed, and master mechanic's office. This telephone system is run upon the trolley bracket poles, transposed every third pole, and has worked satisfactorily.

SUB-STATION EQUIPMENT

The energy for operating the motor-cars is transmitted at 60,000 volts from the Niagara Falls station of the Ontario Power Company, to a sub-station at Avon, about 19 miles south of Rochester. The sub-station equipment consists of three 750-kw single-phase, oil-insulated, water-cooled transformers. Two of the transformers are aranged for T-connection for changing the three-phase current at 60,000 volts to two-phase current at 11,000 volts for the trolley circuits. The third transformer is held as reserve. The cooling water is circulated by gravity, the supply coming from the railroad company's water-tank system at the adjacent round house, being pumped originally from the Genesee River about a mile distant.

The necessary transformation from three-phase to two-phase, fits in very well with the natural subdivision of the electrically equipped line into two sections, one of which is about 19 miles in length, north of Avon, the other about 15 miles in length, being to the south of Avon. The connections were therefore laid out to operate such sections upon separate phases of the

FIG. 8.—SUB-STATION AT AVON.

two-phase secondary system. One of the three secondary terminals is grounded to the rails. The two free terminals which pass to the separate trolley sections are protected by low-equivalent lightning arresters reinforced by electrolytic lightning arresters. A set of call bells is provided so that when the automatic breakers open, a bell is rung in the car-inspection shed, adjoining. Also, if the temperature of any transformer runs above normal, a bell circuit connected to a

FIG. 9.—MAIN TRANSFORMER ROOM, AVON SUB-STATION

thermometer in the top of the transformer tank is similarly made to operate. The station itself does not require the constant presence of an attendant, which is needed in the case of a rotary-converter sub-station. The working force is so organized that the car repair men are always available for

manipulating the sub-station circuit breakers, and the cost of attendance is thereby reduced to a minimum.

OPERATION.

The equipments above described were intended to be sufficient for operating single-car trains with one stop per mile, over the entire road, at an average schedule speed of 24 miles per hour, or to haul one trailer, making stops about 2½ miles apart at the same schedule speed. The company has furnished shelters where the public highways cross the line, there being 22 of these flag stations besides the regular intermediate way-stations at which steam trains stop, 6 in all, or a total of 28

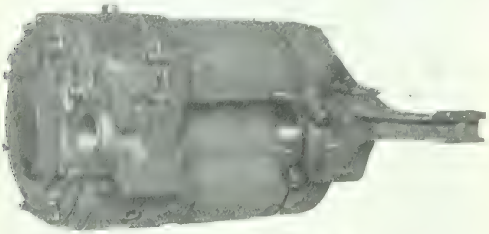


FIG. 10.—SINGLE-PHASE MOTOR.

stations at which electric cars may be required to stop. Practically the electric cars stop at all the regular way-stations, but at only a portion of the flag stations. A single passenger

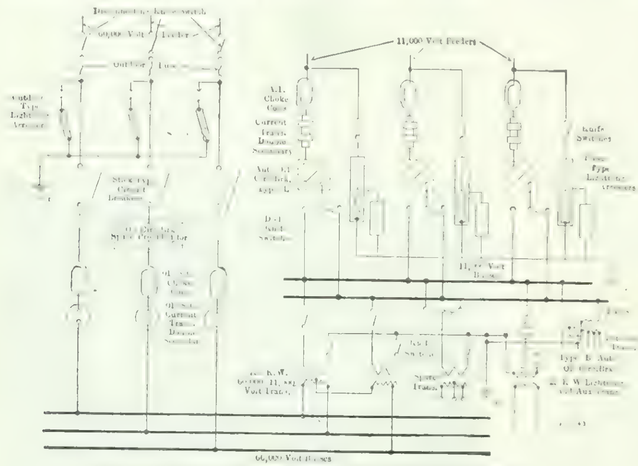


FIG. 11.—DIAGRAM OF CIRCUITS IN TRANSFORMER SUB-STATION.

coach is frequently attached to a motor-car, and on some trains baggage, milk or postal cars are regularly hauled. When two trailers are hauled two motor cars are required, making a four-car train, as shown in the attached photograph. The service has proved immensely popular throughout the Genesee Valley, through which it passes, and it is intended to increase the number of motor-cars in order to handle the business a little more comfortably next season. It is found that the electric trains on the 34 miles of line can be depended on to keep to their running time rather better than the steam passenger and freight trains operating over the main line.

ORGANIZATION.

The single-phase system was recommended for the electrification of this division by the Electric Traction Commission of the Erie Railroad, and after authorization by the company, was installed under the general direction of J. M. Graham, vice-president and head of the construction department of the Erie.

The engineering and the construction work were carried out and the system brought into operative condition by Westinghouse, Church, Kerr & Company, who designed and erected the buildings and the catenary trolley construction, bonded the track and installed the electrical apparatus in the sub-station and on the cars.

The adjustment of the telegraph system was carried out

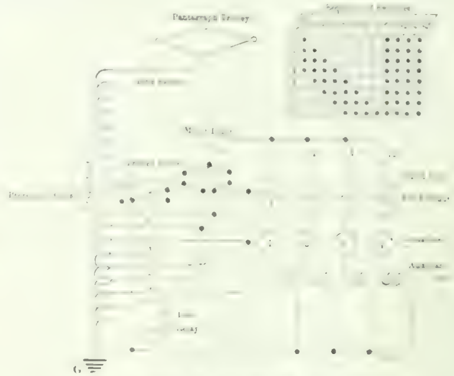


FIG. 12.—DIAGRAM OF ...

jointly by the Western Union Telegraph Company and the telegraph department of the railroad company.

The order was given to the engineers on June 6, 1906, and although the intense activity in construction work all over the country at that time rendered it difficult to secure materials and labor promptly, the work was pushed so rapidly that about 7½ months later, on Jan. 22, 1907, the first official trial trip was run between Avon and Rochester. The severe winter weather thereafter prevailing delayed the completion of the work until spring. During April and May the whole equipment of sub-station apparatus, lines and cars was thoroughly tried out in a course of experimental operation, which also enabled the railroad employees to become familiar with the new system. On June 18 commercial operation began and has since continued permanently with marked success.

The Erie is one of the oldest steam railroads in the country, but that it is also one of the most progressive is demonstrated by its policy of giving a thorough trial to a system of electric traction whose characteristics of simplicity in construction and economy in operation make it so eminently fitted to replace steam motive power wherever the economic conditions point to the desirability of its substitution for the betterment of either passenger or freight service.

Recent Electrochemical Developments—The Edison Storage Battery.

By looking over the numerous patents which have recently been issued for the Edison storage battery one is impressed by the enormous amount of detailed ingenious experimental work which has been done by Mr. Edison. It reminds one of his favorite saying that inspiration is only another way of spelling perspiration. Besides the general construction of the battery, details of the relief valve and gas separator, which are already well known, two special features have been revealed by his recent patents. One is the method of making seamless battery cans, the other the method of mixing flake cobalt-nickel with the active material for the sake of improving the conductivity.

The manufacture of seamless steel cans is carried out by electrolytic deposition in a number of steps, each of which is

important for the success. Hollow brass or copper molds of the proper form are first coated with an exceedingly thin layer of paraffine wax, over which a coating of graphite is applied. The layer of wax is so thin that the graphite apparently makes contact through the wax with the mold. A coating of copper of about 0.004-in. thickness is then applied electrolytically. The mold is then removed, washed and introduced into a second tank, where it receives an electrolytic coating of nickel about 0.001 in. thick. Then it passes into a third tank containing a neutral ferrous ammonium sulphate solution with iron anodes. Here it receives an iron coating of about 0.02-in. thickness. In order to prevent the formation of pits or holes in the deposited iron coating, which would be likely to form by the accumulation of gas bubbles thereon, and in order to secure a very smooth surface, a quantity of crushed charcoal is introduced into the solution, whereby the added material will rub over and scour the surface of the deposited metal, polish the same and wipe off any gas bubbles which may tend to accumulate. During the iron plating the mold is rapidly revolved at a speed of about 1½ revolutions per second. The mold is then removed from the tank and washed in water of a temperature of about 75 degs. C., thereby melting the wax originally deposited on the mold. The deposited can is then removed from the mold and is annealed by heating it to a red heat in a closed retort containing a non-oxidizing atmosphere, such as hydrogen gas. After annealing, the articles are allowed to cool in the same atmosphere. Finally, the copper originally deposited on the graphite is removed by filling the can with a solution of copper nitrate and sodium nitrate and using the can as an anode against a copper cathode.

It is quite evident that in this long process, which is, of course, carried out by automatic machinery, not a single step is superfluous. The wax coating on the mold is applied to permit later an easy removal of the deposited can from the mold. The graphite coat serves for making the surface conductive. The copper coat is necessary because a nickel deposit would not stick to the graphite. The nickel is necessary on account of the caustic soda electrolyte of the battery. In depositing the iron, the use of the small particles of crushed charcoal not only serves for wiping off the gas bubbles, but also for incorporating a small percentage of carbon with the iron. In the subsequent annealing process the iron gets the necessary strength and, on account of the small percentage of carbon incorporated with it, it is, in fact, converted into a superior product of soft steel containing almost 0.4 per cent of carbon.

It was early recognized by Mr. Edison that in order to get high conductivity of the active mass in the little pockets of his storage battery plates, it was necessary to mix the active mass of nickel hydroxide with some material of good conductivity. Flake graphite was first used, but in the course of a long time it was found that the flake graphite undergoes a change in its contact resistance and the capacity of the battery is thereby diminished. Mr. Edison now uses flakes of a nickel-cobalt alloy, containing, say, 60 per cent of cobalt and 40 per cent of nickel.

Of the numerous patents for the production of these flakes or films it will be sufficient to describe the method revealed in the last patent. A copper cylinder with a polished nickel-plated surface is first immersed in a suitable cobalt plating bath, and while the cathode is revolved a thin film of cobalt 0.0001 in. or less in thickness is plated on the cathode. This is then washed and placed in a solution of copper sulphate containing some free acid, whereby the cobalt is caused to go into solution and the copper is deposited as cement copper in granular, but slightly adhesive form. The cylinder is then placed in a copper plating bath and an electro-deposit of copper 0.003 in. to 0.0035 in. thick is obtained on the cement copper, while the cathode is rotated. It is then washed and introduced into a bath consisting of a mixture of chloride of cobalt and chloride of nickel, and a cobalt-nickel alloy deposit is obtained about 0.0002 in. thick. The cylinder is again washed, and a second film of copper is deposited, then another film of cobalt-nickel, and so on, producing electrolytically alternating layers of copper and cobalt-nickel, until a [illegible] has been obtained. This sheet is cut longitudinally of the cathode into small strips which are placed in a basket and introduced into an ammoniacal solution of copper sulphate and moved up and down in this bath. The copper is thereby dissolved, while the nickel and cobalt are not attacked, so that the desired films or flakes of cobalt-nickel are obtained.

New Telephone Patents.

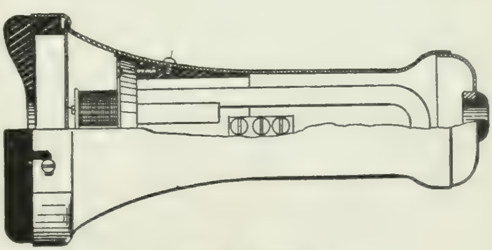
SELECTOR FOR AUTOMATIC EXCHANGES.

Selectors for automatic exchanges have several well-defined functions to perform. In every case the switching mechanism must be advanced by a ratchet arrangement responsive to electrical impulses; the mechanism must be stationary between impulses so that their effects will be accurately cumulative, and again the whole apparatus must be released at will to return to zero position. Usually these combined functions have involved a differentiation of circuits and the provision of two or more magnet actions.

Messrs. C. E. Scribner and C. D. Enochs have, however, recently patented a selector in which one magnetic action and one arrangement of circuit suffices. As usual, the operating magnet oscillates a pall which engages a ratchet to advance this latter one step or tooth for each vibration of the pall. The ratchet is, however, secured to a massive disc which moves with it, a weighted arm tending to resist the forward movement under action of gravity. The inertia of this mass is so great that the unbalanced force is not able to generate appreciable return motion between successive impulses from the pall. When the pall is withdrawn a considerable time, however, the ratchet returns to zero. The patent for this apparatus is assigned to the Western Electric Company.

METAL SHELL RECEIVER.

There is shown below a metal shell patented by E. J. Quinby, of Portland, Maine. The ear cap is of hard rubber



QUINBY RECEIVER.

and slips within the edge of the casing. It will be seen that the magnetic system is insulated from the shell, being mounted upon a hard rubber bushing, which is secured in the proper position within the casing.

LETTERS TO THE EDITORS.

Switchboard Connections of Wattmeters and Watt-hour Meters.

To the Editors of Electrical World:

SIRS:—Referring to Mr. MacGahan's article in your issue of Sept. 14, on "Switchboard Connections of Wattmeters," I would like to ask Mr. MacGahan how he would determine whether the power factor on a three-wire, three-phase system was above or below 50 per cent. If the table is carried below 50 per cent power factor, the ratios of readings are the same as they are from unity to 50 per cent.

In determining the voltage connections Mr. MacGahan is [illegible]

error in his statement at the top of the second column on page 538. There would be no voltage across 3-4 unless 1 and 2 were connected together, and if they were, then the voltage across 3-4 would be the same as that across 1-3 or 2-4.

On small installations a bank of transformers and one or two motors, with the watt-hour meter on the primary, we have found that the starting power factor at the instant of throwing in the switch is above 50 per cent and the slow side of the meter should be connected to rotate forward at this instant; but in the case of large installations the bank and meter are so large in comparison to the size of the motor that this method is not certain. I would like to ask Mr. MacGahan what he would do in such a case.

BUFFALO, N. J. HENRY H. LYON.

To the Editors of Electrical World:

SIRS:—Referring to Mr. Henry H. Lyon's letter concerning the article by the undersigned in your issue of Sept. 14 on "Wattmeter Connections," I am sorry to note that an error has crept into the text, as indicated by Mr. Lyon. The second column of page 538 should read in part as follows:

"The connections should be tested when the load is on and the power factor is higher than 50 per cent. First, the voltage at the shunt binding posts 3-4 should be equal to that on 1-3 and 2-4, the leads 1-2 being connected together for the purposes of this test. If voltage 3-4 is 1.73 times voltage 1-3 and voltage 2-4, one of the voltage transformers must be reversed."

Mr. Lyon brings up the point that there may be cases when the power factor can be reasonably suspected of being below 50. In such cases an additional test is necessary to determine whether the power factor is above or below 50. I would suggest the following method of procedure, which is based on the fact that the sum of the two readings should be positive, so long as the power is in the positive direction. When the currents in the voltage and series coils, as indicated by the clock diagram, are in the same direction, or within 90 deg. of being in the same direction, the meter will read forward. When the current in the series coil is more than 90 deg. out of phase with the voltage, the meter will reverse.

1. By proper testing with an incandescent lamp or a voltmeter obtain three voltage leads, 1, 2, 3, having equal voltages between them.

2. Connect these leads to the voltage circuits of the wattmeters as previously indicated.

3. Connect the series transformer in line 1 to meter *A*, whose shunt is connected to 1-2, and series transformer in line 2 to meter *B*, whose shunt is connected to 2-3. (See clock diagram giving the phase relations.) In this diagram 1-2 represents the voltage in meter *A*, 2-3 the voltage in meter *B*, 1-0 the current in meter *A* and 0-3 the current in meter *B*.

4. Change voltage connections from 1-2 to 1-3 on meter *A*. If power factor is 100, the readings will be alike with both connections. If the power factor is less than 100 and greater than 50, the readings will differ, but be in the same direction (either both positive or both negative). If equal to 50, one of the readings will be 0. If less than 50, the readings with 1-2 and with 1-3 will be reversed in direction, with respect to each other.

5. The same test may be performed on meter *B* by changing the voltage connections from 2-3 to 1-3. If the power factor is 100, the readings will be alike. If less than 100 and more than 50, the readings will differ but be in the same direction. If

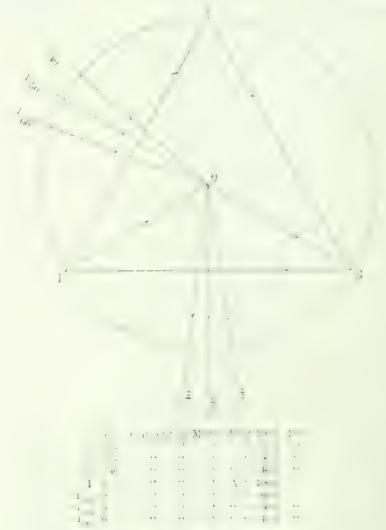


DIAGRAM OF PHASE RELATIONS.

equal to 50, one of the readings will be 0. If less than 50, the readings with connections 1-3 and 2-3 will be reversed in direction, with respect to each other.

6. If it is found from the above tests that the power factor is greater than 50, connect the series coil of the watt-hour meters so that both revolve forward. If the power factor is less than 50, connect the series coil of the slower meter so that meter rotates backward and the series coil of the faster meter so that it rotates forward.

The above description indicates the use of two single-phase meters, but holds equally true for a polyphase meter consisting of two single-phase meter elements driving the same shaft.

PITTSBURG, PA. PAUL MACGAHAN.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Alternating-Current Motors.—H. GOERGES.—A translation in abstract with illustrations of his German paper recently noticed in the Digest on a general theory of alternating-current motors. The author explains the action of single-phase and polyphase alternating-current motors by resolving the magnetic flux through the rotor into two components, displaced relatively to each other by 90 electrical space degrees. The rotor winding is similarly split up into two components, whose magnetic axes coincide with those of the fluxes. The rotor currents are divided into free, externally influenced, and forced currents, and the classification of motors is based on the nature of the rotor currents. The theory is applied to the following four principal types: The induction, the series, the series-short-circuit and the repulsion motor.—Lond. *Electrician*, Sept. 13.

Field Magnet for Turbo-Alternators.—Details of construction of rotating-field magnets of cast steel for turbo-generators, recently patented by a British company. The magnet is divided into two parts in such manner as to facilitate the winding of the field coils.—Lond. *Elec. Eng'ing*, Sept. 12.

Special Alloys for Transformer Sheets.—R. POHL.—A translation with illustrations of his German paper on the design of transformers as influenced by the use of special alloy steels, which was abstracted some time ago in the Digest.—Lond. *Elec.*, Sept. 13.

Predetermining Direct-Current Dynamos.—H. M. HOBART AND A. G. ELLIS.—Continuation and conclusion of their fully illustrated article on a method of determining the leading dimensions of large and high-speed direct-current dynamos.—Lond. *Elec. Review*, Sept. 13 and 20.

Commutating Poles.—H. ZIPP.—An article discussing with the aid of diagrams the influence of commutating poles on the behavior of generators and motors.—*Elek. und Masch.*, Sept. 8.

Lamps and Lighting.

Cheap Metallic-Filament Lamps.—It is announced that the incandescent-lamp syndicate in Continental Europe (Verkaufsstelle der Vereinigten Glühlampen Fabriken) of Berlin "has decided to introduce a metallic-filament lamp which will economize the consumption of power. The economy as compared with that of the carbon-filament lamps will be 30 per cent, and the useful life will be about 500 hours. It is stated that the price of the new lamps will be only a few pfennigs greater than that of the normal lamps." (One pfennig is one-fourth cent.)—Lond. *Elec. Review.*, Sept. 20.

Tungsten Filament.—A reprint in full of a recent patent specification of the British Thomson-Houston Company for making filaments of tungsten, molybdenum, titanium, etc. In case of tungsten a block or rod consisting of pure tungsten powder is pressed into shape under heavy pressure. It is then treated in an electric furnace in which a vacuum is maintained by means of a pump, the lower end of the tungsten rod being inserted in a quantity of ductile metal such as amalgam, etc., which rests on the bottom of the furnace. After the air has been exhausted the tungsten rod is brought into contact with the amalgam. It is then lifted and an arc is established between the tungsten and the vaporizable amalgam below it, which is made the cathode, direct current being used. The tungsten rod, being the anode, gives off considerable quantities of occluded air and other gases and these are taken out through the pump, so that after some minutes of operation the tungsten rod is in a clean and porous condition. The tungsten rod is then suddenly lowered into the amalgam which then percolates through the tungsten and completely fills up all the minute pores in the stick. The quantity of amalgam or other ductile metal taken up by the tungsten stick depends on the degree of subdivision of the tungsten powder and also on the extent to which it has been compressed. In color the impregnated stick generally resembles the ductile material. A special method for impregnating the tungsten stick with copper is also described. After having thus been impregnated, the tungsten stick may be subjected without further treatment to a sintering or soldering action by passing a strong current through in a vacuum or inert atmosphere. The less refractory metal with which the tungsten is impregnated is thereby vaporized, and it is found that the resultant stick is much stronger and better suited for use as a filament than the original stick of pressed or untreated material. It is, however, also practical to roll or draw the impregnated stick much like a pure metal of fair ductility and by careful handling it is possible to convert the sticks into plates or foil or into wires and strips of the size now used in incandescent lamps. All this may be done even though the original refractory stick is pressed up from a nonherent and finely-divided powder.—Lond. *Elec. Eng'ing*, Sept. 12.

Tungsten Lamp.—A note on a recent patent of the Allgem. Elek. Ges. Tungsten filaments for electric lamps are prepared from colloidal tungstic acid by mixing the acid with a binding material such as starch. The resulting paste is squirted into the form of filaments, which are then reduced to metal by heating to a high temperature in hydrogen. In consequence of the omission of an organic binding material the finished filaments are quite free from carbon.—Lond. *Elec.* [illegible], Sept. 12.

Boron Filament.—A full account of a British patent specification of the British Thomson-Houston Company for making boron filaments for incandescent lamps. Boron nitride is heated in a vacuum to a temperature above 1500 deg. C., whereby it is decomposed, the nitrogen being carried off by means of the pump. There is thereby produced pure boron, which is quite different from the boron heretofore described in text books. It is electrically conductive, and can be melted at exceedingly high temperatures without volatilization. To make filaments the boron is pressed into a rigid rod or stick or is mixed with a small quantity of a vaporizable binder such as paraffin so that it may be squirted into the form of a filament. The binder is then removed by direct vaporization. In case an organic binder is used, one is chosen which completely vaporizes without leaving carbon in the boron.—Lond. *Elec. Eng'ing*, Sept. 12.

Accidents Due to Various Systems of Lighting.—A note on statistics of the accidents caused by various illuminants during 1906 in Germany. The following table takes into account only the accidents which happened to people; those which caused fires and explosions, but no other serious injury, have been excluded:

NATURE OF LIGHTING.

Accident.	Gas.	Electricity.	Petroleum.	Alcohol.	Paraffin.	Acetylene.
Slight	112	42	199	119	53	24
Serious	149	46	218	140	62	34
Fatal	41	35	127	58	13	10

Therefore 44.4 per cent of the fatal accidents were caused by petroleum, 20.3 by paraffin, 14.3 by gas and only 12.2 by electricity. The greater part of the fatal accidents due to electricity were caused by carelessness, foolhardiness or drunkenness. Only two were actually due to leakage.—Lond. *Elec.*, Sept. 13.

Power.

Turbo-Alternators.—The first part of an illustrated description of the standard types of turbo-alternators and turbo-dynamos built by Brown-Boveri & Company.—Lond. *Electrician*, Sept. 20.

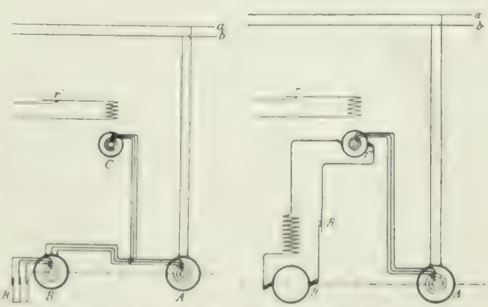
Swiss Hydro-Electric Station.—An illustrated description of a water-power station, which was established recently not far from Engelberg, principally for the supply of electrical energy in Lucerne. A fall of about 1000 ft. is available. Three main 2000-hp generating sets are installed. The alternators are arranged to run either as three-phase or single-phase, for the motor or lamp service, respectively. The switch gear, which includes oil switches on both the 6000-volt and the 27,000-volt sides of the step-up transformers, is very complete. Cellular construction is used throughout, with bare busbars, supported on insulators. — Lond. *Elec. Engineering*, Sept. 19.

Electric Machinery in Mines.—An article on the construction of fire-proof and explosion-proof machinery for mines, dealing especially with the construction and installation of the switch gear, the motors and the transformers.—Lond. *Elec. Review*, Sept. 20.

Superheated Steam.—O. H. WILDT.—The first part of a very long article on the use of superheated steam in generating stations.—*L'Industrie Elec.*, Sept. 10.

Traction.

Single-Phase Traction.—A. HEYLAND.—A long paper read before the recent meeting of the German Association of Electrical Engineers. The author first sketches the general development which resulted from the introduction into practice of single-phase commutator motors. He then endeavors to show



FIGS. 1 AND 2.—SINGLE-PHASE TRACTION.

that no essential further progress can be expected from commutator motors and that it is doubtful whether the results which have been accomplished will be sufficient to justify the use of the single-phase commutator motors for heavy traction. In the second part of the paper various combination arrangements are

described in which simple single-phase induction motors with slip rings and without commutator are used. The fundamental idea is to connect in parallel with the rotor circuit of the motor an excited but unloaded auxiliary motor. This arrangement is of special advantage in connection with two motors in cascade, the excited unloaded auxiliary motor being inserted between the two main motors. Such an arrangement is shown in Fig. 1, where *A* is the first single-phase induction motor being directly connected to the transmission line *ab*. *B* is the second induction motor and between the two the auxiliary unloaded motor, *C*, is connected. The resistance *R* is used for starting. A second arrangement is shown in Fig. 2, in which *A* is again a single-phase induction motor directly connected to the line. *C* is a motor-generator consisting of a three-phase motor and a direct-current dynamo with independent excitation. *B* is a direct-current motor. A third arrangement which the author seems to consider as the most advantageous one is shown in Fig. 3, where *A* is the first single-phase induction motor,

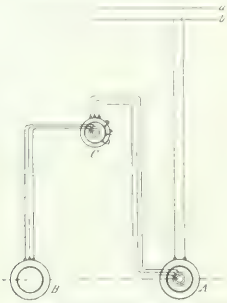


FIG. 3. SINGLE PHASE TRACTION

which is directly connected to the line *ab*. *B* is a second induction motor, the secondary of which is short-circuited, and *C* is the auxiliary motor which is used as a frequency converter. —*Elek. Zeit.*, Sept. 12 and 19.

Electric Traction on Railways.—P. DAWSON.—In a continuation of his very long and fully illustrated serial on electric traction on railways, the author takes up the subject of running curves. He first considers the construction and use of the kilowatt-speed curve of a motor, the tractive-force speed curve and the time-tractive-force curve from which the other two are derived. The value of such curves is shown by a practical application to part of the London, Brighton & South Coast Railway. The effect of varying the gear ratio is then considered, and the derivation of the curve giving the load on the generating station for a given service. Polar curves are the most convenient for this purpose, as is shown by an actual example. The effect of revolving masses is then considered.—Lond. *Elec.*, Sept. 13 and 20.

Installations, Systems and Appliances.

Manchester.—An abstract of the last annual report of the municipal electric works of Manchester. There are three separate works with an aggregate rating of 33,800 kw. The total number of kw-hours sold during the year were 47,564,903, of which 24,786,457 were sold for tramways and the balance for private lamps and motors and public lamps. The total cost per kw-hour, including capital charges, was 3.242 cents, while the corresponding income from all sources was 3.508 cents.—Lond. *Electrician*, Sept. 13.

Electricity on Board of Steamer.—An illustrated description of the electric installations on the White Star liner *Adriatic*. There are a gymnasium with a number of motor-driven appliances, a radiant heat bath, and many other applications of electricity. Its generating plant consists of five 75-kw sets. There are over 3000 lamps, and about 50 motors of various sizes.—Lond. *Elec. Eng'ing*, Sept. 19.

Improving a Small Power Load.—H. S. HATFIELD.—The chief obstacle to an increased use of cheap energy by the average private lighting consumer is that the supply for energy must be separately metered and it is necessary either to install a separate circuit for the purpose or to use a sub-meter. The author strongly favors the latter method and describes an instrument suitable for this purpose which is a miniature mercury electrolytic meter registering either, first, the energy consumed by a tapping taken from the plug and connected to another plug or direct to a radiator, etc., or, second, energy consumed by an appliance plugged in on the lid of the meter.—Lond. *Elec.*, Sept. 13.

High-Tension Condensers.—J. SCHMIDT.—The first part of a serial on different applications of high-tension condensers. The first installment deals with the use of a condenser for overcoming the phase-difference and resonance phenomena in distribution networks.—*Elek. Anz.*, Sept. 8.

Safety Regulations.—The complete set of the new safety regulations for electric installations adopted by the Association of German Electrical engineers. They will be in force beginning with Jan. 1, 1908. Several points in the regulations are explained in an article by K. Wilkens.—*Elek. Zeit.*, Sept. 12.

Wires, Wiring and Conduits.

Sag of Lines.—G. NICOLAUS.—The selection of the proper sag of a line is one of the most important requirements for the best erection of a telegraph line. The author in a long article gives diagrams with curves which permit a graphical solution of all problems referring to the equilibrium condition of overhead lines.—*Elek. Zeit.*, Sept. 12 and 19.

Insulating Varnishes.—A. R. WARNES.—An article on insulating varnishes pointing out the very dangerous effect of the use of linseed oil in such varnishes, and describing experiments which show these effects.—Lond. *Elec. Review*, Sept. 20.

Junction Box.—An illustrated description of a junction box for metallically sheathed electric cables recently patented by an English telegraph company. The mechanical details of the arrangement are described and illustrated, showing that good electrical contact with the sheathing is insured.—Lond. *Elec. Eng'ing*, Sept. 19.

Soldering.—A. LIPPMANN.—The first part of a translation in full of his German article on experiments with solders for electric wires which was recently abstracted in the Digest.—Lond. *Elec. Review*, Sept. 20.

Switches.—Illustrated descriptions of various forms of multiple-contact, two-way and other special types of switches and combined switches and wall sockets, made by a British company.—Lond. *Elec. Eng'ing*, Sept. 19.

Electrophysics and Magnetism.

Oscillations in Direct Currents.—A paper referring to the work of Athanasiadis on the telephone sounds produced by direct-current dynamos with large capacities in the circuit. The author found that such tones were produced as soon as he inserted into the circuit a horseshoe electromagnet used for the study of diamagnetism. He even found them produced on inserting an accumulator with a resistance of manganin plates. With a current of 30 amperes the sound could be heard two or three yards off. The pitch of the note was in all cases equal to the product of the frequency into the number of segments of the commutator. This suggests that it is a temperature effect, produced by the alternating thermal expansion and contraction of the wire coils or manganin sheets, which is communicated to the air and then perceived as sound. The same effect may be produced by connecting up an arc lamp. In one case the note so produced was audible in every part of a hall capable of holding 150 people. This was all the more noteworthy since there was here no question of microphone currents.—*Ann. d. Physic*, No. 9, abstracted in Lond. *Elec. Eng'ing*, Sept. 1.

Electrochemistry and Batteries.

Electrolysis of Fused Salts.—R. LORENZ.—If fused salt, for instance, lead chloride, is electrolyzed with a fused lead cathode, it is found that lead dissolves from the cathode in the fused electrolyte in the form of a mist. The mist formation, of course, represents a reduction of efficiency. The author has found that this may be avoided by adding a chloride of an alkali metal to the electrolyte.—*Zeit. f. Elek.*, Aug. 23.

Units, Measurements and Instruments.

Alternating-Current Wattmeter and Voltmeter.—An illustrated description of new commercial forms of alternating current instruments with iron cores as designed by Sumpner. By the use of laminated iron cores with narrow air-gaps in these instruments, strong magnetic fields are produced, thus permitting of the employment of strong controlling springs for the moving-coil system without loss of sensitiveness, and rendering the instruments proof against the influence of external magnetic fields. It was shown by Sumpner that the difficulties due to hysteresis and variation of permeability which had been expected to arise from the use of iron cores, could be overcome by suitable design, "and the series of instruments which has been developed in no way falls behind the ironless type in accuracy, while the comparatively strong forces at work enable the instruments to be constructed with substantial moving parts, pivots, etc." On account of the displacement of phase between the magnetic field produced and the voltage applied to a shunt-wound electro-magnet, it is necessary to use in connection with the current coil of the wattmeter a special "quadrature" transformer, the primary of which is traversed by the main current, while the secondary is connected through a high non-inductive resistance to the moving coil. Fig. 4 shows the con-

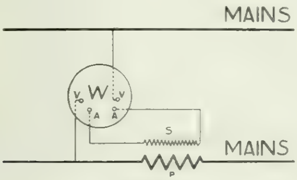


Fig. 4.—Diagram of Connections.

nections of the wattmeter *W* and quadrature transformer *QT* on a single-phase circuit, *VV* and *AA* being the terminals of the field and moving coils, respectively, *P* the primary, and *S* the secondary of the transformer. For e. m. f.s above 600 volts, a voltmeter transformer is desirable. Apart from the use of the special type of ammeter transformer, the connections are the same as those of any other wattmeter. In addition to the two-wattmeter method for measuring the power in an unbalanced three-phase circuit, a single wattmeter can be used, with either a split choking coil in connection with the field coil, or two series transformers with opposed secondaries connected with the moving coil. The "magnetostatic voltmeter" is identical in construction with the wattmeter, but is employed with a condenser in series with a moving coil.—Lond. *Elec. Review and Elec. Eng.*, Sept. 13.

Measuring Instruments.—A note on several improvements in electric measuring instruments which were shown at the recent exhibition of the French Physical Society. Richard showed a moving-coil ammeter provided with an arrangement for greatly extending its range. The pointer has a spiral spring attached to it whose free end comes in contact with a stop after the pointer has moved over a certain prearranged portion of the scale—for instance, up to the 100-amp. point. With any further increase in current the deflecting torque is opposed by the additional force of the spring, so that the motion of the pointer for a given rise in current is greatly reduced—the instrument indicating, for instance, up to 300 amperes in the last part of the scale. In the Meylan hot-wire meter the current to be measured does not exist in the hot wire, but in an insulated wire wrapped round the hot wire, the heat being transferred to the latter by conduction. The hot wire is only .13 mm in diameter, and the insulated wire does not absorb more than 1.5 watts for the full scale deflection. The Compagnie de Compteurs has introduced a novel temperature correction into its supply meters. The aluminum disk on the moving member of the instrument varies in resistivity considerably with temperature, and to compensate for this there is produced a [illegible] but opposed. variation in the magnetic field. The magnet is provided with a magnetic shunt of [illegible] whose permeability falls rapidly with increase in temperature, the material being practically non-magntic at 120 degs. C. If, therefore, the temperature of the instrument increases, the rise in the resistance of the aluminum disk is completely compensated for by the reduced amount of magnetic shunting which takes place owing to the fall is the permeability of the shunt.—Lond. *Elec. Engineer*, Sept. 13.

Testing of Series Motors.—An illustrated article on the commercial testing of series motors, describing four different methods, with particular reference to such motors which are controlled by resistance shunted across the series field coils.—Lond. *Elec. Review*, Sept. 20.

Telegraphy, Telephony and Signals.

Undamped Oscillations.—J. A. Fleming.—An illustrated Physical Society paper describing experiments on the Poulsen arc as a means of obtaining continuous electric oscillations. The author describes various experiments which indicate strongly that the arc method of exciting undamped oscillations give rise to irregular groups of oscillations which are separated by short intervals of time. In order to be successful at all in producing high-frequency oscillations by the arc method he finds it essential to pay attention to a number of details. The carbon electrode should be kept in slow rotation. Hard arc carbons are better than soft ones. As regards the gas, pure hydrogen works with difficulty; coal gas is better, but cannot be used over and over again. The sides of the containing chamber must be kept cool, and the chamber must be cleaned out at intervals.—Lond. *Electrician*, Sept. 20.

Undamped Oscillations.—A note on a recent British patent of Poulsen. "In wireless telegraph or telephone systems where a continuous spark or arc discharge is used to produce the vibrations, the intensity of the vibrations is changed by varying the conditions of the hydrogenous atmosphere in which the discharge takes place. Ordinary illuminating gas may be used, and any ordinary device utilized for varying the amount of hydrogen in the atmosphere immediately surrounding the arc." —Lond. *Elec. Eng'ing*, Sept. 12.

Telephone Cables.—An article on extensions of the cable system of the British Post Office. They are continually laying additional underground cable, and a 118-wire cable has been laid beyond Watford, and may soon be extended to Aylesbury. This cable contains 28 pairs of 150-lb. conductors, 14 pairs 200-lb. conductors, and 34 single 70-lb. wires, screened with copper tape. The cable is not "loaded," but it is not unlikely that a loaded cable (of the Pupin type) may be employed when the next cable from Leeds to Newcastle is laid.—Lond. *Elec. Eng'ing*, Sept. 12.

BOOK REVIEWS.

The Prevention of Accidents. By F. W. Johnson. Second edition. New York: McGraw Publishing Company. 37 pages. Price, 25 cents.

The purpose of this pamphlet is to assist the management of street railway companies in the instruction and education of their carmen as to practical means of preventing the more common class of accidents, and as to procedure in case accidents occur which will assist electric railway companies in meeting fraudulent accident claims. The various heads include the accident report, witnesses to accidents, rear-end collision of cars, collision with teams, passing standing cars, stepping from moving cars, starting on one bell, railroad crossings, safe landing places, and open-car accidents.

Alternateurs a Collecteur Monophasés et Polyphasés et les Dynamos a Courant Continu a Deux Paires de Balais. Par Charles Jacquin. Paris: Gauthier-Villars. 140 pages, 40 illustrations. Price, 3.50 francs.

The object of this little book is to review briefly the various classes of single-phase motors which have recently been brought forward. Mathematics have been avoided as far as possible, the object being to explain the mechanism and the principal features of their operation. Chapters treat respectively of the

direct single-phase commutator motor; compensating single-phase commutator motors; repulsion motors with two brushes and with several pairs of brushes; Latour single-phase motors with four brushes, with six brushes, and of a mixed type; the Arnold single-phase motor with three brushes; single-phase motors with fixed armature and moving brushes. One chapter is devoted to the Gorges-Latour-Heyland type of alternators, which was the subject of some discussion several years ago; and a final chapter has for its subject the Rosenburg and the Leitner-Lucas new types of dynamos. As will be seen from this recapitulation, the book deals with new types of apparatus, descriptions of most of which have not yet found their way into regular text-books or engineering treatises. Accounts which have appeared elsewhere of some of the machines described have been so involved with mathematics as to place the subjects beyond the reach of many readers, and to these the present book will be doubly welcome.

Standard Polyphase Apparatus and Systems. By Maurice A. Oudin, M. S. Fifth edition, revised and enlarged. New York: D. Van Nostrand Company. 369 pages; 207 illustrations. Price, $3.00.

That this treatise is now in its fifth edition indicates that it has met the need for a purely descriptive book on alternating-current machinery, devoid of mathematics and the discussion of points in design that appeal to the relatively few. Among the new matter is an extension of the notice of the single-phase motor, which, however, does not take full account of the present status of that branch. In fact, the book would have a greatly increased value if it did not adhere too closely to so-called "standard" apparatus, meaning the crystallized product of the larger manufacturing companies, but took account also of apparatus in course of development, and added some consideration of the latest forms of European apparatus, which of recent years has usually been in advance of American practice, and in many cases finally becomes "standard" in this country. The increased number of pages required by such an extension of the scope of the book would probably also have the incidental advantage of causing the substitution of book paper for the present glazed card board employed as such, the only object of which appears to be to give size to what would otherwise be a slim volume. These comments are not intended to impeach the high value which the book undeniably possesses within its present scope, nor reflect on the ability the author has shown in its compilation. In fact, it is the latter consideration that has prompted the wish that he might extend the work to a complete descriptive treatise on polyphase apparatus.

The Prepayment Watt-Hour Meter as an Aid in Securing New Business.

By H. W. Young.

To be convinced that the prepayment idea for the purchase of practically all forms of commodities is rapidly growing it is only necessary to consider the large number of automatic devices in use for vending practically all forms of commodities. Like the installment plan of payments, the prepayment meter appeals to a class of people who are accustomed to receive and spend their money in small quantities. The success of gas companies has been greatly aided and furthered by the prepayment meter, and its use in the electrical field should prove as great a success as it has proven in this field.

Prepayment meters are especially applicable in supplying energy to customers whose total consumption is relatively small and the collection of whose bills is a very considerable proportion of the total revenue derived. Their use greatly reduces the amount of bookkeeping and unavoidable monetary loss due to poor accounts, for the service is such that before securing light it is necessary that payment be made. This system, therefore, automatically collects its own bills, registers the actual consumption, and when the energy prepaid for is consumed, automatically disconnects the service. In installations such as flats, dormitories, barber shops, cafés, saloons, boot-blacking establishments, cigar stands, rented houses, or in any other installations where the volume of energy consumed is necessarily small, the prepayment meter will be found extremely useful. Central stations supplying towns having a large "floating" population, such as seashore resorts or college towns, where the rapid shifting of population renders difficult the following of accounts will find the prepayment meters extremely useful.

Another use for the prepayment meter is in the collection of old accounts. Central stations frequently have a considerable number of customers who are usually backward in payments, although they ultimately pay their bills. One method of forcing such customers to pay back bills is to threaten discontinuance of service, but this method is only resorted to as an extreme measure, owing to the resulting unpleasantness and very possible loss of a customer. On the other hand, a central station cannot afford to have its legitimate revenue tied up even with customers who will ultimately pay.

An effective way to collect these old bills, and at the same time continue the service, might be to install a prepayment meter adjusted for a higher rate per kw-hour than the regular rate. For instance, assuming the normal rate to be 10 cents per kw-hour, the meter may be set at 15 cents per kw-hour, so that the customer not only pays for the energy being consumed, but also gradually pays up the old bill on the installment plan. The majority of customers would undoubtedly prefer this method of paying up old bills to being forced by threats of discontinuance of service. After the account has been settled, the meter can be reset for the normal rate per kw-hour.

At the present time many central stations are unable to connect a considerable number of relatively small consumers, owing to the fact that the amount of energy used by each customer would be so small as to hardly justify the collection and accounting expense, which would be a very considerable percentage of the total receipts. For example, many station managers would hesitate to connect up consumers whose bills would probably not average over $1 per month, and, furthermore, these consumers do not understand and will not agree to a fixed minimum charge. However, assuming that the total revenue from such a consumer would average $12 per year, and assuming the cost of generation and distribution is one-half the gross receipts, it would leave a remainder or profit of $6, less the interest, collection and maintenance cost. While the gross profit would not be very large, yet the percentage is very satisfactory, and there is the additional advantage that a large majority of these new customers would gradually use larger amounts of energy and in time come within the class of desirable customers.

The use of electricity increases with the knowledge of its advantages, and there is no better way of introducing its use, especially with the smaller customers, than with the prepayment meter.

With the prepayment meter, differential rates can easily be made, owing to the fact that the rate per kw-hour is not shown on the meter bills and the central station may, therefore, place meters adjusted for different rates to meet the various conditions which arise; for instance, a long-hour consumer could be supplied through a meter adjusted at a lower rate than the short-hour consumer. This method of differential rates, though not in general use, is feasible for the reason that with a prepayment meter consumers feel they are purchasing light and not kw-hours.

Another use for the prepayment meter is in connection with electric cooking and heating appliances, which frequently are supplied with energy from a separate circuit at a different rate than is charged for lighting. These appliances may be supplied through a prepayment meter, and this system has the additional advantage of permitting the consumer to determine accurately just what the electric cooking or heating outfit is costing for the results obtained.

By preparing the meter for a definite amount, it can be used as a time switch to automatically turn off arc lamps, electric

signs and store window lighting. A case recently brought to the writer's attention illustrates quite forcibly another phase of the prepayment method of charge and its possibilities in settling disputes. A public hall largely used for lodge room purposes was electrically lighted and metered in the usual manner, the bill being equally divided between the several organizations using the hall. The secretary of one lodge claimed his bill for lighting was all out of proportion to what was actually used for the rather infrequent meetings, and this complaint was followed by that of another lodge secretary. The prepayment meter furnished a satisfactory solution of the problem, as each lodge was enabled to prepay the meter a sufficient amount for each evening session. Occasionally a case would arise where one lodge would have a small amount of energy to its credit, but as the load was comparatively constant

light as being too expensive. Prepayment meters were installed and within four months the revenue from these same places averaged from $5 to $6 a month. While the exact falling off in the gas bill was not ascertained, it must have been considerable, as the electric light soon became a necessity, rather than luxury.

Many forms of prepayment meters have been devised, and in Figs. 1 and 2 are illustrated one of the later types. The device consists of a regular single-phase measuring mechanism used in conjunction with a special register, automatic electric switching device and coin chute. The entire mechanism is mounted in a substantial cast-iron case, the cover of which is secured in position in a manner similar to that of the regular meter.

The operation of prepaying and using the meter is effected by dropping a quarter in the coin slot and turning the control

Fig. 1.—General View of Prepayment Meter.

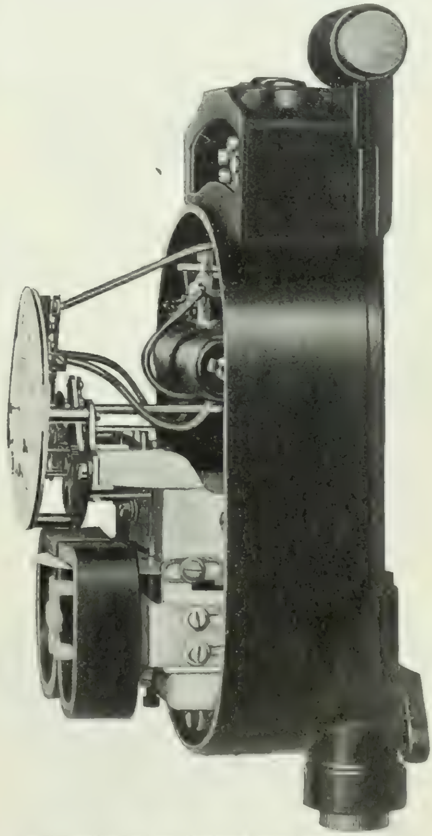


Fig. 2.—View of Prepayment Meter Mechanism.

and the approximate number of hours of burning known, the central station manager was in a position to instruct each secretary as to the amount of money to be deposited each evening, and in the long run these over-deposits would be compensated for by the small amount [illegible] by some other lodge.

Another case where the prepayment meter proved its worth was in a small town where gas competition was quite severe. Several small barber shops had both gas and electric service, but only used the latter when obliged to, such as, for instance, on hot nights when the patrons demanded it. The monthly consumption of electric energy would average only about $1.50, showing that it was used very sparingly, and upon investigation it was found that the several proprietors regarded the electric

drum to its maximum position toward the back of meter base, thus permitting the coin to enter the coin chute through which it drops into the coin receptacle. Insertion of additional coins repeats the operation up to a deposit of 10 coins, when the coin indicating pointer shows "full." If coins of a diameter less than that of a quarter are inserted, they will not pass down the coin chute or register on the coin wheel, owing to the action of a guide, which throws them into a by-pass through which they fall into the coin box without registering.

It will be noted that in addition to the regular set of dials as found in the ordinary meter, there is also a coin dial reading from 0 to 10 and also marked "full." The position of the coin index indicates the amount of money remaining to consumer's credit, the position of the regular dial showing the

total amount of energy which has been consumed. Thus, while the coin indicator moves backward toward zero, the regular dials count up or integrate as in the standard meter. A constant check on energy consumed and money received can thus be maintained by comparing dial reading and cash receipts.

"Beating" or defrauding the operating company by tampering with the prepayment meter is extremely difficult owing to the fact that the coin chamber or receptacle is a part of the meter base, and in order to secure money it would be necessary to practically demolish the entire meter. The meter case is bug and dust proof, thus preventing the introduction of foreign material which would prevent or impair its registration. The scheme of tripping the coin wheel and switch by insertion of coins attached to wires or strings is prevented by the shearing operation of the coin drum, which would immediately cut the wire or string when turned to drop the coin into the chute.

The lock on coin receptacle is of "Corbin" make, is practically impossible to pick, and as every customer has his own combination and key number, no two stations having exactly the same lock and key, keys cannot be interchanged between employees of stations.

The Dynamo for Ignition Work.

By R. V. Sutliffe.

That the dynamo will ultimately replace all other methods of electrical generating for ignition purposes seems highly probable. The reasons which follow will, I trust, demonstrate that as a direct or indirect source of ignition energy, its place in the ignition field is assured. Pre-eminently, the dynamo as a generator is absolutely and permanently self contained and independent of outside asistance at any time. This means much in the long run for the isolated plant, motor-boat owner and commercial work generally.

Perhaps equally important is the fact that a dynamo may be readily designed to generate sufficient e. m. f. for ignition work while running at a speed of not over 1100 r. p. m. It is therefore possible in many cases to start the engine direct from the dynamo without the use of any batteries whatsoever, and thus all "upkeep" expense is permanently eliminated. Furthermore, as it is well understood, slow speed adds greatly to the life of bearings and moving parts and to the wear on the brushes and commutator. The liability of insulated parts breaking down with a slow-speed generator is a remote one.

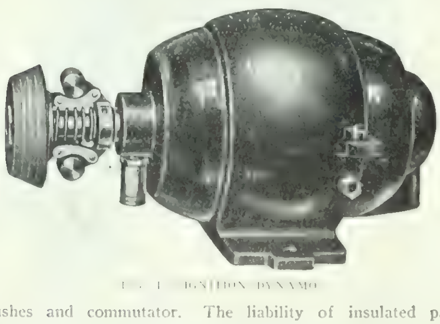


Fig. 1.—Ignition Dynamo.

For touch-spark work the dynamo may be used directly connected through the coil to the engine, and this will be found the most satisfactory method of igniting, because of the higher voltage which it is possible to obtain before the circuit is closed and because of the extreme durability and reliability of a mechanical generator, as above stated.

Owing to the inherent conditions of a dynamo it is advisable for jump-spark work to supply the energy to the coils from a storage battery. Without the slightest doubt the energy from an accumulator is best suited for a vibrating jump-spark coil. Both the current and the e. m. f. are constant.

The dynamo is for all practical purposes the only method of keeping a storage battery in condition, and it will be found that one furnishing direct current at the proper voltage and amperage will be most satisfactory. Alternating current may only be employed in connection with a mercury arc rectifier and in a majority of cases direct current from an outside source is not available.

Under any light a generator especially designed for the work it has to do is most recommended and such an instrument may be directly connected to the battery to be charged without the intervention of resistance material of any kind. Of course, it is well understood that a magneto will not charge a storage battery.

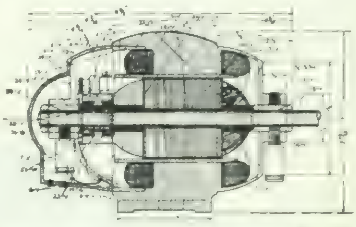


Fig. 2.—Sectional View of Ignition Dynamo.

The writer has found a surprisingly large percentage of cases where a small dynamo of the type referred to above is directly connected to a jump-spark coil and used with absolutely satisfactory results, sometimes with interposition of a lamp or two in parallel with the circuit. The reason why this is not always commended is because of the fact that the condensers of some coils will not discharge against the inductance of the dynamo windings.

There has been some objection advanced against dynamos for ignition work, as it is claimed they cannot or have not been satisfactorily driven. The output of a dynamo varies almost directly as to its speed. It is therefore necessary on a variable speed engine to drive the dynamo with a speed governor, as a constant output is desirable. This can be and is accomplished in a number of successful ways, according to whether the dynamo is driven by belt, gear or friction. It takes but a trifle of power to actually drive the dynamo. Hence a very successful and reliable governor may be manufactured. The writer would state from personal observation that he has seen types of friction and belt drive governors which would maintain the speed of the dynamo constant within a variation of 15 r. p. m. regardless of the speed of the engine. Inasmuch as there are about forty thousand mechanical generators driven by frictional governors on the market to-day, I hardly see how this method is other than practical.

The dynamo for ignition work has been on the market over fourteen years. It has stood the test of time and of actual try-out in the field. Every indication points to the fact that the numerous advantages possessed by the dynamo over any other form of current generation for ignition work, both as regards efficiency, durability and economy, are such that it will eventually be universally employed for work of this nature.

Low Tension Magneto-Generator.

The General Electric Company has developed a low-tension magneto-generator for the ignition system of gasoline automobiles, the construction of which embodies several advantageous features.

Lubrication is effected by the use of waste packing in the same manner as has been successfully applied in connection with this company's automobile motors. Generous oil wells are provided with overflow holes to prevent excessive lubrication. The type of bearing used eliminates the small wick oiling device heretofore so often employed, and insures the ample lubrication necessary for these machines. The oil wells are readily accessible, and when covers are in place, are dust proof and

will operate for months without attention. Oil baffles are provided on both ends of the armature to prevent oil from working into the armature and interior parts of the magneto. Ample bearing surfaces are provided, as well as shaft of large diameter to insure strength, rigidity and a minimum amount of wear.

Both the base and the bearings are of bronze, which has been found a more satisfactory metal than aluminum for this use, as it is less fragile, much more durable and looks cleaner after extended use.

One end of the armature winding is brought out through the hollow shafting by means of a steel conductor. The insulation bushing between the shaft and this conductor is of bone, and it is, therefore, little affected by moisture or heat. The circuit from the steel conductor is completed by means of a phosphor-bronze spiral spring to the lever nut, which forms the outside

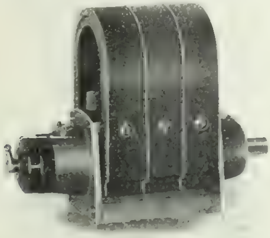


FIG. 1.—MAGNETO-GENERATOR ASSEMBLED.

terminal, thus avoiding any loose contacts. A hard-rubber cover screwed to the bearing carries the contact with all its parts. This cover is provided with a knurled exterior. The "grounded" side of the armature winding is firmly fastened to the core, and a carbon brush insures good contact between the armature winding and frame or ground.

The magnet cores are of the double type, sprung on the frame and secured by one screw on each side, thus minimizing the detrimental effect of drilling the cores. The long experience of the manufacturers in producing millions of permanent magnets for meters and instruments has materially assisted in the production of permanent magnets for these magnetos. The demagnetizing of the field magnets is prevented by avoiding a complete breakage of the permanent flux by allowing the armature core to overlap the pole-gap slightly when it is in a vertical position.

The design of the armature allows generous insulation and

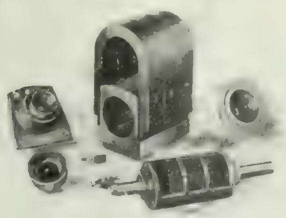


FIG. 2.—PARTS OF MAGNETO-GENERATOR.

also permits two other important advantages. With this magneto, an open circuit e. m. f. of over 100 volts is easily obtained, while a short-circuit current of approximately 0.4 ampere is available. In order to secure this high short-circuit current, the resistance of the armature winding is as low as possible, while the number of turns is sufficiently high to give an adequate open circuit voltage.

In introducing the magneto-generator at this time, after the season's large volume of business is passed, the company states that it is prepared to supply magneto-generators in large quantities, with a view of entering this part of the electrical business extensively during the next season. The above-described magneto-generator will be displayed at the various automobile exhibits this month and next in New York City and vicinity.

Universal Motor-Starter Panels.

The accompanying illustrations show a line of self-contained motor-starting rheostats, fuses and line switches which are designated as "universal panels" because they can be used to

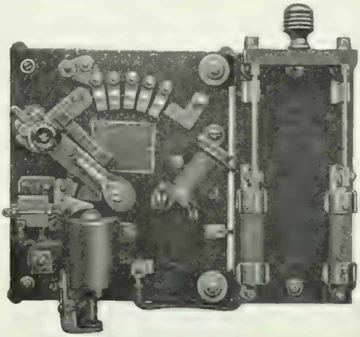


FIG. 1.—FRONT VIEW OF STARTER WITH OVERLOAD DEVICE

start any known type of direct-current motor, whether series-connected, shunt-connected or variable-speed. Fig. 1 gives a front view and Fig. 2 a rear view of a universal motor-starter

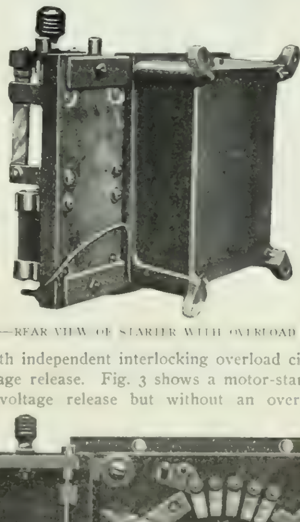


FIG. 2.—REAR VIEW OF STARTER WITH OVERLOAD DEVICE

equipped with independent interlocking overload circuit-breaker and no-voltage release. Fig. 3 shows a motor-starter equipped with a no-voltage release but without an overload circuit-

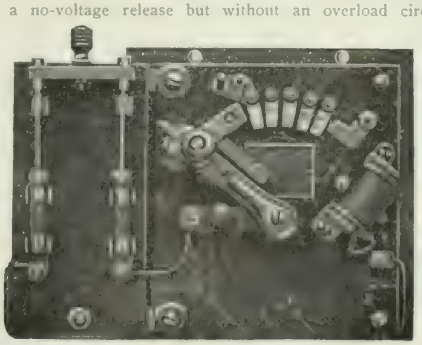


FIG. 3.—UNIVERSAL STARTER WITH NO-VOLTAGE RELEASE

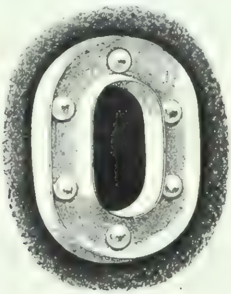
breaker. This starter is provided with a back-mounting plate, and the fuse arrangement is suitable for use where the load requires more than 25 amperes. For smaller loads, use is made of a porcelain base combined switch and fuse

On each of these starters the rheostat lever is provided with a separate renewable spring-actuated "flipper" switch connected to it by a flexible copper cable. In supplement to this there is provided an initial contact, which is a separate removable part readily renewable, and is so placed that no arc at this auxiliary contact can burn the stationary contact segments or the moving contact shoes. The spring flipper breaks the arc between it and the auxiliary initial contact by a quick snap action independent of the slowness of movement of the operator's hand. In the case of starters for motors rated at more than 10-hp the arc rupturing parts of the initial contact are provided with an efficient form of magnetic blowout device.

The above-described starters have been placed on the market by the Ward Leonard Electric Company, Bronxville, N. Y.

Porcelain Electric Signs.

The accompanying illustration shows a letter of a porcelain electric sign as manufactured by the Colonial Sign & Insulator Company, Akron, Ohio. The letters are concave and are of such form that they will reflect the light in parallel rays, thus en-



PORCELAIN SIGN LETTER.

abling the sign to be read at a great distance and at any angle. No paint is used on the letters; they are made of vitrified porcelain, with a permanent and beautiful glaze, and they will withstand all conditions of heat and weather.

The above-described porcelain electric sign letters have been approved by the Board of Fire Unerwriters.

Iron-clad Portable Instruments.

The General Electric Company, Schenectady, N. Y., is now introducing a new line of iron-clad portable instruments. The voltmeters and wattmeters are constructed on the direct reading dynamometer principle, while in the ammeters the Thomson inclined coil principle is applied. Mechanically these instruments are substantial in construction, with light-weight moving element, not susceptible to injury in transportation. The coils of these "Type P-3" instruments are entirely surrounded by a laminated iron shield which protects thoroughly from the influence of external magnetic fields. One of the severest tests of the reliability of these instruments when used for laboratory or general testing purposes is their ability to give accurate indications when used in the vicinity of external magnetic fields.

The instruments excel in mechanical construction, are neat in appearance and very substantial. They are contained in wooden carrying cases provided with hinged cover and snap lock. By the removal of the internal moulded cover and three screws, the entire mechanism can be taken from the case. The binding posts are brought out at the top of the instrument and are provided with suitable thumb screws for securing the leads which connect the instrument to external circuit.

The instruments may be used on circuits of any frequency, wave form or power factor without appreciable error. The voltmeter and wattmeter may be used interchangeably on direct or alternating current. The ammeter, although primarily an alternating-current instrument, may also be used on direct-current circuits by taking reverse readings. The scales subtend an arc of approximately 90 deg. and are very legible, as may be noted by reference to the accompanying illustration.

Careful attention has been given to the construction of the

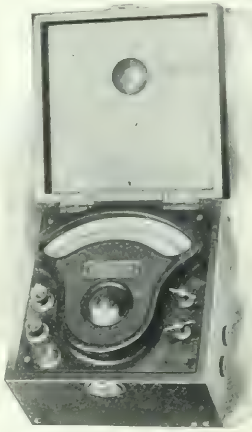


FIG. 1.—INSTRUMENT COMPLETE.

jewels and pivots, as these have great influence upon the continued accuracy of indicating instruments. The pivots are made from the best grade of steel, specially hardened and highly polished, and are suspended in high grade sapphire jewels which are practically indestructible. The pointer fluctuations are damped by means of Foucault currents set up in a thin aluminum segment attached to the shaft, and it oscillates

FIG. 2.—DETAIL VIEW OF INSTRUMENT.

with each movement of the pointer in the field of two statistically arranged permanent magnets. The weight of this segment balances the weight of the pointer, thereby maintaining equilibrium without extra counter weights.

The ammeters are made self-contained in ratings up to and including 30 amperes; the voltmeters up to and including 750 volts, and single-phase wattmeters in ratings up to and including 30 amperes and 750 volts.

Exhibits at the New York Electrical Show.

We described in last week's issue, the exhibits made by the various electric light companies at the Electrical Show which closed on Oct. 9, in Madison Square Garden, New York City. None the less interesting were the displays made by manufacturers of electrical apparatus, dealers and contractors, brief descriptions of whose exhibits follow.

The Westinghouse Companies occupied a space of about 2000 sq. ft.; the exhibit, quite an extensive one, was perhaps the most varied of any at the show. Approximately 20 applications of electric motors were shown, including ironing machines for the home and for laundries; pipe threading machinery, showing the most compact arrangement with this sort of work that has yet been made possible, the same being operated by means of a motor, rheostat, switches and wiring all on one bed; a blower for ventilating mines, subways, etc.; vacuum cleaner, made by the Sanitary Devices Mfg. Company, for the renovation of houses, hotels, etc.; exhaust fan made by the American Blower Company, for ventilating purposes; the Watson-Stillman pump for raising water to small house tanks for summer residences, hotels, etc.; a rotary air compressor for the operation of compressed-air tools, inflation of automobile tires, etc.; Yale & Towne hoist for factory uses; dish washing machinery, for cleaning dishes in the home and in hotels and restaurants; Singer sewing machine for domestic purposes; textile loom, operated to show the manner in which fabrics are woven; dough mixer, showing the manner of mixing dough in the home and in bakeries, and last, but perhaps most interesting to the commercial man, the phonograph in conjunction with the shaver. All of this apparatus was driven by Westinghouse motors, and experts explained the operation of the machinery. In the same space the Westinghouse Lamp Company gave [illegible] lamp manufacturing, showing the different processes through which an electrical lamp passes before it is ready for use. The Westinghouse [illegible] a full line of its arc lamps for all currents and voltages, as well as [illegible] for all circuits were shown as well as transformers of various [illegible] lamps mounted on columns. Cooper-Hewitt mercury vapor lamps were also exhibited from the ceiling of the Garden, demonstrating the value of this lamp for the lighting of large [illegible] The Westinghouse [illegible] for central-station work and also sparking batteries for automobiles. A [illegible] on a 220-volt, direct-current circuit, and attached to this machine was a speed-indicating device. It may be interesting to note that apparatus manufactured by five of the Westinghouse Companies was on exhibition.

The General Electric Company's exhibit was planned with a view to interesting the general public with appliances that appeal most directly to it. Never before has a manufacturer's exhibit been so complete in both the motor and heating applications for household or culinary purposes. The company occupied eight booths on the left of the main aisle in the center of the Garden. The exhibit was laid out with a main booth roofed with an arched canopy forming a galaxy of light and two open wings on each end. The front wing was devoted to the motor household and culinary applications and electric ironing. The visitor could demonstrate personally the advantages of the electric-driven sewing machine, potato peeler, the ice cream freezer, and observe the clothes both washed and ironed. Of particular interest was the electric carpet renovator in which a motor drives a cylindrical brush and a centrifugal fan which produces a suction at the brush and delivers the dust into a receptacle. There were also on exhibit in this wing, motor-driven dough mixers, coffee grinders and meat choppers. To heighten the interest in this wing a moving picture machine illustrated graphically the exciting race between the General Electric Company's electric locomotive and a New York Central flyer running 70 miles per hour. There was also an electrically operated Regina music box. The main booth was devoted to a model dining room and a model kitchen. The former was furnished in mission. Over the table hung an ornate shell dome in which was a 40-cp tantalum meridian lamp. The electric cigar lighter and the corn popper on the table were suggestive dining-room conveniences; the electrically wired side table on which were an electric chafing dish and percolator indicated the best way to provide for these modern necessities. The electric fan was not omitted. In the model kitchen were electric kitchen cabinets, large and small size, in which busy demonstrators prepared biscuits, fudge, rarebits and other delicacies. A counter along the side was stocked with a complete assortment of electric heating and cooking appliances, many in operation, for examination by the curious and interested. The end wing was devoted to industrial applications. Attracting considerable attention, partly on account of its noise, was an Ingersoll-Temple rock drill in operation. A 3-hp motor drove an air compressor and pulsator, the energy being transmitted to the drill through the medium of compressed air. It is a machine which combines both the advantages of the pneumatic and purely electrical drills. A 1-hp motor was also shown driving a cabinet-maker's circular mitre saw. A mercury arc rectifier automobile charging set, which was shown in operation, with switchboard equipment attracted much attention. Of special interest was a 30-kw, four-cylinder, direct-connected gasoline generator set which the General Electric Company is just placing on the market. A new electrically driven floor

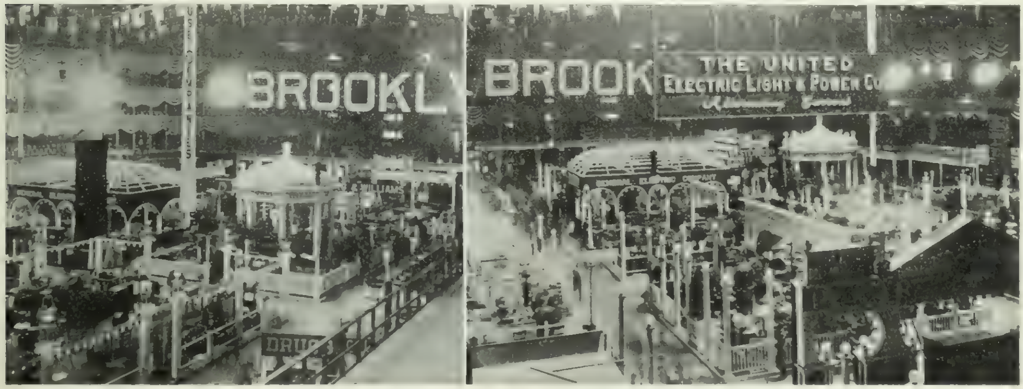


Fig. 1 — General Views of the Exhibits at the New York Electrical Show.

[illegible] was in use for demonstrating. A 20-kw Curtis turbine steam generator set used for train lighting and a disassembled turbine showing the advantages of construction; also a Bridgeport double 12-in. emery planer driven by a 2-hp induction motor and numerous small motors for various applications completed the exhibit in this wing.

On the left side of the main booth, a color booth of four sections was placed, and each section was lighted by a standard illuminant, viz., enclosed arc lamp, Welsbach gas lamp, incandescent lamp and Nernst lamp, for the purpose of illustrating the effect of artificial illuminants on colors.

THE F. ALEXANDER ELECTRICAL COMPANY, New York City, showed a number of 3-ampere miniature arc lamps. These lamps are said to give 500 candle-power.

A. GROTHWELL, New York City, exhibited the Mogul electrical compound, Mogul armature varnish, and Mogul acid and alkali proof compound, together with paints and varnishes for various power house applications.

THE FEDERAL SIGN SYSTEM COMPANY, New York City, made a handsome display of the various types of Federal signs, as well as samples of large cut-out letters for roof sign work. The porcelain enamel stencil unit letters and interchangeable panel signs were a feature of the exhibit.

THE EXCELLO ARC LAMP COMPANY, New York City, exhibited a number of its "Sun Ray" lamps in its booth on the north side of the arena. Four of these lamps were suspended in the tower of the Garden, and a number of "Sun Ray" and "Pearl White" lamps were used in many booths. In the booth of the company the mechanism of the different types of lamps were shown in detail, as well as a number of photographs showing installations at home and abroad.

THE NATIONAL ELECTRIC LAMP ASSOCIATION had a most up-to-date exhibit. At its booth, which was illuminated almost as though by daylight, were to be seen lamps with the following filaments: Cellulose, Gem metalized, tantalum and tungsten, each lamp in turn being more efficient than its predecessor. The clear white penetrating light from the last two named lamps was quite marked. A type of tungsten lamp in which the filament is arranged so that the lamp may be burned horizontally was shown.

THE GARVIN MACHINE COMPANY, New York City, exhibited a number of motor-driven machine tools. These included a universal milling machine operated by a variable-speed motor, two plain milling machines similarly operated, and a milling machine with an automatic slot-milling attachment. There were also shown a radial drill operated by a constant-speed motor, an automatic tapping machine operated by a variable-speed motor, and a die-slotting machine operated by a constant-speed motor.

THE METROPOLITAN ENGINEERING COMPANY, New York City, displayed its various types of signs, including roof signs, overhanging signs, panel signs, and sign fixtures. The company drew attention to the fact that it built the large sign used by the Edison Electric Illuminating Company, Brooklyn, and also the sign used by the United Electric Light & Power Company at the show. The large signs on the Madison Square Garden tower were also made by this company, whose product is so well known as to need no further comment.

THE CONSOLIDATED TELEGRAPH & ELECTRICAL SUBWAY COMPANY, New York City, showed a full-sized brick and concrete manhole, together with the connections from the manhole to the distribution box and to the standard street arc lamp as used in New York. The methods of running the cables in the conduit, splicing, tapping, and also of draining the manhole were clearly shown. The manhole was built from the floor up and illuminated within so that the method of supporting the cables on the cable-racks within the manhole, and also the method of making splices were plainly visible.

THE BECK FLAMING LAMP COMPANY, New York City, has six of its flaming arc lamps illuminating the exterior of the Garden during the Electrical Show, and in addition, the company showed a 12,000-cp arc lamp, which was installed on the corner of Madison Avenue and Twenty-Sixth Street. The lamp was suspended about 20 ft above the street level and illuminated a large section of Madison Square. A number of the company's lamps was strung along the north side of the arena; and in its booth the company demonstrated a complete line of lamps, including series and multiple alternating-current types, and the series and multiple direct-current types. In the booth of this company the H. C. K. Company also showed a full line of portables and fixtures.

THE DRIVER HARRIS WIRE COMPANY of Harrison, N. J., manufacturers of resistance wires, illustrated a few of the many applications of resistance wire to electrical appliances. Among the new and novel uses may be mentioned an instantaneous hot water heater in which the water passes through a coil of electrically heated "Advance" resistance wire; a branding iron in which the metal stamp is kept at red heat continually, and a sad iron. Among other appliances shown were portable cab heaters, arc lamp resistances, stereopticon rheostats, cooking utensils, measuring instruments, theater dimmers, resistance units and a new type of motor starter, which is said to be absolutely flame proof in case of a burn-out and contains a resistance wire of negligible temperature coefficient. A representative line of "Advance" and "Climax" resistance wires, both bare and insulated, were exhibited.

THE ELECTRICAL TESTING LABORATORIES, New York City, displayed a complete line of standard apparatus for making tests for resistance, e. m. f. capacity, inductance, etc. Two special test tables arranged with voltmeter, ammeter and wattmeter, and provided with the necessary rheostats, main switches, reverse

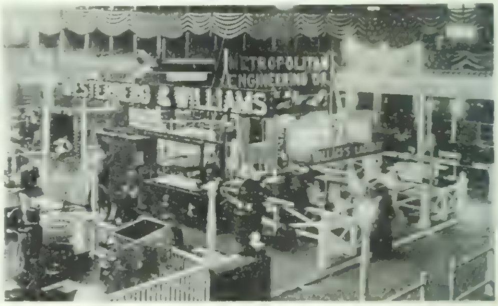


FIG. 2—EXHIBITS IN CENTER OF ARENA

switches, instruments and potentiometer, were shown in actual use testing instruments during the exhibition, energy being supplied by 140 small storage cells and two large storage cells. An oscillograph was shown in operation, one curve showing the e. m. f. wave of a small rotary converter, another curve giving the form of the current wave produced by the converter in an inductance coil, and the third, the form of the charging current curve of a condenser connected with the same circuit. The positions of these curves displayed to the eye the phase relations between the e. m. f. and the currents in the inductance coil and the condenser. The harmonics of the e. m. f. wave were exaggerated in the condenser curve, this latter curve having a large number of saw-tooth peaks. A photometer for incandescent lamps was exhibited, as well as an improved type of industrial photometer extensively used for measuring the candle-power and watts per candle-power of incandescent lamps. A spectrophotometer and a Weber photometer used for measuring illumination were also on exhibition. A stroboscope was shown in connection with the alternating-current arc. The instrument consists of a disc mounted on the shaft of a single-phase induction motor, which is fed from the generator supplying the energy to the arc lamp. The disc has a radial slot for each pole of the motor. By means of a lens an image is projected so that the light passes through the slots of the disc. The motor runs at a point near synchronism, the slip being sufficient to cause the image to go through its alternations on the screen at the rate of about two cycles per second. The screen was in plain view of the visitors and attracted no little attention.

THE AMBOY WORKS, Perth Amboy, N. J., had a very beautiful display of art glass globes and shades.

THE MONATON CONSTRUCTION COMPANY, Brooklyn, N. Y., contented itself with showing engineering plans.

THE STANDARD ROLLER BEARING COMPANY, Philadelphia, Pa., made a very interesting exhibit of its various types of roller bearings.

THE AMERICAN WIRE BRUSH COMPANY, New York City, showed a complete line of wire brushes for cleaning conduits, boilers, flues, chimneys, tracks, surfaces, pipes, etc.

THE AMERICAN MARCONI WIRELESS TELEGRAPH COMPANY had a station at each end of the Garden and demonstrated the method of sending and receiving wireless messages.

THE ADVERTISING MIRRORGRAPH COMPANY, Brooklyn, N. Y., exhibited its mirror signs, advertising signs and single lamp letters, together with its flashers and "thermoblinks."

THE MORELITE COMPANY, New York City, demonstrated the "Just" tungsten lamp in its booth in the northwest corner of the Garden. The lamps were shown operating side by side with the ordinary carbon filament lamp.

THE INDIA RUBBER & GUTTA PERCHA INSULATING COMPANY, New York, had on exhibition a full line of Habirshaw wire, cables and cores, together with material for high-tension transmission, and underground and submarine work.

WESTERBERG & WILLIAMS, engineering contractors, New York City, exhibited some very interesting motor-driven apparatus. A refrigerating plant producing 800 lbs. of ice per day was shown in operation, as well as a float-controlled centrifugal pump, a vertical pump, ice cream freezer and refrigerator.

THE NATIONAL DAIRY SUPPLY COMPANY, New York City showed the Burrell-Lawrence-Kennedy cow-milker in operation. The apparatus operates by means of partial vacuum and is said to give satisfaction. A number of cows were milked at stated intervals for the edification of a large crowd of sight-seers.

THE BAKER MOTOR VEHICLE COMPANY, New York, exhibited an electric automobile, driven by a 2½-hp motor and provided with a battery giving the vehicle a range of about 75 miles on a single charge. The method of charging the battery from the Edison mains was clearly shown.

G. M. GEST, New York City, displayed typical views of conduit installations and also his well-known cable-rack. The H. B. Camp Company also showed in this booth samples of its single and multiple duct conduit; and the Fiber Conduit Company exhibited sections and full lengths of conduit in both its untreated and treated state.

THE KENNY ELECTRICAL MANUFACTURING COMPANY, New York City, had on exhibition a motor-driven printing press, the feature of which is that it may be stopped instantly by a movement of the foot-treadle, without working on the rheostat. The Kenny system of friction drive was also shown. A motor-driven drill saw, a circular saw, and a hack saw formed part of the exhibit.

THE SAFETY CAR HEATING & LIGHTING COMPANY, New York City, showed its axle-driven car lighting system, mounted on a full-sized railroad car truck, such as is used by the Pullman Company. The generator had a rating of 80 amperes at 50 volts, and the system shown included the regulating apparatus and connections. The company also had on exhibition various lighting and heating fixtures used in connection with its system.

THE W. GREEN ELECTRIC COMPANY, New York City, displayed a very interesting line of small motor-driven tools for dental, household and light manufacturing work. The polishing and grinding motors have a double-end connection and are provided with a rheostat in the base so that the whole machine is self-contained. An alternating-current machine, with a friction drive and provided with an automatic oiling arrangement and a special jeweler's lathe attracted much attention.

THE SIMPLEX ELECTRIC HEATING COMPANY, through Roger Williams, its New York representative, made a very elaborate exhibit of electric heating and cooking devices. In fact, this was one of the most complete exhibits of heating devices ever made. In the booth were a corps of demonstrators explaining the working of the various devices. A new type of range, the feature of which is that it does away with the angle-iron frame and the slate back board for connections, was shown. The oven of this range is made to serve as a base for the top of the stove and has an iron framework. All connections are brought through the face plate above the oven, and there are no cord circuits in the way to be covered with grease, etc. Four-way snap switches located on a slate base on the front of the range control the connections. A patented method of clamping the cooking utensil against the heating surface was also shown. This results in a more effective heat transmission between the heater and the cooking utensil.

Open Sale of Bell Telephones.

Some years ago, immediately after the expiration of the earliest Bell telephone patents, the American Bell Telephone Company, whose instruments had theretofore been placed only in the hands of licensee companies, and not sold, began the sale of telephones "across the counter" to the general public. This did not continue very long, however, and the practice was dropped as suddenly as it had begun, and without any explanation. It is now announced that the Western Electric Company, which is largely owned by the American Telephone & Telegraph Company, and which makes the Bell telephone apparatus, will sell its telephones and telephone supplies to all buyers.

President Theodore N. Vail, of the American Telephone & Telegraph Company, has confirmed the report. He explained that the idea had been under consideration for a long time, but that heretofore one difficulty had been that the Western Electric Company needed more plant, its full energies being required to supply the demands of the Bell companies alone. This obstacle to doing a general business has been overcome by the recent completion of very large additions to the Chicago factory of the Western Electric Company, and hence it is now in a position to take care of outside orders.

In reply to a question as to the probable effect of this action on the revenues of the American Telephone & Telegraph Company, Mr. Vail said that no considerable direct increase was anticipated but that a great indirect advantage was looked for from improved relations between the public and all of the associated Bell companies, because there has been an entirely erroneous idea more or less prevalent, that the charges of these companies for their services were based on a monopoly of telephone instruments, while the fact is that the instrument is but a small part of the plant required in giving telephone service. It is felt that this action may cause it to be more clearly understood by the public that the Bell companies' only claim for patronage is based on their ability to furnish the best service at reasonable prices and not on any instrument monopoly.

Mr. Vail aserted that at the present time many inefficient telephone instruments are in use on local and private lines and that the Bell companies desire to see these replaced by standard instruments in order that it may make traffic connections with the greatest possible number of properly equipped lines, assuring proper service and transmission. For example, there are thousands of so-called "Farmers' lines" which will furnish valuable feeders for the toll lines of the larger system when properly equipped and maintained. This situation can be provided for through the sale outright of Bell instruments and apparatus.

In answer to the question as to whether it was intended that the Western Electric Company should become an aggressive competitor of the independent manufacturers who, up to this time, have had a monopoly of the selling trade, the only reply was that the Bell interests were fully prepared, either from the manufacturing or operating side of the business, to meet all the needs of the public, and that they wished to demonstrate that they claimed or asked no advantages other than their ability to meet those needs under square competitive conditions of quality and price.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from the various trade centers were somewhat uncertain in tone, but not without a tendency to optimism. Interest in fall trade was active, and results in this direction are all that could be desired. There is no sectional difference on this point, all leading cities reporting a liberal distribution of seasonable wearing apparel. Among the manufacturers the most notable increase in orders is reported by New England shoe shops, while there is no idleness at cotton mills, and the reduction of steel output is not significant. Crop news of the week was encouraging, all the great staples except corn and cotton being beyond danger from frost, and another week will secure the former crop, with its farm value of approximately $1,250,000,000, while there is little fear of killing frost in the cotton states this month. Railway earnings thus far reported for September exceeded the figures for 1906 by 7.6 per cent, and foreign commerce at the port of New York showed a gain of $4,485,363 in exports and a loss of $1,831,165 in imports. Collections, while still dragging, in consonance with the tightness in money, appear to have improved at a number of centers. Many industrial lines are less active on new business, and working forces in such lines as iron, steel, car manufacturing, electrical goods, shoe manufacturing and copper mining are being reduced. Lumber is less active, and new building is lighter, due in part to the approach of the closed season, but more particularly to the stringency in money. Pig iron continued very dull, foundry grades being weaker. On the other hand, Bessemer pig iron was firm and scarce in the Central West. Demand for structural material was good. Competition for fabricated work is more active, and as a result the price situation is easier. Domestic orders for steel rails are light, but a contract for 12,000 tons has been taken for the Manchurian railroads, with an additional 70,000 tons still under negotiation. Copper is again lower, lake brands for future delivery being quoted at 14⅛ to 14½ cents and electrolytic at 14 to 14⅛ cents. At the lower levels foreign demands developed somewhat, but domestic trade is still of a hand-to-mouth character. The leading interests curtailed production considerably in September, but it is reckoned that the actual decrease was not very marked, owing to the decreased outputs of other mines. Failures for nine months are only slightly more numerous than a year ago, but liabilities, swelled by a number of large suspensions, are considerably heavier. There were 6891 failures reported to *Bradstreet's* for nine months, with liabilities of $111,238,064, an increase of only a fraction of 1 per cent in the number, but of 25 per cent in the liabilities, as compared with last year. The proportion of assets to liabilities for nine months is 55.1 per cent, the highest proportion noted since 1897, indicating a larger number of failures of usually solvent concerns. The number of failures during the week ending Oct. 3 was 177, against 166 in the week previous, and 136 in the corresponding week last year.

AMERICAN RAILROADS.—The advance report of the Interstate Commerce Commission gives figures of the steam railroads of the United States for the year ending June 30, 1906. The total single-track mileage was 224,363 miles, with 51,672 locomotives and 1,958,912 cars of all classes and 1,521,355 persons on the payroll. The number of passengers carried was 799,507,838. The passenger mileage, or the number of passengers carried one mile, was 25,175,480,383, the increase being 1,375,330,947 passenger miles. The number of tons of freight shown as carried (including freight received from connections) was 1,631,374,219, which exceeds the tonnage of the year 1905 by 203,642,314 tons. The ton-mileage, or the number of tons carried one mile, was 215,877,551,241, the increase being 29,414,441,731 ton-miles. The number of tons carried one mile per mile of line was 982,401, indicating an increase in the density of freight traffic of 121,005 ton-miles per mile of line. The average revenue per passenger per mile for the year ending June 30, 1906, was 2.002 cents. The total capitalization was $14,570,421,478, or $67,936 per mile. Of this, $6,803,760,093 was stock, 33.46 per cent of which paid no dividends. The gross earnings were $2,325,765,167. The total income was $1,045,527,487, and the net, after charges, $385,186,328, out of which $272,851,567 was paid in dividends.

LUSITANIA TELEPHONES.—The new turbine-driven monster, *Lusitania*, of the Cunard Steamship Company, has been equipped with a telephone system, the most extensive in use on any vessel. The National Telephone Company installed the equipment and will supply the sister steamer, *Mauretania*, with another like it. The installation on the *Lusitania* consists of eighty-nine stations and ten exchange lines connected to a switchboard having equipment for 200 stations and twenty exchange lines. The telephone instruments are installed in the regal first-class staterooms, in the cabins of the ship's physician, purser and chief steward and in the bureau. When the boats are in port the exchanges are connected for local and long-distance service with the city systems.

WESTINGHOUSE SHOPS.—Advices from Pittsburg state that the new eight-story factory building of the Westinghouse Electric & Manufacturing Co. at East Pittsburg is completed. The tools and machinery have nearly all been set up and the removal of the employes into the structure will begin at once. The readjustment in its operating force at the East Pittsburg Works will mean a saving of approximately $1,000,000 a year in operating expenses, according to a statement of the company. During the last two years, the management has been making a large number of improvements. New and improved machinery has been installed in various departments, which has greatly enhanced the productive efficiency of these branches of the plant, at a reduction of actual labor.

SOUTHERN PACIFIC ORDERS.—The Southern Pacific Railroad has just ordered two 5000-kw turbo-generators to be built by the Westinghouse Company for the electric power plant that is to be erected at the foot of Fruitvale Avenue on the Oakland estuary. These generators will be 13,200 volts, 25 cycles, three-phase. They will cost close to $250,000. In addition to these generators, and the already ordered boilers, the company has placed Eastern orders for the construction of about 90 electric passenger cars, somewhat like, but longer than the Key Route cars. These will be used on the Alameda and the Oakland suburban systems, diverging from both the Oakland shore piers.

SOUTH EAST AFRICA.—An American business man contemplates returning to Southeast Africa in the interest of his concern, which makes rock drills, and states to the Bureau of Manufactures that he desires to represent other manufacturers for the sale of goods in the territory from Lourenço Marquez to Mombasa and Zanzibar. He suggests as among the salable lines, mining and electrical machinery.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and heavy with considerable bearish activity. High money rates discouraged buying, and most of the week's incidents, including the reduction in the Anaconda dividend, the receivership of the Metropolitan Street Railway, and the talk of further governmental action against railroads, resulting in an unsettled tone. New York Central was unfavorably affected by the report that it was negotiating a $50,000,000 loan abroad. Brooklyn Rapid Transit showed a tendency to improve in the face of the weakness in the other tractions, the talk being that its forthcoming annual report will be a very favorable document. One of the objects of bearish attacks was the United States Steel issues, especially the common, this movement being based on further rumors of reduced demands and orders for steel. In the latter part of the week a number of low-priced stocks were taken in hand by the bears and yielded rather sharply, some of them touching the lowest prices they have reached in a long time. Brooklyn Rapid Transit ranged between 42½ and 48½, and closed the week at 46¾, this being a net gain of 4 points. Metropolitan Street Railway dropped 2¼ points. No marked movements occurred in the electric

list, with the exception of Westinghouse, which closed with a net loss of 9 points, the last quotation being 129. The curb market was professional, with an absence of public participation. The closing quotations of Oct. 8 are given in the accompanying table.

NEW YORK.

	Oct. 1	Oct. 8		Oct. 1	Oct. 8
Allis-Chalmers Co.	7⅜	7	General Electric	123	122
Allis-Chalmers pfd......	21½	19½	Hudson River Tel. ...	—	—
Am. Dist. Tel.........	20	—	Interborough Met. com.	8¼	9¼
American Locomotive...	51⅜	50½	Interborough Met. pfd	23	24½
Amer. Locomotive pfd..	99½	90¼	Mackay Cos	60¾	59¾
American Tel. & Cable..	75	75	Mackay Cos pfd.......	[illegible]	[illegible]
American Tel. & Tel...	105	104	Marconi Tel.	—	—
Brooklyn Rapid Transit.	47	45⅝	Metropolitan St. Ry....	36	35
Electric Boat	—	—	N. Y. & N. J. Tel......	[illegible]	99
Electric Boat pfd......	—	—	Western Union Tel....	72	72
Electric Vehicle	—	—	Westinghouse com	[illegible]	115
Electric Vehicle pfd...	—	—	Westinghouse pfd.	165	165*

BOSTON.

	Oct. 1	Oct. 8		Oct. 1	Oct. 8
American Tel. & Tel...	105¾	105	Mass. Elec. Ry. pfd...	47¾	47½
Cumberland Telephone.	—	—	Mexican Telephone....	2	—
Edison Elec. Illum.....	206	—	New England Teleph ..	[illegible]	—
General Electric	124¼	125	Western Tel & Tel. .	—	—
Mass. Elec. Ry........	—	—	West. Tel. & Tel. pfd...	—	—

PHILADELPHIA.

	Oct. 1	Oct. 8		Oct. 1	Oct. 8
American Railways.....	40¾	40½	Phila Electric	[illegible]	[illegible]
Elec. Co. of America...	8⅝	8⅝	Phila Rapid Transit .	19	19[illegible]
Elec. Storage Battery..	44	42	Phila. Traction	86¾	87
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Oct. 1	Oct. 8		Oct. 1	Oct. 8
Chicago City Ry.......	150	150	National Carbon	—	—
Chicago Edison	—	—	National Carbon pfd...	—	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.......	—	—	Union Traction pfd...	—	—
Metropolitan Elec. com.	19	19			

*Asked.

DIVIDENDS.—The Philadelphia Company, of Pittsburg, has declared a regular quarterly dividend of 1½ per cent on the common stock, payable Nov. 1. The directors of the Boston Suburban Electric Company have declared a regular quarterly dividend of 75 cents on the preferred stock, payable Oct. 15. Directors of the Public Service Corporation of New Jersey have declared the regular quarterly dividend of 1 per cent. Directors of the Mexican Telegraph Company have declared the regular quarterly dividend of 2½ per cent, payable Oct. 16. Directors of the Shawinigan Water & Power Company have declared an initial dividend of 1 per cent on the common stock for the quarter ended Sept. 30. Directors of Chicago Pneumatic Tool Company have declared a regular quarterly dividend of 1 per cent, payable Oct. 25. National Carbon directors have declared the regular quarterly dividend of 1 per cent on the common stock, payable Oct. 15. Directors of the Cuyahoga Telephone Company have declared the regular quarterly dividends of 1½ per cent on the preferred stock, payable Oct. 30, and 1 per cent on the common stock, payable Oct. 21. Directors of the U. S. Telephone Company have declared the regular quarterly dividends of 1½ per cent on the preferred stock, payable Oct. 15, and ¾ of 1 per cent on the common stock, payable Oct. 25. Directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1¾ per cent, payable Oct. 15. Directors of the Cincinnati, Newport & Covington Light & Traction Co. have declared the regular quarterly dividends of 1⅛ per cent on the preferred and ¾ per cent on the common stock, payable Oct. 15.

THE MACKAY SYSTEM, now that the New York-Havana cable has just been laid, has a total of 25,000 miles of submarine cable operated by its two subsidiary companies, the Commercial Cable Company and the Commercial Pacific Cable Company. The new cable line, which has cost between $1,400,000 and $1,500,000, has been paid for entirely out of earnings. Of the 25,000 miles of submarine cables, approximately 16,000 miles are operated in the Atlantic Ocean by the Commercial Cable Company and 9000 miles in the Pacific Ocean by the Commercial Pacific Company. The company figures the cost of cable construction at $1,000 per mile, which would represent a property investment in the entire cable system of fully $25,000,000. The Commercial Cable Company is now operating five trans-Atlantic cable lines which are crowded to their utmost capacity. It seems likely that the company will undertake within another year the laying of a sixth Atlantic cable. For operating purposes the officials of the Mackay Companies look upon their land lines, represented by the Postal Telegraph Company and the cable lines in the Atlantic and Pacific as one system. For this reason in pursuing development work it has come to be the policy of the management, when an unusual amount of money is spent in one year on either the cable or land lines in extensions, to expend less during that year on the other and during the following year reverse the course of expenditures. This year telegraph construction on land has been cut down very materially and surplus earnings in part diverted to the payment of the Cuban cable.

B. R. T. ANNUAL.—The Brooklyn Rapid Transit annual report shows that there were carried 511,839,437 passengers, an increase of 59,235,234, or 13.1 per cent over the previous fiscal year. The average gross earnings per passenger are 3.60 cents, as compared with 3.89 cents for the preceding year, a loss per passenger of 7.5 per cent. The average net earnings per passenger, with no deductions for special appropriations or fixed charges are 1.48 cents, as compared with 1.70 cents for the previous year. The statement of earnings shows gross of $19,381,587, compared with $18,473,328 the previous year. The operating expenses totaled $11,465,705, against $10,441,377 in 1906, and the net earnings amounted to $7,915,882, compared with $8,031,951 the previous year. The balance sheet disclosed loans and bills payable of $900,000 and cash on hand $965,670, compared with $2,001,559 the year before. The surplus stood on June 30 last at $3,734,006. On June 30, 1906, the surplus was $2,075,563. On the subject of taxation President Winter says that it has been the disposition of the public to levy every possible tax against corporations holding public franchises. He regards this as short-sighted, and says that every million dollars of excessive taxes would pay interest at 5 per cent on $20,000,000 invested in extensions or enlargement of transportation facilities.

THE CONOWINGO ELECTRIC COMPANY, with charter rights to dam the Susquehanna River at Conowingo, 8 miles from Havre de Grace, is getting ready to build a new power plant with 100,000-hp capacity, rivaling the great McCall's Ferry power plant. The object is to deliver power to Baltimore, Philadelphia, Wilmington and New York City. Men are at work converting the old boarding house of the Conowingo Paper Company into shape so as to facilitate accommodations for hundreds of persons to be employed. It is proposed to construct the power house on the Hartford County side of the river, the same as the York Haven Water & Power Company's plant, and make the dam about the same height as the McCall's Ferry dam and back the water as far as Peachbottom, a few miles below McCall's Ferry. If this is the case, the Susquehanna River from Chesapeake Bay to York Furnace will be navigable. It is said that the capital backing the company will be about $10,000,000.

SALE OF NATIONAL WIRE PLANT.—It was announced last week at the office of the United States Steel Corporation that one of its subsidiary companies had purchased at receiver's sale the plant of the National Wire Corporation, at New Haven, Conn., for $650,000. The company has two large plants at New Haven, and was capitalized at $5,000,000. Although it is not definitely known which one of the subsidiary concerns of the United States Steel Corporation purchased the New Haven plants, it is understood that it is the American Steel & Wire Company. The plants have been rated at nearly twice the amount of the sale price. The concern failed about two months ago. Its assets amounted to about $1,000,000 and liabilities about $3,000,000.

DENVER INTERURBAN BONDS.—The Denver & Interurban Electric Railroad, which is an auxiliary of the Colorado & Southern, has made a first mortgage to the Guaranty Trust Company, as trustee, to secure an issue of $1,250,000 6 per cent bonds, maturing July 1, 1937. This road is under construction from Denver to Louisville Junction, about 16 miles, and from that point to Boulder will use under lease Colorado & Southern tracks, aggregating 28 miles, which are to be electrified. The stock and bonds are all held in the treasury of the Colorado & Southern.

BALTIMORE CONSOLIDATION.—It is stated that there is a plan on foot to consolidate the Consolidated Gas, Electric Light & Power Company, of Baltimore, and the Baltimore Electric Company. An offer was made by interests friendly to the Consolidated a year ago for the Baltimore Electric stock, and it is reported that this offer still holds good and is now being considered. It is understood to have been $10 a share for the stock and a guarantee of the bonds, principal and interest.

CUYAHOGA TELEPHONE, of Cleveland, shows an August gross of $65,875 and net of $28,356. The net for the eight months was $232,747 and the surplus after charges $95,273, an increase over 1906 of $33,316.

GENERAL NEWS

Construction News.

[illegible], ALA.—The [illegible] Light & Power Company [illegible] having plans and specifications prepared by E. N. Cunningham, of New Orleans, for the construction of a light and power plant. When plans are ready estimates will be asked on machinery and supplies. J. A. Shannon is president and S. E. Shannon, secretary and treasurer; present address, Hattiesburg, Miss.

HARTSELLS, ALA.—The Hartsells Electric Light & Power Company is being organized for the purpose of constructing an electric light plant. It is expected to have the plant in operation within eighty days. J. C. Rogers is interested in the enterprise.

TUSCALOOSA, ALA.—Architect Lockwood has been instructed to prepare plans and specifications for the building for the heating, lighting and water plant, to cost $80,000.

FLORENCE, ARIZ.—The Florence Water, Light, Ice & Power Company will soon incorporate with a capital stock of $50,000. The directors will be Dr. G. M. Brockway, P. A. Chamoer and A. C. Sieboth. The purpose of the company is to build water works, an ice plant, a gas plant and an electric light and power plant in Florence.

LITTLE ROCK, ARK.—Arrangements are being made by the St. Louis, Iron Mountain & Southern Railway Company to construct a power plant to furnish heat and light for the Union Station now under construction; light for passenger yards, heat for passenger equipment and compressed air for cleaning and brake testing. The equipment will consist of two 240-hp water-tube boilers, two 75-kw direct-connected generators, two exciters, one small generator and one air compressor having a capacity of 800 cubic feet per minute. The construction and installation will be done under the direction of Westinghouse, Church, Kerr & Company, of New York, N. Y.

ALAMEDA, CAL.—The annual report of the municipal electric light plant shows the gross earnings of $71,447 for the year, and the operating expenses to have been $44,491, making the net earnings $26,956. The plant shows a heavy increase in earnings in all departments and in net profits over the operation for the preceding year.

ALAMEDA, CAL.—The Board of Electricity is advertising for bids for additional machinery for the municipal electric lighting plant as follows: One 500-kw direct-connected alternating-current generator and cross-compound engine, or steam turbine, with switchboard panel and wiring. A. D. Goldsworthy is secretary of the board.

CHICO, CAL.—It is reported that plans are contemplated for electrifying the Butte County Railroad, from Chico to Paradise.

FRESNO, CAL.—The San Joaquin Electric Power Company is contemplating extending its transmission lines to the Mt. Campbell district and will soon extend its line to Lac-Jac. The company has recently awarded a contract for an engine to be placed in its plant, two and one-half miles above Riverdale. A. G. Wishon is manager. The company is now engaged in putting in a line to the Stokes Mountain country.

KENNETT, CAL.—The two new furnaces at the Mammoth Copper Company's smelter will be put into operation this month. A large amount of electrical motor equipment is being installed to operate the machinery in the plant. Four blowers furnish the air blast, three of which will be operated by three 250-hp General Electric induction motors, and the fourth by a 200-hp Westinghouse motor. A blower system for the converters, which is being installed, calls for a 750-hp electric motor. The hydraulic system in connection with the converters needs a 45-hp motor. There will be no overhead wires, the conduit system being used exclusively.

LODI, CAL.—The City Trustees are considering the question of submitting to the voters at the next municipal election the proposition of bonding the city for the purpose of establishing a sewer system and taking over the electric lighting plant and water works system.

LOS ANGELES, CAL.—Contracts have been let for the construction of a ten-story office building at Sixth and Main Streets. A large power plant will be installed to furnish light, heat and power for this and other buildings. The machinery will include a Corliss pumping engine, electric generators and boilers.

NAPA, CAL.—At the last meeting of the City Council the city clerk was instructed to notify the Napa Gas & Electric Company that unless a better light service was given the city, the municipality would cancel its contract with the company.

OAKLAND, CAL.—The Mono Power Company, which is backed by Edson F. Adams, of Oakland, Cal., and for which Leon M. Hall, of San Francisco, is consulting engineer, has already expended about $40,000 preliminary to installing a large power plant on the Owens River in eastern California. The company has recently let contracts for a temporary power plant, which will be used to furnish light and compressed air for driving the water tunnel leading to the permanent generating plant. The tunnel is to be 7x7 feet and 8000 feet in length, and is to be completed in six months. The energy will be transmitted about 100 miles to Goldfield and the principal mining camps of Nevada. The temporary plant that has been contracted for includes a 200-hp Ingersoll air compressor, driven by a Platt Iron Works turbine and a 75-kw generator to supply electricity for lamps and fans. The Schaw-Batcher Company has taken the contract to install 22 feet of 40-inch and 300 feet of 36-inch steel pressure pipe for the temporary installation. A 3-mile road has been completed at an expense of $25,000 into the so-called "Impassable Canyon," where the main power plant is being constructed, at a point 20 miles north of Bishop, Cal. Bids have been received on the three large generators which are to be installed in a chamber cut into the ledge of rock just above the water in the canyon.

PASADENA, CAL.—The City Council has granted a franchise to the Pacific Electric Railway Company to construct a double-track railway system in the business section of the city.

PASADENA, CAL.—Superintendent C. G. Glass estimates the cost of the improvements contemplated at the municipal electric plant at $195,000. Expert Scattergood places the figures at $245,000. Because of this difference of opinion Prof. C. L. Cory has been appointed to make a closer examination of the project.

PLACERVILLE, CAL.—The City Trustees are considering the question of constructing a municipal electric light plant.

REDLANDS, CAL.—The Edison Electric Company is said to be planning to install a new power house to utilize the waters of Bear Creek. The water will be taken through a tunnel already partly constructed.

SAN FRANCISCO, CAL.—Officials of the Metropolitan Light & Power Company state that their company has, through the Knickerbocker Trust Company, of New York, N. Y., floated an additional $600,000 of bonds for extensions and improvements to its gas plant. It is about to close a deal with the Stanislaus Electric Power Company by which it will be able to sell electricity in the city for light and power purposes. In addition to a deal with the Stanislaus Electric Company, by which the company will secure electricity from the hydro-electric plant of the Stanislaus company, the company will also have a number of auxiliary power stations in the city.

TULARE, CAL.—The Mount Whitney Power Company, of Tulare, is contemplating extending its transmission lines into the northern part of Kern County to furnish electricity to use in the development of water for irrigating purposes. The line will be extended from Porterville and will probably extend to Wasco.

MONTEZUMA, COL.—L. D. Bailor, of Lead, secretary of the Montezuma Gold Mining Company, writes that the company will not be ready to commence work on its proposed power plant until next spring.

HARTFORD, CONN.—President A. C. Dunham, of the Hartford Electric Light Company has applied to the Board of Street Commissioners for permission to install new arc lamps in the streets of the city. The company proposes to install 50 of the new lamps subject to the approval of the Common Council.

WILMINGTON, DEL.—Owing to the expense the Board of Water Commissioners has decided not to install an electric light plant in connection with the water works at the present time. The department will arrange for the water wheel by building an addition to the present gate house, where the water wheel will probably be placed at some future time.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct. 15, to furnish at the navy yards and naval stations the following supplies: New York, N. Y., schedule 357—transformers; Charleston, S. C., schedule 361—motors, conduit and elbows, snaking wires and electrical supplies. Also until Oct. 29, Mare Island, Cal., schedule 375—electrical fittings, etc. Also until Oct. 22, Mare Island, Cal., schedule 336—rotary blower. Applications for proposals should designate the schedules desired by number. F. B. Rogers, Paymaster-General, U. S. N.

LAKE CITY, FLA.—A company is being organized to construct a hydro-electric plant of 15,000 horse-power to supply electricity to surrounding towns. J. D. Callaway is interested in the project.

ST. AUGUSTINE, FLA.—We are informed that the St. Johns Light & Power Company is planning to construct about five miles of additional track, and will also purchase considerable new rolling stock. T. R. Ormond is general manager.

TAMPA, FLA.—The stockholders of the Tampa & Sulphur Springs Traction Company have decided to increase the capital stock of the company from $100,000 to $300,000.

ATLANTA, GA.—Bids will be received until Oct. 16 at the office of the chief quartermaster, Atlanta, Ga., for one 30-hp boiler to be delivered at Port Royal, S. C. Address Charles C. Clark, captain and acting chief quartermaster.

ATLANTA, GA.—The State Railroad Commission has authorized the Atlanta Telephone & Telegraph Company to issue $1,000,000 in bonds for the purpose of taking up outstanding bonds to the extent of $481,500, and for making extensions of its ducts and lines in and around Atlanta.

BLACKSHEAR, GA.—It is reported that the city is considering the question of building an electric lighting plant.

DUBLIN, GA.—An election will probably soon be held to vote on the proposition of issuing about $60,000 in bonds for improving the water and light plant, installing a fire alarm system and paving Jackson and Jefferson Streets.

MACON, GA.—The Macon Railway & Light Company has applied to the County Commissioners for the right of way along the Columbia road to Brown Place.

RATHDRUM, IDA.—The plant and holdings of the Rathdrum Electric Light Company have been purchased by A. O. Skinner, of Rathdrum.

SAND POINT, IDAHO.—Charles R. Foss, John C. Cleary and Peter Johnson have applied to the City Council for a franchise to operate a steam or electric railway on the streets of Sand Point.

CANTON, ILL.—Plans are being made by the Illinois Central Electric Railway to build a power station to operate a 12-mile line, and to purchase electrical equipment for the same, also three closed motor cars.

CARLYLE, ILL.—Plans are being made for enlarging the municipal electric light plant and extending the water works system.

CHICAGO, ILL.—President R. R. McCormick, of the sanitary district, states that the board will make another effort to obtain a permit from the city of Chicago for the erection of the necessary poles and wires to distribute the electrical energy to be generated by the water power at Lockport. The power plant of the sanitary district at Lockport was put into operation Sept. 25 for the first time. Edward B. Ellicott, electrical engineer, has announced that the district will be ready to furnish electricity to Chicago by Oct. 15.

FARMER CITY, ILL.—The City Council has granted the Corn Belt Interurban Railway Company a franchise for a right of way along the east city limits of the city.

PRINCETON, ILL.—Sealed bids will be received until Nov. 29 for the purchase of the municipal electric lighting plant and system, owned and operated by the city of Princeton.

SILVIS, ILL.—Preparations are being made by the Union Electric Telephone & Telegraph Company to extend its lines from Silvis to East Moline.

WATSEKA, ILL.—The Home Telephone Company and the Central Union Telephone Company have been consolidated under the name of the Watseka Telephone Company.

BICKNELL, IND.—The Town Council will receive bids for the construction and equipment of a combined water and electric plant.

BRAZIL, IND.—Among the improvements decided upon by the directors of the Brazil Farmers' Telephone Company are the installation of a new switchboard and the construction of new lines to a number of towns in the territory.

CLAY CITY, IND.—The Clay City Lighting Company is stated to be in the market for material, equipment and expert labor for the construction of an electric light plant. J. M. Long and H. R. Vandevier are among the directors.

DECATUR, IND.—The Ft. Wayne & Springfield Traction Company has decided to ask for bids for the construction of 12 miles of road from Decatur to Berne.

FARMLAND, IND.—The Farmland Telephone Company has moved its headquarters and exchange into a new building recently bought for that purpose. The company will next install a mile or more of new cable and make other improvements to the plant.

KOKOMO, IND.—Bids will be received until Nov. 8 by the Board of Public Works for furnishing electric lamps for the streets and alleys and public places and buildings in the city. J. A. Burkhalter is chairman of the board.

LAMB, IND.—The Farmers' Telephone Company will erect new lines and a telephone system in this place.

LINTON, IND.—The owners of the New Home Telephone Company, who also own or control the exchanges at Jasonville, Bloomfield, Switz City, Lyons and Worthington, have decided to expend $35,000 in the work of repairing and improving the several exchanges and building new toll lines.

MISHAWAKA, IND.—The Mishawaka Textile Company has purchased the north raceway of the local water power and will install new machinery to generate electricity for power purposes.

NORTH JUDSON, IND.—John H. Wilkinson, who bought the North Judson Telephone Exchange, has taken charge and will make a number of extensions.

BOONE, IA.—The Boone County Telephone Company has announced that it would expend $5,000 on its system in this city within the next six months. Charles C. Deering is general manager.

COUNCIL BLUFFS, IA.—The Omaha & Council Bluffs Street Railway Company has been granted permission by the City Council to build the proposed line to the School for the Deaf on South Avenue. The line will be about two miles in length, work on which will start this fall.

FORT DODGE, IA.—The officials of the Spirit Lake, Emmetsburg & Fort Dodge Railway Company, which was recently organized to construct an interurban line from Fort Dodge via Emmetsburg to Spirit Lake, which will be 62 miles in length, state that the road will be constructed without the issuance of bonds or the contracting of any debt, and also state that they are already assured of enough stock subscriptions not only to build the road, but to equip and operate it.

FORT LEAVENWORTH, KAN.—Bids will be received until Oct. 12 by Captain J. E. Normoyle, quartermaster, U. S. A., for furnishing and installing electric fixtures in eight double sets non-commissioned staff officers' quarters, one double stable guard building and two quartermasters' stables, and electric wiring in two quartersmasters' stables at this post.

LOUISVILLE, KY.—The contract for the electric light and steam-heating plant at the City Hall and engine house has been awarded to F. A. Clegg & Company, of this city.

PORTLAND, MAINE.—Bids will be received until Nov. 5 by Captain F. J. Morrow, quartermaster, U. S. A., for the construction, plumbing, electric wiring and electric fixtures, etc., for one double barrack building at Fort Williams, Maine, and one single barrick at Fort McKinley, Maine. Plans and drawings of details can be seen in the office of the quartermaster, Army Building, New York, N. Y., or 263 Summer Street, Boston, Mass.

ANNAPOLIS, MD.—The Baltimore & Annapolis Shore Line Railroad is contemplating the erection of a substation at Jones Station, about six miles from Annapolis. The equipment will be installed by the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. Electricity for operating the cars will be supplied from the power house of the Consolidated Gas, Electric Light & Power Company at Westport.

BALTIMORE, MD.—Bids will be received until Oct. 16 by the Board of Awards (J. Barry Mahool, president) for installing a 60-hp, direct-current, 440-volt motor at the new Eastern Female High School.

TOWSON, MD.—The Chesapeake & Potomac Telephone Company has acquired a building and lot on Pennsylvania Avenue for a telephone exchange. The company will move its exchange into the building and install a new and up-to-date switchboard and other equipment.

ASHBURNHAM, MASS.—Arrangements are being made by the town officials of Ashburnham to secure electricity from the Gardner Electric Light Company to furnish electricity to operate the local electric lighting system. The company offers to furnish electrical energy to the town at the rate of 4 cents per kw-hour. The town is considering the purchase of the poles and wires of the Greene Electric Light Company, which have been offered at a reasonable price. Under the law regarding municipal lighting the proposition must receive an affirmative vote at two town meetings at least 60 days apart. As the vote in August was practically unanimous in favor of the project, it is expected that similar action will be taken at the meeting to be held Oct. 25.

CAMBRIDGE, MASS.—The Cambridge Electric Light Company has applied to the Gas and Electric Light Commissioners for permission to issue an increase in capital of $100,000, and to determine the price at which the new issue should be placed on the market.

LAWRENCE, MASS.—The capacity of the power plant of the Lawrence mills will be doubled by the installation of a steam turbine of 3000 horse-power. The machine was purchased from the General Electric Company.

LEICESTER, MASS.—The Worcester Electric Light Company is negotiating for the purchase of the plant of the Rawson Light & Power Company, of Leicester.

MARLBORO, MASS.—The Marlboro Electric Company will soon commence work on extension of its line to Northboro, where the company has secured a contract for lighting the streets. The company is also contemplating extending its lines to Westboro, and is now negotiating with the selectmen of the town for lighting the streets of the town. E. W. Godfrey is superintendent.

NORTHAMPTON, MASS.—Plans are being made for the construction of an electric railway between Northampton, Easthampton and Westhampton. Eugene D. Parks, of Russell, is interested in the enterprise.

PITTSFIELD, MASS.—The Pittsfield Electric Street Railway Company has applied to the Railroad Commissioners for permission to extend its line from West Pittsfield through the town of Hancock to Lebanon, N. Y.

STOCKBRIDGE, MASS.—The Stockbridge Lighting Company is extending its lines to the farmhouse of H. C. Eldridge on the West Stockbridge road to furnish electricity to operate an elaborate private water system.

TURNERS FALLS, MASS.—The Franklin Electric Light Company will furnish electricity for heating and cooking purposes for 5 cents per kw-hour. A monthly minimum charge of $1 will be made on meters installed. The company will renew, free of charge, burned-out incandescent lamps of 10 or more cp.

BAY CITY, MICH.—The Michigan Pipe Works is contemplating the installation of a new power plant at its works.

BAY CITY, MICH.—The National Cycle Manufacturing Company has made extensive changes at its plant in North Madison, and the entire plant will be operated by electricity.

BAY CITY, MICH.—It is reported that the Aldermen are discussing the question of removing the east side lighting plant to the old water works building on the west side.

CORUNNA, MICH.—The Shiawassee Light & Power Company, which has been lighting Corunna, Perry, Bancroft and Morrice, is now prepared to light Durand, Vernon and Byron. The capacity of the plant has been increased to [illegible] horse-power by the installation of a new 250-kw Warren generator, which will be doubled when the dam is raised to give a 15-foot head of water.

[illegible] has been granted the right to furnish electricity to operate the municipal electric light plant and also for commercial lighting and power purposes for a term of ten years. The officers of the company are: O. L. Hule, of Marinette, Wis., president; J. M. Malloy, of Watertown, Wis., vice-president; P. L. Utley, of Watertown, Wis., secretary and treasurer.

GRAND HAVEN, MICH.—The Eagle Tanning Company is preparing to install electric equipment in its factory. W. H. Mead, of Holland, has the contract for the installation of the machinery. The plant has been equipped with a 300-hp engine and a 200-kw generator. Induction motors of from 15 to 50 hp will also be installed.

MANCHESTER, MICH.—Prof. John R. Allen, of Ann Arbor, has been engaged to make an appraisal on the Kingsley power plant at this place, with the idea of establishing a municipal electric lighting system. Mr. Kingsley wants $22,000 for the plant, which was established 15 years ago.

MENOMINEE, MICH.—It is reported that plans have been made by the Michigan State Telephone Company for the entire rebuilding of the Menominee system, which will include the removal of all wires along the principal streets to the alleyways and replacing the wires with cables as far as possible.

PAINESDALE, MICH.—W. O. Rankin, of Painesdale, is interested in the construction of a power plant about five miles from this town.

TRAVERSE CITY, MICH.—Work of construction by the Electric Land & Development Company on the Tyler dam site has begun near Walton Junction. The survey has demonstrated the fact that four dam sites are available; two with 40-foot head, one with 37-foot head and one with 35-foot head.

WYANDOTTE, MICH.—The contracts for the equipment for the extension of the municipal electric light plant have been awarded as follows: Arbuckle, Ryan & Company, of Toledo, Ohio, for engine, and the Westinghouse Electric & Manufacturing Company, for other necessary equipment for extension to the plant for $13,566.

BEMIDJI, MINN.—The City Council has granted a franchise to Carl C. Gowran, A. A. Carter and George W. Teitsworth to construct and operate a street railway on the streets of the city for a term of 25 years.

RED WING, MINN.—The State Board of Control has awarded the contract for installing an addition to the power plant at the Red Wing training school to the Northern Engineering Company, of Minneapolis, for $2,197.

COLUMBUS, MISS.—The Columbia Ice & Power Company, to which a franchise was recently granted, will erect an electric light plant and ice plant, the cost of which is estimated at from $40,000 to $50,000. Lee Elder, of Biloxi, Miss., is manager.

LAUREL, MISS.—The Gulf States Investment Company has been granted a 25-year franchise by the City Council for the purpose of constructing and operating an electric light and power plant.

SPRINGFIELD, MO.—It is reported that W. C. Farmer, the Springfield representative of the Pabst Brewing Company, of Milwaukee, Wis., is planning to move his electric light plant from Osceola to Springfield, to be operated in connection with the Pabst brewing establishment and cold storage plant, soon to be erected.

CENTRAL CITY, NEB.—Mr. Martin, of Fremont, has made application for a franchise for an electric light plant in this place.

FREMONT, NEB.—The city is negotiating with the Fremont Gas & Electric Light Company for the purchase of its Fremont plant and franchise.

WAHOO, NEB.—A commiteee has been appointed to make preparations and secure estimates of the cost of a municipal electric light and water plant. The members of the committee are Mayor E. Linrud, Louis Milins, E. Killian and S. P. Wahlstrom.

MORRISTOWN, N. J.—The directors of the Morris & Somerset Electric Company have decided to proceed with the work of building and equipping its plant, notwithstanding the certiorari proceedings instituted by the Public Service Corporation, decision upon which is still pending.

LAS CRUCES, N. M.—Extensive improvements are being made to the plant of the Las Cruces telephone system in this place. The office will be enlarged and cable will be installed from the central to all main leads. W. E. Baker is manager.

BUFFALO, N. Y.—The Department of Public Works is advertising for bids for four 600-hp boilers for the pumping station. F. G. Ward is commissioner.

BUFFALO, N. Y.—Bids will be received until Oct. 15 for the sale and removal of two pumping engines, Nos. 3 and 5, at the pumping station. Henry L. Lyon is Deputy Water Commissioner.

BUFFALO, N. Y.—The Economic Power & Construction Company has notified the Board of Aldermen that it proposes to begin at its convenience the construction of steam mains and electric wire conduits in most of the streets of the thickly settled parts of the city. B. L. Jones is president of the company.

CLIFTON SPRINGS, N. Y.—Plans are being made by Ford S. Burgett, owner of the grist mill and water power north of this village, for the organization of a company to develop the water power, and to furnish electricity for lighting the nearby villages.

NEW YORK, N. Y.—Bids will be received until Oct. 24 by James W. Stevenson, Commissioner of Bridges, for the electrical equipment of the University Heights Bridge.

EAST SYRACUSE, N. Y.—The Syracuse Lighting Company has submitted a proposition to the Village Board for lighting the streets of the village. The proposed contract is to run from July 1, 1907, and provides for 43 arc lamps to burn all night at $70 per lamp per year. The price under the old contract was $85. The company offers to furnish electrical power to the pumping plant for the sewer system at 4 cents on a meter basis, to be used at any time, or 3½ cents if used only between midnight and noon. It is stated that the officers of the company have agreed verbally to furnish electrical energy for private lighting at 9 cents per kw-hour for September, and after Oct. 1 at 8 cents. The old rate was 12 cents per kw-hour, with 2 cents off for prompt payment.

LOCKPORT, N. Y.—The city will soon advertise for electricity for operating the new pumping station on the grounds of the Tonawanda Iron & Steel Company, of North Tonawanda.

SYRACUSE, N. Y.—The Syracuse Independent Telephone Company will expend $450,000 in extending and improving its system in this city. J. B. Pierce is general manager.

SODUS, N. Y.—The Sodus Gas & Electric Light Company has been granted franchises in the village and town of Webster to distribute electricity and gas, which completes the franchises needed for extending its lines a distance of more than 30 miles. The company is contemplating extending its lines to East Williamson, Ontario, Ontario Center, Union Hill, Webster and West Webster on the west, and Wallington and Sodus Point on the east to build up local systems in those villages. It is also possible that the company may extend its lines to Alton and Sodus Center in this town. It is expected that when the new machinery, which was recently ordered, is installed that a day service will be furnished.

TOTTENVILLE, S. I., N. Y.—Plans are being made for the construction of an electric railway to connect Richmond, Rossville, Kreischville and Tottenville. The road will be 10 miles long and will be known as the Richmond & Tottenville Railway. The cost of the construction and equipment of the road is estimated at $400,000. Thomas B. McGovern and Cornelius G. Kloff, both of New York, are interested in the project.

WHITEHALL, N. Y.—A new 150-kw generator has recently been installed in the plant of the Consolidated Light & Power Company, which has doubled the capacity of the plant. The company has several orders to install electric signs for business houses in the town, and is planning to extend this branch of its work.

ANDREWS, N. C.—It is reported that an electric light plant will be erected in this town in the near future.

NEWTON, N. C.—The contract for the construction of the electric light plant has been awarded to the Southern Hydraulic Construction Company, of Washington, D. C.

RALEIGH, N. C.—The Agricultural & Mechanical College has awarded contracts for the installation of a power plant and electric lighting system. The total cost of the work is estimated at about $50,000. W. H. Ragan, of High Point, is chairman.

BISMARCK, N. D.—Bids will be received until Oct. 10 by the Board of County Commissioners for wiring the county courthouse. I. W. Healy is county auditor.

RUGBY, N. D.—The Brazil Telephone Company has been granted a franchise to operate a telephone system here.

CLEVELAND, OHIO.—An increase of capital stock from $100,000 to $300,000 has been announced by the Jandus Electric Company of this city.

COLUMBUS, OHIO.—The capital stock of the Ohio & Southern Traction Company has been increased from $75,000 to $90,000. F. W. Schumacher is president of the company.

COLUMBUS, OHIO.—Wade M. Ellis, Attorney-General of Ohio, has delivered an opinion to the State Board of Public Works that the franchise that has been held over the towpath of the old Hocking Canal by the Columbus, Hocking Valley & Athens Railroad Company is void, and that there is nothing in the way of leasing the property to the Logan & Athens Construction Company for the construction of an electric line from Lancaster to Athens.

HUDSON, OHIO.—A citizen of Hudson has decided to construct and present to this town an electric light plant and water works system, to cost about $100,000. Dr. W. I. Chamberlain and G. Mead will be trustees for the donor and Mayor E. L. Filius will represent the town.

NEW BREMEN, OHIO.—An election will be held in this village Nov. 12 to vote on the proposition to issue $20,000 in bonds to purchase the electric light plant. The plant is owned by private parties, who, it is stated, are willing to sell.

SPRINGFIELD, OHIO.—The City Council on Sept. 26 passed a resolution authorizing the Service Board to advertise for bids for lighting the entire city at the expiration of the present contract, which will expire Jan. 7, 1911. The construction of a municipal plant is said to be favored by many of the councilmen.

TOLEDO, OHIO.—The Citizens' Lighting & Heating Company has applied to the City Council for a franchise to furnish light, heat and power in Toledo. C. S. Ashley is interested in the company.

TOLEDO, OHIO.—A franchise has been granted to the People's Heat & Power Company to operate a heat and power plant in the city. The company has agreed to spend $200,000 on the west side of the river and $100,000 on the east side within two years, and to put up certified checks for $30,000 with the clerk of the Council as an insurance of good faith. The company is not allowed to merge with any other than the company now controlled by Homer T. Yaryan, who is also the promoter of this company. The city buildings are to be furnished with heat and power at half price.

WARRENSVILLE, OHIO.—Bids will be received until Oct. 18 by the Board of Public Service, Cleveland (A. R. Callow, secretary), for installing complete electric wiring and conduits in the new quadrangle building of the Cleveland Farm Colony at Warrensville.

WOOSTER, OHIO.—It is announced that the Wooster & Mansfield Electric Railway Company has secured all the right of way for its proposed railway to connect Wooster and Mansfield. Davis Collier is vice-president of the company.

HENNESSEY, OKLA.—The capital stock of the Hennessey Electric Light, Power & Ice Company has been increased from $15,000 to $30,000.

THOMAS, OKLA.—The city proposes to establish an electric lighting plant in connection with the water works system. The cost of the combined plants is estimated at $30,000. The O'Niel Engineering Company, of Dallas, Tex., has charge of the construction work.

ALBANY, ORE.—The City Council has granted a franchise to A. Welch to operate a street railway on several streets of the city for a term of 25 years.

EUGENE, ORE.—A committee has been appointed to raise $20,000 for an electric railway to run through the Willamette Valley from Eugene to Portland. P. E. Snodgrass, Walter Griffin, A. C. Woodcock and others are on the committee. A corporation is to be organized to complete the project for an electric line already commenced by A. Welch and associates.

HAINES, ORE.—J. W. Anderson, vice-president of the Baker City Light & Power Company, states that his company is planning extensive improvements to its Rock Creek plant.

PANAMA.—Bids will be received until Nov. 4 at the office of H. F. Hodges, general purchasing officer, Isthmian Canal Commission, Washington, D. C., for electric fixtures, etc., as per circular No. 396.

BUTLER, PA.—A charter will be applied for a company to be called the Butler & Chicora Street Railway Company, which proposes to construct a street railway from Butler to Carns City, East Brady and Kaylor. The application will be made by John Daly, W. J. Morgan, W. Criswell, W. G. Stern and E. W. Dewey.

CHAMBERSBURG, PA.—The Town Councils of Chambersburg and Greencastle have granted franchises to the Chambersburg, Greencastle & Waynesboro Street Railway Company for the proposed extension from Greencastle to Chambersburg and over certain streets in Chambersburg.

RIDGWAY, PA.—The property of the Ridgway Electric Light Company changed hands on July 1, and the new company is building a new plant, which is expected to be in operation by Dec. 1. The machinery to be installed comprises one 110-hp and two 125-hp Warren gas engines; one 50-kw and two 75-kw, 1100-110-volt, 60-cycle, two-phase, Crocker-Wheeler generators. C. H. Law is manager.

RIEGELSVILLE, PA.—John S. Riegel, of this place, has under consideration the construction of a large water power plant on the Delaware at the Narrows' lock to furnish power to operate his paper mill at Milford.

STROUDSBURG, PA.—The Stroudsburg Passenger Railway Company is contemplating the installation of a new water turbine and storage battery in its power station next spring. E. F. Smith is general manager.

WOMELSDORF, PA.—W. W. Lengel, borough secretary, writes that bids will be received on Oct. 15 for the construction of an electric light plant, to cost about $15,000. F. W. Darlington, Real Estate Trust Building, Philadelphia, is engineer.

PAWTUCKET, R. I.—The Pawtucket Electric Company has announced a new rate of sign advertising of 15 cents per month per lamp for lamps of 4 cp. to be burned every night except Sunday, from 6 p. m. until 11 p. m., with a minimum charge of $1 per month. From this rate there is a reduction of 5 per cent if bills are paid before the tenth of the month.

MARION, S. C.—On account of the unsatisfactory service in furnishing water and light to the town by the Marion Water, Light & Power Company, the town is suing the company for $60,000 damages and asking that a receiver be appointed, and further that the franchise granted by the town be rescinded and annulled. The franchise under which the company has been operating, granted by the town upon the vote of the taxpayers, is an exclusive one. The Town Council is considering the question of furnishing its own overhead system and to purchase electric energy from the Marion County Lumber Company or the Carolina Yellow Pine Lumber Company.

ABERDEEN, S. D.—C. F. Freehauf, of Cresco, Iowa, has declined the franchise for the construction of an electric light plant, recently granted by the City Council. The franchise [illegible]

EDGEMONT, S. D.—Chris Jensen, owner of an independent telephone system operating through the [illegible] extending his system to cover the whole [illegible]

ALVIN, TEX.—It is reported that E. N. Sanctuary and Mr. Durland, of Galveston, are contemplating establishing an electric lighting plant in Alvin.

GONZALES, TEX.—The Gonzales Telephone Company is contemplating extensive improvements to its system at Smiley. A new switchboard and cables will be installed.

HOUSTON HEIGHTS, TEX.—The new machinery for the plant of the Houston Heights Water & Light Company has been received and installed. The new machinery includes two 100-hp boilers, a 250-hp engine and a dynamo of 150 kw capacity. The cost of equipment is about $25,000 and gives the plant a capacity of 6000 lamps.

LAREDO, TEX.—Capitalists of San Antonio and Southwest Texas are planning the construction of an electric plant at Rio Grande coal mines to furnish power for irrigating several thousand acres of land between the mines at Laredo. The plans include the construction of a transmission line to Laredo, a distance of 26 miles, where a substation will be erected to furnish the city of Laredo with electricity for lighting purposes. The cost of the work is estimated at about $100,000, work on which, it is stated, will begin within two months. Samuel Kahn, chief engineer of the San Antonio Traction Company, will have charge of the work.

SAN ANGELO, TEX.—President J. H. Ransom, of the proposed street railway system, states that work will commence on the construction of the power house within 60 or 90 days.

PROVO, UTAH.—Plans are being made by W. H. Lepper, architect, for the construction of a large electrical plant on the Bear River, near Grace, which, when fully developed, will have a capacity of 40,000 horsepower. At present the design is for a plant of half that capacity. The power will be supplied by water from the Bear River. The system is to be operated in connection with the Provo River system.

BENNINGTON, VT.—The question of installing an electric lighting plant at the Vermont Soldiers' Home for the purpose of lighting the buildings of the institution is now under consideration. The buildings are now lighted by the Bennington Light & Power Company at an annual expense of about $600.

ST. ALBANS, VT.—The Vermont Power & Manufacturing Company has made a contract for the erection of a duplicate transmission line between its plant at Fairfax Falls and Bennington.

FREDERICKSBURG, VA.—The Fredericksburg Water Power Company will soon commence work on the construction of a reinforced concrete dam across the Rappahannock River, one mile above the city, which will cost $60,000.

DEER PARK, WASH.—The Board of County Commissioners has granted to A. M. Wood and R. H. Long a franchise for an electric lighting system in Deer Park.

SEATTLE, WASH.—The City Council has granted a franchise to the Loyal Railway Company to construct and operate an electric railway in Seattle.

SEATTLE, WASH.—A syndicate headed by J. A. Moore has been formed to develop the old university tract. Plans will be prepared immediately for the construction of the first of the buildings, which will consist of two six-story buildings on Union Street, between Fourth and Fifth Avenues, at a cost of about $500,000. A large heating and lighting plant will be erected on the grounds to light and heat all the buildings on the tract.

VANCOUVER, WASH.—The Washington Railway & Power Company has been reorganized and the assets taken over by local capitalists. The officers of the new company are: E. M. Rands, president; J. H. Elwell, vice-president; H. C. Phillips, treasurer and M. M. Conner, secretary. The company estimates that it will cost about $75,000 to complete the city system and the first four miles extension.

WALLA WALLA, WASH.—C. L. Whiting has applied to the City Council for a franchise to construct an electric railway from Fourth and Alden Streets to the fair grounds.

CHARLESTON, W. VA.—The capital stock of the Charleston Home Telephone Company has been increased from $300,000 to $600,000, the proceeds to be used for further extensions of the system.

ELKINS, W. VA.—The Elkins Power Company is contemplating the construction of an electric light and power plant, the cost of which is estimated at about $35,000. The engineer has not yet been selected. John T. Davis is president; N. I. Hall, secretary and manager; C. C. Bosworth, superintendent.

GRAFTON, W. VA.—It is reported that the Grafton Traction Company will extend its lines to West Grafton and South Grafton. The company has decided to extend its system to Blueville, a suburb two miles east of the city, and is also contemplating extending the line to Pruntytown, Webster, Simpson and other towns in the west end of the county.

PRINCETON, W. VA.—The Princeton Power Company, recently incorporated with a capital stock of $25,000, will establish an electric power plant in this place. E. S. J. Evans is general manager.

LUCK, WIS.—Peterson Brothers have been granted a franchise to erect an electric light plant in this village.

MILWAUKEE, WIS.—City Attorney Kelly has notified the City Council that the city of Milwaukee cannot enter the field of commercial lighting without first presenting its case to the State Railway Rate Commission and showing that there is a necessity for such action.

[illegible] town has decided to sell Edmonton the energy required at 7 cents per kw-hour, the purchaser to furnish the transmission lines. Address Mayor May, Edmonton, Alb., or City Electrician Ormsby.

KINGSTON, ONT.—The City Council has decided to ask the Hydro-Electric Power Commission for Ontario to give the municipality an estimate of the price to be charged for 1000 to 2000 horse-power to be supplied at the power station to be distributed by the municipality.

OTTAWA, ONT.—Negotiations are being made for the purchase of the Ottawa Electric Railway Company, the Ottawa Electric Light Company and the Ottawa Gas Company by an American syndicate.

SARNIA, ONT.—The Town Council has granted the Sarnia Street Railway Company permission to construct a railway line, a distance of about one and one-half miles. It is expected that work will commence this fall, and the company will be in the market for poles, wire and electric equipment for the overhead work.

SUDBURY, ONT.—The Ontario Railway and Municipal Board has approved the application of the by-law of the town for providing for the extension of the water works and electric lighting system. Debentures to the amount of $10,000 will be issued.

MEXICO CITY.—Charles H. Cahan, attorney of the Mexican Light & Power Company, Ltd., states that a second large hydraulic plant on the Necaxa River has been decided upon. It will be installed near Huachinango and will cost $5,000,000. R. F. Hayward is general manager.

New Industrial Companies.

THE ANDERSON-LACY ELECTRIC HEADLIGHT COMPANY, of Houston, Tex., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing electric headlights. The incorporators are: H. T. D. Wilson, T. J. Anderson and B. B. Lacy.

THE ELECTRIC HOME SUPPLY COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The directors are: Cornelius D. Wood, Jr., Max Loewenthal and Solomon P. Mendel, of New York.

THE GREEN INSULATION COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $50,000 by J. E. Chadwick, D. J. Barry and others.

THE REVERSIBLE ROTARY ENGINE COMPANY, of Douglas, Ariz., has been incorporated by M. E. Donohue, J. F. Hassey and M. J. Hassey. The company proposes to manufacture steam engines, boilers and machinery.

THE GEORGE H. RICE COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $40,000. The purpose of the company is to do electrical engineering and the directors are: George H. Rice, John J. Holshush and Thomas H. Harvey, all of Brooklyn.

THE UNIVERSAL CARBON TRUST COMPANY, of Adams, Mass., has been organized for the purpose of manufacturing carbon. The trustees are: R. N. Richmond, of Adams; C. J. Howe and Enoch H. Beer, of North Adams.

THE ZOAR BATTERY COMPANY, of Zoar, Ohio, has been incorporated with a capital stock of $30,000 by John Bimeler and others.

New Incorporations.

SAN FRANCISCO, CAL.—The Hanbridge-Loyst Electric Company has been incorporated with a capital stock of $25,000 by W. W. and G. G. Loyst and W. S. Hanbridge.

SAN FRANCISCO, CAL.—The Central Electric Company has filed articles of incorporation with a capital stock of $25,000. L. R., H. W. and J. L. Boynton are the incorporators.

NAPA, CAL.—The Napa & Lakeport Railway Company has been chartered with a capital stock of $2,000,000 to build a road from Napa to Lakeport, a distance of 90 miles, with a branch to Monticello, 14 miles in length. The incorporators are E. C. Amedee of San Francisco, A. J. Brown and W. F. Ansell of Alameda County.

NAPA, CAL.—Articles of incorporation have been filed for the Napa Valley Electric Company with a capital stock of $200,000. The company proposes to conduct and carry on the business of generating, buying and furnishing electric energy for lamps, heaters and motors; to acquire and operate electric light, heat and power plants and systems; and also to operate gas plants. The board of directors for the first year consists of Attorney Percy S. King, Derrel L. Beard and Henry Brown, of Napa, and Dr. G. S. Conner and H. J. Lewelling, of St. Helena.

TRINIDAD, COL.—The Stonewall Valley Electric Railroad Company has been chartered with a capital stock of $100,000 by P. M. Johnson, of St. Elmo, Ill.; Frank P. Read, James McKeough and J. C. Huddleson, of Trinidad. The company proposes to extend the Trinidad Street Railway from Cokedale through the Stonewall Valley into the Stonewall Mountains.

GARYSBURG, N. C.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $25,000 to build a telephone line from Garysburg to Roanoke Rapids. The incorporators are W. H. Joyner and others.

WELLSVILLE, PA.—The Dillsburg & Wellsville Railroad Company has been granted a charter by the Secretary of State to build an electric railway from Dillsburg to Wellsville, a distance of 7½ miles. The capital stock of the company is placed at $75,000, and the directors are Augustus C. Hetrick, of Wellsville, president; Hobert J. Beet, Joseph Milligan, W. D. Brougher, J. J. Seiple, J. N. Logan, Edward W. Shapley, Daniel W. Beitzel and S. G. Bushey.

HOUSTON, TEX.—The Galveston-Houston Electric Company has been organized by the Stone & Webster interests, of Boston, Mass., with a capital stock of $6,000,000 as a holding company for the Houston Electric Company, the Galveston Electric Company and the Galveston-Houston Electric Railway Company, which has been organized for the purpose of constructing an interurban line between Houston and Galveston, a distance of 52 miles. The road will run on private right of way, for which surveys have been made.

BURLINGTON, VT.—Articles of association have been filed with the Secretary of State for the Green Mountain Lighting & Heating Company. The company proposes to manufacture, sell and deal in lighting and heating plants, etc. The company is capitalized at $15,000, and the incorporators are G. S. Blodgett, C. D. Ordway, J. P. Cobb, of Burlington; W. M. Spear, John T. Spear, of Charlotte, and others.

TACOMA, WASH.—The Aztec Power Company has been incorporated with a capital stock of $25,000 by A. R. Warren and others.

TOMAHAWK, WIS.—The Tomahawk Power Company has been incorporated with a capital stock of $25,000 by R. A. Curtis, A. R. Reid and others.

Legal.

ELECTRIC COMPANY HELD NOT LIABLE FOR FIRE CLAIMED TO HAVE BEEN CAUSED BY TROLLEY WIRE.—A mill belonging to [illegible] Imeson, located at [illegible], Washington, [illegible] by fire, Imeson made a claim against the insurance company with which he carried insurance on the destroyed property. It was Imeson's conception that the fire was caused by the falling of a trolley wire belonging to the Tacoma Railway & Power Company and in filing his claim for insurance he gave this as his belief as to the origin of the fire. The insurance company, upon paying the insurance money, took a subrogation receipt from Imeson and then an action was begun by Imeson and the insurance company jointly to recover the amount of the loss. Imeson himself was acting as watchman on the night of the fire, and he stated in his testimony that, upon discovering the conflagration, he went to the rear of the mill for the purpose of starting the pumps. In doing so he crossed the tracks of the electric railway company, over which was strung the wire which he claimed was responsible for the fire. But he did not notice the wire at the time and it was not until after the fire had burned out that the wire was found lying on the ground. It was held that as it was hardly possible that Imeson could have passed over the wire without having in some way become apprised of its presence, the presumption was that the wire fell after the fire had started and that the electric railway company could not, therefore, be held liable in damages. Imeson vs. Tacoma Railway & Power Company, Supreme Court of Washington, 84 Pac. Rep. 624.

TELEPHONE COMPANY OPERATING UNDER ORDINANCE FIXING RATES PRECLUDED FROM CHARGING HIGHER RATES.—The ordinance of the city of Chicago, passed Jan. 4, 1889, which granted permission to the Chicago Telephone Company to construct and operate its system in that city for a period of twenty years, prohibited the company from increasing to its subscribers at any time the rates for telephone service when established. Some time after the granting of the privilege the telephone company presented to its patrons in the city of Chicago propositions to enter into what they called "special service contracts," by which the patrons, taking advantage of the benefits so offered, were to have the improved service at higher rates than were charged at the time of the passing of the ordinance. This scheme of presenting to the patrons an option to retain the antiquated service at the ordinance rate or to have a better and more satisfactory service at a higher rate resulted in the substitution of the better service as to a very large majority of the company's subscribers. In quo warranto proceedings against the company the claim of the company as to the improvements in service was that a proper construction of the ordinance only required it to furnish the same style of service and equipment that was furnished when the ordinance was passed at the rate then fixed and that it could charge a higher rate for better telephone service if the patrons agreed to the special service contracts. But it was held, contrary to the company's contention, that if higher rates than those fixed by the ordinance were charged to subscribers in the city of Chicago during the period of the grant the same would constitute a breach of the contract which arose between the company and the city upon the acceptance of the ordinance by the company. People vs. Chicago Telephone Company, Supreme Court of Illinois, 77 N. E. Rep. 245.

POWER COMPANY HELD NOT LIABLE FOR INJURY BY CONTACT WITH LIVE WIRE.—During a very severe wind storm two uninsulated electric wires belonging to the Grande Ronde Electric Company, having a power plant at Cove, Ore., where it generates electricity which is transmitted to La Grande and Hot Lake for supply to consumers, were blown down. The owner of the land upon which the wires fell, [illegible] end over a picket in a fence surrounding his property. Various tests were tried by the persons living in the vicinity to find out whether the [illegible]

menters received a shock from which he did not fully recover for several days. One of the farm workmen, although aware of the fact that several persons had had experiences with the wire indicative of danger, seized the picket fence to which the wire was fastened with one hand, and, in his ignorance of electricity, pointed the index finger of his other hand in the direction of the wire. The wire carried 23,500 volts and when the workman's hand approached within about eight inches of the wire, the one or two spectators who happened to be there saw a sudden flash of electricity which caused the workman's death. In the action against the power company for damages the defense of contributory negligence was depended upon and it was held that though the company was guilty of negligence the workman's negligence also contributed to the accident and that, therefore, the company could not be held in damages. The care which the law exacts from any person or corporation engaged in operating a dangerous instrumentality is always in proportion to the degree of danger reasonably to be apprehended from the use of the means employed. Electricity is a natural force, the power of which is fully comprehended only by experts, and the wires conducting it should be placed and kept beyond the reach of people who have no conception of the danger to which contact will necessarily expose them. But, where, as in the present case, a man of mature years, with knowledge that other persons have come to grief by getting into too close proximity with a live wire is injured through a desire to see how near he can place his finger to the wire without sustaining a shock, there is contributory negligence and damages cannot be collected. Carroll vs. Grande Ronde Electric Company, Supreme Court of Oregon, 84 Pac. Rep. 389.

Educational.

WASHINGTON UNIVERSITY.—The electrical engineering department of Washington University, St. Louis, Mo., received recently, as a donation from the United Railways Company of St. Louis, a pair of G. E. 800 railway motors, appropriately mounted for the regulation stand-test; a K-2 controller and necessary resistance grids, and a tap from the feeder system of the company into the laboratory building.

Personal.

MR. N. F. BRADY, treasurer of the New York Edison Company, has returned from Europe, where he spent the summer months with his wife.

MR. HARALD WALLEM and Mr. C. F. Schrottke, chief engineers of the Siemens-Schuckert Werke, Berlin, are now making their first visit to this country for the purpose of seeing the progress that has been made here in high-tension electrical engineering. They will be in and around New York during the first two weeks of October.

MR. ALPHAMEO MORRILL, who has served the Salem Electric Lighting Company, of Salem, Mass., as superintendent for nearly twenty-five years, has been promoted to the office of assistant to the manager and Mr. Harry Kingsley, who has been assistant superintendent under Mr. Morrill, has been promoted to the position of superintendent.

MR. ROBERT W. CLARK, manager of the Union Light, Heat & Power Company, of Fargo, N. D., has resigned to accept a position with the Minneapolis General Electric Company, of Minneapolis, Minn. Mr. Clark will remain in Fargo until Nov. 1 to complete the work in connection with the reconstruction of the plant of the Union Light, Heat & Power Company. Mr. W. H. Thompson, Jr., of St. Paul, Minn., will succeed Mr. Clark.

DWIGHT-KIRCHHOFF.—The marriage took place on Sept. 26, in New York City, of Mr. Theodore Dwight to Miss Linda Kirchhoff, sister of Mr. C. Kirchhoff, editor of the *Iron Age*. The honeymoon has been spent in the recesses of the Adirondacks. Mr. Dwight, well-known to electrical engineers from his early Thomson-Houston affiliations, was more recently assistant secretary of the American Institute of Mining Engineers and a member of the committee to erect the new Enginering Societies Building. He is a member of the board of the Engineers' Club and chairman of the Library Committee.

MR. PUTNAM A. BATES, 42 Broadway, New York, announces that to insure the best results, from the point of view of operation, he has extended his field of engineering to include heating and ventilating, where problems in these branches have to be solved in conjunction with electric lighting and power installations. Owing to the close intimacy of these four branches of engineering, and the fact that the proper solution of the problems of one often depended upon the disposition of the others, he has decided that the best interests of his clients will be served in cases where these problems are thus interlinked, by having them treated under the direction of one mind. To this end he has added to his staff [illegible] them especially for directing and carrying out the details of such work.

MR. J. G. WHITE, head of the American and British corporations of J. G. White & Company, is the subject of a sympathetic illustrated article in the October *Review of Reviews*. It is under the title, "A Yankee Engineer on Five Continents," and is written by Mr. David F. St. Clair, who gives many interesting details about a notable personality. Mr. White, it is said, [illegible] man, this quiet dynamic man is building up the world's industrial forces [illegible] * * * [illegible] the engineer became his own contractor, and the magnitude of the work commanded the [illegible]

Trade Publications.

BATTERIES AND SPARK COILS.—If gas engine owners understood that the success and regular running of their engines depended more on the reliability of their ignition than anything else, they would, of course, be careful to buy only batteries and spark coils which had proved these qualities during the severest tests. The Edison primary battery and the Edison spark coil have been used under the most unfavorable conditions, in all climates, with perfect satisfaction. The Edison primary battery possesses constant and high electro-motive force and is able to withstand heavy currents without damage because of its very low internal resistance, which in the largest Edison cell is only 0.02 ohm. The two appliances naturally complement each other. Full particulars are given in an interesting booklet, "Battery Sparks," sent free to any reader on receipt of a postal by the Edison Manufacturing Company, 10 Fifth Avenue, New York.

THE CURTIS STEAM TURBINE-GENERATOR is the title of a large pamphlet (No. 4531), issued by the General Electric Company, Schenectady, N. Y. The printing and general style of the pamphlet are very attractive, but will be found of a special interest to engineers on account of the information given with regard to superheat, vacuum, consumption, etc., and the details of construction and operation of all parts of the Curtis apparatus. Under the heading of "Economy," detailed tests are given of 9000-kw, 5000-kw, 2250-kw and 1000-kw turbines, which show some very remarkable high efficiencies. The advance made by this type of turbine is illustrated by the statement that nearly 1,000,000 kw of Curtis steam turbine-generators have been sold. Special attention is called to the flat efficiency curve, giving high efficiency at overloads and light loads, the simplicity of design, the low maintenance, the economy in space, etc. This publication seems to be typical of the recent desire to have such information written by and to engineers, and the following synopsis of its contents will show the wide field covered: Advantage of vertical-shaft type, economy of space, building materials and steam, clearances, flow of steam, balance, lubrication, the construction of buckets, governors, foundation, low-pressure turbines, vacuum, regulation, parallel operation, ventilation, consumption, etc. Of the illustrations, the following may be taken as having special interest: Those showing the interior of the Fisk Street Station at Chicago and cross sectional view of a 9000-kw turbine, the method of cutting and riveting buckets, the hydraulic governor, low-pressure turbine sets installed, and consumption curves.

Business Notes.

PORCELAIN SIGNS.—The Colonial Sign & Insulator Company, of Akron, Ohio, has just been notified by the board of underwriters that its porcelain electric sign letters were approved on Sept. 10.

THE CROCKER-WHEELER COMPANY announces that its Birmingham, Ala., office has been changed from 2119 Third Avenue to the Woodward Building, that city, where all communications relative to business in that territory should now be addressed.

THE CENTRAL ELECTRIC COMPANY, of Chicago, reports very large sales on Stanley G-I arc lamps, for which it is agent. The company claims for the new type "K" lamp that it is the simplest on the market, and asserts that no matter what the conditions of current or circuit it can furnish a type "K" lamp which will give good light, and do it economically. The company is sending out to its trade special bulletins on this lamp, and invites requests for descriptions and prices.

HILL CLIMBING CARS.—The electric car is generally considered a convenient and elegant town equipage, but its horse-power is not high as compared with that of gasoline cars; gasoline is therefore generally considered as putting electricity out of the running when it comes to hill climbing or other time contests. But intelligent cutting out of the various elements that decrease efficiency can do much. The Woods electrics have cut out journal friction by the liberal use of Hess-Bright ball bearings in the motor and running gear. As a result at the Algonquin Hill climb on Aug. 9 this year many a big and small gasoline car was unable to approach the time made by the Woods electrics.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is receiving a great many inquiries and orders for the Just tungsten lamps, for which it is Western distributor. The company is at present importing only the standard 40-cp lamp, Edison base, 105 to 120 volts. These lamps consume but 1 watt per candle, representing therefore a saving of 70 per cent over the 3½-watt carbon filaments. The lamps are packed with the tip downward and shipped in a special package to assure their being kept this way while in the hands of the transportation company. Since the adoption of this package the Central Electric Company asserts that reports from its customers of breakage of filament have been rare.

TRUMBULL ELECTRIC MANUFACTURING COMPANY.—A Plainville (Conn.) journal in a recent issue devotes several columns to an account of the Trumbull Electric Manufacturing Company, the occasion being the [illegible] to the factory of that company. The Trumbull Company began business in Feb., 1899, with Messrs. Frank T. Wheeler, president; John H. Trumbull, treasurer, and Andrew Trumbull, secretary, who still occupy these positions. The build[illegible] added to the plant and a year and a half [illegible] found necessary. The capacity of this was soon outgrown and the new building just erected almost doubles the capacity of the plant.

Weekly Record of Electrical Patents.

[illegible]

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

867,236. PIPE-CAP; William H. Blood, Jr., Wellesley, Mass. App. [illegible] ple, at the telephone circuit connections for a dwelling. The conduit pipe has an annular collar with a hood and means for simultaneously securing the hood to said collar and the latter to a support.

867,256. SUBAQUEOUS LIGHT SYSTEM; Leon Dion, Wilkes-Barre, [illegible] of imparting safety to navigation, consisting in illuminating the course by a series of submerged practically fixed lights.

867,257. FUSE BOX SUPPORT; James S. Doyle, New York, N. Y. App. filed Jan. 24, 1907. Construction of fuse box for street railway cars designed to prevent injury by the jar and vibration. Has [illegible]

867,312. ELECTRIC WIRE CONNECTOR; John A. Shutz, Richmond, Ind. App. filed Dec. 3, 1906. The connector has two surfaces which are tightly wedged into contact with [illegible] another by compression springs.

867,317. ATTACHMENT FOR ICE BOXES; Winfield W. Stevenson, Philadelphia, Pa. App. filed April 11, 1906. An electric switch or device which serves to automatically turn on the lights within a refrigerator when the door is opened.

867,319. ELECTRODE; John W. Stubbs, Middlewich, England. App. filed April 9, 1907. Relates to electrodes having conductors partly protected from the electrolyte and carbon blocks connected to the conductors and exposed to the electrolyte. Provides a composition of high conductivity which may be molded around the ends of the conductors to protect them while the surface of the mass or composition may be finished to a form which can be readily fitted into the usual external carbon blocks so as to render renewal of the latter easy.

867,320. ELECTROLYTIC PROCESS AND PRODUCT; Clinton P. Townsend, Washington, D. C. App. filed April 24, 1905. The process of producing lead oxide which consists in decomposing a suitable electrolyte with an anode of lead and producing compounds in which lead occurs in the basic and acid radicals respectively, and effecting a reaction between said compounds.

867,329. BLOCK SIGNAL APPARATUS; Frank C. Williams, Philadelphia, Pa. App. filed July 17, 1905. The patentee has a pair of trolley poles upon the locomotive cab which engage depending plates connected in the circuits of semaphore apparatus along the track.

867,331. AUTOMATIC SAFETY CONTROLLING MEANS FOR TRAINS; David S. Affleck, Chicago, Ill. App. filed Aug. 16, 1906. Specific construction of an engineer's valve and throttle operating apparatus by which a locomotive is automatically stopped by the completion of circuits from the track rails dependent on the position of a preceding train.

867,349. TESTING SYSTEM FOR TELEPHONE LINES; W. W. Dean, Chicago, Ill. App. filed July 27, 1903. In a telephone system, the combination with a plurality of cord circuits, of a test responsive device common to said cord circuits, a sleeve supervisory relay associated with the answering end of the cord circuit, and contacts of said relay in the circuit of said test responsive device, substantially as described.

867,364. AUTOMATIC RAILROAD SIGNAL; William H. Harris, Stark, Mont. App. filed Jan. 9, 1907. Provides means to notify the engineer and train crew, as well as the despatcher's office where a train is located on the line. Has a step-by-step device analogous to a messenger call.

867,391. STORAGE-BATTERY PLATE OR GRID; Joseph Marx, Buffalo, N. Y. App. filed Jan. 30, 1907. Storage-battery plate comprising a frame embodying spaced side bars, top and bottom bars and horizontally extending shelves with ribs.

867,406. RAIL BOND; Lewis T. Pates, Upper Alton, Ill. App. filed Dec. 26, 1906. Form of rail bond having forked extremities which are driven through divergent holes in the rail flange so as to be locked therein by said divergence.

867,415. RAIL BOND; Frank W. Richey, Chicago, Ill. App. filed Dec. 5, 1902. Rail bond formed of ribbons bent so as to avoid breakage by expansion and contraction of the rails and pressed into copper [illegible]

867,416. ELECTRICAL CONDUCTOR; Frank W. Richey, Schnectady, N. Y. App. filed Feb. 10, 1904. Relates to modifications of the above.

867,436. LEAD PIGMENT AND SIMILAR COMPOUNDS; Elmer A. Sperry, Brooklyn, N. Y. App. filed Aug. 30, 1906. Process of producing lead compounds of salts such as are used for pigments.

867,440. THREE-WIRE MOLDING RECEPTACLE; James S. Stewart, New York, N. Y. App. filed June 29, 1906. Relates to several features of improvement in molding wire receptacles and particularly of the three-wire type. The receptacle is designed to make connection with one branch or the other of the three-wire system, being systematically placed on the three-wire molding in all cases. For this purpose the axis of the threaded shell lies directly over the central wire, the remaining terminal clip falling over one of the outside wires. An additional feature of the invention lies in the vitreous coated or stoneware metal outside housing for the receptacle.

867,448. SIGNALING SYSTEM FOR RAILWAYS; Louis H. Thullen, Edgewood, Pa. App. filed June 23, 1906. Relates to signaling systems for railways and especially to railways the track rails of which are included in and form part of the return path or conductor to the generator for the current employed for propelling motor cars along the railway.

867,452. ELECTROLYTIC BLEACHING OF COTTON; August A. Vogelsang, Dresden, Germany. App. filed Sept. 21, 1901. Relates to improvements in electrolytic bleaching of cotton and textile materials.

867,456. ELECTRODE FOR ARC LAMPS AND METHOD OF MAKING THE SAME; William S. Weedon, Schenectady, N. Y. App. filed Dec. 10, 1903. [illegible] oxide of titanium.

[illegible] Orange, N. J. App. filed May 25, 1905. Circuit controller having a plurality of resistance units in series, a short-circuiting device for each unit, a movable controlling element and means whereby said devices may be successively operated to cut out said resistance units by moving said element from any position as a starting point.

[illegible]476. SYSTEM OF CONTROL; Eugene R. Carichoff, East Orange, N. J. App. filed Jan. 19, 1906. Relates to modifications of the above.

[illegible]482. LOCKING MECHANISM FOR CONTROLLER HANDLES; Archibald S. Cubitt, Schenectady, N. Y. App. filed Jan. 2, 1906. Mechanical construction of the handle of a controller having a locking lever depressed by a button on the handle.

[illegible]494. FIRE ALARM TELEGRAPH SYSTEM; Manious Garl, Akron, Ohio. App. filed Oct. 20, 1905. A fire alarm system magneto electric telegraph designed to avoid all batteries at local stations.

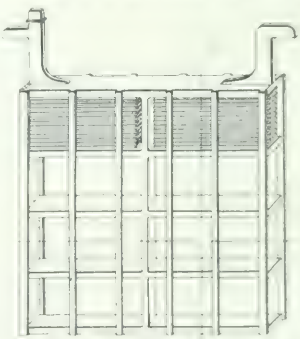
[illegible]496. [illegible] and compels the contacts to separate widely when the fuse blows.

[illegible]509. ELECTRIC SWITCH; Edwin Johnson, Schenectady, N. Y. [illegible] spring pressed stem and a toggle lever.

[illegible] ULATOR-PLATES; Henry Leitner, Maybury, Woking, Eng. App. [illegible] by the use of which the formation of the plates treated on the Plante [illegible] has artificial means for keeping the electrolyte cool.

[illegible]519. ELECTRIC FURNACE; John T. Marshall, Metuchen, N. J. App. filed Jan. 26, 1907. Means for producing metallized filaments for incandescent lamps. Includes a specially constructed furnace in which the filaments may be subjected to excessively high temperatures for a considerable period of time. Has a graphite tube through which the filaments are impelled in little graphite boats.

[illegible]528. POINT SHIFTER FOR TRAMWAYS AND THE LIKE; [illegible]



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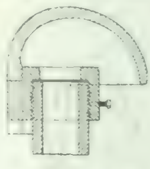

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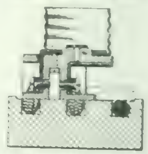

[illegible]

ical construction of a switch point shifter, including a clock-work device released by an electromagnet so as to cause successive actuations of the switch point in alternate directions.

[illegible] ATTACHMENT FOR ELECTRICAL FURNACES, Samuel M. Weaver and William Ambler, Cleveland, Ohio. App. filed Sept. 29, 1905. Relates to attachments for electrical furnaces employed by dentists in baking porcelain fillings for crown and bridgework. Is especially designed for use with a thermo-pile.

[illegible] thermal cut-outs consisting of granules or pellets of slaked lime and a binder.

867,544. ELECTRIC ARC LAMP; Edward F. Winfield, Los Angeles, Cal. App. filed March 14, 1905. Devices for supporting and adjust- [illegible] disc clutch with tubing link connections to the operating magnet.

867,547. STARTING DEVICE FOR ALTERNATING CURRENT MOTORS; William C. Yates, Schenectady, N. Y. App. filed Oct. [illegible] a device for starting motors of the induction type and bringing them up to running speed.

867,561. MEASURING INSTRUMENT; Albert G. Davis and Caryl D. Haskins, Schenectady, N. Y. App. filed March 15, 1904. Complete features of construction of a watt meter having means energized from [illegible] practically all of the frictional or idle load.

[illegible] AUTOMATIC BLOCK SIGNALING SYSTEM. [illegible] energized by an alternating current in separate block sections. Uses alternating current relays.

[illegible] ELECTRIC TRACTION APPARATUS; [illegible] on standards so that the center of gravity is below the point of support.

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NEW YORK, SATURDAY, OCTOBER 19, 1907.

CONTENTS.

THE STREET RAILWAY CONVENTION.

The convention now being held by the American Street & Interurban Railway Association at Atlantic City, promises to be like so many of its predecessors, one of the most important meetings of the year in which it is held. The street railway industry has grown tremendously since electricity was applied to it, and the magnitude of the interests involved in a development that now represents up to $4,000,000,000 of capitalization needs no emphasis. Fortunately the association has as a body responded to the call upon it, and under able and influential leadership exerts throughout its field a power wholly for good. The largeness of the attendance and the excellence of the exhibits alike testify to the drawing capacity of the annual convention, and we are glad to note the high quality, also, of the papers brought before the parent and allied associations. Prof. Swenson, the secretary, and the special committees, are indeed to be warmly commended for their preparatory work along these lines. Moreover, the scheme of alliance or cooperation between the various bodies embraced under the generic name appears to be working out admirably. In short, the doubts that hung over the future of this great association a few years ago have been thoroughly dissipated, and the new career of usefulness lies ahead, a track of well-laid, shining rails.

THE TECHNICAL GRADUATE AND THE ELECTRIC RAILWAY.

Elsewhere we print an abstract of a paper presented this week by Prof. H. H. Norris before the Atlantic City Convention of the American Street & Interurban Railway Association, which invites the most earnest attention of those in charge of electric railway properties. The manufacturing branch of the electrical industry has for many years recognized the value to it of the technical graduate, and at present openings in every department of that industry leading to positions of responsibility and profit, are reserved for him alone, and a similar situation in the central-station field is being rapidly developed. On the other hand, as Prof. Norris points out, those in charge of electric railway properties have in recruiting their staffs offered little or no encouragement to this element. Indeed, their attitude of indifference has been such as to recall the earlier days of the electrical industry, when the technical graduate was regarded with pity when he was not ridiculed as an absurdity. The reason for this anomaly appears to be that in the past conduct of the electric railway, questions of finance and of policy towards the public have been considered of the first importance, and have been given a preponderating weight in the selection of higher railway officials; and there has been lacking a form of organization whereby proper consideration of such questions may be possible without minimizing attention to others of high importance incident to the managerial and technical conduct of electric railway properties, with respect not only to present conditions, but also with regard to preparations for the conditions of the future. In other words, there appears

[illegible] policy which enables a telephone company to estimate conditions over a future period of a score of years, and to prepare in advance plans to meet these conditions as they arise; and similarly, which enables electric lighting companies to estimate increase in business and to prepare and file away plans for future increase of equipment to correspond.

It is certainly high time that the loose organization of electric railways, so far as pertains to staff, should be changed to correspond with the practice of other branches of the electrical industry and with that of our more successful steam railroads. This implies resort to a definite system for recruiting the raw material of the personnel and for molding it into shape, coupled with assurance of permanent tenure and a chance of promotion for faithful service. As to raw material, the technical schools may be drawn upon for an ideal supply, not alone for the engineering department but for utilization, after a probationary period, in every department of the electric railway. Experience with technical graduates extending now over 15 years, has completely demonstrated that, owing to the flexibility of mind and systematic habit of thought and work which results from their scholastic training, and an esprit de corps which dignifies any task allotted and incites zeal to its performance, they can, if taken as fledglings into an organization which knows how to adapt their capabilities to its needs, and after a period of general training, be drafted for permanent service equally as efficient in the executive and commercial branches of the organization as in the technical branch. Prof. Norris, in his paper, outlines an admirable scheme for the preliminary training of the young graduate for electric railway service, during the period of which he is worked over from raw material to a state fitting him for duty in any branch. This scheme cannot be too strongly commended to those who may decide to recognize the technical schools as a source upon which to draw in building up and maintaining an efficient and permanent electric railway organization of personnel; for failure in many cases may be predicted should such a decision merely result in taking on the young men with no provision for a probationary period of systematic training having for its purpose the development along specific lines of their potential value at the plastic period of life.

Some Questions in Ethics.

One who frequently reads specifications for engineering works is continually and sadly impressed with the lack of such definite canons of righteousness as should properly define what may and what may not be done in the way of implicitly demanding the output of particular makers. It is frequent enough to find more or less clumsily concealed in general phrases limitations which practically eliminate all chance for open competition. Doubtless such limitations may sometimes be inserted almost unconsciously, the author of them having, perhaps somewhat vaguely, particular things in mind and erring merely in describing them somewhat too closely. In other cases he evidently means to favor certain articles while preserving the possibility of competition, and again he may draw so close a description that the terms could be met only by infringing the patents of the favored maker. Anyone who is used to reading specifications can easily classify them in somewhat this fashion, and gains thereby no great respect for the integrity of their authors. Now in point of fact, the author is probably more upright than his specifications, and part of the difficulty arises from lack of a definite moral law in such matters, and also from inexactitude in describing the really general properties of the article desired.

As regards the latter count in the indictment, very few engineering students get adequate training in expressing themselves for the purposes of their professional work. Such training in English as they get is generally viewed from the academic side only. It would be well if special training in writing specifications were regularly given, as it sometimes is to a rather meagre extent, but bearing directly upon the meaning of descriptions and their legal force. The other matter is more difficult. Some engineers undoubtedly think they are doing their full duty by describing the concrete things which they prefer and letting the makers fight it out among themselves afterwards. Others go to the opposite extreme of describing things very vaguely and letting the bidders guess at the real requirements. For instance, it is perfectly easy to draw such a specification for a traveling crane as shall give only a single maker a chance to bid on a standard product, or to specify it so loosely that one will be overwhelmed with useless and discordant bids. Of course, the use of patented articles raises the specification question in its acutest form. It strikes us that in this particular matter the ethical considerations are perfectly plain. If for good reason an engineer believes that the best interests of his client demand the use of a particular patented thing, he should fully inform his client of the situation and then call for the thing he wants in plain words, without any attempt at open competition. As a rule, by so doing he is likely to get fully as good terms as by inciting a bogus competition. Moreover, an engineer who thus conducts his affairs does not lay himself open to the suspicion of unfair dealing.

In case there are no patents to be infringed but makers have very different standards, even to the point of differing widely in method, it is next to impossible to draw a specification that shall be both accurately descriptive and entirely fair. In such a case the engineer either has or has not made up his mind as to what form of apparatus is conspicuously best for the purpose in hand. If he has, his duty is plain, just as in the case of patented articles. If relative advantages are pretty closely balanced, and several makes can meet the requirements acceptably, though with quite different appliances, patented or not, then there is a clear case for a very open specification, to be sent, not broadcast, but only to those who are on approximately even terms. It is little short of indecent to ask for bids from people who on the face of things stand no show of putting in an acceptable offer. Finally it may be that there are no obvious leaders in the race, in which case a fully detailed specification covering the thing wanted should be prepared with scrupulous care that no peculiarities of particular makers find place in it. Such a specification can be sent out pretty freely without doing injustice to anybody. No finely drawn code of ethics is needed to enforce fairness in drawing up and sending out specifications, but only a keen sense of honor and a determination to give everybody a square deal. Since, however, electrical engineers are to be blessed with an official code of ethics, the subject here considered might appropriately receive recognition in it, even though exigencies of limited space would thereby require the elision from the draft of the proposed code.

of the delphic admonition concerning "standards of construction," which ethical precept on occasions would probably be construed against newly developed types of apparatus if they came in competition with so-called standard types established by manufacturers.

Regulations for Safety in the Operation of Central Stations.

Every year brings along with increased use of electricity and electric apparatus a corresponding need for increasing care in the handling and control of this apparatus. This is particularly the case with installations that extend the territory of high-tension transmission, or that increase their voltage over a given territory. While it is true that year by year there is more training and knowledge of the dangers of careless installation, yet on the other hand, there are ever more untrained and unskilled persons being drawn into the service of electric supply, either at the generating stations or on consumers' premises, with the result that precautions have to be more widely advocated in order to protect those whose training has not fitted them to protect themselves. The *Elektrotechnische Zeitschrift* has recently published an additional series of safety regulations for central-station service adopted by the Verband Deutscher Elektrotechniker. These are set out with the detail and precision which characterize public precautionary measures in Germany. The most important of these refer to storage-battery installations and to high-tension installation; that is, to installations employing pressures exceeding 750 volts in the case of direct-current power. Some of the rules would seem to be of an obviously necessary character. For example, it is set down that eating, drinking and smoking are to be forbidden in storage-battery rooms. All epicures familiar with storage-battery work would certainly endorse this rule. It is, of course, well to err on the safe side when deciding what to ordain and what not to ordain, in dealing with safety regulations for personnel. Clear notices of danger to person from electric discharge are called for in every case of risk and it is stated that such notices must be on placards not less than 8 x 4 ins.

The Institution of Electrical Engineers of Great Britain has also recently issued a series of Wiring Rules for securing satisfactory results with electrical supply and distribution at e. m. f.'s not exceeding 250 volts. These rules state in general what constructions may not be used. It is questionable whether such rules should be promulagted by an engineering body. They should unquestionably be promulgated by a proper authority, but that authority should be one which possessed power to enforce the rules. An engineering body naturally seeks to find the best, safest and most economical methods of construction and seeks to advocate such methods. It does not, however, form a court of enquiry into all installations, to see whether good methods have been followed, and with a view to mulcting or admonishing offenders who may have carelessly or irregularly installed. This is the natural task and duty of insurance interests. It is the insurance officers who should be qualified to say what constructions should not be used and it is the engineering institutions that should be occupied by determining [illegible] the two bodies cooperate in committee, their respective duties can [illegible] and are kept apart.

Excitation Characteristics of the Synchronous Motor.

Although the complete theory of the relations between the internal m. m. f.'s, fluxes, reactances and e. m. f.'s of the synchronous motor may be worthy of careful study from the standpoint of the designing engineer, yet it is a matter of indifference from the standpoint of the operating engineer. The operating engineer wants to understand the action of the synchronous motor to the extent at least of being able to protect, control and fully utilize the machine. But he must have comparatively simple rules and formulæ to guide him. Long and difficult formulas do not usually help to elucidate ideas, and particularly do not help the man who has to apply his knowledge in sudden practical emergencies. The operating engineer's theory of the synchronous motor must be, quantitatively, a fairly simple one. The only hope we have of keeping a reasonably simple set of formulæ and working theory of synchronous motor action is to make certain assumptions which are not strictly justified, and compare the results so arrived at with observations on actual machines. If the quantitative results reached by simplified formulas are not far from the observed facts, the simplified theory becomes acceptable, at least to a first degree of approximation. If, on the other hand, the simplified assumptions do not lead to substantially verified conclusions, then the theory attempted must be rejected as untenable. The simplest assumptions are, perhaps, that a synchronous motor has no armature reaction, but has a virtual synchronous reactance, which includes the effect of armature reaction, which remains constant at all loads. It may be also assumed that the currents and e. m. f.'s are simple sinusoids, and that the degree of saturation of the magnetic circuits is relatively low as well as constant. On this simple basis a working theory of synchronous motors has been developed by various students of these machines. It is, however, admitted to be applicable to a first approximation only, although the actual error or deviation between the results of the theory and the results of actual observation are but imperfectly understood. It is probable, however, that such formulas, which are not too difficult for the use of the operating engineer, apply with a sufficient degree of accuracy for most practical purposes.

In the article appearing on page 762 of this number, Prof. A. S. Langdorf develops the theory of synchronous-motor excitation characteristics one stage further than the above—namely, by taking into account an armature-reaction m. m. f., separate and apart from the reactance of the armature. This is one stage nearer to the facts of the case. The formulas derived are not much harder to handle than those of the simpler synchronous reactance theory. What would be of great interest in this connection is a series of careful observations on the behavior of one or more synchronous motors under definitely varied excitation and load, to ascertain how much nearer to the mark the new theory may come than the old theory. There seems to be room for a careful set of comparative reasearches on a basis of motors, undertaken with the object of determining how nearly our various existing synchronous-motor theories apply. It is important, however, that those who conduct and sum up these researches should not allow themselves to be influenced by preconceived notions in favor of any particular theory.

Convention of the American Street & Interurban Railway Association.

The annual convention of the American Street & Interurban Railway Association and its affiliated bodies, consisting of the Accountants', Engineering and Claim Agents' Associations, was held in Atlantic City, N. J., Oct. 14 to 18, 1907. The meetings of the parent body were held on the Steel Pier on Oct. 16, 17 and 18, while the sessions of the Engineering Association were also held on the Steel Pier on Oct. 14, 15 and 16. The meetings of the Claim Agents' Association were held in the St. Charles Hotel, Oct. 14, 15 and 16, and the Accountants' Association met in the Chalfonte Hotel on Oct. 15, 16 and 17.

MONDAY'S SESSION.

The opening session of the Engineering Association began at 2:40, Monday afternoon, with the president, Mr. H. H. Adams, in the chair. Immediately after the session opened, Mr. John I. Beggs, president of the parent association, made an address in which he dwelt at length on the importance of the work undertaken by the Engineering Association. He pointed out that the engineers are the right hands of the executive heads of the railway companies upon whom rests the success of the administration of the properties. The standardization of the various methods of operation means, he said, the saving of dollars and cents. His motto was not the best possible service, but the best service practicable under the conditions of operation. Mr. Beggs commented on the harmony existing between the affiliated association and the parent organization, which condition, he said, was conducive to effective work.

Following Mr. Beggs' address, Mr. C. L. S. Tingley, president of the Accountants' Association, delivered a few words of greeting. He was followed by Mr. E. W. Olds, past president of the affiliated association. President Adams then read his address. In it, he called attention to the advantages of committee work, and said that the work of the standardization committee demonstrated the necessity of going further into such work, so that the various parts of railway equipment might be treated separately. He recommended that committees be appointed to cover the subjects of wheels, axles, brake-shoes and heads, motors and various other important items so that the best results be obtained. Commenting on the work of the standardization committee he said that its work represented not only the views of the operating men, but those of the manufacturer as well. The committee met with a cordial response from motor designers in its work toward uniform practice in gearing for motors, and in motor design. The recommendations of the committee, he said, cover the best practice, and the importance of their adoption, from a commercial standpoint alone, is very great. In the name of the association he thanked the committee for its work.

The reports of the executive committee, treasurer and secretary were then read and adopted. The committee on control apparatus in lieu of a report had Mr. F. E. Case, of the General Electric Company, give what data his company had upon the latest developments in control apparatus for railway equipments. A number of changes made in controllers were noted, with the reasons therefor. The paper went into the subjects of changes to meet the requirements of higher voltages.

Speaking on the subject, Mr. J. W. Corning made some remarks with reference to the adjustment of the steps on the accelerating rheostat. One of the officials of the Boston Elevated Railway Company reported cases of uneven acceleration on a number of cars. Recording ammeters were applied and in some instances it was found that the setting of the resistance connections was very bad. For instance, it was found that on the last step in parallel, just before going into full multiple, there was a peak of about 325 amperes in accelerating on a grade of about 5 per cent. The average current in multiple on the controller in question was much larger than the average current in series per motor. By a readjustment of the resistances the peak was brought down to about 190 amperes. Much trouble was also experienced with flashing of motors, blowing of fuses and short circuits in the controller; but since the readjustment of the resistances these troubles disappeared.

Mr. W. Roberts stated that in his opinion the secret of successful operation lies in the thoroughness of the inspection of the equipment, both night and day.

Mr. N. W. Storer, speaking for the Westinghouse Electric & Manufacturing Company, said that his company still has the electro-pneumatic type of multiple-unit control, and is using the same contactors for both alternating and direct current. For direct-current work his company employs a battery for the valve magnets, and the same battery and valve magnet apply for alternating current, the only difference between the contactors being in the blow-out, which is modified slightly for alternating currents. The heavy pressure on the contactors, combined with an effective blow-out, makes a good operating switch. The Westinghouse Company, Mr. Storer said, believes in a multiple unit equipment not only for heavy work, but for street car service as well.

Mr. L. I. Smith then presented the report of the committee on maintenance and inspection of electrical equipment. The paper gives the result of a canvass of electric railway companies, to whom questions on the subject of the committee's work were sent. The committee discusses in detail many of the replies received, which together cover a wide range of subjects, and in some cases definite conclusions are based upon the information received.

TUESDAY'S SESSIONS.

The whole of the meeting on Tuesday morning was devoted to the report of the committee on way matters. F. G. Simmons, the chairman of the committee, stated that the report includes the results of investigations which are embodied in reports of the various sub-committees. One report was presented in the form of a paper by L. Wilson on the care of electric railway tracks. This paper dealt with interurban tracks, city tracks, oil sprinkling and snow removal. The discussion was opened by E. O. Ackerman, who remarked that the maintenance bill after the track has been laid depends very largely upon the original construction. He expressed the opinion that the most effective work is done at the lowest cost when use is made of the best laborers available. C. H. Clark stated that best results are obtained when the maximum use is made of machinery in preparing and maintaining the roadway. Mr. Simmons said he believes in amplifying the use of machinery by preparing written specifications for all persons connected with the work. A. M. Schreiber remarked that one great disadvantage in using track machinery is that it interferes with the traffic. Boardman Reed explained in detail the working of the plan used in New York City for paying for the removal of snow. For the last few years the snow has been removed by contract, the price paid being determined by the depth of snow as recorded by the weather bureau. The subject of the proper tiling for drainage was discussed by E. N. T. Ryder, E. O. Ackerman, M. J. French, and W. J. W. Griffin.

The report of the sub-committee on rail corrugations was presented by the chairman, F. G. Simmons. This report embodied the replies to a circular letter sent to the various members. Out of 48 replies only 13 contained any definite information on the subject, and even these were considerably at variance with each other. The chairman remarked that the investigation of rail corrugation should be referred in the future to a committee dealing with all of the details of the rails. In opening the discussion, G. L. Wilson called attention to the curious fact that although the corrugations are ascribed to defects in the foundation, yet almost all of the cases of corrugated rails occur in paved streets. The irregularities may be removed by filing the rails, but their recurrence is not prevented. C. Voynow expressed the opinion that the corrugations are caused by the elongation of the upper surface of the metal under traffic. It has been noted that the firmer the foundation of the rail the more readily do the corrugations occur. It has been found that after the rail has been thoroughly filed the corrugation does not occur again. It is probable that

the filing causes the metal to be knitted into a more firm consistency. W. B. Reed stated that his observations confirm the theory of Mr. Voynow. In reply to a question by E. W. Olds, Mr. Voynow said that when the corrugations first form they are perpendicular to the rail. As they increase in size they become cone-shaped. They change in form regularly and constantly approach a nipple in shape, but no creeping has been observed. Mr. Voynow suggested that a systematic investigation of the corrugations should be carried out by the committee on rails.

The report of the sub-committee on rails and rail matters was presented by Chas. E. Clark. As a result of its study the sub-committee recommended as a standard for city construction in paved streets, a 7-in. T-rail, known as the Lorain section No. 95,400 and the Pennsylvania Steel Company's section No. 272. Mr. Simmons, as chairman of the committee on maintenance of ways, said that there are probably from 50 to 100 types of rails in use in the various cities, and it is desirable, if possible, to reduce the number of types to two or three. It is not the intention, however, to recommend the T-rail as the best for all service conditions. The report, which was not discussed, was the last item on the Tuesday morning's program.

At the session Tuesday afternoon the most important committee of the Engineering Association, the committee on standardization, presented its report. So great was the interest in this report that the convention hall was crowded. The report deals with axles, journals and journal fittings, brake shoes and their fittings, wheel treads and flanges and rails. The text of the report consists principally of references to a large number of accompanying drawings.

In the discussion which followed the reading of the report N. W. Storer, speaking for the Westinghouse interests, asked that that portion of the report relating to the overhang of the gear hub on the gear for small axles be changed so as to permit the placing of the gear flush on the motor side and making the overhang on the wheel side 1⅛ ins. The matter was left in abeyance until after the convention. E. W. Olds said that it was a matter of very great importance for the association to adopt standards, since by this means it would be possible for the operating companies to change one motor for another on the same truck.

M. Ayers, speaking for the Boston Elevated Railroads, suggested that some changes be made in the axle dimensions and that keyways be omitted, especially for high-speed work. Objection, however, was made to any change since the committee felt that its report covered the best practice of the day, and that it would be difficult to reconcile a report of this character to the practice of every individual road. C. S. Sergeant and E. G. Connette, of the American Association, spoke of the need of some standardization and sympathized with the committee in its difficulty in arriving at recommendations with respect to a department where nothing before was standard. Mr. Evans spoke of the difficulty in getting motor designers, truck builders, wheel manufacturers and axle makers to agree. The recommendations made by the committee, he said, very nearly coincide with the standards adopted by the largest railway systems of the country.

A. H. Weston, speaking for journal-box manufacturers, said that he believed that the association in adopting the journal-box standard as recommended by [illegible] would confer a great benefit on the traction companies. One of the most discouraging things [illegible] up to the present time has been the great variety of patterns he had to carry to supply traction companies' demands.

The recommendations regarding brake shoes and brake-shoe heads met with the approval of the manufacturers, who were anxious to reduce the number of patterns necessary to carry in stock.

The section of the report [illegible] standard [illegible] of tread and flange of wheel [illegible] in which is was shown that despite the objections made in some quarters, a wide tread is desirable for interurban work and even in city work, the wide tread in the latter case resulting in increasing the wheel mileage from 15,000 to 20,000.

The report was finally adopted as read, and presented to the American Street & Interurban Railway Association for its approval. The committee was given a vote of thanks for its work, and in reply said that it hoped its recommendations would be put into practical use.

The report of the committee on open versus closed terminals for car houses was then read. The committee on operating and storage car house designs not being able to prepare anything for definite presentation to the association, the final order of business, the Question Box, was then taken up for discussion. The only questions brought up for further discussion concerned lightning arresters and where to place them. The answers showed that many companies placed the lightning arresters on high spots and in deep railway cuts; others distributed them at least every half-mile on interurban lines; while still others clustered them thickly around the power house. One company marked on a map the points where lightening struck oftenest. By this means it was enabled to know where to put the lightning arresters to the best advantage, with the result that the burn-outs due to this cause were reduced enormously.

WEDNESDAY'S SESSIONS.

The opening session of the American Association and joint meeting of the affiliated associations took place in Casino Hall over the entrance to the Steel Pier on Wednesday morning.

After the usual addresses and committee reports, Prof. H. H. Norris of Cornell University read his paper on "The Technically Trained Man and the Electric Railway Profession," an abstract of which appears elsewhere in this issue. This paper was followed by one written by Ralph Sweetland on "The National Fire Protection Association." "The Influence of the Design of Railway Structures on Economy of Operation," by H. T. Campion and William McClellan was the title of the final paper of the morning session.

At the Wednesday afternoon session, the following papers were read before the Engineering Associations: "A Year's Experience with Gas Engines," by Paul Windsor, an abstract of which will appear next week; "Some Practical Points in Steam Turbine Construction, with Particular Reference to the Parsons Type," by St. John Chilton; "Operation of Curtis Turbines in Railway Service," by A. H. Kruesi, and "Recent Developments in Steam Turbine Power Station Work," by J. R. Bibbins. Abstracts of these three papers follow.

The paper by Mr. Chilton described certain improvements that have been introduced in the Parsons type of turbine as built by the Allis-Chalmers Company. He stated that in reaction turbines small clearances between stationary and rotating blades, in line with the flow of steam, are unnecessary. In practice the clearance is never less than ⅛ in. between the smallest blades, and it is often as much as ¾ in. between the largest blades. Thus ample room is allowed for difference in expansion of the rotor and the cylinder. It is essential, however, to minimize the leaking of steam past the ends of the blades, where it does no work. The necessity for small radial clearance has demonstrated the advisability of protecting the tips of the blades to prevent them from being knocked out through accidental contact with the cylinder or the rotor. A method that experience has proved both practical and effective is one in which the blades are cut from drawn stock, and each blade is formed by special machine tools so that at its root it is of angular dovetail shape, while at its tip there is a projection. To hold the roots of the blades firmly there is provided a foundation ring which is first formed to a circle of the proper diameter, and then slots are cut in it by a special milling machine, and these, accurately spaced and inclined to give the required pitch and angle to the blades, are of dovetail shape to receive the roots of the blades. The tips of the blades are substantially bound together and protected by means of a channel-shaped shroud-ring, in which are holes punched to receive the projections on the tips of the blades. The blading is mad[illegible]

[illegible] construction any blading trouble would be localized and damaged rings can be removed and the turbine can continue in operation until such rings can be replaced conveniently. Mr. Chilton stated that the improvements effected by this construction may be summed up as follows: 1, firm attachment of blades; 2, ample stiffening of blades of all lengths against effects of vibration; 3, accurate spacing and accurate angles of blades; 4, protection of blade-tips, so that accidental contact will not rip out blades; 5, smaller clearance, resulting in diminished steam-leakage and, hence, increased economy; 6, improved baffling against steam-leakage by reason of the shape of the shroud-ring; 7, protection against a possibly defective blade coming out and destroying other blades; 8, accurate machine work, as against uncertain hand work; 9, the facility for thorough inspection of workmanship; 10, the localizing of any possible trouble and the convenience of making quick repairs.

A paper by August H. Kruesi outlined the results obtained with Curtis steam turbines in actual railway service. A 9000-kw turbo-generator used by the Commonwealth Electric Company, Chicago, Ill., consumes 13 lbs. of steam per kw-hour. A 5000-kw unit installed in the power station of the Edison Illuminating Company, of Boston, consumes 14 lbs. of steam per kw-hour. A 2000-kw unit in the Westville power house of the West Jersey & Seashore Railroad Company consumes 16.2 lbs. of steam per kw-hour at full load. The tests on the above machines showed that the total steam used per hour varies regularly with the load from a certain value at no load. In the Boston Edison unit the value at no load was 12.5 per cent of the total amount at full load. The additional quantity of steam per kw over and above the fixed amount at no load was 12.1 lbs. per hour. In a theoretically perfect engine driving a generator at unity efficiency the increase in consumption would be 9.27 lbs. per kw-hour. Thus the added amount of steam was used in the turbine at an efficiency of 76.4 per cent.

Probably the greatest single improvement which has been effected in the Curtis turbines relates to the governors. All of the turbines for large 25-cycle generators are now equipped with hydraulically operated valves controlled by balanced pilot valves connected to the governor and taking oil from the step-bearing pumping system. These governors have proved reliable, permanent in adjustment, sensitive and responsive to abrupt changes in load and they require very little attention in operation. They are ordinarily set for a 2 per cent change in speed from no-load to full-load, which degree of regulation is sufficiently large to afford stable operation of generators in parallel.

The step bearings of the machines are now lubricated with oil instead of water which was formerly employed. The change to oil involves the use of an additional shaft packing where the turbine shaft passes through the base, but as this packing has only to seal against the atmosphere its duty is relatively light and its operation simple. The upper bearings of these machines are now being lubricated under pressure from the step oiling system, thus dispensing with tanks and sight-feed glasses. The pressure lubrication enables the bearings to be supplied with any quantity of oil desired. It is found that a flooded condition of lubrication in the guide bearings gives the best operation of the machines as regards freedom from vibration. The oil is filtered continuously.

A paper outlining recent developments in steam-turbine generating stations, with special reference to the Spy Run station of the Fort Wayne & Wabash Valley Traction Company, was presented by Mr. J. R. Bibbins. It was shown that a Westinghouse-Parsons turbo-generator of large size requires only 1/20 sq. ft. of floor area per generator horse-power, which is less than ¼ of that required by a horizontal Corliss, and less than ⅓ of that occupied by a vertical Corliss. In a few very large stations (above 10,000 kw) the investment cost has been somewhat less than $100 per kw. In the Spy Run 8500-kw station the total cost was $66.25 per kw of total generating rating. This cost was distributed as follows: Building $10.97; generating plant, complete, $30.55; boiler plant, $13.92; condenser plant, $3.98; coal-handling plant, $0.94; erection superintendence, engineering and miscellaneous, $5.94. It is interesting to note that a positive pressure fan has been installed to insure ventilation of the generators. This system of ventilation has the advantage of maintaining low generator temperature throughout the whole year. Moreover, a large excess of air can be supplied to any of the units that may for any reason be overloaded abnormally. Thus the fan blast in a generator auxiliary allows greater overload to be carried without damage.

An Electric Light Celebration.

A memorable banquet was given at Delmonico's, New York City, on Oct. 12, by Charles R. Huntley, of Buffalo, past president of the National Electric Light Association, to his former associates in the electrical industry. It was his fiftieth birthday, and the generous and felicitous idea had occurred to him on his recent return from Europe to celebrate it in this manner. There were 44 guests present out of the 47 invited, and the regrets of the absentees were poignant. An epitome in itself of 25 years of electrical history, the gathering was also delightful as a reunion of old friends, many of whom had not seen each other in years; and the rapidity of change and of events was shown by the fact that C. W. Price was the only man present who attended the preliminary gathering to organize the body in Chicago in 1885. Mr. Huntley gave a place next to himself, it should be noted, to the veteran master of transportation, C. O. Baker, who, by coincidence, celebrated his own fiftieth birthday on the twelfth.

The dinner was given in the famous red room, scene of many notable festivities, and the guests assembled at a huge round table banked profusely in ferns and flowers, in the center of which sparkled all the evening a multi-colored electric fountain. The sorbet was served in little mugs with appropriate inscriptions and the ice cream was served in dainty satin boxes containing a little primary battery, each capped with an incandescent lamp in full glow.

By request of the host, T. C. Martin officiated as toastmaster. Most admirable speeches were made in the following order by Samuel Insull, W. J. Clark, Edward Weston, Nikola Tesla, John J. Carty, Wm. Stanley, H. G. Stott, C. L. Edgar, G. F. Porter, John A. Seely and Alex. Patterson—men and names in themselves suggesting the living story of the arts with which they have been associated. It may be noted that there were four past presidents of the National Electric Light Association present, viz., Huntley, Insull, Edgar and Arthur Williams. Mr. Stott, who spoke as president of the American Institute of Electrical Engineers, began his professional career in this country in Mr. Huntley's employ, laying the underground system of Buffalo and inaugurating "Niagara power" there. Every speaker was full of reminiscences and data of a most interesting character, and every health was a literal "salamander."

In addition to those already named, were the following well-known "old timers": W. M. Habirshaw, H. L. Shippy, Morris M. Mead, Alex. Henderson, George Jackson, J. R. Lovejoy, George Urban, W. C. Warren, De Lancy Rankine, Ambrose Butler, Henry Stanley, James Kempster, Ed. Peck, E. E. Bartlett, A. J. de Camp, H. H. Harrison, E. S. Keefer, F. A. C. Perrine, R. B. Corey, P. C. Ackerman, C. D. Shain. Mr. Huntley was accompanied by his two sons, both in the industry, and Mr. Urban by his son, also engaged in work at Buffalo.

During the evening a flash-light photograph was taken of the assemblage, and a copy was presented later by the thoughtful host to every one of his guests. The dinner closed with a final rousing health to "Charlie" Huntley, and the singing of "Auld Lang Syne," but even then the party did not break up and the jubilee was still in full swing when Sunday morning dawned serenely.

October A. I. E. E. Meeting.

The October meeting of the American Institute of Electrical Engineers was held on Friday, the 11th, in the auditorium of the Engineering Societies' Building, President H. G. Stott being in the chair. The meeting was devoted to the discussion of the grounded neutral, with and without series resistance, in high-tension systems, a paper on this subject being presented by Mr. P. M. Lincoln. Experience papers on the same subject were read by Mr. F. G. Clark and Mr. George I. Rhodes. Abstracts of the above papers are given elsewhere in this issue.

President Stott stated that of the 5100 members of the Institute, 4600 reside in this country, and 22 per cent of the latter live within one hour's travel of New York City. To meet the needs of the members who cannot conveniently attend the New York section, 17 University branches and 20 local sections have been organized. It is the intention to broaden the scope of the Institute work so as to include not only electrical engineering but also the "allied arts and sciences" as mentioned in the constitution. The old high-tension transmission committee has been made a sub-committee of the papers committee, and a new sub-committee on railways has been formed. Moreover, a committee on education has been authorized, and a special meeting will be devoted to educational subjects. . President Stott suggested the appointment of a reception committee in each large city for assisting visiting foreign engineers. The annual banquet will probably be held in January, at which time several distinguished guests will deliver addresses.

Buying and Selling Illumination.

A paper with the above title was presented before the recent meeting of the Empire State Gas and Electric Association by Mr. Elliott, of which an abstract follows.

After a preliminary general consideration of the subject, the question of what measurements should be used as a basis for the payment of street illumination, was discussed. With reference to the intensity of illumination, four different measurements were detailed as determining factors in the general result: 1. Maximum illumination; 2. minimum illumination; 3. average illumination; 4. illumination at a given distance from the lamp.

Which one or more of these measurements should be used? Maximum illumination was dismissed with little argument. Beyond a certain intensity, which is reached with all ordinary light-sources at the present time, a high maximum illumination is a defect, rather than an advantage, and if any use is made of it, therefore, it should be rather to limit it to a certain intensity.

Maximum illumination has many points of advantage. If a certain minimum illumination were specified, motives of economy would induce efforts to reduce the maximum to the lowest possible degree, with a result that a more nearly uniform intensity of illumination would be obtained; and this is the one most desirable improvement to be sought for over the methods that now prevail in street lighting. There are a considerable number of cases, however, in which the minimum is so low as to render its measurement too inexact for practical purposes.

This brings out the fact that street lighting may be divided in two quite distinct classes: First, street illumination, in which every part of the street is sufficiently illuminated to make it plainly visible; and, second, what may be termed beacon lighting, in which no attempt is made at general illumination of the entire street, but merely to use a sufficient number of light-sources to indicate the direction and location of the street. The name is suggested by the similarity of this kind of lighting to the use of lighthouses in harbors and waterways. Beacon lighting forms by no means an inconsiderable part of street lighting. In fact, it is not improbable that the total number of miles of streets lighted in this manner is larger than the mileage of illuminated streets. This cannot generally be set down as a fault. There are a great many cases in which this kind of street lighting serves the purpose sufficiently well, and in which the use of a large enough quantity of light to illuminate the entire length of the street would be unjustifiable expense. If minimum illumination is to be taken as a standard, upon which to base street lighting contracts, it is evident that it can only be applied to those streets which may be classed as "illuminated," leaving beacon-lighted streets to be provided for on some other basis.

Average illumination is evidently subject to the same limitations as minimum illumination, *i. e.*, it would be practcally unsuitable for beacon-lighted streets.

Illumination at a given distance from the base of the light-source offers a way out of the difficulties presented by minimum illumination, and is the method recommended by the committee of the National Electric Light Association, which had the matter under advisement last year. This method amounts practically to the use of the intensity of the light given out by the source at a certain angle. This is theoretically objectionable, as putting a premium on freak illumination, *i. e.*, illumiation which has its brilliancy concentrated in one given spot. Practically, however, this objection is of little force, since there are no available means of abnormally concentrating the light at an angle beyond 45 deg. The actual working of such a standard would, therefore, be to secure a minimum illumination at a stated distance from the lamps, and a higher degree of illumination between that point and the base of the lamp. The height of the lamp must, of course, in such a case be specified.

In the case of street illumination, as distinguished from beacon lighting, there seems to be no practical objections to the use of minimum illumination as a basis. This method, carried out in its fullest sense, leaves the whole question of light-sources, height, distance apart and accessories used wholly within the choice of the seller.

The result of making this the basis of a contract would invariably be the use of light-sources of small candle-power, except possibly in the rare cases in which a very high minimum was specified for the purpose of producing spectacular effects. In this case arc lamps would probably hold their own, but in most other cases would be hopelessly outclassed by incandescent electric or gas lamps.

The electric lighting interests have frankly admitted their opposition to such a method of measuring street illumination, for the reason that it would give the advantage to the light; but this is only one side of the story. If better street illumination can be produced at less cost with gas than electricity, the public, *i. e.*, the buyer, will naturally demand gas lighting. What the public wants is the best illumination for the money expended, and is quite unconcerned whether this is produced by gas or electricity with arcs, incandescents, or what not. It may be stated as a safe prophesy that what the people want they will in the end have. Ignorance or artificial conditions may for a time restrain the march of progress, but the fittest will always survive and come to the front.

In the case of beacon lighted streets, the only possible method of basing it upon the measurement of illumination, is by the illumination produced at a given distance from the base of the lamp placed at a given height. As previously stated, this amounts practically to specifying a lamp having a certain distribution of its rays, and it would be simpler and more satisfactory to make such a specification at once.

The payment for street illumination on the basis of the illumination produced offers advantages to both buyer and seller. The buyer pays for the actual goods delivered, it puts a premium upon progress and improvement, of which the producer will reap the first advantage. Thus, if a more efficient form of lamp is developed by which the stated illumination can be produced at less cost, it is obvious that the producer will be the gainer, at least for a greater or less length of time.

A reform, therefore, which works to the advantage of all parties, and to the disadvantage of none, is worthy of at least a most careful and serious consideration. That there is ample need of reform in the general practice of street lighting, both

professional and laymen must agree, and there is no surer means of inaugurating such a reform than to make better prac- [illegible].

Direct-Current Motor-Control Systems.

A [illegible] Mr. W. [illegible] on Sept. 24, contain- ing 54 claims, relates to a modification of the control system for mill and hoisting motors described on page 610 of our issue for Sept. 28. As noted in Fig. 1 the field windings of the motor

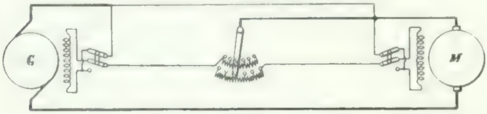


FIG. 1.—CONTROL SYSTEM FOR REVERSING MILL MOTOR.

and the generator are in parallel with each other and in series with the armatures of these machines. The relative values of the currents in the field windings of the two machines are adjustable inversely by the movement of a single rheostat arm.

A second patent issued on the same date to the same inventor deals with a system for controlling a single motor from a number of different positions. The controller, which is diagram-

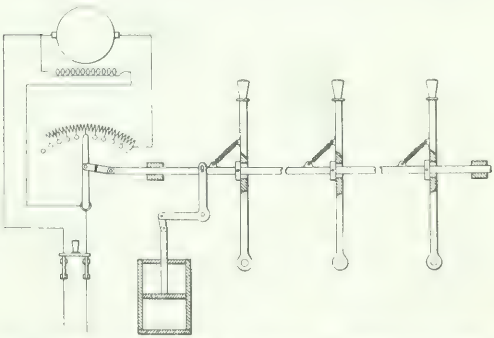


FIG. 2.—CONTROLLING A MOTOR FROM SEVERAL DIFFERENT POSITIONS.

matically illustrated in Fig. 2, is so arranged that if different operators conflict in simultaneously attempting to move the controller, the one desiring to decrease the speed of the motor or to operate at the smallest speed will prevail. In case two or more of the operating handles are simultaneously moved dissimilarly, the controller arm will move to the point determined by that handle which is moved farthest to the left, the movement of the other handle or handles merely putting under tension the spring or springs associated therewith.

Electrical Development in Asia Minor.

U. S. Consul-General G. B. Ravndal furnishes some interesting details as to trolley development at Beirut, Asiatic Turkey, and Consul W. C. Myelssen also states that a trolley system is to be built from Bagdad to a suburb, El Azamieh, distant about three miles. In both instances, it is urged that American manufacturers should pay closer attention to this field. Mr. Ravndal says: Some of the streets of Beirut are being widened and buildings torn down to give room for this modern improvement. In the old town a passage is being cut through an almost solid mass of square, flat-roofed stone houses erected more than a century ago. Of all the cities of the Ottoman Empire, Damascus was the first to employ electricity. Beirut is now following in the wake.

The concession for Beirut, which holds good for 99 years, was granted by the Sultan's Government to an Ottoman corporation, which in turn leased its charter to a Belgian company. The director-general informs me that the company is spending some $500,000 for rails, rolling stock, machinery, cables, buildings, tools, etc., and that a large portion of the material needed has been ordered in Belgium, some minor bills being filled in Germany and France. For the generation of electricity the company has decided to use coal.

Electric light will speedily be introduced in Beirut by the owners of the present gas plant. American trade in new markets would be greatly encouraged and promoted by American investments of capital for the development of natural resources which lie dormant and in public works. Our capital seems too timid and too suspicious of foreign conditions.

Underground vs. Overhead Distribution.

In a paper presented before the recent meeting of the Empire State Gas & Electric Association, Mr. W. W. Cole considered the subject of the agitation for the substitution of underground for overhead distribution from central stations.

There is undoubtedly, he said, an increasing desire to substitute underground lines for overhead, and generally where this is done the company has been granted a more liberal franchise, especially in cities of the third class, on account of the small income per hundred feet of conduit, and the city has granted an increased price per lamp and the company has had to maintain higher prices on the sale of current. The conclusion I have come to after considerable correspondence and investigation is that the cost of installation of an underground system, including conduit, manholes and cable, is about four times the cost of overhead construction. Overhead services can be run to consumers free, while an underground service will cost from $1.20 to $1.50 per foot, in proportion to the capacity and conditions. In one city in the state the charge for underground service is at the rate of $1 per foot from the curb to the inside wall of the customer's premises, and 10 cents per foot for overhead service under the same method of measurement. The interruptions from the alternating-current distribution system have been numerous and annoying, both to the company and consumer. It is estimated where street lighting is furnished from underground that it costs $20.50 per year over and above that of overhead service. In a recent contract in a city of northern New York they received $10 per lamp per year more. The additional price of $10 instead of $20 was made on account of their having more than half of the lamps to be supplied from the underground system. Another city, in a recent contract, was allowed $19 more for each new lamp supplied from the underground. By referring to the schedule of lighting prices throughout the country you will observe that all companies are charging very much higher prices when lamps are being furnished from underground circuits. But I desire to specialize somewhat on cities of the third class, and in several I believe conditions are against the placing of wires underground. First, additional cost of street lighting; second, additional cost to consumers for underground services; third, service from underground wire is less reliable than from overhead. This applies particularly to alternating-current distribution. One of the chief arguments raised against overhead wire lines is that they interfere with the work of firemen and are, therefore, a menace to the city, but in answer to this there is the danger of having the service switch fuses and connections in the cellar, which is generally filled with inflammable material, boxes, papers, and so forth, as we all have seen. Another source of danger which is not always remembered is the possibility of a service fuse blowing out, when it then becomes necessary to carry a light of some kind through the cellar to reach the switch. In order to reduce to a minimum the danger of fire, it is essential that a service switch should be located in some accessible place, and cellars are generally blocked with boxes and barrels, and in case of emergency very difficult to get through. There is one more source of danger from the underground system, and that the chance of explosion of gas in junction boxes and manholes, and I don't think any system yet developed has entirely obviated this danger.

Boston Edison Company Discusses Earnings.

At a hearing before the Massachusetts Gas and Electric Light Commission, Sept. 30, the Boston Edison Company presented an extended statement through its counsel, E. W. Burdett, in reply to the inquiries of the Public Franchise League whether the company's total income is proper, and whether it is properly distributed among the different classes of customers. Mr. Burdett's statement was divided into three parts. The first part gave the company's reasons why its income is a proper one, making numerous comparisons with other companies in the United States and Great Britain. These statistics showed that the present income is fully justified. The second part was a discussion of reasons why the present method of apportioning the income among the customers is correct. This consisted of a historical review of methods of charging, a discussion of the maximum-demand system and the universal use of differential rates. The company argues that it is not the customers paying the maximum rate of 15 cents who make the profits for it, but that the profits come from the customers who pay 10 cents per kw-hour or under. The third part stated that present conditions are abnormal, owing to the effect which will be produced by the introduction of high-efficiency lamps. These lamps are expected to produce a reduction for the consumer now paying 15 cents, the equivalent of a decrease twice as great as would be effected by an alternative rate of 10 cents per kw-hour. The company suggested that any change in the kw-hour charge be postponed until the effect of the new lamps is ascertained.

Reviewing the main question at issue, Mr. Burdett said: "Regarding the distribution of costs among customers, our theory recognizes classes rather than individuals. All individuals taking current under the same conditions receive exactly the same price, which price bears a definite relation to the cost of serving those in that particular class. The classification of these costs is that common among all the electric lighting companies, and has already been explained in the answers submitted to the board earlier in the year.

"We have pointed out that at least 80 per cent of the income of the company is required to pay expenses depending more upon the size of the customer than upon any other factor, the remaining expenses being dependent upon the kw-hours sold. Hence, if the first item is apportioned among the customers in proportion to their size, and the second item in proportion to their use, much greater accuracy of cost distribution is secured than under any other known method of charging.

"As to the allegation that the relative cost of the Edison Company's plant and property is much higher than in certain other cities—New York, Chicago, Worcester, Salem, Lowell, Cambridge, Fall River and Lynn—this claim does not conform to the facts. As far as we have information, it is not true of Chicago. Statistics show that it is not true of New York; and that as to the Massachusetts cities named, it is not true when underground investment and the higher price of land in Boston are considered, as well as the absence of distribution investment in those cities where power is supplied to railways.

"As to the relative higher cost of management of the company, as compared with certain other Massachusetts companies, after takihg into consideration the excess of our taxes and of our 'New Business Department,' this statement is true only within very narrow limits. This excess of management excess is offset nearly four times over by the saving in generating and distribution expenses; so that the total operating expenses, even considering [illegible] and the 'New Business Department' are as low as those of the other Massachusetts companies named.

"The benefits derived by the community from our acquisition of other electric lighting plants consists in the distinctly lower costs of electricity [illegible] not only in the districts acquired, but throughout the company's whole territory. The prices paid for these plants were not excessive. Regarding [illegible] price charged for electricity by [illegible] and [illegible] companies named by the petitioners as having a lower maximum price, it has been impossible to obtain the necessary facts from all of these cities. The two following reasons will doubtless cover the majority of cases: first, either the investment in these cities is lower than ours, largely on account of the difference in underground investment, or the return on the investment is less than a fair return; second, that while the maximum price in some of these cities may be lower, the average net price to the retail consumer is higher than ours.

"In the case of New York, to which neither of these reasons apply, we would call attention to the fact that the New York Legislature at the time of fixing the New York price at 10 cents, fixed the price in Brooklyn at 12 cents, and considering the comparative sizes and conditions of the three cities, it is fair to assume that had they at the same time been fixing a rate for the city of Boston, they would have made it 15 cents. It is important to note in this connection that the legislative act which fixed the minimum rate of New York at 10 cents and in Brooklyn at 12 cents, and would have given Boston 15 cents, resulted in an average rate to retail customers in New York and Brooklyn of substantially 10 and 12 cents, respectively, whereas the net average rate to retail customers in Boston is actually well below 12 cents, and not 15 cents.

"As to the statement that the Boston Consolidated Gas Company is able to charge a lower maximum rate for gas than the companies in many of the above cities, there is nothing in common between gas and electricity other than that they are both available for light, heat and power. Generally speaking, there is not the difference in the cost of street construction between large and small cities which exists in the electric lighting business, gas companies all being underground, regardless of the size of the city, whereas electric light companies may or may not be underground.

"As to the sliding scale, the company is in thorough sympathy with the principle, and while there seem to be some difficulties in adapting it to the electric lighting business, these can possibly be overcome. A definite plan has not been suggested, as a basis can only be determined upon on consultation with the board. It is impossible to measure the effect of a 10-cent per kw-hour alternative rate at this time on account of the complication of the situation by the introduction of high economy lamps."

Inauguration of the New York Edison Lecture Course.

For the benefit of its employees the New York Edison Company has inaugurated a course of lectures on electrical engineering to be delivered weekly at its auditorium, 44 West Twenty-Seventh Street, throughout the coming fall and winter. The first lecture was given on Tuesday evening, Oct. 1, to an interested audience which taxed to the utmost the seating capacity of the spacious auditorium.

Mr. Alexander Maxwell, chairman of the Lecture Committee, called the meeting to order and introduced Mr. John W. Lieb, Jr., who spoke on behalf of the management of the New York Edison Company. Mr. Lieb, in his opening remarks, dwelt on the deep interest felt by the company in the educational welfare of its employees, describing the successive steps in its welfare work, such as the building of the auditorium, the equipment of an employees' library and the institution of these experimental lectures.

Prof. Sydney V. Ashe was then presented as the lecturer conducting the course. In his address he emphasized the fact that there is an imperative demand for technical training in preparing to enter the engineering profession to-day.

The subject of his lecture was "Magnetism" and dealt with the fundamental principles governing the magnetic properties of iron. He laid great stress upon the necessity for a thorough knowledge of these peculiar characteristics of iron in order that the effect upon the growth of the electrical industry may be comprehensively grasped by the student.

Lantern slides and numerous experiments illustrated the

particular points of the lecture, which terminated at 10 o'clock. Prof. Ashe was assisted by Mr. C. S. Kern, of the Brooklyn Polytechnic Institute.

The Colorado Electric Light, Power & Railway Association's Question Box.

The Colorado Electric Light, Power and Railway Association, at its convention, in September, in Denver, conducted a question box which was taken up at various sessions. The following are some of the principal subjects and questions discussed, with the principal discussion they drew out.

[illegible]

"Has lignite coal been successfully used on mechanical stokers?" brought the answer from Mr. John A. Beeler, general manager of the Denver City Tramway Company, that his company's power house had used mechanical stokers with lignite coal for several years, and obtained a better combustion than with hand-fired coal, resulting in a saving of probably 25 to 30 per cent in fuel. The load on the plant is fairly steady. Stokers would probably not be so successful in a small electric light plant with a poor load-factor.

The question, "How often do steam turbines have to be adjusted, and is the wear noticeable?" brought the answer from Mr. J. F. Dostal, superintendent of the electrical department of the Denver Gas & Electric Company, that his company had been operating the Parsons turbine for a year and without any perceptible wear in the moving parts.

"Are small compound engines preferable to high-speed turbines operated non-condensing?" brought the answer from Mr. Rogers, of the Westinghouse Machine Company, that a small compound engine would show greater steam consumption than the turbine.

"In steam turbine operation, what is the economy gained by superheating?" brought the reply that the saving is about 1 per cent for each 10 deg. of superheat up to 100 deg. superheat, and about 1 per cent per 5 deg. above that. It does not pay to superheat over 150 deg.

[illegible]

"What has been the experience of companies in grounding their secondary systems?" Mr. J. C. Lawler, of the Colorado Springs Electric Company, said that with the neutral grounded on a three-wire system, leaks in the customers' wiring would sometimes cause the meter to register. Mr. R. P. Bache, of Colorado Springs, said that a company ought to ground all secondaries. This question had been brought up in the National Electric Light Association time after time, and all authorities recommended it as an important safeguard. The question was raised whether transformers were more likely to be burned out by lightning with the secondaries grounded. It was said that at Manitou the company was losing many transformers when secondaries were grounded. Mr. Bache said that the Manitou plant did not have good lightning protection. One member said that the interests controlling the Public Service Company of New Jersey and those of the United Gas Improvement Company had ordered all superintendents to ground secondaries. He had not believed in it at first, but found no evil effects. A water-pipe system was usually the best ground to be obtained in Colorado. A pipe driven into the ground was satisfactory in a wet, clay soil, but was not likely to give a good ground in Colorado. Mr. R. T. Rossi, chief engineer of the Northern Colorado Power Company, told of an effective lightning arrester ground his company had used the past summer. This consists of a copper disc, shaped like a dishpan, so placed in the ground that whatever water sinks down to it is caught and held in the pan.

"Is it safe to work with the wires of a three-phase circuit of 13,200 volts when the line is dead with a live circuit of the same voltage on the other side of the pole?" Mr. Bache said that this was done in the East. The men wore rubber gloves [illegible]

Mr. Clark told of handling a 12,000-volt live line. Mr. J. R. Cravath said that on a 33,000-volt line in southern California, where there were two circuits on one pole line, it was the regular practice to change poles and renew insulators without interrupting the service.

"What are the relative merits of 'carbolinium,' 'antiseptine' and creosote oil for preserving poles?" Mr. G. R. Hall, of Westinghouse, Church, Kerr & Company, said he had used considerable carbolinium on poles. It was applied hot. The workmen had to cover hands and face, as when handling the hot liquid the fumes would affect the skin. It was applied on the pole butts up to 1 ft. above the ground. Mr. Rossi said that in some recent construction work he had set aside a certain number of poles to be treated with carbolinium. It had been suggested that a hole be bored in the pole and that kerosene be poured into this hole until it saturated the pole. Mr. Mathews, of the Denver City Tramway Company, said that he had tried this by boring a 1-in. hole 12 ins. to 14 ins. deep. This was tried on a northwestern cedar pole and on a native Colorado pole. Only a small amount of kerosene soaked in during the six weeks. Mr. Buttles reported finding dry rot underneath the surface with carbolinium-treated poles. About 75 per cent of the poles were so affected. Mr. Hall said that he had had similar experience with tar.

"What is the smallest size soft-drawn insulated wire you use for overhead lines with spans of 120 ft.?" Some members reported satisfaction with No. 8 wire, and even smaller, in places where there was no sleet.

"What means have been taken to prevent persons from shooting and breaking insulators?" Mr. Rossi said that his company, on a new line, lost 145 insulators in 7 miles, within a short time. They had, therefore, placed a notice on every fifth pole offering $150 reward to any one giving information leading to the conviction and punishment of persons shooting at insulators. A reward of $250 was offered to sheriffs of counties who catch such persons. A similar advertisement was run for five weeks in all the local newspapers in the district covered by the transmission lines, and by properly presenting the matter to the local editors, the local newspapers printed editorials calling attention to the great loss and inconvenience caused a large number of people by interruption to service and the shutting down of industries operated from transmission lines. This had practically stopped the trouble.

Mr. Mathews said that the Denver City Tramway Company was much troubled by persons shooting at insulators. Signs offering reward had done some good.

"What is the best and cheapest method of insulating wires when they pass through trees?" Mr. J. C. Lawler, of Colorado Springs, told of a long wooden sleeve which he had used at some places where it was impossible to trim the trees.

Mr. E. P. Dillon thought the best way was to trim the trees. In one case the fire department had been called upon to enforce the trimming on the ground of preventing fires. In another case the trimming of trees in a city required an ordinance passed by the Council. The company's engineer went over the whole city with a professional tree trimmer. A list of the trees to be trimmed was drawn up and an ordinance for their trimming passed the Council. There was thus no trouble about the trimming.

"How can transformer oil be readily tested for moisture and impurities?" Mr. G. R. Hall described a method of testing with a spark-gap. A tube holding 200 cu. cm of oil was provided with adjustable brass knobs in the ends, set 150 mils [illegible] was supplied from a generator, the excitation of which could be varied to give different voltages. A light fuse in the primary circuit was used to blow and disconnect the transformer when the spark-gap broke down. He mentioned the method of dehydrating oil with lime. The method of testing for moisture in oil with a red-hot wire was not good. The theory was that the oil would hiss, due to the escape of steam when the red-hot wire was plunged into it: but, as a matter of fact, oil entirely free from moisture, would frequently hiss.

Power Supply for Fryeburg, Maine.

A new power plant will shortly be completed at Swan's Falls, in the Saco River, about three miles from Fryeburg, Maine. The fall of the river at this point is about 10 ft., and the plans include a dam 225 ft. long and 5 ft. high, and a smaller dam 30 ft. long and 10 ft. high; a 20 ft. x 40 ft. wood and iron power house, and two 300-hp water-wheels, with electric generators. Only one wheel will be installed at first.

The supply of water is practically unlimited, as the river channel is wide with high banks for five or six miles back from the power house site. Work on the dam was begun in June, 1907, and advantage was taken of the natural conditions. An island in the river channel forms a canal on one side, in which the small dam has been built, of concrete, the larger dam serving to turn the water toward the smaller dam and the penstock, which is over 300 ft. long. Energy will be distributed from the plant by the Fryeburg Electric Light Company, which supplies the villages of Fryeburg and East Conway, N. H. It is estimated that at least 600 horse-power will be available during the midsummer low-water period, and 1000 horse-power for the greater part of the year. It is hoped eventually to supply energy for manufacturing and for the Fryeburg Street Railway, which will probably be extended to the adjoining towns of Lowell and Chatham. If possible, the work will be completed by Nov. 1, but at present high water is delaying the work in the wheel-pits.

American Production of Tungsten.

In view of the growing importance of tungsten-filament lamps, the recent report on the production of tungsten in 1906 in the United States, made by Mr. Frank L. Hess, for the Geological Survey, is of unusual interest. The tungsten ores produced in the United States in 1906 amounted to 928 short tons, valued at about $349,000. The output for the year is a gain of 125 tons, or 15.56 per cent, in quantity, and of $89,191, or 29 per cent, in value, over the known production of 1905.

The noticeable rise in the price of tungsten during 1905 continued during 1906, and the production was stimulated accordingly. There was, however, a very great discrepancy in the prices paid for ore in various places, as there is almost sure to be when an article is produced spasmodically in widely separated and often little-known localities, while at the same time the market is limited and the isolated small producers have slight chance to become acquainted with buyers and market conditions. Prices during the year ranged from $5 to $9 per unit for the contained tungsten trioxide or, as it is often erroneously called, "tungstic acid." The market for tungsten ores is expanding and seems now to be almost as sure as the market for copper or other staple ores. Firms requiring large quantities of tungsten have had difficulty in obtaining sufficient supplies to guarantee future deliveries.

The greatest producing locality in 1906 was Boulder County, Col., but tungsten mining was carried on also in California, Arizona, Montana, New Mexico, and Washington. The Boulder County ore is wolframite, but the deposits in California are chiefly scheelite. No production of tungsten was reported from the deposits in Alaska, Connecticut, Oregon or Idaho, but considerable development work was done at Osceola, Nev. New deposits of scheelite have also been found at Murray, Idaho, where it is hoped that production will soon begin.

During the year, it is noted in the report, experiments that have been carried on for a long time produced incandescent lamps, the filament of which is made of metallic tungsten. Large quantities of sodium tungstate are manufactured, much of which is said to be used in fireproofing cloth for curtains, drapery, etc., and as a mordant in dyeing. Tungsten salts are also extensively used in silk manufacture, being added to the silk with the dye to give more apparent weight to the [illegible]

CURRENT NEWS AND NOTES.

THE TELEGRAPH STRIKE has been called off by President Small of the Commercial Telegraphers' Union, and in several places the operators are seeking their old jobs, but meantime in Chicago the National Executive Board has suspended President Small and declared the strike still a fact. A greater welter of confusion it would be hard to imagine. The friends of the strikers are exhausted, and but for the sufferings of many of those who went out, the whole affair would seem to have degenerated into a howling farce.

TELEPHONE CONVENTION.—The annual convention of the International Independent Telephone Association will be held at the Coliseum, Chicago, on Jan. 21, 22 and 23, 1908. This date falls during the period of the third annual Electrical Show and in connection with the exhibit of other electrical lines the independent telephone manufacturers have arranged to make a large combined exhibit of telephones and telephone apparatus and will occupy the entire Annex, containing over 100,000 sq. ft. of floor area. This will be the largest and most complete exhibit of telephone devices ever held at any one time under such circumstances.

AUSTIN POWER DAM.—A special dispatch from Austin, Tex., of Oct. 13, says: "The contract between this city and the New York Construction Company for the rebuilding of the great dam across the Colorado River at this place has been signed. The structure will cost about one and a half million dollars. The original structure was washed away by a flood in the river several years ago. The dam will form a lake 30 miles long and ½ mile wide, and will afford power for a large hydraulic electric plant." It will be remembered that the city has already incurred enormous indebtedness and loss over the previous plant and dam that were washed away.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its next regular monthly meeting on Tuesday evening, Nov. 12, at 8:15 o'clock, in the building of the Engineering Societies, 29 West Thirty-Ninth Street, New York. The principal address will be made by Mr. Charles R. Pratt and will treat of features of construction and operation of the gearless traction electric elevator, which is being installed in the Singer and Metropolitan Life, New York's two latest and highest buildings. The paper will be discussed by engineers and architects from New York, Philadelphia and Chicago. It is expected that the subject will be very exhaustively treated from the view of the architect and the engineer. The members of all professions are cordially invited to attend.

WORK IN MANCHURIA.—According to a long and interesting report by U. S. Consul-General W. D. Straight, the Imperial Chinese telegraph administration has established offices throughout Manchuria. New lines have been constructed since the war, and although some opposition was offered by the Japanese military authorities to their crossing the line of the South Manchurian Railway this difficulty has been overcome. Wires formerly controlled by the Russians have, moreover, been transferred to Chinese hands, and the service, therefore, is now operating in all centers of importance except Antung. All offices accept English messages. At Mukden there are two telephone services, the public exchange operated by Japanese and the Chinese official line connecting the various yamens, police offices and government bureaus. The two systems are connected. The Japanese have a long-distance service along the railway lines from Dalny to Mengchiatun, with a branch to Newchwang, and a second between Mukden and Antung. Instruments are also in use at Liaoyang, Tieling, Antung and Tatungkou, having in all of these places been originally installed by the Japanese military authorities. The Chinese, [illegible] of the method of communication and propose to control their own lines.

SUBMARINE LIGHTING.—A patent has been issued to Mr. Leon Dion, of Wilkesbarre, Pa., on a means for installing electric lamps at the bottom of the harbor or similar channels in order to allow vessels to make their course at night or during [illegible].

LECTURES ON PRACTICAL ELECTRICITY.—A series of free public lectures on electricity, its principles and application, were begun at the New York Electrical Trade School, Tuesday evening, Octt. 15, at 8 o'clock, in the lecture hall of the school at 39 West Seventeenth Street, New York.

BRITISH TELEGRAPHS.—The report of the British Postmaster General shows that the number of telegrams dispatched during the year was 89,493,000, against 89,478,000. The profit on the postal service was £5,071,255, or £143,756 less. The net deficit on working the telegraphs was £88,764 less at £652,055. The nominal profit on the telephone system was £451,787, most of which was absorbed by interest payments on a capital expenditure of £7,255,000 and by appropriations for depreciation.

TRANSATLANTIC WIRELESS.—According to a despatch from Sydney, N. S., Oct. 8, Mr. Marconi, in an interview, said: "I shall be ready on Oct. 15. I was speaking to Clifden yesterday, and to-day exchanged many private messages." The Marconi people at Clifden, says a London despatch, assert that recent highly successful daylight exchanges of messages with Cape Breton prove that they have succeeded at last in overcoming daylight transmission difficulties. They say that daylight work is now almost on a par with night transmissions.

CALIFORNIA ELECTRICAL DEVELOPMENT.—In 1902 a "California Promotion Committee" was organized to promote the interests of that state generally, and in particular to give encouragement to the establishment of new industries and to invite desirable immigration. Among the means to this end is the issue of a monthly bulletin, which is now in its fourth volume. The October number of this publication is devoted entirely to the electrical development in California, and includes descriptions of some of the more important plants, and a table giving a list of 106 California power stations generating electricity from water power, together with the horse-power capacity of each station.

A MODEST MILLIONAIRE.—It is stated from Hudson, Ohio, that because the town authorities permitted his name to be divulged to the public as the donor of $75,000 to $100,000 to be spent in constructing an electric light and water plant sewage system, James W. Ellsworth, millionaire coal operator, whose home now is in New York City, has withdrawn his offer. Mr. Ellsworth offered to pay for the improving of the village where he was reared, a poor boy, on condition that no one should know who furnished the money. He feared a deluge of begging letters. The name became noised about soon, and in a letter Mr. Ellsworth takes the town's officers to task and blames them for losing Hudson its chances to become a model village. Mr. Ellsworth is a director of the Postal Telegraph Company.

TELEPHONY IN CHINA.—Mr. I. Laing, superintendent of telegraphs in China, and Chow Tszchi, first secretary of the Chinese legation in Washington, visited Columbus, Ohio, recently to inspect the automatic telephone system of the Columbus Citizens' Telephone Company. They were the guests of G. R. Johnston, general manager of the company, and were entertained by him. They spent most of the day at the exchange. It is said that the Chinese government is considering the establishment of a telephone system, but the visitors would not admit that they were securing information for this purpose. They went on to Chicago to continue their investigations, however. Some years ago Burton Ferguson, a Columbus man, established an automatic system in Shanghai, and he is now traveling in China, Japan and portions of Siberia demonstrating the system.

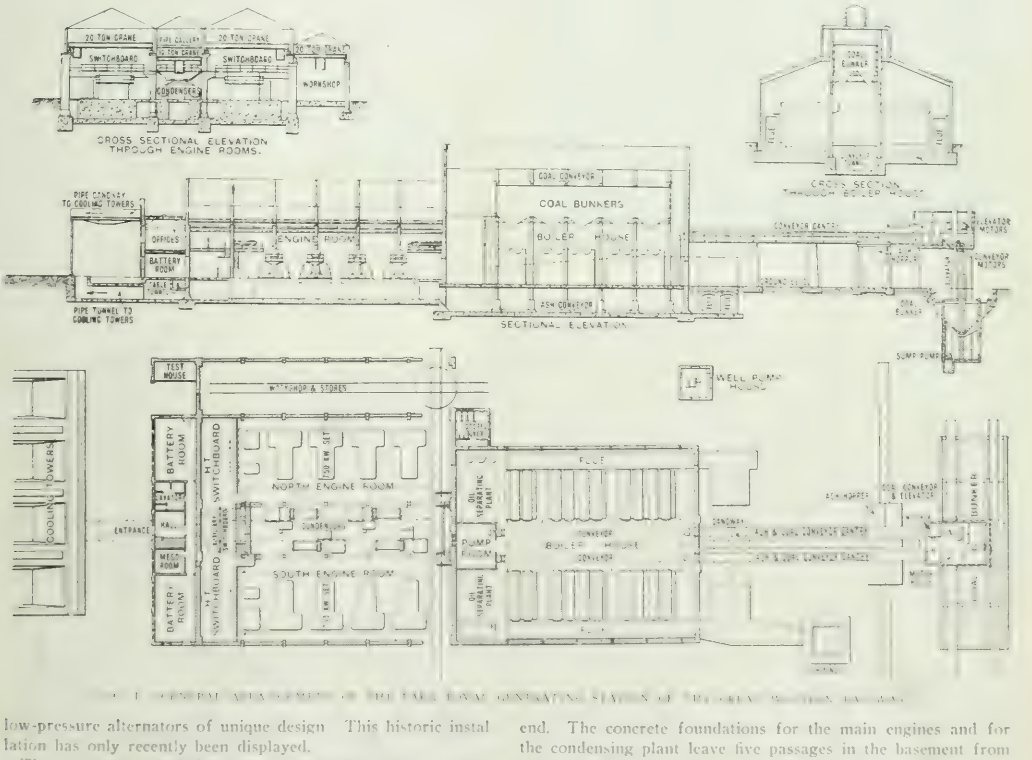
[illegible] convention of the Federation of Trade Press Associations was held at the Willard Hotel, Washington, last week, and was ably presided over by Mr. John A. Hill, whose strong and forceful address will be long remembered. His successor in the presidency is Mr. J. Newton Hind, of Chicago. At the banquet Postmaster-General Meyer made an important speech, promising that no change would be made in the rate of postage for publications—second-class matter—and outlining his whole plans as to postage, parcels delivery and postal savings banks. The third assistant postmaster-general, Hon. A. L. Lawshe, also made a most interesting speech as to postal ideals and policies. During the convention Mr. J. M. Wakeman served as chairman of the committee on nominations and Mr. T. C. Martin as chairman of the committee on resolutions.

THE LABOR UNIONS.—It is interesting to note that President James W. Van Cleave of the National Association of Manufacturers believes and freely confesses that the large majority of the members of labor unions are law-abiding, public-spirited men. It is also his belief that the incapable, unfaithful and corrupt leaders of unions are to blame for most of the labor troubles which have been and are being inflicted on the country. In an address recently delivered at Battle Creek, Mich., he said that all good citizens should unite in remedying the abuses which the labor unions have perpetrated. In order to supply the lack of apprentices which the labor unions have virtually abolished, influence should be brought to bear to have manual training departments attached to every public school of the primary grade in the United States, where boys from 10 to 14 years of age would learn to handle most of the tools used in the more important mechanical trades, and there should be established public industrial high schools open to boys who take the manual training course in the primary schools, and from these industrial high schools after a two or three years' course boys could graduate as first-class mechanics. This plan of making the education of the hand keep step with the education of the head, in President Van Cleave's opinion, would give the country more and better mechanics than the dead and gone apprenticeship system ever furnished.

TRUST CONFERENCE.—As already noted in these columns, the conference on Trusts and Combinations, which is to meet in Chicago from Oct. 22 to 25, will probably be the largest gathering of well-known people ever assembled in this country for the purpose of discussing trade combinations. The delegates are being appointed by the National Association of State Railway Commissioners, and by Atty.-Gen. Hadley of Missouri, the latter being chairman of the recently formed organization of attorneys-general. The first day of the conference will be devoted to the discussion of the regulation of trusts and combinations by the State and Federal Governments. In the remaining days of the conference corporations and their capitalization and control, the protection of investors and stockholders, the just and practicable limit of regulation by state and nation of combinations in transportation, production, distribution and labor, and the relation of labor organizations, employers' organizations, and the various farmers' organizations and societies to the trust question will be discussed. "Is the Tariff the Mother of Trusts?" is another subject that will receive much attention, and the discussion, it is expected, will be participated in by many of the best-known members of the American Protective Tariff Association and of the American Free Trade League. Another interesting topic on the programme will be presented for discussion by J. A. Everitt, the president of the American Society of Equity, a farmers' organization with a membership of more than 2,000,000. In his speech Mr. Everitt will discuss that organization's proposition to control prices of farm products. The White Paper Trust and the "Labor Trust" will also be subjects handled by Herman Ridder, of the New York *Staats Zeitung*. Other well-known persons who are interested in the paper question will also probably be heard.

The Park Royal Generating Station of the Great Western Railway, London.

THE new electric supply system of the Great Western Railway has been installed partly to meet the requirements of the Metropolitan Railway Act, providing that the Hammersmith & City line, owned jointly by the Metropolitan Company and the Great Western Company, and also the lines of the Great Western Company used in connection with the Hammersmith & City Railway, should be operated electrically, concurrent with the electric operation of part of the Metropolitan Company's Inner Circle Railway. The new electrical system also provides for a supply of electrical energy for arc and incandescent lamps and for small motor work throughout the Great Western Company's system in the London district. For the past 23 years, the lighting supply of the Great Western station at Paddington has been provided by a generating station at that place which was equipped with



[illegible]

low-pressure alternators of unique design This historic installation has only recently been displayed.

The new system includes a main generating station at Park Royal and three sub-stations at the following points: Old Oak Common, Royal Oak and Shepherd's Bush. The distributing centers are situated as follows: one at each of the Royal Oak and Shepherd's Bush sub-stations, two at Old Oak Common, one at Westbourne Park station, one at Hammer- [illegible]

The general arrangement of the generating station at Park Royal is shown in Fig. 1. The present station only occupies about one-sixth of the available ground, the idea being that when future needs warrant, another station can be designed to satisfy the then conditions, untrammeled by anything in the [illegible]

The main building is a steel structure, filled in with brick and [illegible] the latter being lined on the inside with fireproof plaster. The boiler house at the east end of the main building is arranged in three bays. Over the center bay is a set of steel coal bunkers having a total storage capacity of 600 tons. A main flue is built behind each row of boilers, and the two flues are joined outside the east end and are carried into the base of a chimney in such a way as to leave room for a connection to the same chimney of a similar main flue when the present station is enlarged to twice its size. A by-pass flue is also provided outside the east end of the boiler house. The flues are arranged so that connection can be made to a second chimney which will be built outside the northeast corner of the building when the station is extended.

To the west of the boiler house, and separated therefrom by a party wall, is the main engine room, which is likewise arranged in three bays, the two side bays taking the engine sets, and the center bay the condensing plant, which is also above floor level. The switchboards are arranged on galleries extending across the breadth of the engine room at the west end. The concrete foundations for the main engines and for the condensing plant leave five passages in the basement from end to end of the engine room. The three center passages and the space at the east end of the foundation blocks contain all the pipe lines. These passages and the space are separately drained and entirely shut off from the remaining two passages and the switchboard basement at the west end which accommodates the cables. Room is provided for a workshop and stores in an annex to the engine room. Coal is brought over a siding in 20-ton hopper cars, which empty into reinforced funnel-shaped concrete hoppers having a total capacity of about 400 tons of coal. Beneath these hoppers are two tray conveyors which carry the coal from any hopper to the bottom of two vertical bucket conveyors, which lift the coal about 50 ft. above the boiler-room floor-level and there deliver it to two horizontal bucket conveyors running into the boiler house and emptying into the main coal bunker. The same horizontal con- [illegible]

into an ash-hopper, standing over railroad tracks. These conveyors are all driven by three-phase motors.

Water is taken from the canal at Old Oak Common, an alternative supply being obtained from the Water Board, and is delivered to the water tank in a yard outside of the west end of the engine room. From this tank, the water passes to the pump-room basement in the boiler house and is taken thence through two cylindrical drain-water coolers into the overhead feed tank in the engine room. The make-up feed water is supplied from this overhead tank through a water-softening plant into the hot-well tanks. The feed-water pumps are connected to the hot-well tanks and also to the main water-supply pipe, and deliver the water through meters and feed-water heaters to the boiler. The engines exhaust normally passes through mechanical oil-separators and into surface condensers, from which the condensed water is drawn by means of air pumps and delivered by force pumps to the inlet of an oil-separating and filtering plant at the west end of the boiler house, and thence to the hot-well tanks. The circulating water for the condensers is drawn from lodges under the cooling towers by centrifugal pumps, and after passing through the condensers is forced to the top of the cooling towers; make-up water being supplied from the water-supply tank in the yard.

FIG. 2.—CONVEYOR GANTRY BETWEEN BOILER HOUSE AND DRIVING HOUSE.

The boiler-room equipment comprises 10 Babcock & Wilcox water-tube boilers arranged in rows along the walls. The coal bunker over the stoking floor does not obstruct light from the side roof glazing, so that the boiler room is light and airy. The boilers are fitted with chain-grate stokers, and the coal is delivered into the feeding hopper of each furnace through a chute from the coal bunker above. The boilers are fitted with superheaters and the tubes are divided up so that the circulation of the feed water is definite, passing first through a set of tubes intended to act as economizers. The feed-water pumps are installed at the engine-room end of the boiler house with the oil-separating and water-softening plant on either side. The main work of oil separation is done by mechanical oil separators placed between the engine exhausts and the condensers, and the last traces of oil are removed from the feed water by means of the "Davis-Perritt" electrical process.

The water, in being treated by this process, flows under and over a series of cast-iron plates fitted in a vat. Direct current passing through these alternate anodes and cathodes exercises a directive effect on the oil particles, the greater portion of which unite with the iron oxide formed on the anode plates and are precipitated. The remainder is buoyed up by the escaping hydrogen so that the oil is thus separated and the water is said to carry no trace of oil recognizable by analysis. The direction of the current is reversed from time to time when the instruments in the vat circuit show that the resistance has risen to a certain value.

In the pump room there are four vertical steam-driven feed-water pumps, each of which has a rated capacity of 6000 gals. per hour delivered against the working pressure of 200 lbs. per square inch. The make-up water can be supplied direct to the hot-well tanks from the supply main, but is normally pumped into the overhead tank in the boiler room. The inlet to the softening plant is controlled by a float in the hot-well tank below so that the quantity of make-up water is regulated automatically. The water-softening plant is arranged in duplicate, each part being capable of drawing 2500 gals. of water per hour. Lime and soda are used as the softening reagents. From the precipitating chamber the treated water passes upwards through a wood-fiber strainer and then through a filter bed of quartz sand.

The engine room contains eight main generating sets arranged in two rows, of four in each bay. In the central bay are four surface condensers with their air and circulating pumps. Each generating set consists of a Bellis engine, direct-connected to a three-phase, 50-cycle, 6300-6600-volt, alternator built by the Electric Construction Company. Each alternator has a rating of 750 kilowatts and an overload capacity of 25 per cent. The engines are of the three-crank, triple-expansion type. The governor is controlled by an electric motor from the main switchboard gallery, so that the speed of the engines may be easily controlled for synchronizing and also for adjusting the load between the sets running in parallel. An emergency valve, electrically controlled from the switchboard, is also fitted to each engine so that steam may be entirely cut off, if necessary. The generators are of the ordinary revolving-field type. The stationary armature is wound in open slots and is star connected, but the center point is not permanently earthed. Screws are provided for sliding the armature sidewise for inspection.

The main steam pipes are brought through from the boiler room in two lines and joined into a ring by cross piping at the end remote from the boilers. Each of the condensers is capable of handling 42,000 lbs. of steam per hour. The air pump of each is steam-driven and the centrifugal circulating pump is driven by a three-phase motor. The circulating pumps [illegible] 175 gals. of water per [illegible]. A general view of the condensing plant is given in Fig. 3.

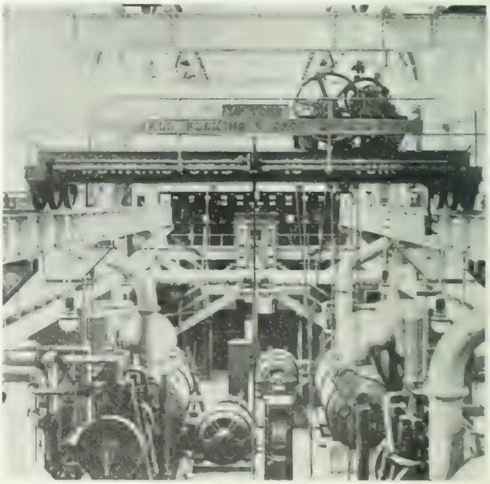


FIG. 3—GENERAL VIEW OF CONDENSING PLANT.

There are four cooling towers of the natural-draft, wood type. Each tower can be divided into two sections, and under ordinary [illegible] gals. of

water 35 degs. from 115 deg. F. The cooling towers are 104 ft. long and 21 ft. wide at the base; the height from the base to the water inlet being 24 ft., and to the top of the tower 74 ft.

The western end of the engine room, between the main generating units and the switchboard, is occupied by auxiliary machinery for supplying direct current and low-tension three-phase current. Two exciter units are provided, one being steam-driven, and the other being driven by an induction motor. There are also two storage batteries used as a standby for

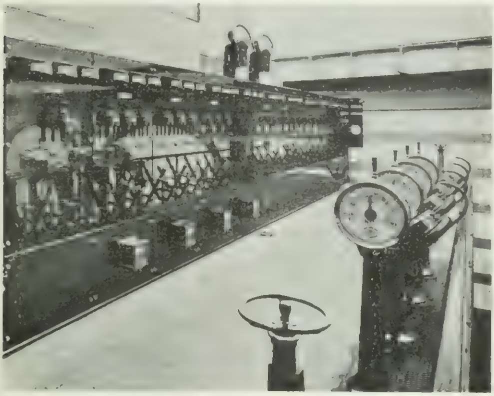


FIG. 4.—NORTH MAIN CONTROL BOARD

excitation purposes. One of the three-phase generating sets is steam-driven, and the other is driven by a direct-current motor fed from the exciter bus-bars. It will therefore be evident that only by an extraordinary coincidence of breakdowns in different places can the station be deprived of energy for excitation and auxiliary motors.

The three-phase motors used throughout the station are supplied with current at a potential of 630 volts either from the low-tension alternators or from two sets of step-down transformers supplied from the bus-bars. The motor-driven three-phase generator can be used for supplying energy through the transformers mentioned or the set may be reversed for supplying direct current. The safeguards are thus rather complete and are made so by the various combinations of steam and motor-driven direct-current and alternating-current machines, rather than by duplication of apparatus. Each main engine room bay and also the workshop is equipped with a 20-ton traveling crane. The condenser bay is provided with a 10-ton crane. All of the cranes are equipped with direct-current series motors.

From the main generators, the leads pass into tunnels under the engine-room floors and are brought into a cross-tunnel at the western end of the station under the switchboard galleries. The switch gear includes two high-tension switchboards for controlling the 6500-volt three-phase circuits, and auxiliary switchboard for controlling 650-volt, three-phase circuits, and two switchboards for controlling the 220-volt, direct-current circuits. The switchboards were supplied by the British Thomson-Houston Company. The high-tension part of each high-tension switchboard extends from the basement to a height of 33 ft., and consists of a steel framework filled in with stone slabs. Each circuit runs from the bottom to the top of the board and is separated from the rest by stone barriers. The switches, transformers, etc., on each circuit are further separated from each other by four horizontal partitions which divide the whole structure into a set of fireproof cells. Iron doors on each gallery give access to the individual cells so that each may be easily examined. The control board is placed on a gallery about 14 ft. above the engine-room floor and slightly in front of the high-tension portion of the switchboard. [illegible] Fig. 4.

Each main high-tension switchboard controls the four 750-kw main generators in the bay opposite which the switchboard is placed; three high-tension feeders; cables leading to an artificial load tank and some local branch circuits. The two main high-tension switchboards can be worked independently or can have their bus-bars connected for working in parallel. Each board has a duplicate set of main bus-bars and also a set of high-tension synchronizing bus-bars which are used in connection with the testing and charging of the feeders as well as for synchronizing the generators. Each set of main bus-bars is placed in a stone chamber with wire-woven glass sliding doors running the length of the switchboard structure in front of the switch cells. The main switches are mechanically operated from the control board. Advantage has been taken of the rodding system to interlock the switches by an adaptation of the railway signal frame lock so that a generator cannot be connected to one of the bus-bars unless the exciting and synchronizing switches of that generator have been previously turned to the proper positions. All of the instruments are placed on the control panels and are worked from transformers.

Immediately in front of the control panels are the main generator field regulating resistance columns, the engine governor and emergency valve switches; and also a set of signal columns and indicators by means of which the switchboard attendant can communicate with the engineers below. The circuit for each main generator or feeder starts in the basement in a cell containing a three-core cable sealing and dividing box to which it is connected by three-phase changing links. These links (Fig. 6) are arranged and shaped so as to enable any core of the cable to be connected to any one of the conductors of the switchboard circuit in order that the phases of a circuit may at any time be arranged correctly and symmetrically with reference to the phases of the other circuits, irrespective of the position of the cores of the cable in the box. Above the phase-

FIG. 5.—GENERAL VIEW OF SOUTH MAIN HIGH-TENSION SWITCH-BOARD AND [illegible]

changing links a set of disconnecting links is provided, which, when open, disconnects the cores of the cable from the switchboard circuit and connects them direct to earth. The links can be locked in the "open" or in the "earthed" position. On [illegible] a pair of glass tubes is connected to indicate when the cable is alive. The circuit is connected to three oil-break automatic switches, the lowest

or switch is directly connected to the synchronizing bus-bars, and the two top switches connect to one or the other of two sets of main bus-bars. The main bus-bar switches are used as selector switches, and also serve as a standby to each other.

The generators or feeders may be changed from one set of bus-bars to the others through the generators' own switches or through a separate bar coupling switch. The necessary transformers for the instruments are connected on the cable side of the main switches and are also used to energize the instantaneous reverse and time limit overload relays used in connection with the main switches. Time limit overload relays are also provided on the main feeder circuits, the cables cross-connecting the two main boards, the bus-bar coupling circuits, the branch circuits, and the high-tension synchronizing selector switch feeder. The tripping relays are mounted on the front of the control panel and release the main switches by knocking out a link or toggle joint in the switch movement. Pilot lamps are used to indicate whether the tripping supply circuit is in working order or not.

A charge and test panel is provided on each main high-tension switchboard for the purpose of testing and charging the main high-tension feeders, either through water rheostats containing three-phase variable resistances or through the step-up transformers from the auxiliary 650-volt switchboard. The feeder-charging gear was supplied by Messrs. Ferranti, Ltd. The auxiliary three-phase switchboard for controlling the 650-volt alternating-current circuits is placed in line with and between the contact panels for the two main high-tension switchboards. The auxiliary board is equipped with two sets of bus-bars which may be coupled together when required. Each of the three-phase, 650-volt generators and the low-tension side of each set of

FIG. 6.—CELL IN BASEMENT, SHOWING PHASE CHANGING LINKS.

step-up auxiliary transformers can be connected to either set of bus-bars through one or the other set of contacts of a special double switch, fitted with an overload release and an interlock between the two sets of contacts. The auxiliary feeder circuits supplying the various three-phase motors throughout the buildings are connected to the top set of bus-bars through switches and fuses where required.

The two direct-current exciter switchboards on the ground floor can be worked separately or in multiple, and each controls one of the auxiliary direct-current generators, one of the storage batteries, three feeders for supplying the direct-current crane motors, and the arc and incandescent lamps of the power house, together with an excitation circuit for the main and auxiliary three-phase generators. There is no automatic protection between the exciter board and the exciter bus-bars, but a switch is provided with a discharge resistance and contacts, so that, if necessary, the excitation of the fields of the alterna-

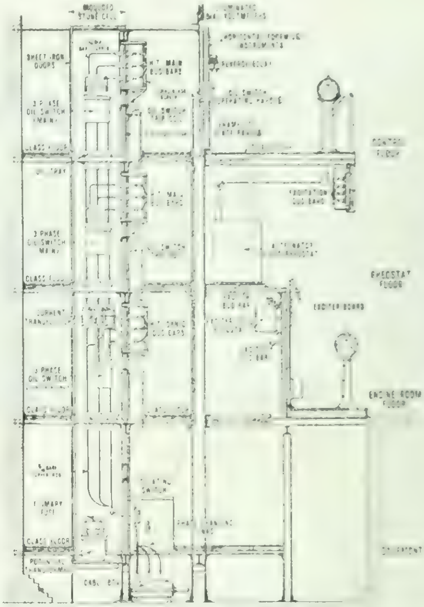


FIG. 7.—SECTION THROUGH CONTROL AND CELLS OF SWITCHBOARD.

tors may be switched off separately on the exciter board. In a shed outside the engine room are two tanks supplied with circulating water, each of which forms an artificial load corresponding to the output of one of the main generators.

Between the generating station, the sub-stations and the distributing centers are about 37 miles of high-tension, three-core cable, and about 14 miles of low-tension concentric cable, in addition to 4 miles of jumper cables. Each high-tension feeder between the generating station and sub-stations has three cores of .15 sq. in. sectional area, insulated with paper, lead sheathed and armored with galvanized iron wire. The high-tension distributor cables are similar in construction. The low-tension direct-current and alternating-current cables are concentric, paper insulated and lead-covered.

The high-tension supply mains are led from the station at Old Oak Common along the railway. Each cable is laid in a separate Howard asphalt trough filled in with bitumen, and covered with asphalt concrete. Where they cross railway lines a concrete and brick trench is built, with old rails or steel troughing above to form a floor for the sleepers and rails.

At points where the cables are laid across railway bridges, the cables have been laid on steel plates fixed to the bridge girders, the ends of the plate being built into the concrete bed of the cable trench at each end of the bridge, but left free for a few feet between the bridge structure and the anchoring points so as to minimize as far as possible the effect of vibration.

All the laying and joining had to be done without interfering with the traffic, and great care had to be taken to avoid accidents. The usual method of jointing the cables was departed from, the last 20 ft. or 30 ft. of each length of cable being left unlaid until the end had been jointed to the next length. The

ends to be jointed were laid on a temporary platform placed over the trench protected by a jointer's tent. The continuity of the armoring at the joints is maintained by copper strips, clipped to the armoring beyond the wiped plumber's joint.

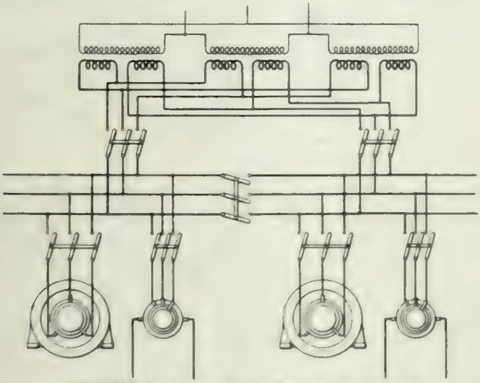
The three-phase current is transmitted from Park Royal by six high-tension feeder cables as far as an inspection chamber adjoining the sub-station at Old Oak Common. From this point five high-tension feeders are carried on to another inspection chamber at Westbourne Park. From Old Oak Common inspection chamber two high-tension feeders supply the Old Oak Common sub-station. From the Westbourne Park inspection chamber four high-tension feeders are carried to supply Royal Oak sub-station, and three to supply Shepherd's Bush sub-station.

The inspection chambers referred to are small brick buildings, into which the feeders are brought and terminated in trifurcating-boxes. The separate conductors are then led to sockets on vertical bars. The incoming and outgoing feeders are arranged along two walls of the chamber, and are normally connected by conductors taken up the walls and across the roof. But sets of horizontal bars crossing the feeder bars, and also socketed, permit of a certain amount of cross-connection by plugs between incoming and outgoing feeders, so that spare feeders on each side may be connected up as desired. The arrangements admit of the testing of every feeder or conductor.

The Royal Oak sub-station is equipped with four 400-kw motor-converter sets, worked in parallel with a battery having a one-hour discharge rate of 1680 amperes, in conjunction with reversible boosters. The sub-station also contains two 200-kw motor-converters for direct-current lighting circuits and for motor circuits. The Shepherd's Bush sub-station is equipped with seven 400-kw motor converters worked in parallel with a battery having a one-hour discharge rate of 840 amperes, in conjunction with reversible bootsters. The Old Oak Common sub-station is equipped with one 400-kw and two 200-kw motor-converter sets for direct-current lamp and motor circuits. All three sub-stations are designed on the same lines.

Inductive Paralleling of Rotary Converters.

The accompanying illustration shows a means for operating two or more rotary converters in a generating station without conductively connecting the converters on the alternating-current side, for which a patent was issued to Mr. L. C. Marburg on Sept. 24. The step-up transformers are provided with a plurality of independent low-tension windings adapted to be connected to bus bars or to the converters. It will be noted that when the bus-bar sectionalizing switch is open each generator supplies energy to the step-up transformers and to a rotary converter, and yet the converters are not conductively interconnected on the alternating-current side and there can be no objectionable cross-currents between the converters.



Inductive Paralleling of Rotary Converters.

Excitation Characteristics of the Synchronous Motor.

By A. S. Langsdorf.

Numerous contributions to the theory of alternator regulation have made it clear that a complete treatment of the subject must take account of a large number of more or less interdependent actions and reactions, such as armature reaction and reactance, variations of magnetic leakage with load, cyclic change of magnetic reluctance, etc. It follows that a like analysis of the synchronous motor must also take account of these disturbing factors, but the difficulties in the way of such an analysis are so considerable that it appears necessary to assume certain ideal conditions in order to arrive at reasonably simple results. In the following discussion of the synchronous motor it has, therefore, been assumed that the magnetic circuit of the machine is unsaturated, that the reluctance of the magnetic circuit and the armature reactance are constant (or that their variable values may be replaced by their averages) and that the m. m. f. of armature and field circuit currents may be combined vectorially. The extent to which these assumptions are approximate will affect the results given below in like measure.

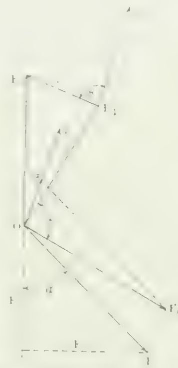


Fig. 1.—Vector Diagram of Currents, E. M. F.'s and Fluxes of Synchronous Motors.

Fig. 1 represents diagrammatically the relations between the various quantities involved. It is drawn in such a way that counter-clockwise rotation is to be considered positive, and in consequence the complex expression for impedance is $r + jx$, instead of $r - jx$, as used by Steinmetz. The figure is similar to the one given in a recent paper* by Mr. B. T. McCormick.

Let E_0 = impressed e. m. f. at motor terminals
E_1 = counter-generated e. m. f. of motor
e = resultant e. m. f.
i = armature current
F_a = armature m. m. f.
F = field m. m. f.
F_r = resultant m. m. f.

Moreover, let r and x represent the effective resistance and reactance of the armature, respectively.

The essential condition of Fig. 1 is that E_1 shall be in time quadrature with F_r.

Expressed in complex quantities,

$$i = \frac{e}{r + jx} = \frac{E_0 - E_1}{r + jx} \qquad (1)$$

$$F_r = F + F_a \qquad (2)$$

$$F_a = ki \qquad (3)$$

$$F_r = -jmE_1 \qquad (4)$$

where k and m are constants whose values are obvious.

*Effect of Armature Reaction on Synchronous Motors and Rotary Converters. Canadian Society of Civil Engineers, March 14, 1907.

Algebraic transformation and combinations of these four equations result in the following equations for E_1 and i:

$$\dot{E}_1 = \frac{k\dot{E}_0 + F\,(r + jx)}{[illegible]} \qquad (5)$$

$$i = \frac{jm\dot{E}_0 + \dot{F}}{[illegible]} \qquad (6)$$

where

[illegible]

The power developed by the motor is obtained by multiplying E_1 by that component of i which is in time phase with it (or in time phase opposition); or in complex quantities, by taking the real part of the product of $\dot{E}_1$ and the conjugate of i; that is, the power is

$$P = [\dot{E}_1 i']^1 \qquad (7)$$

where i' is the conjugate of i.

Counting time from the instant when E_0 is at its maximum,

$$\dot{E}_0 = E_0,$$

and noting from Fig. 1 that F is itself of the form

$$\dot{F} = F' - jF'',$$

there results the following expression for P on substituting values in (7):

$$P = \frac{aE_0F'' + bE_0F' - F^2r}{a^2 + b^2} \qquad (8)$$

Treating the equation (6) in a similar manner, and rationalizing, the current is given by

$$i^2 = \frac{m^2E_0^2 - 2mE_0F' + F^2}{a^2 + b^2} \qquad (9)$$

Referring to Fig. 1, it will be seen that

$$F' = F\,sin\,\alpha$$
$$F'' = F\,cos\,\alpha$$

hence, substituting these values in (8)

$$F = \frac{Q}{2} \pm \sqrt{\frac{Q^2}{4} - \frac{P\,(a^2 + b^2)}{r}} \qquad (10)$$

where

$$Q = \frac{E_0}{R}\,[a\,cos\,\alpha + b\,sin\,\alpha] = \frac{E_0}{R}\sqrt{a^2 + b^2}\,sin\,(\alpha + \Phi)$$

The value of Φ in the last equation is determined by the condition $\tan \Phi = \frac{a}{b}$.

Equation (9) becomes, after similar substitutions,

[illegible] $\qquad (11)$

Equations (10) and (11) give the general values of armature current and field excitation in terms of a variable parameter, α, and the power developed; and from them may be drawn the usual "V-curves" by giving definite values to P, and for each value allowing α to take all possible values. Certain special cases, however, present features of general interest, and will be discussed in what follows.

Imposing the condition $P = 0$, representing the limiting condition of running light, (10) and (11) become

$$F = \frac{E_0}{r}\sqrt{a^2 + b^2}\,sin\,(\alpha + \phi) \qquad (12)$$

$$i = \frac{E_0}{r}\,cos\,\alpha \qquad (13)$$

The geometrical meaning of (12) and (13) is clearly seen

FIG. 2.—[illegible] OF EXCITATION AND ARMATURE CURRENT.

from Fig. 2, the significance of the parameter α being especially prominent. Evidently, the relation between F and i is repre-

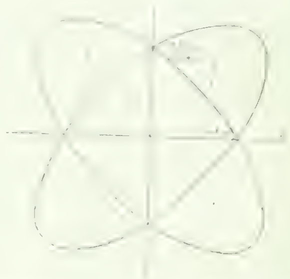


FIG. 3.—PHASE CHARACTERISTIC OF SYNCHRONOUS MOTOR.

sented by two ellipses, as seen in Fig. 3. The ellipses cut the axis of i where

$$i = \pm \frac{mE_0}{\sqrt{a^2 + b^2}} \qquad (14)$$

and the axis of F where

$$F = \pm mE_0 \qquad (15)$$

The maximum value of i (from (13)) is

$$i_{max} = \frac{E_0}{r} \qquad (16)$$

and that of F is

$$F_{max} = \frac{E_0}{r}\sqrt{a^2 + b^2} \qquad (17)$$

[illegible] (representing no armature reaction), these equations become identical with those derived by Steinmetz.

[illegible] when

$$P\frac{a^2 + b^2}{r} = \frac{Q^2}{4};$$

substituting the value of Q, there is obtained for this value of maximum power

$$P_{max} = \frac{E_0^2}{4r}\,sin^2\,(\alpha + \Phi) \qquad (18)$$

but for any given value of F, P becomes a maximum when

$\frac{dP}{da} = 0$: from (8)

$$\frac{dP}{da} = \frac{-aE_0F\sin\alpha + bE_0F\cos\alpha}{a^2+b^2} = 0$$

hence $\tan\alpha = \frac{b}{a} = \cot an\,\phi$, or $\alpha = \frac{\pi}{2} - \phi$; hence (18) becomes

$$P_{max} = \frac{E_0^2}{4r} \qquad (19)$$

or independent of the value of k.

Minimum current at any given power is determined by the condition that the armature current must be in phase with the impressed electromotive force. Since the expression for the latter is $\dot{E}_0 = jE_0$, it follows that the complex expression for i must also be of the form $i = ji$; if now in equation (8) there is substituted for $\dot{F}$ its value $(F' - jF'')$, and the resulting expression is rationalized, there results

$$i = \frac{[a\,(mE_0 - F') - bF''] - j\,[aF'' + b\,(mE_0 - F')]}{a^2+b^2}$$

Hence, for in-phase current, it must follow that

$$a\,(mE_0 - F') - bF'' = 0$$

Substituting for F' and F'' their values in terms of α, and reducing,

$$F\sqrt{a^2+b^2}\cos(\alpha - \phi) = amE_0 \qquad (19)$$

The real value of the armature current under these conditions is, therefore,

$$i = \frac{aF'' + b\,(mE_0 - F')}{a^2+b^2}$$

and on substituting for F' and F'' as before, this becomes

$$F\sqrt{a^2+b^2}\sin(\alpha - \phi) = bmE_0 - i\,(a^2+b^2) \qquad (20)$$

Squaring (19) and (20) and adding,

$$F^2 = m^2E_0^2 + i^2\,(a^2+b^2) - 2bmE_0i \qquad (21)$$

Equation (21) represents analytically the curve drawn in dashed lines in Fig. 3. It is obviously a hyperbola. The coordinates of its vertex are $F = \frac{mE_0a}{\sqrt{a^2+b^2}}$ and $i = \frac{bmE_0}{a^2+b^2}$.

The power corresponding to this point may easily be found by substituting these values in (10) and (11), and eliminating α; the actual value* of this particular power is thus shown to be

$$P' = \frac{m^2E_0^2a^2r}{(a^2+b^2)^2} \qquad (22)$$

Equation (22) gives that value of the power which corresponds to the minimum excitation consistent with unity power-factor. It is interesting to compare this value with the maximum power that the machine is capable of yielding (see equation 19). As an approximation, made for the sake of simplicity, assume that k is negligibly small, or in other words, that the armature magnetomotive force is small compared with that of the field winding; the value of a then becomes equal to mx, and on substituting this value in (22) there results

$$\frac{P'}{P_{max}} = \frac{4r^2x^2}{(r^2+x^2)^2} = 4\sin^2\theta\cos^2\theta = \sin^2 2\theta \qquad (23)$$

where θ is defined by $\tan\theta = \frac{x}{r}$. Equation (23) shows very clearly that r must be small compared with x if the motor is to have large overload capacity under normal operating conditions (unity power-factor and moderate excitation).

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*[illegible]

Contact Method of Gas Engine Ignition.

By E. J. EDWARDS.

In the design of a "contact" or "make-and-break" sparking equipment for a gas engine there are, from an electrical standpoint, four factors to be considered; electro-motive-force, inductance, resistance and time of contact; all of which are constant or nearly so for any given arrangement for igniting at constant engine speed. If these constants of the circuit are known the current, the energy stored in the magnetic field of the coil at the time of break and the efficiency with which this energy is stored can be calculated.

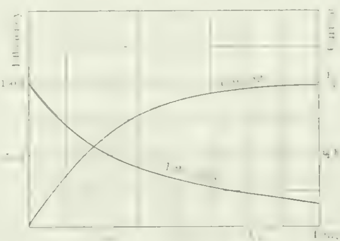
Let E = electromotive force, in volts.
L = coefficient of self inductance, in henrys.
R = resistance of the circuit, in ohms.
t = duration of contact, in seconds.
ϵ = base of the naperian system of logarithms = 2.718.

The current at any time, t, after closing the circuit is

$$I = \frac{E}{R}\left(1 - \epsilon^{-\frac{Rt}{L}}\right) \qquad (1)$$

This equation shows that for a duration of contact of $L \div R$ seconds, the current at the time of break will be $.632\,\frac{E}{R}$; which is true for all circuits. If time be measured in terms of the time constant $L \div R$ the rate of increase of current will be the same for all circuits, as shown below, plotted from equation (1).

Letting W = the energy stored magnetically at the end of t



RELATION BETWEEN THE CURRENT AND EFFICIENCY AND THE TIME CONSTANT.

seconds after closing the circuit of the coil and denoting instantaneous values by small letters, $dw = e\,i\,dt$ (2) where e is the e. m. f. of self induction;

$$e = -L\frac{di}{dt} \qquad (3.)$$

From (2) and (3)

$$dw = -L\frac{di}{dt}\,i\,dt = -L\,i\,di \qquad (4)$$

$$w = -\int_0^I L\,i\,di = -\tfrac{1}{2}LI^2 \qquad (5.)$$

The negative sign indicates that work has been done in storing the energy in the magnetic field during the time t, throughout which the current was increasing to the value I.

The efficiency of this process is the ratio of the stored energy to the energy given to the circuit in a given time. The latter can be determined as follows: The quantity of electricity in ampere-seconds Q passed through the circuit during the time t is proportional to the area between the current curve, above, the [illegible] axis and the vertical line through the time t. This

multiplied by the e. m. f. acting in the circuit gives the energy supplied W'.

$$\text{Efficiency} = \frac{W}{W'} \qquad (6.)$$

$$W' = \int_0^T E\,\frac{E}{R}\left(1-\epsilon^{-\frac{Rt}{L}}\right)dt \qquad (7.)$$

$$= \frac{E^2}{R}\left(T - \frac{L}{R} + \frac{L}{R}\,\epsilon^{-\frac{RT}{L}}\right) \qquad (8.)$$

and the energy supplied is

$$W' = \frac{E^2}{R}\left(T - \frac{L}{R}\,\epsilon^{-\frac{Rt}{L}} - \frac{L}{R}\right) \qquad (9.)$$

From (1) and (5) the energy stored is

$$W = \frac{E^2 L}{2R^2}\left(1-\epsilon^{-\frac{RT}{L}}\right)^2 \qquad (10.)$$

The efficiency is therefore

$$\frac{W}{W'} = \frac{\dfrac{L}{2R}\left(1-\epsilon^{-\frac{RT}{L}}\right)^2}{T + \dfrac{L}{R}\,\epsilon^{-\frac{RT}{L}} - \dfrac{L}{R}} \qquad (11.)$$

Letting $T = K\left(\frac{L}{R}\right)$, that is, expressing T in terms of the time constant, and substituting in (11) gives:

$$\text{Efficiency} = \frac{\left(1-\epsilon^{-K}\right)^2}{2\left(K+\epsilon^{-K}-1\right)} \qquad (12.)$$

This expression shows that the efficiency with which energy is stored in any magnetic field is independent of the constants of the circuit if the time during which the energy is stored is expressed in terms of the time constant. The efficiency when $K = 1$ is 54.3 per cent, and it falls to 22.1 per cent when $K = 3$; the complete curve, plotted from (12) being shown above. The efficiency of storing energy in the magnetic field of the induction coil will therefore be better the shorter the time of contact. The energy delivered to the spark will in general be different from that stored in the coil at the time of break. The energy of the magnetic field of the coil could be greater because some of the energy is lost in the iron and copper of the coil as the energy is given up to the spark. Again it could be less, due to the fact that the battery potential acts in the same direction as the e. m. f. of self induction and therefore aids in making the spark.

Little can be gained from a mathematical discussion of the spark energy because it would involve a knowledge of the resistance inserted in the gap during the time of break, which would vary, by some unknown law, from zero at the instant of release to nearly infinity at the time when the arc is broken. There is good reason to believe that, within working limits and for coils with properly built cores, the energy delivered to the spark does not differ greatly from that stored in the magnetic field of the coil, since the two unknown factors are of necessity comparatively small and have opposite effects.

In order to obtain experimental data with which to check the above deductions, a running test was made on a fully loaded engine. The coil used was wound with No. 12 B & S copper wire, and had about a thousand turns with seven taps arranged so that various inductances could be obtained up to .27 henry; which range is greater than is used in practice. A battery of seven 2½ in. x 6 in. dry cells was used as a source of energy. The sparking mechanism of the engine was remodeled so that the time of contact could be varied without changing the time in the engine cycle at which release would take place. This gave a test with three variables; inductance, e. m. f. and the duration of contact. The object of the test was to ascertain how nearly the results would conform to the above-discussed relations, and to determine the quantity of stored energy required to give perfect ignition.

The coefficient of self induction had seven values (.002 to .27 henry), the time four (.006 to .066 second) and the e. m. f. seven (1.5 to 10.5 volts). The engine was run under the several possible conditions, and the percentage of failure of ignition was noted.

The results show that the engine operated in general as would be expected from the theory. For each period of contact used the engine gave perfect ignition at a certain induction with a minimum number of cells. For a time of contact of .006 sec. perfect ignition could not be had with less than four cells while for a time of .066 sec. the engine ran perfectly with two cells with a range of inductance from .04 to .27 henry.

Table 1 shows the calculated stored energy for each value of the inductance, and the time, with the least number of cells which would give perfect ignition.

[illegible]

Time Sec.	Inductance in Henry [illegible]					
.0062.......	.0064	.0060	.0060	.0100	.0120	.0280
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

One is forced to the conclusion that the efficiency of "unbuilding" is not constant, but varies in the same way as the efficiency of "building." The shorter the time and the higher the inductance the less the stored energy required. That the efficiency of "unbuilding" should become less as the inductance decreases is to be expected, because the resistance becomes large in comparison to the inductance and thereby causes a large resistance loss. The fact that the efficiency of "unbuilding" should decrease with increased time used is not so easily accounted for. This result is due partly to the fact that for the longer times polarization of the battery took place, with the result that the calculated value of the stored energy is somewhat too large; but this does not fully account for the difference. It must then be accounted for by the only other variable, which is the condition under which the break is made. With the sparking mechanism used, the circuit was opened by a hammer blow, which was hardest for that adjustment which gave the longest time of contact. Therefore the conclusion that, within the range afforded by this experiment, the slower the separation of the contacts the more efficient the spark.

The following facts must therefore be considered in the design of a sparking equipment. The shorter the time of contact the higher the inductance and the smaller the resistance, the more efficient is the operation of the system. Also, the shorter the time in terms of $\frac{L}{R}$ the higher the factor of safety [illegible] when T is less than $\frac{L}{R}$, if the engine speed should decrease the spark energy would be much increased, due to the increased period of contact. If T is much greater than $\frac{L}{R}$ the spark energy would in no case be much increased by a reduction of the engine speed and would probably be decreased in most cases due to increased polarization of the battery.

The decrease of the resistance of the system is limited by the cost of construction or by the size of the coil. The inductance is limited by the same considerations and also by the fact that a high inductance requires a high e. m. f. A high [illegible]

ductance, therefore, involves a high battery investment so that the gain in efficiency is offset by the fact that the battery will deteriorate more from age than from use. If perfect ignition is to be obtained at the least cost per year, the number of hours per day that the engine is to run must be taken into consideration. When an engine runs only a few hours per day the electrical efficiency can be sacrificed in order to keep down the battery investment.

On the basis of battery tests and prices, in connection with the above conclusions, the following empirical formula for determining the most advantageous number of 2½ in. x 6 in. dry cells is offered.

$$n = .4 \times \text{hours per day} + 3 \qquad (13)$$

This gives 3 cells as the minimum, and 8 cells for an engine running for 12 hours per day. If the engine is to be run for more than 12 hours it is advisable to employ two batteries; each being in use half the time.

The inductance should be rather high in all cases; that is, higher than present practice, and never less than .05 henry. When a battery of few cells is used the time of contact must be made long, in order to have sufficient spark energy. When a battery with a large number of cells is used the period of contact can be made short, thereby maintaining the same factor of safety, but increasing the electrical efficiency.

The relation of the inductance to the time of contact can be obtained from equations (1) and (5).

$$W = \frac{L E^2}{2 R^2}\left(1 - \epsilon^{-\frac{Rt}{L}}\right)^2 \qquad (14)$$

where W is the value of the spark energy, taken from the above table, and multiplied by a factor of safety. The e. m. f. E for a dry battery is approximately 1.5 per cell.

$$R = r'n + r'' + \sqrt{LC} \qquad (15)$$

where r' is the resistance per cell (about .16 ohm), r'' the resistance of the connections (about .2 ohm) and C is a constant depending on the size of wire used for the coil and the relative dimensions of the coil (1.85 for the coil tested). From this equation it is seen that for any assumed values of W and E, L bears a certain relation to t, but it cannot fall below a certain value. If the value of t is required to bear a certain relation to $\frac{L}{R}$ the possible minimum value of L is still further limited.

The above relations can be approximately maintained by expressing L and t as straight line functions of n, where n has previously been obtained from (13). Assuming a factor of safety of 3, the following empirical expressions are obtained.

$$L = (.04\,n - .06), \text{ in henrys.} \qquad (16)$$

$$K = (1.45 - .15\,n) \qquad (17)$$

$$t = K\frac{L}{R} \qquad (18)$$

For an engine running for 12 hours per day using a coil with $C = 1.85$ the following constants are obtained:

$n = 8$,

$L = .26$, in henrys.

$R = 2.65$ in ohms

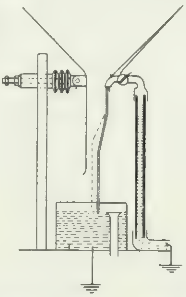
$\frac{L}{R} = .098$, in seconds

$K = .25$

$t = .024$, in seconds

Water-Jet Lightning Arrester.

In the water-jet lightning arrester shown herewith, for which a United States patent was granted to Mr. S. Schneider, of Berlin, Germany, on September 17, the connection to ground through the water path is incomplete except when extra high potential exists on the transmission line. Thus there is no constant consumption of energy. The arrester is of the horn type the horn which is connected to the ground being formed in part by a jet of water supplied through an insulating tube. Statically charged water drops in the jet are attracted by means of the opposite charge on the high potential conductor, and



SCHNEIDER WATER JET GROUNDER

hence when the charges are excessive the jet is deflected over against the conductor and a high resistance path is formed from the conductor to the ground.

The Grounded Neutral in High-Tension Systems.

At the meeting of the American Institute of Electrical Engineers, held Oct. 11, the subject of the grounded neutral with and without series resistance in high-tension systems was treated at length in a paper by Mr. Paul M. Lincoln. Papers relating experiences with the grounded neutral were presented by Mr. George I. Rhodes and Mr. F. G. Clark. Abstracts of these three papers are given below.

Mr. Lincoln showed that the following advantageous results accompany the use of the grounded neutral: The electromotive force between a conductor and the ground remains fixed and constant. Abnormal static induction on neighboring circuits is eliminated. Opportunity for using the ground as a working conductor is provided. It is possible to detect (and remove immediately if desired) a "ground" on any portion of the system. The condenser currents drawn from the several phases are rendered equal. Among the disadvantages were noted the following: One "ground" disables a part or the whole of the system. A proper "ground connection" is difficult to obtain.

Even where good engineering practice dictates a resistance in the neutral, the unavoidable resistance in the ground connection is not so valuable as it might be, because of its extreme variability. The difference of the seasons, as well as the drying-out action of any ground current that may flow, will cause large variations in ground-resistance. However, on high-potential systems the presence of even the maximum amount of resistance that is contingent upon good construction is rarely sufficent to cause trouble.

The object sought in "grounding" the neutral is to take care, not of normal conditions, but abnormal ones. It is the first thought of the operating engineer to maintain the service, and he therefore installs automatic circuit-breakers and other devices to protect the system in case an abnormal condition arises. The abnormal conditions that may arise are: 1, short circuits; 2, open circuits, and 3, "grounds."

With the neutral connected direct to earth, a "ground" on any conductor means a short circuit, the action of automatic circuit-breakers will then take place. The amount of current that will flow through such a short-circuit can be limited by inserting resistance, and practically the only object of resistance is to cause such a limitation of current.

The flow of excessive currents, such as would take place were there no resistance, is detrimental for several reasons. It throws an unnecessarily great strain upon the circuit-breakers

which are called upon to interrupt the current. The large current-flow which takes place may cause a phase distortion and a drop in voltage which may, in turn, be sufficient to cause synchronous apparatus on the line to drop out of step. Almost invariably an arc takes place at the point of "grounding" of conductors, and an excessive current will cause excessive destruction at this point. A dead short circuit on any system causes a heavy shock due to the tremendous currents, and a consequent tendency to distort the windings of any synchronous apparatus connected to the system.

All of these objections can be overcome to a greater or less degree by inserting resistance in the neutral. Increased neutral resistance, however, while it limits the current flow through a grounded conductor, and overcomes the above objections, can do so only by allowing an increase in the potential of the two good conductors "above ground" while the current exists. If the object in "grounding" is to prevent such an abnormal rise, the insertion tends to defeat that purpose. The choice of the proper resistance becomes a question of compromise between the disadvantages of going to either extreme. There seem to be good reasons for adopting a "grounding" resistance which will lie between the following limits—that large enough to prevent a severe shock to the system, or the voltage on the affected phase dropping to a point where the synchronous apparatus will drop out of step and that small enough to permit sufficient current to flow to trip the circuit breaker.

In relating the experience of the Interboro Rapid Transit Company with the grounded neutral, Mr. Rhodes stated that the chief circumstance which led to the grounding of the neutral of the high-tension system was the serious nature of cable burnouts. The system was operated for about three and one-half years without a grounded neutral, in which time about 160 miles of cable was operated for three years and 340 miles for one-half year. Since grounding the neutral, the system has been in operation for two years with about 340 miles of cable.

Previously to grounding the neutral, there were twelve distinct operating burn-outs, and since then there have been sixteen. It appears from this fact that grounding the neutral has had no material effect on the number of burn-outs. This is as was expected.

Of the twelve burn-outs occurring previously to the grounding of the system, four shut down the power station; one other shut down two sub-stations, and four more shut down one substation. Of the other three which did not shut down the substation, two were isolated in time to prevent a short circuit.

Of the sixteen burn-outs that have occurred since grounding the neutral, not one has caused a shutdown of the power station; eight have shut down the sub-station fed by the cable, two have caused one other feeder to open, and six have caused no disturbance other than the opening of the switches of the feeder in trouble.

Previously to the grounding of the neutral, the switches operated with explosive violence on the short circuiting of a cable, at times throwing oil and burning the contacts. Under present operating conditions, however, the switches always open very quietly, so quietly in most cases that it was necessary to install a telltale to indicate when there had been abnormal current through the neutral rheostats.

Before grounding the neutral, in all burn-outs the cable was so badly injured that it was impossible to make any bridge test, and it was necessary to open a great many manholes before locating the trouble. Of the sixteen burn-outs that have occurred since the grounding of the neutral, fourteen of them were in such condition that the fault could be easily located by the Murray loop method.

In the above system the neutral point of only one of the generators is connected to earth, experience having shown that when the neutral points of several generators are simultaneously grounded very serious trouble is encountered from triple-frequency cross currents in the neutral connections. Mr. Rhodes stated that probably something would be gained by increasing the resistance between the neutral and the earth connections. When the scheme was first contemplated it was planned to ground the neutral through six ohms, there being at that time only one power station. Now with two stations in parallel the effective grounding is through only three ohms, making the possible ground current twice that originally planned for. The use of the former resistance would have decreased the number of shutdowns of the sub-stations.

Mr. Clark stated that in a certain 11,000-volt system, a part of the circuits of which are aerial and a part underground, the neutral point of each generator is connected to a bus-bar through a fourth pole of the generator circuit breaker. The neutral bus-bar is connected to one end of a cast grid resistor suitably insulated. The other end of the resistor is connected to a ground plate located in earth kept moist with salt water. There is 6.7 ohms of resistance, or sufficient to allow 1000 amperes in the neutral circuit in the event of a "ground." A current of 1000 amperes will raise the temperature of the resistor by approximately 1000 degs. Fahr. in one minute. An ammeter on the switchboard indicates the amount of current in the neutral connection. A pilot lamp lights whenever 50 amperes or more flows through the resistor. This lamp remains lighted until an auxiliary circuit is opened, and has been instrumental in determining the number of short circuits that were also grounds.

During two years' operation there have been more than 70 short circuits. About 25 of these have caused sub-station interruptions, and six have been at locations near enough to the power station to cause power-station interruptions. About one-half of these short circuits showed a ground connection. There have been 10 "grounds," of which the neutral ground connection assisted in "clearing" eight. One held for four minutes and one for three minutes, both developing into two-wire short circuits. Although in case of a short circuit to earth the resistance of the ground path is sufficient to divert some current to neighboring telephone lines, no serious telephone troubles have been encountered, and there have been no indications of trouble in telephone or telegraph lines caused by induced potential.

A communication from Mr. F. G. Baum was read by Mr. Percy H. Thomas. Mr. Baum stated that experience has demonstrated that when the equipment has been properly designed and the insulation is ample, the system operates equally as well when delta-connected as when star-connected. For very high voltage work it is preferable, however, to use the star-connection, in which event the neutral can be reached without trouble.

A communication from Mr. O. S. Lyford, Jr., called attention to the great advantage of the Δ-connection, on account of the fact that the system can continue in operation with the transformers V-connected, when one of the transformers has been damaged. Moreover, when the Δ-connection is used without a grounded neutral, the system can be continued in operation when a single ground occurs on one circuit.

Mr. P. Junkersfeld related the experience of the Chicago Edison Company, which has in use about 270 miles of cable work. The neutral point of the system, in almost all cases, is connected solidly to ground. In a few cases, a certain amount of resistance is used. He expressed the opinion that it is advantageous to ground the neutral point.

Mr. Philip Torchio stated that the New York Edison Company has in use about 200 miles of cables, operated at 66,000 volts and at 11,000 volts. The neutral point is not grounded, yet very few troubles have been encountered. He stated that the only real advantage in using a grounded neutral is the assistance received in disconnecting the damaged circuit. That is to say, the safety devices may be made to operate more positively when a grounded neutral is used than when such neutral is omitted. The New York Edison Company has employed in connection with its ungrounded system a relay device for disconnecting defective circuits, which is believed to be equally as reliable as any device employed with grounded systems. The device consists of a circular transformer core, which is placed over the cable. When the condenser currents in the three-conductor cables are in the normal three-phase relation, there is no resultant m. m. f. in the surrounding iron ring. When, however,

there is a ground on the system, a certain amount of current which passes outward through one conductor of the cable does not return through the other conductors, but reaches the power house by some other route. Thus magnetism is produced in the surrounding iron ring. A coil wound on this ring is connected to a relay device which serves to open the circuit when the leakage current reaches a certain permissible maximum.

Mr. N. J. Neall discussed the bearing of the grounded neutral upon the lightning arrester equipment, and expressed the opinion that so far as the lightning arresters are concerned, a grounded neutral is of no real assistance. It is probably better to use a well-insulated, delta-connected system without a grounded neutral.

Mr. C. W. Stone called attention to the fact that the difficulty in selecting a proper value for the resistance in the ground circuit, when several generators are connected in parallel, can be eliminated in part by using a separate resistance for the circuits of each generator.

The discussion of the papers was closed by Dr. C. P. Steinmetz, who remarked that practically every opinion that had been stated by one speaker had been contradicted in equally as strong terms by another speaker. This condition is attributable to the fact that each speaker discussed the problem from the viewpoint of his own system. What might be proper for one system operating under certain conditions would be improper for another system in which the conditions were different. Thus the solution of the problem would be entirely different for a system in which only cable work was used and a system in which only overhead transmission lines were used. He stated that in general it is preferable not to ground the neutral of a system unless the conditions are such as to necessitate such grounding. In former years, the general plan was to keep all parts of the system thoroughly insulated from ground. At the present time, the general tendency is to connect everything to ground that can be so connected. Dr. Steinmetz stated that it is usually good practice for the engineer when in doubt as to whether to use a certain scheme not to employ it if such scheme is in common use, because he unintentionally in most cases favors that side which is the fad of the time.

A New Mercury-Vapor Lamp in Competition with Arc Lamps.

A series of abstracts published in the Digest (Kuech and Retchinski, Jan. 19, 1907, p. 148; Arons and Kuech, July 13, 1907, p. 97; Bussmann, Sept. 7, 1907, p. 479) has given information relating to an interesting and novel development of the mercury-vapor lamp. From a paper read by Director O. Bussmann before the Berlin Electrical Society and published in the last issue of *Elektrotechnische Zeitschrift* it appears that the new lamp has now passed from the experimental into the commercial stage. In construction it is nothing more nor less than a mercury-vapor lamp; its distinguishing feature is that the tube in which the mercury arc plays is made of fused quartz instead of glass, so that it stands very much higher temperatures, while its properties and form render it a direct competitor of the high-candle-power arc lamp for general use.

Mr. Bussmann pointed out that if the curve of specific power consumption (with the watts per candle-power as ordinates and the watts as abscissæ) is plotted for the ordinary mercury-vapor lamp, this curve has a minimum corresponding to a specific consumption of 0.6 watt per candle. If the supply of power is increased, the candle-power increases to a less degree than the watts; in other words, the watts per candle increases. If this experiment is pushed so far that the glass tube containing the arc begins to soften, the lamp consumes about 1 watt per candle-power.

This observation was the starting point of experiments of Dr. Richard Kuech, engineer with W. C. Heraeus, in Hanau, a well known German platinum firm, which in the past few years has developed a line of fused-quartz apparatus for very high-temperature work in physical and chemical researches. As is now well known, fused quartz has the property of having practically a zero temperature coefficient of expansion, so that it may be heated or cooled suddenly without damage. It is, for instance, possible to pour cold water into a quartz tube brought up to red heat without danger of cracking it.

Dr. Kuech, who was acquainted with the possibilities of fused quartz, was led to the consideration that the increase of watts per candle-power with watts in the mercury-vapor lamp could certainly not go on forever and for certain theoretical reasons he concluded the curve of the specific consumption must reach a maximum somewhere, and would then come down to very low values. This conclusion was confirmed experimentally. With the arc playing in a quartz tube it was possible for him to raise the temperature very much higher than could have been done in a glass tube. A curve determined experimentally by Dr. Kuech, reproduced in Fig. 1, shows that the expected maximum is reached at about 1 watt per candle, and that afterwards the specific consumption decreases rapidly down to about 0.16 watt per candle.

It is instructive to observe what happens after the arc is started. In the new lamp, as in the ordinary mercury-vapor lamp, the tube is exhausted when cold. When the circuit is closed, the arc in the quartz lamp fills the whole tube, just as is the case of the ordinary lamp; but after some time the arc contracts into a thin line and not only does not increase in candle-power, but changes in color, the unpleasant greenish-

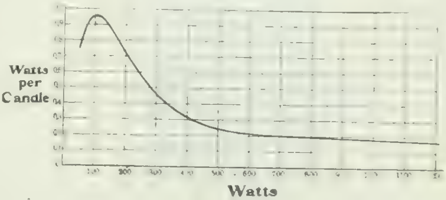


FIG. 1.—VARIATION OF SPECIFIC CONSUMPTION.

blue light of the mercury arc becoming a more pleasant yellow-white light. By a comparison of the spectra of an ordinary mercury-vapor lamp and the quartz lamp, it is found that the latter shows in addition to the well-known mercury line spectrum, a continuous spectrum, and the intensity of the latter increases with the watts. Moreover, the intensity of the different lines in this spectrum increases in a different degree. The yellow and red rays increase much more in intensity than the green and blue rays, and the lamp emits distinctly red rays.

In the ordinary mercury-vapor lamp the vapor pressure increases to about 2 mm. On the other hand, in the quartz lamp, when it is operated to its best advantage in practice, the pressure has gone up to about one atmosphere. For this reason the new lamp may be called a "high-pressure mercury-vapor lamp." For experimental purposes it is possible to push this increase of pressure still further, for instance, up to about 2 atmospheres, but in practice this involves dangers from escaping mercury vapor. For this reason the commercial lamp is operated at about 1 atmosphere pressure, or slightly less. For a vapor pressure of about 1 atmosphere the specific consumption is 0.2 to 0.25 watt per hefner candle-power, if the electrical power is measured at the terminals of the lamp and the candle-power in a direction perpendicular to the axis of the tube.

The third feature which strongly distinguishes the quartz lamp from the ordinary mercury-vapor lamp is that the arc is very much shorter. For this reason the dimensions of the tube are very much smaller. This will be seen from the following comparison:

	[illegible]	Quartz Lamp
	[illegible]	[illegible] cm length
[illegible]	[illegible]	[illegible] cm diameter

For this reason it is possible to use for the new quartz-tube lamp fittings similar to those ordinarily used for arc lamps, the

[illegible] volts. The lamps for indirect illumination appear to be even more agreeable in form, as is seen from Fig. 3, which shows a 2.5-ampere, 220-volt quartz lamp in connection with incandescent lamps.

The quartz tube of the 3.5-ampere, 220-volt lamp (Fig. 2) is shown in Fig. 4. This illustration shows plainly two metal vanes at the two ends which serve for cooling purposes. The heat produced in the mercury poles is conducted away by these vanes and radiated. The size of the vanes regulates the heat removal and determines, therefore, the current which the lamp consumes after having reached the stationary condition. The quartz tube is movable around a horizontal axis and may be easily replaced. For lighting it the tube is automatically tilted on closing a switch by means of a shunt electromagnet, so that a thin stream of mercury flows from one end to the other.

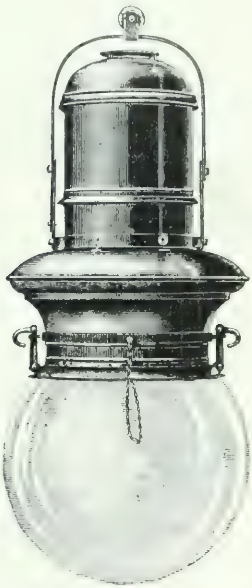


FIG. 2.—3.5, 200-VOLT QUARTZ LAMP

When the circuit is closed, the shunt magnet will carry no current, and the tube, therefore, comes back to its normal position and the arc is started. Besides the tilting mechanism, the lamp contains the necessary resistance in series with the line connection. Since no further accessories are required and as the lamp can be operated singly at 110 volts or 220 volts, its installation is exceedingly simple.

In tests of the new lamp in the Reichsanstalt the results given in the following table were obtained. The volts represent the potential difference at the poles of the lamp (without series resistance). The amperes are the current through the lamp. The next column gives the candle-power in hefners, measured horizontally and perpendicularly to the quartz tube, followed by the mean spherical candle-power. The last two columns give the specific consumption in watts per hefner.

Volts	Amperes	Horizontal c.p.	Mean Spherical c.p.	Watts Per Horizontal c.p.	Watts Per Mean Spherical c.p.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	0.23	[illegible]

If it is taken into consideration that the series resistance consumes about 35 to 40 volts, and that the light radiated upwards is reflected by means of a metallic reflector with a loss of not more than 50 per cent, there results, if all losses are included, a specific consumption of 0.25 watt per lower hemispherical candle-power if clear globes are used. For globes, [illegible] higher. For "opal globes" it is 20 to 30 per cent higher.

Simultaneously with the increase of pressure in the quartz tube, the resistance of the arc changes. Shortly after closing the current [illegible]

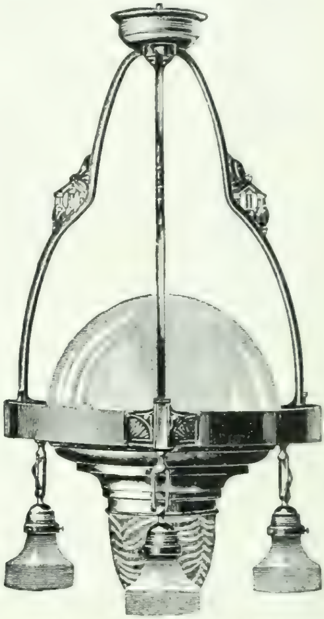


FIG. 3.—QUARTZ LAMP, WITH FILAMENT LAMP AUXILIARIES

the normal current passed through it, the total normal watts (about 100 watts) would not be sufficient to bring the tube to the required high temperature. It is, therefore, necessary to pass in the beginning as high a current through the tube as practicable in order to arrive as quickly as possible at the high temperature. For this reason the series resistance is so designed that the initial current is more than double the normal current. A few minutes after closing the circuit the current

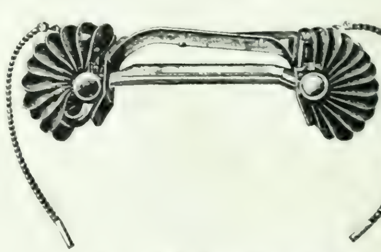


FIG. 4.—TUBE OF QUARTZ LAMP

decreases, but the voltage increases until the normal current has reached the normal value at 180 to [illegible] volts with larger lamps and [illegible] volts with smaller lamps.

The temperature within the tube is very high. A normal 180-volt lamp reaches a temperature of [illegible] deg. C. when it is operated at 60 volts only. When it is operated at the normal voltage of 180 the temperature is estimated to be about 6000 deg. C. Since for experimental purposes the voltage may be

raised to about 250, whereby the pressure becomes 2 atmospheres. Mr. Bussmann thinks that the temperature then reaches the highest values which it is possible at present to obtain.

The price quoted for the 3 to 4-ampere lamps for 220 volts, which in energy consumption correspond to 12 to 16-ampere arc lamps, is about $50, including one quartz tube. The price of the smaller 2½-ampere lamp is $42.50. The high first cost of the lamp, in comparison with ordinary arc lamps, is due to the high cost of the quartz tube, for which up to 80 grams of fused quartz are required. The market price for fused transparent quartz is now about 25 cents per gram. It may be expected that ways and means will be found to decrease the cost of preparing fused quartz so that the quartz tubes which now cost singly from about $26 to $32.50 will also become cheaper. In spite of this high first cost, the quartz lamp will be found satisfactory even now for many applications on account of its long life and because practically no attendance whatever is necessary. The life of a quartz tube is guaranteed by the factory to be 1000 hours, but this is stated to be a low figure which is greatly surpassed by the results in practice.

Practically the only cost of operation—besides power cost—will be for replacing the quartz tubes by new ones. As mentioned before, this is after a use of 1000 hours, and then the charge for a new quartz tube is only $5, if the old quartz tube is returned, since it can be worked over again at the factory. It is stated that the Quartzlampen Gesellschaft, in Pankow, which manufactures these lamps, will put them regularly on the market during this autumn.

The new lamp is thought to be specially suitable for lighting extended railroad stations on account of the high voltage and the small attendance, and also for lighting workshops, parks and streets. Since for interior lighting the lamp yet lacks sufficient red rays, it is useful to combine it with ordinary incandescent lamps as shown in Fig. 3. Besides the visible radiation, the quartz lamp has a very strong ultra-violet radiation, which makes it useful for therapeutic work and also for photographic purposes, etc. For these purposes a special type of lamp has been developed.

Since the ultra-violet radiation is injurious to the skin and the eye, protection from the ultra-violet radiation is afforded by means of glass screens, which absorb this radiation completely. In the lamp as shown in the illustrations for general lighting purposes, this result is, of course, obtained by the surrounding glass globe.

Mr. Bussmann's paper was discussed at great length. Many speakers referred to the difficulty of making accurate photometric tests of such sources of light as the mercury arc, on account of its peculiar spectrum compared with ordinary sources of light. Other speakers claimed there was no difficulty in this case.

Dr. Norden pointed out that the new quartz lamp should not be compared with the ordinary mercury-vapor lamp with respect to its commercial applications. The ordinary mercury-vapor lamp is a source of light of medium intensity, say of, 300 to 600 candle-power, while the new quartz lamp has an intensity of several thousand candle-power, and is, therefore, one of the strongest artificial sources of light which we have. [illegible] lighting, while the new quartz lamp should compete with flame- [illegible]

It was further pointed out by Dr. Gehrcke that while the new lamp contains red rays it does not contain them in great quantities, and its color cannot be called "beautiful." If an [illegible] less. Mr. Wangemann suggested to put some highly refractory material around the mercury arc and by thus heating it to an [illegible] nature of the Drummond light. Mr. H. Heraeus replied that [illegible]

purity has a bad effect on the life of the lamp. His firm, however, makes special lead-bismuth-zinc-cadmium-amalgam lamps as suggested by Dr. Arons. This lamp is excellent for spectroscopic purposes, but not suitable for ordinary illumination.

The Germans now make it a practice to compare arc lamps on the basis of the mean lower hemispherical candle-power. But it would seem that for the comparison of different types of lamps the only true criterion is the mean spherical candle-power.

It may, therefore, be interesting to compare this new German lamp with our ordinary arc lamps in this respect. Data introduced at the hearing in the Colorado Springs arbitration proceedings (Electrical World, April 27, 1907, v. 49, p. 821) indicated that "the maximum candle-power of the open 'full arc' is only about 1200 instead of 2000 as popularly believed, its mean spherical candle-power being 400 to 450, or about 1 candle-power per watt; while the usual 6.6-ampere enclosed arc gives only 150 mean spherical candle-power, corresponding to 3 watts per candle-power."

According to the Reichsanstalt tests mentioned above, the 4.20-ampere quartz tube lamp gave 2680 and 3110 mean spherical hefner candle-power, the voltage at the terminals of the quartz tube being 174 and 197, respectively. If we add 40 volts as lost in the series resistance, the voltage at the terminals of the lamp becomes 214 and 237, respectively, hence the watts 899 and 995. Since 1 spherical hefner candle-power equals 0.88 spherical British candle-power (if we use the older official ratio), the corresponding British candle-powers of the quartz lamp are 2358 and 2737. We therefore get for the specific consumption the figures 0.38 and 0.36 watt per mean spherical (British) candle-power measured without outer globe.

New Telephone Patents.

[illegible]

E. J. Grenier, of Menominee, Mich., has invented a combined drop and jack. The shutter hook has its upper face shaped into a cam so that in rising it not only releases the shutter, but also gives it a positive kick outward. The falling shutter engages a lever, elevating it to close the right bell contact and also swinging its farther end into the plug channel of the jack thimble. The entering plug thus actuates the lever, its forward end coming down on the tube of the shutter. The shutter thus is lifted back home automatically.

[illegible]

Except in the extremely short line house systems there has been little thought of dividing the signaling and talking circuits, it having been considered decidedly economical to make the same line and apparatus suffice for both in so far as possible. However, H. F. Joeckel, of Clayton, Ill., has now patented a system wherein if two line wires be provided, one is used to ring over to ground and the second to talk over to ground. There is nothing in the patent specification which shows where one could afford to use such a system in practice.

[illegible]

In some classes of telephone instruments, the transmitter is placed with its edge to the user, the mouthpiece then having a right angle bend near its base so that its mouth will be presented to the user. With such an arrangement an adjustment of the height of the mouthpiece can be accomplished by swinging it in a vertical plane about its base as an axis. To this end R. Knoll, of Austria, has patented a special mounting for such a mouthpiece. This consists of a nipple having a flange midway its length and a split end, the nipple being attached to the transmitter. The metal mouthpiece has an expanded slit end which snaps off the flange, while the split tube engages its bore tightly.

[illegible]

Whenever cut-off relays have been used in connection with subscribers' line circuits, there has been found a disagreeable tendency to a loud report at the instant of operation. This is,

of course, due to the fact that within the limits of practical construction it is found impossible to prevent an abrupt change of the potentials impressed upon the line. Mr. H. P. Clausen of Chicago has patented an arrangement of circuits designed to reduce the click in the telephone. This comprises auxiliary contacts for the line relay by which, as it operates to display the line lamp, it also short-circuits the line. When the cut-off relay acts, the short-circuit provides a path for the disturbing currents. The short-circuit, of course, opens after the line relay is cut off. Mr. Clausen has assigned his patent to the American Electric Telephone Company.

In the accompanying Fig. 1 is shown the circuits of a two-wire system patented by E. E. Clement, of Washington, D. C. It will be seen that in the case of a call in, the lower relay responds to cut in the line lamp and also the upper or cut-off relay. This latter does not operate because of the resistance of the line or lower relay. Now when a plug is inserted, the coils in parallel with the line relay provide sufficient current to operate the cut-off relay. This clears the line relay and puts out the line lamp. It will be seen that the line relay must fall back slowly enough to enable the cut-off to act completely before the line relay begins to fall back. For an inward call, the insertion of a plug in the jack is of no effect until the subscriber answers. When this occurs the relays rapidly operate in succession.

An improvement in automatic exchange circuits has been patented by Mr. E. D. Fales, of Chicago. This relates to the release circuit, which during switching and conversation is maintained to prevent the apparatus from returning to zero or normal. It has been usual to arrange this circuit so that each machine involved in a connection controlled the release circuit of that machine subordinate to it until the last or connector machine. Now when a subscriber hung up, an appreciable time was required to restore the mechanism, as the first switch had to

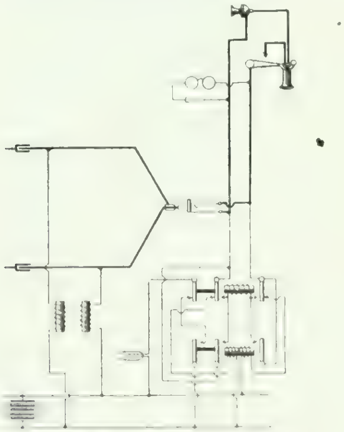


FIG. 1.—CLEMENT SWITCHING CIRCUITS.

return clear to normal before releasing the second, and so on. In the present improvement the various release circuits are in series, so that at the first break of this circuit all machines involved start back home simultaneously. This patent has been assigned to the Automatic Electric Company.

INTERCOMMUNICATING SWITCH.

C. E. Lee, of Chicago, has patented an intercommunicating switch with an automatic release feature. An extension from the hook lever latches over the springs in a manner to secure them in the operative position until the receiver is returned to the hook. The springs are set in the operative position by push buttons.

SUPERVISORY CIRCUIT.

Supervisory lamp signals are almost universally included in local circuits controlled by relays in the main cord circuit. The number of relays required has varied from one to four, according to the arrangement of signals and the type of switchboard.

In Fig. 2 is shown a two-wire system in which no relays are required in the cord circuit to control the supervisory, this control being accomplished by the arrangement of relays and circuits of the line. The line relay serves in a dual capacity, its back and front contact circuits being controlled by the cut-

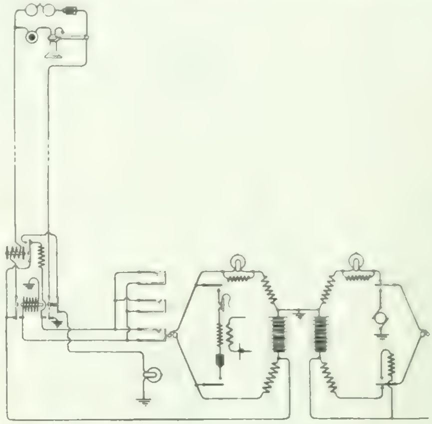


FIG. 2.—DEAN SUPERVISORY SYSTEM.

off relay. The supervisory lamp included in the talking circuit is so proportioned as not to glow for the talking current, but it will glow when an auxiliary low resistance path is provided by the dropping back of the line relay armature. W. W. Dean is the inventor of this circuit, his patent being assigned to the Kellogg Switchboard and Supply Company.

Letter to the Editors.

Leakage Reactance of Induction Motors.

To the Editors of Electrical World:

SIRS:—In the issue of the ELECTRICAL WORLD dated Sept. 14, there appears a letter headed "Standardization of Scientific Notation," by Mr. J. P. Nikonow, in which reference is made to an article on "Leakage Reactance of Induction Motors," by the writer, printed in the ELECTRICAL WORLD, dated March 30, 1907.

In his letter Mr. Nikonow very kindly calls attention to certain errors and omissions in the article in question, which I should like to correct.

Mr. Nikonow remarks that the article is practically an abstract of Professor Adams' papers; this fact is mentioned in the article itself, where it is stated that the various formulas are practically those of Professor Adams, rewritten to make the computation easier. Professor Adams' paper states that in the case of motors with squirrel-cage rotors no belt-leakage exists; this is evidently incorrect, and in the article in question a formula is given for this leakage element.

In my article p represents the number of phases, and q the number of poles. The expression for the leakage of the end connections contains the terms:

[illegible] length of end connections per turn, [illegible] and

log $\frac{[illegible]\lambda}{d}$ where:

[illegible] λ [illegible] the span of the coil, [illegible] being the winding pitch as a fraction of the pole pitch λ,

d_s = diagonal of the cross section of a phase-bundle, approximately equal to $\frac{\lambda}{[illegible]}$.

Expressed in terms of the machine dimensions, we get:

$$\log \frac{k_s \lambda}{d_s} = \log \frac{k_5 \dfrac{\pi D}{q}}{\dfrac{\pi D}{q p}} = \log k_5 \, p$$

The expression for the belt-leakage (5) should contain S_o^2 instead of S_o.

General formula (6) is therefore correct with the exception that one half of the parenthesis around $k_0 + \frac{p_0 S_0}{p_1 S_1} k_1$ is missing.

The coefficient 20 applies to the slot leakage only; the whole of formula (6) is also expressed in inches, not partly in centimeters as suggested by Mr. Nikonow, as all the terms contain the factor 2.54.

The slot constant is exactly like Prof. Adams' and the multiplying factor 3.2 is contained in the factor 20 ($3.2 \times 2\pi = 20$).

$\frac{2h}{ag}$ should read $\frac{2d}{a+g}$; $\frac{t_{10}\, t_{11}}{2Q}$ should read $\frac{t_{10} + t_{11}}{2Q}$, and d should be δ.

I fail to see the advantage of retaining such expressions as π, 2π, $\sqrt{2}$, $\sqrt{3}$, etc., in a final working formula, which already is bulkier than desirable.

INDIANAPOLIS, IND. I. E. HANSSEN.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Series Single-Phase Motor.—R. RICHTER.—A detailed description of the series single-phase motor of the Siemens-Schuckert Company. The left hand diagram in Fig. 1 shows the original design. A is the rotor of the motor, T is a transformer, and the switch S serves for obtaining by voltage control the desired speed and torque. By means of U the direction of rotation is reversed by reversing the flux in the winding E. There are four stator windings, E, K, N, H. Winding E supplies the useful magnetic flux, while the three other windings, K, H, N, the axles of which are normal to that of winding E, serve for the following purposes: The winding H is placed on the commutating pole and the flux produced by it neutralizes the reactance voltage in the coils undergoing commutation. The winding K neutralizes the armature flux as far as distortion and reactance are concerned. The auxiliary winding N produces a flux which compensates "the e. m. f. at rest" in the armature coils short-circuited by the brushes. The right-hand diagram of Fig. 1 shows the new construction of the same motor; it will be seen that in this case the four windings of the former construction are replaced by a single winding by

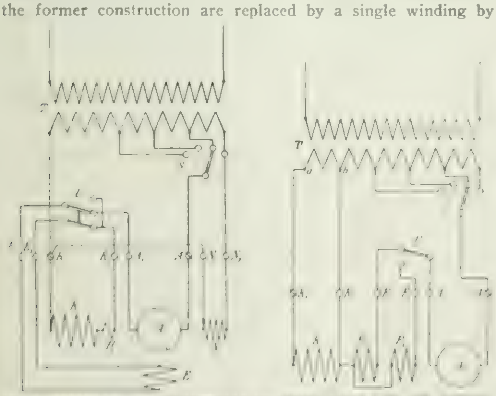


FIG. 1.—DIAGRAM OF CONNECTIONS OF SERIES SINGLE-PHASE MOTOR.

simply connecting K_2 to d, whereby K produces those results which were obtained in the former design by the three windings, K, H and N. It will also be seen that there is only a single-pole switch, U, necessary for reversing the direction of rotation of the rotor. The latter arrangement not only simplifies the construction, but the total copper losses are reduced. —*Elek. Zeit.*, Aug. 22.

[illegible] from a Single Dynamo.—E. J. BRUNSWICK.—An article illustrated by diagrams summarizing a study by C. C. Garrard on dividing the tension at the terminals of a single dynamo into equal parts by stationary arrangements, as in the three-wire dynamo of Dobrowolsky.—*L'Industrie Electrique*, Sept. 25.

Lamps and Lighting.

Lamps and Fittings.—An illustrated account of a very large number of accessories and fittings for electric lamps of British make, with some additional notes on heating apparatus and power appliances. Among the new lamps is mentioned the tungsten lamp of the British Westinghouse Company, which is suitable for alternating-current or direct-current circuits and has the same life in either case which is given at 1000 hours as a minimum. The specific consumption is one watt per candle-power. This lamp is supplied for constant-voltage circuits in sizes from 20 to 100 candle-power for from 50 to 125 volts. It is also adapted for series operation. Another British company is putting a metallic-filament lamp on the market for which a specific consumption of 1.2 watt per candle-power is claimed, with a useful life of 1000 hours. It is said to be equally suitable for alternating or direct current, and it is called the Metalik, although nothing is said concerning the nature of the filament.—Lond. *Electrical Review*, Sept. 27.

New Metallic Filament Lamp.—A note stating that a British company is now introducing a 50 to 60 candle-power, 100 to 130-volt metallic filament lamp, consuming 1 watt per candle-power. The lamp can be used only in a vertical position. The average life is given as from 800 to 1000 hours, with practically no decrease in candle-power. The lamps should be operated only in parallel. Their price is $1 each.—Lond. *Elec. Eng'ing*, Sept. 26.

Carbon Suspenders for Tungsten Filaments.—A note on the patent of the Deutsche Gasglühlicht A. G., relating to the employment of carbon in place of metal or refractory oxides for suspending the filament in tungsten lamps. The carbon-filament suspender is found to remain comparatively cool even when in contact with a white-hot metal filament, and can hence be made very thin. Although such suspenders cannot be used with osmium filaments, owing to the formation of a carbide, this objection does not apply in the case of tungsten filaments. —Abstracted from the British patent in *Science Abstracts*, Section B, Aug. 26.

Metallic Filaments.—R. JAHODA.—A note stating that all metalic filaments used in the new high-efficiency lamps—even those very thin, of about 0.02 mm diameter—are not solid, but are really hollow cylinders. This is the case with the metal not only in the finished filaments, but also in the raw state before formation. He describes a method for demonstrating this by microphotographs. It seems that the filament made from a plastic mass, when being dried, hardens first at the outside and the hardening action proceeds from the outside to the inside leaving a hole in the center. This phenomenon is to be taken into consideration when calculating the conductance from the diam[illegible] [illegible]

Arc Lamps.—A [illegible] British patent granted to [illegible] for an arc lamp in which the feeding of the electrodes is controlled by the expansion and contraction of a thermal strip or wire. The lamp is provided with a contact on the lever, which is worked by the thermal strip. In the event of this strip becoming overheated, a contact is made which cuts it out of circuit.—Lond. *Elec. Eng'ing*, Sept. 26.

Flame Arc Lamp.—An illustrated description of a converging carbon flame arc lamp recently developed by C. E. Gilbert, in which a number of electrodes are arranged in a parallel group on both positive and negative sides. Only one pair of electrodes is used at a time, however.—Lond. *Elec. Eng'ing*, Sept. 26.

Power.

Power from Peat.—A review of a number of papers of Frank and Caro on the utilization of peat. Most attempts in the past have been in the direction of making fuel from peat, and many special machines have been devised for crushing, kneading, compressing and mixing the peat so as to render it suitable for fuel. Frank thinks, however, that such methods must always be restricted to certain localities where other fuels are expensive. Since peat is essentially an inferior fuel, there is no possibility of peat competing with coal in general. Another process for the utilization of peat is dry distillation and production of peat coke with by-products. A plant using the Ziegler process of this kind is in successful use in Germany. A third method of utilizizng peat is in gas producers for the production of power, also with the recovery of by-products. On the basis of the Mond process, Caro has worked out a new method for gasifying peat in a mixture of air and overheated steam in excess. One of the chief features of this process is that peat containing from 50 to 55 per cent of water can be used. Moreover, almost the total nitrogen contained in the peat is recovered in the form of ammonia, and can easily be worked up into ammonium sulphate, which is sold for fertilizing purposes. The gas produced is suitable for use in gas engines. The process is now tested in a large plant in the Mont Cenis mine in Germany. In a letter by A. Frank the importance of the subject for the United States is pointed out, and it is stated that his analysis of samples of peat from the United States and Canada have shown that there are in these countries large deposits of peat containing considerably more nitrogen than does European peat. The output of ammonia should, therefore, be correspondingly greater. The subject is also discussed in a long editorial.—*Electrochem. and Met. Ind.*, October.

Electricity from Blast Furnaces.—B. H. Thwaite.—An Iron and Steel Institute paper on the economic distribution of electric energy from blast furnaces. The great importance of using electric energy throughout any iron and steel works is pointed out, and also the objection which has been advanced against electric operation of rolling mills with the aid of gas power, namely, that a heavy expenditure is involved in such a technical reform. Only large companies can undertake it. The basis of the programme of the author is to pool the waste furnace gases from all the furnaces of an iron-making district independently of the ownership of such furnaces. The energy, electrically transformed, of the different furnaces would be transmitted to a central distributing and transforming station in which the e. m. f. is transformed to the value to satisfy different customers. The first call on this energy would be the satisfaction of the internal demands of the iron and steel works. The balance of the energy would be sold to outsiders. In case the blast furnaces should be shut down, it would be possible to get a satisfactory gas from a gas producer, which therefore would act as a standby, its cost being small.—*Electrochem. and Met. Ind.*, October.

[illegible] *Gas.*—J. von Ehrenwerth.—An Iron and Steel Institute paper describing a simple method for determining the total quantity of blast furnace gas for a given make and its calorific value, which can be utilized for power purposes.—*Electrochem. and Met. Ind.*, October.

Superheating.—O. H. White.—The conclusion [illegible] illustrated article on the use of superheat in electric generating stations, especially turbine stations.—*L'Industrie Electrique*, Sept. 25.

Traction.

British Municipal Tramways Association.—[illegible] an account of this year's annual conference of the (British) Municipal Tramways Association, which was held in Manchester. J. M. McElroy in his presidential address pointed out that "in practically all the cities and towns in the United Kingdom the tramways have now been taken over and are operated by the municipalities, and that the benefits accruing to the traveling public, the ratepayers, and the tramway employees has been enormous. In the case of unrestricted private enterprises, such as are found abroad [United States], however, the undertakings are not up to the high efficiency to be found in many cities in England." Other papers abstracted, together with an account of the discussion which followed, relate to long wheel-base trucks by R. L. Acland, hours of labor and rates of pay by A. Baker, and staff organization by J. Dalrymple.—Lond. *Electrician*, Sept. 27.

Installations, Systems and Appliances.

Cost of Coal in Operation of Stations.—An editorial note on the effect which the threatened increase in the price of coal will have on the works cost. The effect may be quite serious in the case of gas companies, because the cost of coal consumed is more than half of the total cost, including capital charges, while in electric stations it may be as small as one-eighth, as for instance in Manchester. There are, however, cases in which the price of coal has considerable effect on the cost of electricity supply—namely, where the price per kw-hour has been based principally on running charges; that is, where it has been assumed that stand-by and capital charges are less important. As an instance in point, restricted hour supply is mentioned. In such a case the coal costs probably account for more than one-half of the total cost of supply, and it is advisable to insert in any agreement with such customers over a lengthy period a provision whereby the price charged per kw-hour would be controlled by the prevailing price of coal. In general, the higher the load factor, the greater is the effect of a rise in the price of coal and the more necessary is it to quote prices for electricity supply dependent upon a coal clause. —Lond. *Elec.*, Sept. 27.

Electricity on Board Ship.—The first part of an illustrated article on the electric equipment of the steamship *Mauretania* of the Cunard Line, which is an example of the varied uses to which electric energy can be put on a modern steamship. In the present installment the system of energy distribution, electric generating plant, fans, motors for dismantling the turbines, cranes, lifts, etc., are described, while in the concluding article the lighting, refrigerating plant, the telephone installation, and the means adopted for measuring the power of the turbines will be dealt with.—Lond. *Electrician*, Sept. 27.

Wires, Wiring and Conduits.

Aluminum Cables.—An article on the aluminum cables which are to be used for the Loch Leven Power Company, in England. It will be the most extensive plant using aluminum cables in the United Kingdom. This power company is affiliated with the British Aluminum Company, which will furnish the aluminum. Owing to the position of the works, a tramway about 1¼ miles long is needed to bring materials from the wharf on the river to the power house. The trolley wire will be of copper, but the main and return feeders will be of aluminum. These involve some 500 yards of aluminum cable and about 2600 yards beyond this will be used in connection with the lighting of the tramway route, which will be carried out from the poles. For the lighting of the model village which is being erected for the workmen, the whole of the feeders and distributors will be of aluminum. Three thousand seven hundred yards of aluminum feeders, 4300 yards of distributors, and 1200 yards for house service will be needed. All

aluminum used in the stranded cables and other conductors is to have a conductivity of not less than 61 per cent of that of hard-drawn high-conductivity commercial copper. The tensile strength of the aluminum used in the stranded cables and other conductors is to be not less than 11 tons per sq. in., with an extension of not less than 4 per cent in 5 ins. The sectional areas of the finished cables vary between 0.899 sq. in. for the feeders to the factory, and 0.016 for house services. As regards the joint, it is specified that all permanent joints between aluminum conductors are to be welded, the ends of the wires being butted together and enclosed in an approved metal mold, into which molten aluminum is poured. After the mold is removed the joint is to be cleaned up and any roughness filed off. The joints between the feeders and distributors and at points where the distributors may require to be disconnected, are to be formed by aluminum thimbles bolted together, and the thimbles are to be welded to the ends of the wires as described above.—Lond. *Electrical Engineer*, Sept. 27.

Insulating Varnish.—Several diagrams showing the effect of linseed oil in insulating varnishes. Such varnishes which contain no linseed oil absorb moisture much more slowly, and to a smaller extent, than do those which contain linseed oil. A large moisture absorption necessarily means a low ohmic insulation resistance, but, more important than this, it produces a low dielectric strength. The latter varies according to the dryness of the insulation.—Lond. *Electrical Review*, Sept. 27.

Electrophysics and Magnetism.

Electric Origin of Radiation from Hot Bodies.—J. J. Thomson.—The idea on which this paper is based is that the radiation from hot bodies is analogous to Roentgen radiation; that is, that it consists of a series of electromagnetic pulses produced by the stopping or starting of charged corpuscles in the hot body. Lorentz formerly followed up this idea of Thomson for the special case of very small frequencies. The object of the present paper is to solve the problem for the general case. The paper is highly mathematical, and the results are somewhat startling. The amount of energy transformed per cu. cm of a metal into radiant energy per second is surprisingly large, but nearly the whole of this is absorbed by the metal and passes into a form other than that of radiant energy. Under special assumptions, the author finds that the flow of radiant energy produced in a cubic cm of silver represents about 8000 horsepower. "Thus, though a cubic cm of silver does not distribute its radiant energy well, it produces as much as a good-sized electric lighting station."—*Phil. Mag.*, August.

[illegible] Mackenzie.—A long account of an experimental research concerning the change from uranium into radium.—*Phil. Mag.*, August.

Rays of Positive Electricity.—J. J. Thomson.—A reply to Wien's recent criticisms on this subject.—*Phil. Magazine*, [illegible]

Electrochemistry and Batteries.

Electrometallurgy of Copper.—J. W. Richards.—The first part of a discussion of the different methods for applying electric energy in the metallurgy of copper. In the present installment the author deals with electrolytic processes, namely, the electrolytic treatment of copper ores, the electrolytic treatment of copper matte and the electrolytic extraction of copper from solutions with soluble iron anodes.—*Electrochem. and Met. Ind.*, October.

Phosphorus.—G. W. Stose.—A review of the different electric furnace processes which have been devised for the production [illegible] chiefly from rock phosphate and from apatite, wavellite has be[illegible]

Units, Measurements and Instruments.

[illegible] slow high-potential electric oscillations, the author thinks that an electrostatic method would require simpler apparatus than most of the electromagnetic methods, and would have the advantage that no additional self-inductance is introduced into the circuit. He made experiments with the apparatus shown in Fig. 2. A piece of phosphor-bronze strip S is soldered at one end to a terminal on an ebonite pillar, P, and at the other to a small spiral spring, L, attached to a screw. A second ebonite pillar supports the screw, which can be drawn through by a nut, thus allowing the tension of the strip to be varied. The strip rests horizontally against two vertical glass rods, R, about 2 cm apart. To the middle of the strip is attached a small mirror, M, of very thin silvered glass, rectangular or triangular in form, and 1 or 2 sq. mm in area. In front of the strip, and connected to the terminal by a thin wire, is a thin plate of copper (not shown in the figure), bent so that its edge faces the strip and is less than 1 mm from it. A gap in this plate allows a beam of light to pass to and from the mirror. Behind the strip is another thin plate of copper imbedded in a sheath of ebonite, K, and also with its edge facing the strip. The whole is mounted on an ebonite support, and placed in an ebonite vessel provided with a small window and filled with a transparent, insulating oil of suitable viscosity and of fairly high dielectric strength. It is also advantageous that the oil should have a high specific inductive capacity. A small platform, N, of ebonite tipped with cork can be raised by a screw until it comes into contact with the lower edge of the mirror. A horizontal adjustment of the platform then allows the mirror to be tilted so that the reflected ray can be made horizontal, or can be given any desired small elevation. The phosphor-bronze strip is thus located between two plates, to one of which it is connected. If the plates are charged to a difference of potential, the strip is repelled by one plate and attracted by the other. The mirror then, since one of its edges is fixed, is deflected through a small angle proportional to the square of the

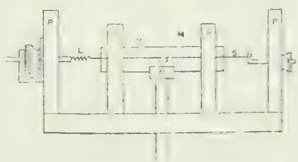
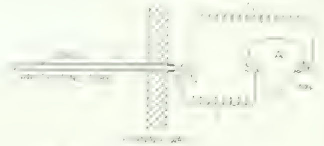


FIG. 2.—DIAGRAM OF ELECTROMETER.

difference of potential of the plates as in the idiostatic use of the quadrant electrometer. A beam of light, proceeding from a small circular aperture illuminated by an arc lamp and condenser, passes through a convex lens and is reflected by the small mirror on to a rotating concave mirror, driven by a motor. It is focused so that an image of the aperture is formed on a plate of ground glass or on a photographic plate. A tuning-fork, carrying a small mirror, is mounted vertically in front of and close to the window of the oil vessel. A part of the beam of light falls upon this mirror, whence it is reflected to the rotating mirror and focused on the plate. When the concave mirror rotates, two horizontal lines are thus traced by the spots on the ground-glass plate. By adjusting the small platform one of these traces can be brought to a short distance from the other. At a certain point of the rotation of the mirror, the tuning-fork is struck by a hammer worked by a lever, after the manner of a pianoforte-key action. The arc lamp is enclosed in a light-tight case and the whole apparatus is set up in a dark room. The author's experiments relate to measurement of periods of oscillations, to measurements of capacity of condensers, to measurements of damping factors, and other applications.—*Phil. Magazine*, August.

Electric Pyrometer.—A description of the Crompton pyrometer in which the thermo-electric couple is used with a suitably calibrated indicator of the moving-coil type, no battery being required. Fig. 3 shows the method of connections for measuring the temperature in a furnace or flue. For temperatures up to 1100 deg. C. the couple is composed of a nickel rod inside a steel tube, the two being welded together at one end [illegible]

tures, up to 500 deg. C., a constant-copper couple is used. The terminals are marked *N* and *S*, respectively, and the leads are of nickel and steel, so that the materials forming the couple are continuous up to the indicating instrument; very slight insulation is required between them. As the cold junction is at



—PYROMETER CONNECTIONS.

the indicator, and is not always at the same temperature, it is necessary to provide corrections; this has been accomplished by attaching a thermometer to the indicator, and constructing the scale in the manner shown in Fig. 4. The several arcs are calibrated at different temperatures of the indicating instrument ranging from 10 deg. to 30 deg. C., in steps of 5 deg., and the reading should be taken on that arc which corresponds with

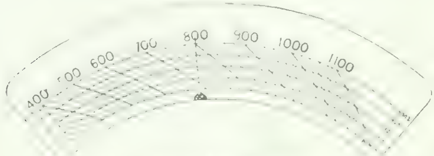


FIG. 4.—SCALE OF PYROMETER.

the thermometer reading. The melting points of sulphur, aluminum and copper are specially marked on the scale for the purpose of checking the readings.—Lond. *Electrical Review*, Sept. 27.

Resistance Coils.—C. V. DRYSDALE.—The first part of a fully illustrated paper read before the British Association for Advancement of Science, at Leicester. The author gives a survey of resistance coils, showing their evolution up to the present time, and the methods used in accurate measurements of resistance. Results of tests on a number of resistance-alloys are given. The desirable features and temperature compensation of resistance coils are then discussed, and the author describes attempts which he has made at compensation by electro-depositing films of suitable thickness of certain metals on the resistance wires. In conclusion, the methods of standardizing coils and bridges are considered, and a modified form of the Cary Foster bridge, due to the author, is described. In the present installment a great many different designs of resistance coils are described and illustrated in diagrams.—Lond. *Electrician*, Sept. 27.

Telegraphy, Telephony and Signals.

Undamped Oscillations and Wireless Telephony.—S. EISENSTEIN.—An account of experiments which he has made on the basis of Duddell's well-known arrangement, using the arc for the production of undamped oscillations. In order to increase the oscillation energy, the pressure of the gas in which the arc plays may be raised, and this results also in an increase of the frequency. The nature of the compressed gas which is used around the arc is of no account as long as the gas is of such a nature that the arc does not become a stable one. Methods of obtaining an unstable condition of the arc by means of electromagnetic devices or by air-blast are described. Fig. 5 shows an arrangement for wireless telephony with undamped oscillations. A microphone circuit acts on the machine, which gives the exciting current for the arc. This method has been repeatedly proposed, but always in such a way that an increase of magnetism is produced in the poles of the machine by the microphone circuit. It is, however, evident that the oscillations produced by the speech in the microphone circuit cannot pass with sufficiently large speed through the coils of the poles of the machine. Therefore a lag takes place, so that the main oscillations exert the desired effect on the machine. This disadvantage is overcome in the arrangement shown in the illustration, since the microphone circuit is not used for increasing the magnetism of the machine, but, reversely, for demagnetizing it. For this purpose special windings, *a*, are placed on the poles of the machine and they are supplied with current from the microphone circuit. The direc-

FIG. 5.—DIAGRAM OF CONNECTIONS.

tion of this current, however, is opposite to that in the main windings, *b*. The currents in *a*, therefore, demagnetize the poles of the machine. The demagnetization is much quicker than the increase of magnetization, and for this reason the transmission of speech is better than with the other arrangement.—*Elek. Zeit.*, Aug. 22.

Electric Oscillators.—J. A. FLEMING.—While a strict and highly mathematical theory of electric oscillators has formerly been developed, the present author gives in this article an elementary theory for use by workers in electric-wave telegraphy. He elucidates the theory of the oscillator for a few of the simple and most practically important forms of open and closed radiating circuits. The article is to be continued.—Lond. *Electrician*, Sept. 27.

Wireless Telephony.—H. ARMAGNAT.—A concise summary, with diagrams, of the present situation of wireless telephony.—*L'Industrie Elec.*, Sept. 25.

Poulsen Arc.—J. A. FLEMING.—His British Physical Society paper in full, with illustrations, giving some observations on the Poulsen arc as a means of obtaining continuous electric oscillations.—*Phil. Mag.*, August.

Cable Ship.—A fully illustrated description of the new cable ship, *Guardian*, built for a British cable company. One novel point in her equipment is that her larger cable tanks are provided with a division wall which divides them into two concentric parts. Great care has been taken in all details to render the vessel suitable for continuous service in tropical latitudes.—Lond. *Elec. Eng'ing*, Sept. 26.

Miscellaneous.

Machine for Working Metal Sheets.—R. HUNDHAUSEN.—A fully illustrated description of a machine for treating metal ribbons or strips cut from sheet metal. The ribbon or strip is moved with greatest accuracy and at high speed step by step, and is simultaneously worked into the desired form by cutting, stamping, bending, drawing, etc.—*Elek. Zeit.*, Aug. 22.

BOOK REVIEWS.

"THE ELECTRICIAN" PRIMERS. Edited by W. R. Cooper, M. A., B. Sc. London: "The Electrician" Printing & Publishing Company. Three vols. in one. Illustrated. Price, $5.

The first edition of this set of primers of electricity appeared in 1891, and for this edition has been thoroughly revised by Mr. W. R. Cooper, editor of *The Electrician*, London. The set comprises 25 primers on "Theory," 31 on "Electric Traction, Electric Lighting and Power," and 25 on "Telegraphy, Telephony, Electrolysis and Miscellaneous Applications of Electricity." In plan and scope the work resembles the instruction books

the primers antedates the latter, and in turn is antedated by the popular primers issued during the Philadelphia electrical exhibition of 1884.

The primers are particularly adapted for self-study by practical men who cannot take up a systematic and broad course of study in electrical science and engineering. Each primer is devoted to a specific subject, the treatment of which is complete, so far as possible, in itself, and without reference to other primers. The student can thus select for first reading the topics which appeal most directly to him, leaving the others for later consideration or for possible future reference. The treatment is entirely practical and largely descriptive. A useful feature is a list at the end of each primer referring to books which may be consulted for information in fuller detail.

HANDBOOK ON ENGINEERING. By Henry C. Tully. Sixth edition. St. Louis: Henry C. Tully & Co. 1072 pages; 473 illustrations and frontispiece portrait of author. Price, $3.50.

The author in his preface says that an experience of 25 years with all kinds of engines and boilers, pumps and "all other kinds of machinery" enables him fully to understand the kind of information most needed by men having charge of steam engines of every description, and that he has excluded from the book everything not strictly connected with steam engineering. The long sub-title, however, includes dynamos, motors and electric elevators, and we find that no less than 14 of the 31 chapters deal with electrical subjects. The author is at times rather unfortunate in his choice of material, and its arrangement is rarely logical while there is little distinction between the more and less important, and old and wellnigh obsolete apparatus is apt to be described to the exclusion of the more modern. The chapters on electrical matters will doubtless suffice for the practical steam engineer who has the care of electrical apparatus thrust upon him, and who desires only a smattering of electrical knowledge. While the book contains much that is good, its sins of omission and commission are many, and this is hardly excusable in a sixth edition.

DIE TELEGRAPHIE OHNE DRAHT. By Prof. Augusto Righi and Prof. Bernard Dessau. Braunschweig: Friedr. Vieweg & Sohn. 665 pages, 312 illustrations. Price, 15 marks.

This volume is the second and revised edition of the excellent treatise on wireless telegraphy by Prof. Righi, of the University of Bologna, and Prof. Dessau, of the University of Perugia. The matter in the book has been thoroughly revised to date of publication, and a number of sections added to take account of the latest developments in wireless telegraphy. A new section is that on the theory of electrons and the section on electric waves has been enlarged in order to take account of the latest investigations on this subject, having particular bearing on wireless propagation. Magnetic and electrolytic detectors form the subject of still another new section.

About half the book is devoted to descriptions of systems and of apparatus, in which all the newer apparatus is fully covered. An appendix is devoted to the Poulsen system, written after the main portion of the book had gone to press. It may be added that the authors in their preface speak highly of the possibilities of this system. Another appendix contains German rules that have been laid down for the control of wireless communication, and the full text of the regulations laid down at the recent International Wireless Telegraph Congress.

A valuable feature of the book is a list at the end of each chapter of references to all of the authorities quoted or referred to in any manner, the aggregate of these additions forming a valuable contribution to the bibliography of wireless telegraphy. References to the principal patents are given by number and date.

All interested in wireless telegraphy will find this work not only of value and interest as a treatise on the subject, but a most useful book of reference. It is, in fact, the most important treatise on wireless telegraphy which has thus far appeared in print, both from its authoritative character and the thoroughness in which every phase of the subject is considered.

PRACTICAL MAGNETISM AND ELECTRICITY. A First Year's Course Specially Adapted to the Wants of Technical Students. By P. E. Shaw, B. A., D. Sc. London: "The Electrician" Printing & Publishing Company. 64 pages (interleaved), 51 illustrations. Price, $1.

The author in his preface states that this little book is designed for the use of a large and growing class of technical students who have not even a primitive mathematical training, and who cannot, or will not, acquire it as a foundation for physical science; this class is later referred to as consisting of skilled or unskilled artisans who require some knowledge of electricity in their daily work.

Aside from brief explanations of elementary theory, the contents of the book consists of brief descriptions of, and simple experiments with, galvanometers, resistance boxes, potentiometers, ammeters, voltmeters, telephones and telegraphs. Various other subjects are briefly considered, such as primary cells, the wireless telegraph, the electric motor, and the candle-power and efficiency of the incandescent lamp. The range is a large one to be covered in 64 pages, but the book should be of service to those who desire to obtain a speaking acquaintance with electrical principles with the least possible labor, or may serve as a reference book for manual training school students. The sheets are interleaved with blank paper.

"THE ELECTRICIAN" ELECTRICAL TRADES DIRECTORY, 1907. London: "The Electrician" Printing & Publishing Company. Price, $6.

With the present issue, the well-known "Blue Book" completes a quarter century of useful existence, during which it has grown from a slim volume to a bulky tome of more than 2000 pages. The present edition returns to a former practice by including in one volume the directory and biographical sections; the wisdom of this recombination one may well doubt in handling the bulky results. To recapitulate adequately the features of this valuable combination of reference book and directory would take columns of space, and would be unnecessary in the case of such a well-known publication. Among new matter are notes on progress during 1906 in electric traction, electric power, and on the application of electric motors to industrial work; submarine and overland telegraphy, and of wireless telegraphic development, both at home and abroad. In addition are noted the salient features of post office, national and municipal telephone progress in the United Kingdom in 1906, the development of the steam turbine, the progress made in electric lamp improvements. A summary is given of Parliamentary work in the past session so far as legislation has affected the electrical industry. The law of electric lighting, electric power, electric traction, telegraphs and telephones is covered by a digest prepared by Mr. A. C. Curtis-Hayward, solicitor, and the principal legal decisions of the High Courts in 1906 affecting the electrical industry are also digested. The subject of patent law and expiring patents, of rules for the installation of electric light, power and traction plants in Great Britain, the underwriters' rules of all the leading companies, as well as those which govern electrical installations in the United States, Germany, France, Switzerland and other Continental countries, and also in the British colonies, are included in this volume.

ESSAIS DES MACHINES A COURANT CONTINU ET ALTERNATIF. By P. Bourguignon. Paris: Ch. Beranger. 298 pages. Price, 15 francs.

The author of this volume has presented a very practical and fully illustrated treatise of elementary tests on direct and alternating-current machines. The scope of the work is indicated by the following brief analysis of the chapters:

I, Introduction; II, Rheostats; III, Characteristics of Generators and Motors; IV, Measurement of field and armature winding resistances, and of temperature-elevations; V, Measurement of efficiency; VI, Different types of mechanical brakes; VII, Opposition methods; VIII, Tests of series motors; IX, [illegible]; X, Measurement of the [illegible]

[illegible] alternating currents; XII, Tests of alternators; XIII, Tests of transformers; XIV, Tests of synchronous motors and commutator motors; XV, Tests of synchronous motors; XVI, Tests of single-phase commutator motors; XVII, Determination of magnetic distribution along pole pieces.

At the end of the book is a collection of the standardization rules of the American Institute of Electrical Engineers, of the German Verband Deutscher Elektrotechniker, of the Association Alsacienne des Proprietaires d'Appareils à Vapeur and of the Syndecat Professionel des Industries Electriques in Paris. The provisions of these various sets of rules are repectively compared in a brief final chapter.

The treatment is clear and employs graphic methods to a considerable extent. The book will be of value to students of electrical testing of machinery in all parts of the world. An index of subject-matters is much needed and it is hoped that a subsequent edition may furnish one.

Modern Lightning Conductors. By Killingworth Hedges. London: Crosby, Lockwood & Son. 119 pages, 74 illustrations. Price, 6 shillings 6 pence.

The author of this useful book is the honorary secretary of the British Lightning Research Committee, and in that capacity has since 1901 personally or through several hundred enrolled observers investigated numerous cases of lightning stroke with a view to gathering data bearing upon the protection of life and property from this danger. The book gives under a number of heads digests of the more instructive of the reports received, in many cases accompanied by illustrations, which matter is supplemented with practical information on the subject of lightning protection, together with notes on a wide range of subjects having more or less connection with lightning. In fact, the book lacks logical arrangement, and has rather the character of a collection of notes, many of a random nature, than that of a systematic treatise on the subject indicated by the title. It supplies, however, a much needed contribution to a subject represented by a very meagre literature.

The book opens with a reprint of Sir Oliver Lodge's introduction to the Lightning Research Committee's Report of 1905, which is short and perfunctory. Chapter I gives an account of the formation of the committee. The following chapter has the head, "Characteristics of a Flash of Lightning," and consists principally of abstracts from the committee's report and Lodge's "Lightning Conductors." Chapters III and IV are the most important in the book, consisting of a reprint of the committee's suggestions and rules for lightning protection, with an illustrated account of methods of protection and testing. Chapter V, entitled "Considerations as to Cost and Specifications," includes a specification by the author for various kinds of buildings. Chapter VI consists of notes on American and Continental practice, and the two following chapters contain selections from observers' reports. The two final chapters consist of miscellaneous notes. A method patented by the author for lightning protection figures largely in the text and in an advertising section bound with the book.

Brakes for Tramway Cars. By Henry M. Sayers. London: "The Electrician" Printing & Publishing Company. 76 pages; illustrated. Price, $1.50.

This little pamphlet is based upon a series of articles contributed by the author to *The Electrician*, of London. The opening chapter treats of general considerations; the three following chapters are devoted to wheel brakes; chapter 5 has for subject track brakes, mechanical and magnetic; chapter 6 treats of the adjustment and maintenance of brakes, and the following chapter gives a reprint of a long report on an accident caused by a defective brake, while in the final chapter are formulas and constants for the calculation and tests of brakes and of acceleration and retardation. The descriptions of brakes are confined to somewhat summary accounts of the Raworth's regenerative brake, the General Electric magnetic track brake, and the Westinghouse combined track and wheel brake.

Electricity in Mining. By Sydney F. Walker. New York: D. Van Nostrand Company. 385 pages, 163 illustrations. Price, $5.00.

The author is well known as an authority on application of electricity to mining work, of which he has been a doughty advocate for a score of years or more, through the technical press and in papers before professional societies. He is therefore particularly fitted to be the author of a book on the subject. While the work has little of the character of a systematic treatise, it enters fully into the practical side of the subject, although the different phases of it are treated without much connection with each other. Considerable space is given to the description of boilers, prime movers and the accessories, which have no further connection with the subject than that they are necessary in the generation of electric power, and similarly many of the descriptions of electrical apparatus, such as the mechanism of various types of arc lamps, appear out of place. The book opens with the inevitable chapter on electrical theory. Its real subject is taken up in the second chapter, which deals with electric mining signals in detail, blasting by electricity, and electrical firing apparatus. Apparently in order to be considered up to date, the author has added a section on "Wireless Telegraphy for Mines." The following section is on electric lighting for mines, very little of which, however, relates specifically to electric mining work except the final section on portable electric lamps. Chapters 4 and 5 on the generation of electricity and distribution of power by electricity deal largely in descriptions of apparatus that would appear to have only an academic interest to the average person connected with mining. Here and there, in these chapters, however, there are pages in which specific applications to mining work are described. Chapter 6 is on application of electricity to driving machines, etc., in mines, and this is directly to the point, relating specifically to the use of electric motors at the shaft-head and in the mines for cutting, hauling and ventilation. The final chapter is on faults in electric apparatus, their detection and correction.

Owing to the rather haphazard arrangement of the book, and the large amount of extraneous matter, the work is not so well fitted for consecutive reading as it is for reference; but in the latter respect, it will be found useful by everyone interested in mining operations.

Prüfung Elektrischer Maschinen und Transformatoren. By Friedrich Weickert. Hannover: Dr. Max Jänecke. 119 pages, 64 illustrations. Price, 1.80 marks.

This little book is No. 50 in the Jänecke "Bibliothek der Gesamten Technik," which at present includes almost 60 titles. It is intended more particularly as a handbook for working electricians in the testing of electrical generators, motors and transformers. The first section gives brief descriptions of various forms of measuring apparatus. The second section treats the methods of measurements, and the third section—which occupies more than half the book—gives instructions for the application of the methods to direct-current machines, alternators, synchronous motors, and single, two and three-phase motors and transformers. The book should be useful to the class for which it is intended, and is not without interest to electrical engineers in general.

Die Krankheiten Elektrischer Maschinen. By Ernst Schulz. Hannover: Dr. Max Jänecke. 88 pages, 42 illustrations. Price, 1.40 marks.

The English translation of the above title—"The Diseases of Electrical Machinery"—indicates clearly the character of the contents. The present is a second and revised edition of the book. There are four main sections, treating respectively the subjects of direct-current machinery, single and polyphase generators, single and polyphase motors, and single and polyphase transformers. A fifth section considers the subject of efficiency. All the various troubles that may arise in the operation of these types of machinery are considered in turn, and directions given as to how they may be remedied.

Electric Blasting. Apparatus and Explosives, with Special Reference to Colliery Practice. New York: D. Van Nostrand Company. 166 pages, 84 illustrations. Price, $3.50.

While written with reference more especially to coal mining, this work will be found useful to all having to do with electric blasting. The subject is treated under the heads of electric fuses and detonators, exploders, wires and cables, testing, explosives and explosive risks, practical applications, laws and regulations relating to the storage and use of explosives. The sections of the book of the greatest value from the practical standpoint are the two latter. That on practical applications gives instructions in full detail for drilling, adjusting the charge to the work in hand, tamping, connecting up, precautions to observe, etc. The British laws and regulations relating to the use and storage of explosives are valuable both for reference and information of direct practical value.

Explanations of Switch and Signal Circuits. By John T. Doran. New York: Doran & Kasner. 140 pages; illustrated. Price, $1.50.

Evidently intended for the guidance of railway men needing practical information relating to the connections and maintenance of railway track signals, this little book merits favorable consideration from this class. Numerous diagrams of circuits are given with accompanying descriptions in many cases, and a number of half-tone plates illustrate apparatus in place. The text also includes a short section on storage batteries and a reprint of such rules of the National Electrical Code as apply more particularly to the conditions of signal wiring in railroad buildings.

Electrical Equipment of the Laurentide Pulp & Paper Company.

By Norman G. Meade.

The mills of the Laurentide Pulp & Paper Company are located at Grand Mere, Province of Quebec, Canada, on the banks of the St. Maurice River, which supplies water power for the generating station and the departments that are operated by hydraulic power. The credit for the successful design and installation of this plant is due to Mr. George F. Hardy, mill architect and hydraulic engineer, of New York City, who was one of the first engineers to advocate electric drive for pulp and paper machinery.

The generating equipment consists of two 300-kw, three-phase, 25-cycle, 440-volt revolving-field generators direct-coupled to 40-in. water wheels rated at [illegible] brake horse power each. Lombard water wheel governors are used and direct current for excitation is furnished by a 37½-kw. [illegible] generator.

The motor equipment is supplied with energy from a three-phase, 25-cycle, 440-volt system [illegible] and consists of the following applications: One [illegible]-hp motor driving [illegible] machines for ground wood pulp, with a combined capacity of from 130 to 150 tons per day, and 20 Decker screens; one 40-hp motor driving 14 screens; one 200-hp motor driving the variable speed end, and one 50-hp motor driving the wet end of a Fourdrinier paper machine making newspaper 114½ ins. wide at the rate of 374 ft. per minute. This machine is

Fig. 2.—100-hp Induction Motor Driving Triplex Pumps.

equipped with 30 dryers; one 200-hp motor driving the variable-speed end, and one 75-hp motor driving the wet end of a Fourdrinier paper machine making newspaper 92 ins. in width at the rate of 503 ft. per minute. This machine is equipped with 29 dryers; one 40-hp motor driving a beater, used for beating waste paper from the paper machines. By means of

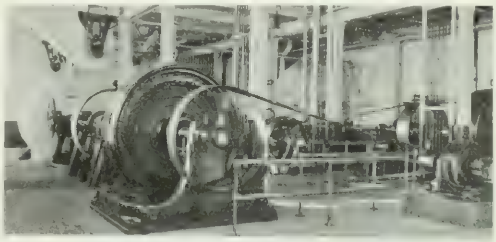


Fig. 3.—Interior of Power House.

a Morse chain-drive, slippage with belts is avoided, and the vertical adjustment of the beater roll is easily accomplished. One 40-hp motor operating a block chain for conveying wood blocks to the wood room. This chain runs at an angle to a height of 65 ft. and extends 350 ft. horizontally. One 100-hp motor driving five triplex pumps for general water supply.

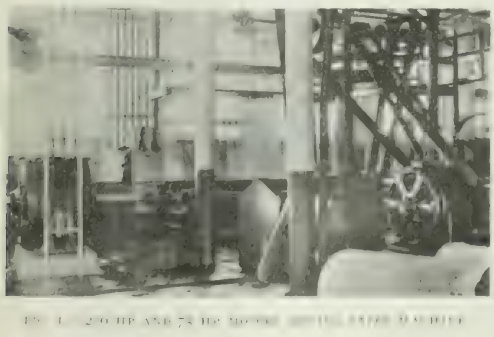


Fig. 1.—200-hp and 75-hp Motors Driving Paper Machine.

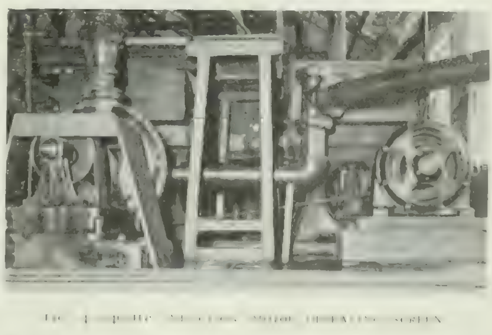


Fig. 4.—[illegible] Motor Operating Screen.

One 20-hp motor operating [illegible] elevator and small repair shop; one [illegible] motor operating a small elevator, and one 15-hp motor operating an elevator in the wood tower.

The motors are all of the polyphase induction type and were supplied, with the rest of the electrical equipment, by the Westinghouse Electric & Manufacturing Company.

Vertical Turbo-Generators.

The accompanying illustrations indicate some interesting solutions of the many difficult problems encountered in the design of high-speed turbo-generators. A four-pole smooth-core rotor field structure in course of construction is shown in Fig. 1. The main body of the magnetic material is built up of steel discs containing uniformly spaced dovetails. The pole faces are built up into place by inserting bundles of steel "teeth" which fit snugly into the dovetailed slots, the coils are then

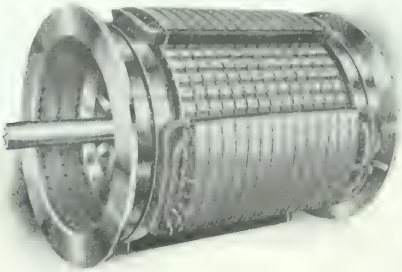


FIG. 1.—FOUR-POLE SMOOTH-CORE ROTOR IN COURSE OF CONSTRUCTION.

laid on the remaining surface, and additional teeth, with recesses for containing the coils, are slipped into place. When the "dental work" is completed, the form-wound field coils are contained in slots that are almost closed, and from which they can not possibly be thrown by centrifugal force. The end portions of the field coils are held in position against the outward thrust by means of heavy steel bands, which are bolted to the armature spider. The rigid method of supporting the field coils insures

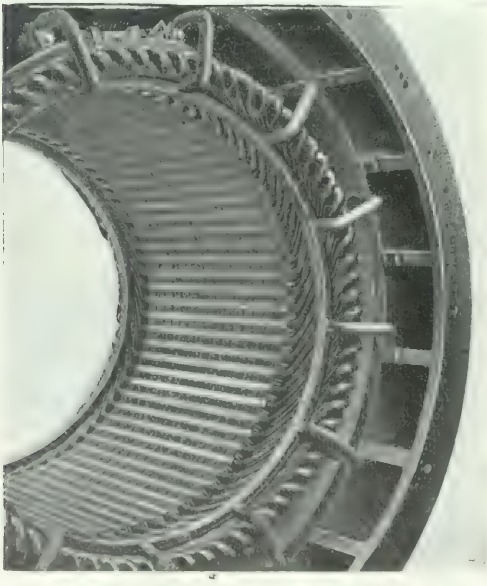


FIG. 3.—STATIONARY ARMATURE WINDING.

the maintenance of perfect balance and gives wonderful mechanical strength to the whole revolving structure.

Fig. 3 shows the solid support used for the end portions of the stationary armature coils, which effectually prevents the possibility of injury by motion which otherwise would be caused in the end portions by the magnetic strains imposed by short circuits.

The rotor core is so designed that it acts as a powerful impeller, which forces a large volume of air definitely into the parts of the generator structure requiring ventilation. The air is taken into the generator usually through a single opening and is discharged after it has circulated through the cores and windings. The outside casing of the stator is a closed casting which serves to deaden the sounds which may be occasioned by movements of air in the machine, and at the same time it does not prevent proper flow of air to all parts which it should reach. The air-impelling force of the rotor is so definite that the air supply can be drawn through a pipe from some outside source,

FIG. 2.—SMOOTH-CORE ROTOR FOR 9000-KW TURBO-GENERATOR.

which is generally desirable in order to secure cool air. It is stated that the generators provided with the ventilating devices described above operate practically without noise.

The method of constructing turbo-generators here outlined is the one employed by the General Electric Company with its large machines that are driven by vertical Curtis turbines. The illustrations show parts of one of four 9000-kw turbo-generator units installed in the Fisk Street station of the Commonwealth Electric Company of Chicago. It is interesting in this connection to note that at a load of 10,186 kilowatts, a steam gauge pressure of 176 lbs. per sq. in., superheat of 147 degs. F., and a vacuum of 29.47 ins. mercury, the steam consumption was 12.9 lbs. per kw-hour.

Motor-Driven Valves.

One of the great inconveniences of a large water-works system resides in the fact that the valves and gates cover such a large area that control of them is very difficult. This inconvenience is very simply overcome by operating the valves by means of electric motors, each valve being equipped with a small motor. Not only does this system permit control from a distance, but the time consumed in opening and closing the

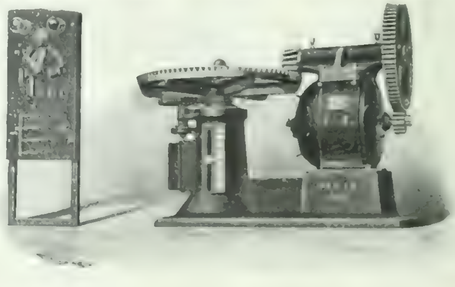


FIG. 1.—FLOOR STAND AND CONTROLLING PANEL.

valve is reduced to a minimum as is also the labor expended. In the case of valves of any considerable size the latter is an important item.

Each valve equipment consists of valve and gearing, a motor and an automatic limit switch. The controlling mechanism consists of a double-throw switch and a starter. A floor stand and

controlling panel are shown in Fig. 1, and a complete equipment in Fig. 2.

The operation of the valve is as follows: The limit switch is so constructed that when the valve is at either end of its motion the motor can be operated only in the proper direction. If the valve be open and it is desired to close it, the double-throw switch on the panel is thrown over and the motor is thus started. When the valve closes, the limit switch automatically opens the circuit and stops the motor. The motor can then be started only in the opposite direction. This is done by throwing over the double-throw switch and re-starting the

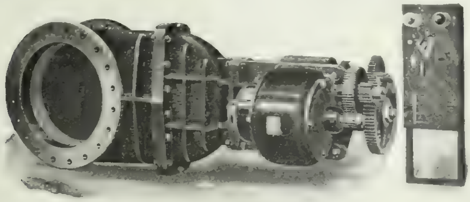


FIG. 2.—COMPLETE MOTOR-DRIVEN VALVE EQUIPMENT.

motor. When the valve opens fully the limit switch again opens the circuit. Thus, it will be seen that the operation is very simple and accidents from misuse impossible.

The motors, which are built by the Crocker-Wheeler Company of Ampere, N. J., are of very compact construction, have a large torque, and are capable of withstanding heavy over-loads. For this reason very small space is necessary for the motor, in comparison with the force required. A large number of these valve equipments have been recently installed in the Cincinnati Water Works, and have given satisfaction.

Sectional Cooling Tower and Spray Preventer.

The principal difficulties that have been experienced in the operation of cooling towers of the open, natural draft type have been the limited exposure of the water to the air currents, due to the spray in the outer portion of the tower blanketing the inner portions of the tower, and the loss of water in spray

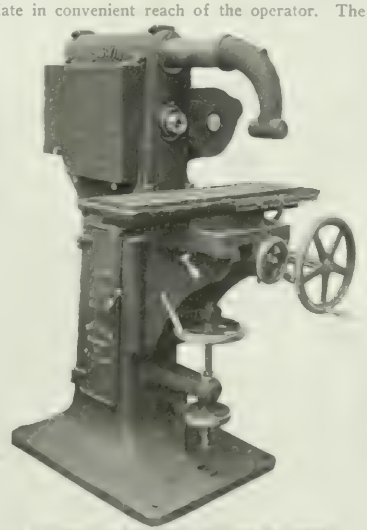
COOLING TOWER AND SPRAY PREVENTER.

blown by the wind beyond the limits of the tower. These have both been eliminated, it is claimed, in the new design of tower construction recently perfected by B. Franklin Hart, Jr., & Company, New York, which is here illustrated. The feature of the new tower is the use of a new form of sectional cooling tray with serrated edges causing the water to fall from stage to stage in finely divided streams, and yet permitting the general distribution of air currents throughout all portions of the tower between the sectional trays. The sectional trays as installed are long, shallow troughs a few inches in width which are built in any length required by the capacity of the tower and are located in the tower in stages with small spaces between edges. While ordinarily built of galvanized iron, they may be built of copper, wood or cast-iron where the liquid to be cooled might attack the sheet metal, it only being necessary to cut grooves in both edges at frequent intervals through which the water may run over the edges. The trays are of light construction, and are supported by structural iron framing, the attaching bolts at either ends of the trays serving as the spacers between edges. This permits them to be easily removed at any time desired for replacement or for change in arrangement. The entire construction is well adapted to installation in old towers which have been found of insufficient capacity or where tower construction is not permissible and it is necessary to install the system in ill-adapted spaces. Owing to the spaces between trays, the efficiency of this type of construction in operation is claimed to be greater than that of the other forms.

The spray preventer construction involves the use of galvanized-iron baffle plates or enclosures, which are hung at each stage and on such sides as to catch the spray carried outside by prevailing winds. The baffles are hung some distance out from the tower so as not to interfere with the wind currents of ordinary intensity, and are inclined inward toward the bottom which is flanged into a gutter to collect the water and deliver it to the tower again. The tower is intended for cooling water and liquids for any purpose and is effective without the use of fans or moving machinery.

Electrically-Driven Milling Machine.

The illustration herewith shows a recent application of motor drive to a milling machine. A 2-hp. 3-to-1 variable-speed motor is mounted on a plate on the rear side, and geared direct to the spindle. The motor is thus located in the most desirable position as regards space, protection from dirt, and efficiency of transmission. The rheostat and switch are mounted on the front plate in convenient reach of the operator. The gearing



ELECTRICALLY-DRIVEN MILLING MACHINE.

is totally enclosed. The machine, which is simple and substantial, is intended for general plain milling. The table has a screw feed, with automatic trip and quick movement by a large hand wheel. Micrometer vertical adjustment of the knee is provided, and the telescope arm carries a hardened and ground outboard bearing for the arbor. The weight of the machine is 1700 lbs. The maker is the Garvin Machine Company, of New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of the mercantile agen [illegible] the conditions in 1906 were more favorable and there is now the handicap of almost prohibitive rates for commercial paper. Many contemplated undertakings await more normal financial conditions, but general business throughout the country is making fairly good progress. Seasonable merchandise moved briskly but reports of collections were irregular. In agricultural districts the marketing of the crops at high prices makes the payments satisfactory, but at many Eastern centres there is complaint of delayed settlements. Several strikes are still retarding progress and some machinery is idle at woolen mills, but most industrial plants are well occupied and are assured of continued activity, up to the end of the year, at least. Railway earnings in September were 11.1 per cent larger than in 1906, and foreign commerce at the port of New York during the week showed a gain of $588,181 in exports, and a loss of $2,114,735 in imports. Building materials as a whole are quieter. Iron is quiet and the volume of finished goods ordered is smaller than some time ago, although rails and structural material are slightly more active. Future trade in the latter, however, is not up to expectations, for which the tightness of the money market is largely responsible. The demand for steel rails is somewhat improved, but financial difficulties and the failure of the manufacturing and railroad interests to agree on specifications retard the placing of much new business. Copper was weaker, the pressure to sell being very marked. Quotations for lake brands for future delivery are now on the basis of 14 to 14¼ cents, while for electrolytic as low as 13½ to 13⅝ cents has been named. Lake closed at 14 cents; electrolytic 13⅝ cents; casting 13½ cents. *Bradstreet's* reports 192 business failures in the United States during the week, against 177 in the previous week and 192 in the corresponding period of 1906.

THE B. F. STURTEVANT COMPANY, Hyde Park, Mass., reports the following sales of electric generating sets, noted by F. R. Chinnock of the electrical department from its New York office, Engineering Building, 114 Liberty Street: Benj. Hitchings, Flatbush, Brooklyn, N. Y., one 9 x 8 vertical engine, 22½-kw generator. David Rodgers Company, Paterson, N. J., one 13 x 12 horizontal engine, 50-kw generator. International Paper Company, New York City, one 5 x 5 vertical engine, 6-kw generator. Chas. E. Ring & Company, Brooklyn, N. Y., one 9 x 9 vertical engine, 30-kw generator. Peter Hauck Brewing Company, Harrison, N. J., one 13 x 13 horizontal engine, 50-kw generator. Chas. Hakemeyer Company, Paterson, N. J., one 17½-kw generator. Bedford Reformatory for Women, Bedford, N. Y., one 13 x 12 horizontal engine, 50-kw generator. Department of Docks and Ferries, New York City, ferryboat *New York*, two 9 x 8 vertical engines, 30-kw generators; ferryboat *Richmond*, two 9 x 8 vertical engines, 30-kw generators; ferryboat *Castleton*, two 9 x 8 vertical engines, 30-kw generators; ferryboat *Queens*, two 9 x 8 vertical engines, 30-kw generators; ferryboat *Middletown*, two 9 x 8 vertical engines, 30-kw generators; ferryboat *Gowanus*, two 9 x 8 vertical engines, 30-kw generators; ferryboat *Bay Ridge*, two 9 x 8 vertical engines, 30-kw generators. J. G. White & Company, New York City, two 3½ x 3 vertical engines, 3-kw generators. American Sapphire Company, Colorado, one 7 x 7 vertical engine, 15-kw generator. Chrome Steel Company, Chrome, N. J., one 3½ x 3 vertical engine, 3-kw generator. American Can Company, Lubec, Maine, one 13 x 12 horizontal engine, 50-kw generator; one 10-hp motor; one 15-hp motor. Wm. Sheehan & Company, New York City, one 11 x 10 horizontal engine. H. Wales Lines Company, Meriden, Conn., one 11 x 10 horizontal engine, 30-kw generator; one 7 x 7 vertical engine, 15-kw generator. Eagle Brewing Company, Newark, N. J., one 11 x 10 horizontal engine, 40-kw generator. James Shewan & Sons, New York City, four 7 x 7 vertical engines, 25-kw generators. Vulcan Detinning Company, Sewaren, N. J., one 7 x 7 vertical engine. Tintern Manor Water Company, Redbank, N. J., one 4½ x 4½ vertical engine, 5-kw generator; one 6 x 5 vertical engine, 7-kw generator. Hudson Companies, York Street operations, Jersey City, N. J., three 10-18 x 10 vertical cross-compound engines with 100-kw generators; one 8-14 x 8 vertical engine, 50-kw generator; two 8-14 x 8 vertical engines, 50-kw generators; two 12 x 10 vertical engines, 50-kw generators.

WESTINGHOUSE FACTORIES.—A prominent official of the Westinghouse Electric is reported from Boston as follows: "Both the General Electric and Westinghouse Electric Companies have been conducting their manufacturing operations under such high pressure during the past five or six years that they have fallen far short of the best manufacturing results obtainable under normal conditions. Until within a few months the orders of both companies had greatly exceeded their respective manufacturing facilities, and all operations were necessarily conducted under high tension and with much crowding. The Westinghouse Company is taking advantage of the present general condition, while maintaining its output at the rate of $40,000,000 per year, to make rearrangements and changes which, when completed, will greatly increase the total capacity of its several works. In carrying out these changes many employees who have been engaged in night work can be dispensed with, as well as a large number who have been engaged in building operations, which are now practically completed."

NEW METHOD OF INSULATING WIRE.—An invention for insulating wire for electrical purposes with an enamel finish instead of with silk or cotton, has been sold by Charles H. Shaffer, of Muskegon, Mich., to W. H. Reynolds, Harry Diefendorf and Abraham Weymouth, of Chicago. Mr. Shaffer retains the royalty of 10 per cent and the right to manufacture. The machine consists of a slender perpendicular over [illegible] tall, through which the wire passes to be heated for the process, and of a chemical bath beneath, in which the wire is dipped. The solution is a secret one. Wire as fine as a No. 40 has been thus prepared in the tests and it is asserted works successfully at double the voltage as in the old method. The buyers say that they are now negotiating to sell their acquisition to a large Chicago wire firm

TURBO ALTERNATORS FOR YOUNGSTOWN.—The Youngstown Sheet & Tube Company, of Youngstown, Ohio, has just completed the purchase of two 1500-kw Allis-Chalmers steam turbine units for addition to the present plant at Youngstown. Mr. Julian Kennedy, of Pittsburg, was the consulting engineer. Both units are for 25-cycle, 3-phase currents at 6600 volts, one to operate condensing and the other non-condensing with steam pressure of 150 lbs. per sq. in. The exhaust from the non-condensing turbine will be utilized for heating boiler feed water in an open-type heater.

CATALOGUES AND PRICES.—Mr. Miller Reese Hutchison, exporting engineer, 1 Madison Avenue, New York City, representing in the United States several foreign importing concerns, requests six catalogues and six export price lists of the following: mining machinery and supplies; steam plant machinery and supplies; pipe fittings and pipes; electrical machinery and supplies; sawmill machinery and supplies; industrial railway machinery and supplies; gasoline, gas and oil engines; building materials; machine and hand tools.

NAVY BIDS.—The Bureau of Supplies and Accounts, Navy Department, Washington, will open bids Oct. 29 for electrical supplies, as follows: 22 distribution cabinets and panels for the Charleston, S. C., Navy Yard (schedule No. 413); electrical supplies and 40,000 glass tube fuses for the Mare Island, Cal., Navy Yard (schedule No. 375); 1 motor generator outfit for the Norfolk, Va., Navy Yard (schedule No. 378), and 1 motor drive outfit for the Charleston, S. C., Navy Yard (schedule No. 381).

NEW JERSEY ELECTROCUTION.—The Board of State Prison Inspectors of New Jersey has just awarded the contract for the electrical apparatus for the new electrocution building to the Adams Electric Company, of Trenton, for $1,040. The

bid calls for the work to be completed in six weeks. From the appropriation of $10,000 which the Legislature appropriated for the electrocution building the board has only $362 left. The matter of the expense of the electrocutions for which the Legislature made no appropriation has been taken up by James Mitchell, of Millville, president of the board of inspectors, with Attorney-General McCarter, who was asked by Mitchell if the surplus left from the general state prison appropriation, which will amount to about $7,000 this year, could be used to defray the expenses of electrocuting condemned murderers. The attorney-general recommended that a special act or appropriation be asked for of $2,500. It is stated that the average cost per electrocution in other states is $200.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was nervously irregular and showed decided weakness at times, with declines throughout the list, due to high money rates, threatened gold export, and heavy foreign liquidation. Other unfavorable features were the failure of the expected Northern Pacific extra dividend to materialize, and disquieting revelations regarding traction finance at New York. Both industrial and railroad stocks suffered equally; the copper shares being also depressed on renewed concessions in the metal. There was further pressure on the United States Steel shares, coupled with reiterated statements that the company's orders were diminishing. Southern Railway was again the object of selling, and made another low record for the year. There was little business transacted in electric stocks and in some cases the declines were heavy. Westinghouse led the declines with a net loss of 16½ points, the closing quotation being 110. General Electric followed with a net decline of 10 points, closing at 114½ after touching 113⅛. On the curb market, prices reached new low levels for the year in some issues under renewed liquidation. The mining group suffered most, but various high-priced shares stood the pressure of the selling very well. Following are the closing quotations of October 15:

NEW YORK

	Oct. 8	Oct. 15		Oct. 8	Oct. 15
Allis-Chalmers Co.	7	[illegible]	General Electric	122	[illegible]
Allis-Chalmers Co. pfd.	19½	16	Hudson River Tel.	—	—
Am. Dist. Tel.	—	20	Interborough Met. com.	[illegible]	8
American Locomotive	50½	45½	Interborough Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	99¼	92	Mackay Cos.	[illegible]	57½
American Tel. & Cable	75	75	Mackays Cos. pfd.	[illegible]	56
American Tel. & Tel.	104	100	Marconi Tel.	—	—
Brooklyn Rapid Transit	45⅝	41	Metropolitan St. Ry.	35	35
Electric Boat	—	—	N. Y. & N. J. Tel.	[illegible]	—
Electric Boat pfd.	—	—	Western Union Tel.	72	69
Electric Vehicle	—		Westinghouse com.	115	110
Electric Vehicle pfd.	—	—	Westinghouse pfd.	165*	

BOSTON.

	Oct. 8	Oct. 15		Oct. 8	Oct. 15
American Tel. & Tel.	[illegible]	102	Mass. Elec. Ry. pfd.	47½	—
Cumberland Telephone	-	98½	Mexican Telephone	—	[illegible]
Edison Elec. Illum.	—	198	New England Teleph.	—	—
General Electric	125	112¼	Western Tel. & Tel.	—	[illegible]
Mass. Elec. Ry.	—	—	West. Tel. & Tel. pfd.	—	—

PHILADELPHIA.

	Oct. 8	Oct. 15		Oct. 8	Oct. 15
American Railways	46½	46½	Phila. Electric	7½	[illegible]
Elec. Co. of America	8¾	8½	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery	42	39	Phila. Traction	87	86¾
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Oct. 8	Oct. 15		Oct. 8	Oct. 15
Chicago City Ry.	[illegible]	[illegible]	National Carbon	[illegible]	[illegible]
Chicago Edison	[illegible]	[illegible]	National Carbon pfd.	—	117
Chicago Subway	—	16¾	Union Traction	—	—
Chicago Tel. Co.	—	[illegible]	Union Traction pfd.	-	-
Metropolitan Elev. com.	[illegible]	20*			

*Asked.

WESTERN UNION REPORT.—The annual report of the Western Union Telegraph Company, which was made public last week, shows the largest increase in gross earnings in the past eight years. The actual gain in gross was $2,180,752, or 7.1 per cent, of which approximately $1,100,000 appears to have been created through new business, and $1,000,000 by an advance of 2.1 cents in the average gross receipts per message. At the end of the 1905 year the company had $593,514 greater current liabilities than current assets. On June 30 last the balance had turned to a credit item of $[illegible], of which $3,104,016 was in cash. This is, of course, the direct result of the issuance, during the year, of $7,200,000 4 per cent convertible bonds. Another favorable factor is the persistency with which the company has kept up its maintenance charges against earnings, in spite of a very heavy increase in other operating expenses.

In the past seven years the gross receipts of the company have increased $8,097,837, or 32.7 per cent. Wire mileage has grown 400,987 miles, or 35.6 per cent. Maintenance charges per mile of wire have been considerably increased, being $3.45 per mile last year, against $2.63 per mile in 1900, a gain of 31.1 per cent. Some of the essential features in the seven years' growth are contained in the following:

	1907.	1900.	Increase.	Per Cent Inc.
Gross	$32,856,406.00	$24,758,569.00	$8,097,837.00	32.7
Operating expense	26,532,196.00	18,593,205.00	7,938,991.00	42.1
Operating ratio	80.7%	75.1%	5.6%	....
Miles wire and cable	1,526,845	1,125,858	400,987	35.6
Maintenance	5,278,293	2,959,998	2,318,295	78.3
Main. per mile wire	$3.45	$2.63	$0.82	31.1
Av. toll per message	33.7c	30.8c	20.9c	9.4
Av. cost per message	30.2c	25.1c	5.1c	20.3
Av. profit per message	3.5c	5.7c	22.2c	...

*Decrease.

President Robert C. Clowry says that the increase in operating expenses is due to the necessary outlay to care for the large number of messages handled, to the increase of 10 per cent in salaries of all the operators, which went into effect last March, and to the continued high prices of materials.

WESTERN ELECTRIC FINANCES.—Official announcement is made that the Western Electric Company will create a bond issue of $15,000,000. The directors have called a special meeting of the stockholders, which will be held in Chicago on Nov. 5 for the purpose of ratifying the proposition made by the board. The belief prevails that the company is preparing to increase its business and perhaps to engage in some other branches of the electrical line. This may involve the purchase of other interests, although the possibilities of this theory are not conceded by its officers. President E. M. Barton says that the bonds probably will not be sold for some time. In 1906 the Western Electric's gross sales aggregated $69,245,331, to finance which necessitated the piling up at one time during the year of a floating debt of $24,000,000. The company has at present but $15,000,000 capital stock outstanding, so that the percentage of gross sales to capitalization in 1906 was 461 per cent. How much of an anomaly there was in this situation, says the *Wall Street Journal,* may be judged by the following comparison of the gross sales and capitalization of the three large electrical companies during their last fiscal year:

Company.	Gross sales.	Capital.	Gross to cap.
Western Electric	$69,245,331	$15,000,000	461%
General Electric	60,483,659	66,455,550	91%
Westinghouse Electric	34,170,047	48,274,150	70%

The above comparison makes no allowance for the floating debt which the Western Electric was obliged to accumulate. This debt has been reduced through payments made by the telephone companies for supplies, and now stands at about $16,000,000. Adding to the $15,000,000 of stock $15,000,000 of floating debt, which probably represents a fair average for the year, gives a total of $30,000,000 "capitalization," and makes the percentage of gross sales to "capitalization" 230 per cent.

TELEPHONE SALE.—The United States Independent Telephone Company has sold its holdings in the Home Telephone Company, of Jamestown, N. Y., to a group of Jamestown capitalists, represented by Arthur C. Wade, of Jamestown. Negotiations looking to this sale were begun last winter. It is said that the Consolidated Telephone Company, of Buffalo, and the Jamestown Company, through the Inter-Ocean Telephone Company, a long-distance subsidiary of the Consolidated, will hereafter hold a close working agreement as a result of this sale.

CANADIAN GENERAL ELECTRIC.—A special meeting of the shareholders of the Canadian General Electric Company will be held Oct. 23 to amend the by-laws recently passed to issue $2,000,000 preference stock having priority of claim over the common stock in the matter of dividends. English capitalists, who will take the bulk of the stock, have demanded for the new stock having this preference a priority also in the matter of assets of the company.

DIVIDENDS.—The Boston Edison Company has declared the regular quarterly dividend of 2½ per cent, payable Nov. 1. Directors of the Mexican Telephone & Telegraph Company have declared the regular semi-annual dividend of 2½ per cent, payable Nov. 1.

BELL TELEPHONE STOCK.—Application has been made to the New York Stock Exchange to list $21,925,300 additional capital stock of the American Telephone & Telegraph Company

GENERAL NEWS

Construction News.

DECATUR, ALA.—The North Alabama Traction Company is con- [illegible]

JACKSON, ALA.—The Jackson Light & Power Company has perfected organization and will purchase and enlarge the present electric light plant, and will furnish energy for the proposed water works system, and also for several gravel pits near the city. It is proposed to construct a dam across Bassett's Creek, where a 35-foot head of water may be secured and about 600 horse-power developed. The capital stock of the company is $16,000, with the privilege of increasing it to $20,000. The officers are: B. H. Warren, president; S. H. Andrews, vice-president, and S. A. Stewart, secretary and treasurer.

EUREKA SPRINGS, ARK.—The plant and holdings of the Citizens' Electric Company have been purchased by a syndicate organized by George Sengel and George Tilles, of Ft. Smith. The company operated the street railway system, electric light plant and ice plant. It is said that the electric line will be extended south three miles to the lake, where a club house will be built, and also to Beaver, a distance of six miles, where an amusement park will be established. The following officers have been elected: George Sengel, president and treasurer; George Tilles, vice-president, and L. P. Miles, secretary, all of Ft. Smith.

PINE BLUFF, ARK.—The Central Arkansas Electric Railways Company is contemplating the construction of an electric power plant to operate its proposed railway. The present plan is to purchase coal mines and build the power plant at the mines, but as yet nothing definite has been decided upon. A. M. Van Auken is chief engineer.

ALAMEDA, CAL.—F. E. Browning, city clerk, writes that it is proposed to erect a fireproof building for the municipal electric light plant and install some new machinery.

BADITO, CAL.—The Southern Colorado Power Company has been incorporated to construct a reservoir and water power plant on Huerfano River at Badito The plant will have a capacity of about 10,000 horse-power and will supply electricity to all the towns and mines in the vicinity of Badito. It is probable that the company will furnish electric energy to operate the mines of the Colorado Fuel & Iron Company.

CHICO, CAL.—L. D. Macy has applied to the City Council for a franchise to construct and operate an electric lighting, heating and power plant in this city for a term of 50 years. Mr. Macy owns water rights on Little Chico Creek, near West Branch, and contemplates erecting a plant at that place.

ENCINAL, CAL.—Plans are being made by the Northern Electric Railway Company to erect a freight and passenger depot and a substation at this place. The power house is now located in a portable car used for installing power-house machinery.

EUREKA, CAL.—The North Mountain Power Company has recently secured additional water power in Trinity County by another high head located on Canyon Creek, a tributary to the main Trinity River. The company is now building another large plant near this new head, which has a fall of 1200 feet, and is located 16 miles above the present power station at Junction City. The new plant when completed will have a minimum capacity of 14,000 horse-power. H. L. Jackman is superintendent of the company.

FRESNO, CAL.—The San Joaquin Light & Power Company has been awarded contracts for furnishing electricity to the Redbanks Orchard and other orchards and farms in Antelope and Stone Coral country for pumping water. The company is making arrangements to obtain franchises for its transmission line, work on which will commence at once. The line will be extended from Dinuba.

GLENDALE, CAL.—The right of way has been granted and a bonus subscribed for an extension of the Los Angeles-Pacific Railway from the Eagle Rock line to the centre of Glendale. Work will soon commence on the construction of the line.

MONTEREY, CAL.—Extensive improvements and extensions are being made to the power plant of the Monterey Gas & Electric Company at a cost of $100,000.

NEVADA CITY, CAL.—Work has been abandoned for the season on the Deer Creek power plant of the California Gas & Electric Corporation owing to the company not being able to secure water pipe.

OROVILLE, CAL.—The Southern Pacific Company is said to have purchased water rights on the Robinson place near Oroville, where 10,000 [illegible] be [illegible]

PASADENA, CAL.—A franchise for a double-track railway was awarded to the Pacific Electric Railway for $5,000.

PASADENA, CAL.—Heman Dyer, city clerk, writes that there is talk of calling an election to vote on the proposition to issue bonds for an addition to the municipal electric light plant. Charles C. Glass is manager of the plant.

SAN BERNARDINO, CAL.—The [illegible] Electric Light Company is making plans to erect a substation in this place and a transmission line from the plant of the Edison company to connect with its system in this city. The company has elected the following officers: I. C. Boyd, president; A. B. Paddock, vice-president, and I. F. Martin, secre- [illegible]

SAN DIEGO, CAL.—The City Council has granted a franchise to the Point Loma Electric Railway Company to construct and operate a street railway system on certain streets of the city.

SAN FRANCISCO, CAL.—Plans have been completed by the Southern Pacific Company for another large extension of its local system, consisting of an electric railway to Hayward.

SAN JOSE, CAL.—The Board of County Commissioners has granted J. A. Belloli permission to erect transmission lines or underground conduits over roads and public highways in the townships of Milpitas, Alviso, Santa Clara and all that part of San José township extending south as far as the northern limits of the city of San José. The franchise is for 50 years.

YREKA, CAL.—The Siskiyou Electric Power Company has installed another 1500-hp generator at the Fall Creek plant, which gives the plant a capacity of 2200 horse-power. Another generator of 1500 hp will soon be added to the plant.

ESSEX, CONN.—The citizens on Oct. 7 voted to accept the proposition offered by the Essex Light & Power Company to light the streets from Essex steamboat dock to Ivoryton. The company offers to supply 47 lamps at $1,259 per year for a three-year contract.

HARTFORD, CONN.—The Park Board has granted the Hartford Electric Light Company permission to lay a conduit across Lafayette Park.

TORRINGTON, CONN.—The W. W. Mertz Company, which has operated its own electric light plant for 15 years, is making arrangements with the Torrington Electric Light Company for service.

DUBLIN, GA.—An election will soon be held to vote on the proposition of issuing $60,000 in bonds to improve the water and light plants.

FITZGERALD, GA.—A franchise has been granted to C. A. Holtzendorf and associates to construct and operate an electric railway on certain streets in Fitzgerald. The franchise is for a term of 40 years.

MADISON, GA.—The citizens [illegible] $50,000 in bonds for water works, sewerage and improvement of the municipal electric light plant.

OROFINO, IDAHO.—Plans are being made for the installation of a water and electric light plant at Orofino at a cost of about $12,000. F. G. Lynch is interested in the project.

BUNKER HILL, ILL.—The Wood River, East Alton & Bunker Hill Traction Company is contemplating the construction of an electric railway from Wood River through East Alton, Bethalto, Moro and Bunker Hill, a distance of 20 miles. The Rude Engineering Company, of East St. Louis, is in charge of the engineering work. J. T. W. Rudisill is president of the traction company.

CHICAGO, ILL.—Application has been made to the Secretary of State by Fred W. Blocki, William F. Brennan, Jeremiah P. Bartholow, James P. Early and Kurt Stoehr to incorporate the Chicago Heat, Power & Refrigerating Company. The capital stock of the company is placed at $10,000. An ordinance asking for a franchise to operate in the streets of the city will soon be presented to the City Council by the company.

NASHVILLE, ILL.—New machinery is being installed in the plant of the Nashville Electric Light Company. Owing to the great increase in demand for electricity it has been necessary to increase the capacity of the plant. K. A. Steinhauser is manager.

CENTERVILLE, IND.—The Council is contemplating establishing a lighting plant.

EAST CHICAGO, IND.—[illegible] chancery of the East Chicago Water Works Company and the East Chicago Light & Power Company, practically one concern, has been confirmed by the Federal Court. The property was bid in by the bondholders to be taken over by the East Chicago & Indiana Harbor Water Company and the Indiana Harbor & East Chicago Electric Company, recently incorporated. It is understood that the city received $154,000 [illegible] companies. The city will also receive certain concessions for light and water.

EVANSVILLE, IND.—[illegible] building. Harry Stinson is county auditor.

MADISON, IND.—[illegible] son, Edward and William Powell, are organizing a company, the object of which is to purchase outright the plant and holdings of the Madison [illegible] contract.

FT. DES MOINES, IA.—[illegible]

MARSHALLTOWN, IOWA.—The business men of Marshalltown have agreed to subscribe $25,000 for the Melbourne interurban project, promoted by Hamilton Browne. It is expected that the banks here will take over another $25,000, and if they do Mr. Browne agrees to build the road. A 3 per cent tax has already been voted to aid the project, but to get the tax the road must be built and in operation by July 1, 1908.

COVINGTON, KY.—The Board of Aldermen has agreed to a proposed contract with the Union Light, Heat & Power Company for lighting the streets of the city and furnishing electricity for private purposes, which will be submitted to the Council for consideration. Under the terms of this contract the company is to furnish 2000 cp arc lamps at $65 per lamp per year, with a rebate of $5 per lamp if the contract is renewed at the end of the year, providing more than 380 and less than 450 lamps are used, or $10 per year in case more than 450 lamps are used. The contract also provides for 32-cp incandescent lamps at $27 each per year. A reduction of about 10 per cent has been made in the cost of electricity for private use and a list of discounts will be allowed, according to the amount of the bills, as follows: From $1 to $10 a month, 10 per cent; from $10 to $15, 15 per cent; from $15 to $30, 20 per cent; from $30 to $50, 25 per cent; from $50 to $75, 30 per cent; from $75 to $100, 35 per cent; from $100 up, 40 per cent.

GEORGETOWN, KY.—The City Council has decided to enter suit against the Georgetown Water, Gas, Electric Light & Power Company to annul its franchise, or compel compliance with its contract, which it is charged that it has violated in both light and water service.

LATONIA, KY.—Bids were opened recently for a thirteen-year exclusive franchise for electric lighting as follows: Dr. R. Lee Bird agrees to furnish lamps, 2000 cp, for $59 per lamp per year; incandescent street lamps of 32 cp for $24 each per year; commercial lighting, 9 cents per kw-hour, with a discount of 5 per cent on cash payments. The Kentucky Electric Company will furnish any number of lamps for the first three years at $60 per lamp per year and during the remaining ten years for $58 per lamp per year; any number of 32-cp lamps during the thirteen years for $24 each per year; electricity for commercial purposes, 10 cents per kw-hour, less 15 per cent for payment within ten days; for power and heat, 10 cents per kw-hour, less 20 per cent discount for payment within ten days after date of the monthly bill. In addition to the proposition for light, heat and power the Kentucky Electric Company agrees to give the village the ground on which the Cincinnati, Newport & Covington Railway & Light Company is operating after leaving Madison Avenue to the tunnel under the Louisville & Nashville Railroad tracks to be used for street purposes and in order to avoid the payment of toll on the Madison Pike. In addition $1,000 will be given toward the construction of the street and $5,000 is offered toward the expenses of constructing subways under the car tracks. The company has made these propositions in order to secure the adoption of plans that will prevent the street cars passing over the steam railroad tracks and to increase the facilities of transportation on the electric lines between Latonia and Cincinnati.

PADUCAH, KY.—Bids will be received until Oct. 18 by the Board of County Commissioners, at Paducah, to install steam heating and electric light system in the county court house and jail.

BUCKSPORT, ME.—The Penobscot Bay Electric Company, which is building a power house at East Orland, is making surveys of the country in this vicinity under the charge of Engineer W. F. Greenleaf, of Boston, Mass., and expects to set the poles to Orland at once. They also contemplate opening an office in the village soon.

MILO, ME.—The Milo Electric Light & Power Company has been granted permission by the town officials to operate a steam engine in its new power station.

BALTIMORE, MD.—Charles L. Stockhausen, of Baltimore, has secured the contract for the construction of the power house for use of the Dr. Samuel Leon Frank Memorial Hospital. Boilers, electric and laundry machinery will be installed.

CONOWINGO, MD.—Plans are being made by capitalists, headed by James H. Harlow, president of the Conowingo Bridge Company, for utilizing the Susquehanna River with another large dam to generate electricity to supply Baltimore, Philadelphia and other markets. The plant will be erected at Conowingo, near Havre de Grace, Md., about nine miles above the mouth of the river. The plant will have a capacity of 100,000 horse-power. The company is capitalized at $10,000, and bonds to the amount of $10,000,000 will be issued. The five turbines in the old paper mill will be utilized to generate electricity for lighting and operating purposes during the construction work. An electric railway will also be built from the reservoir site to Havre de Grace to handle material, etc., for construction work.

OAKLAND, MD.—[illegible] Company, which was recently incorporated to erect a power plant below Deep Creek Falls to [illegible] Maryland, West Virginia and [illegible] and the following officers [illegible] president; [illegible] West, vice-president; [illegible] treasurer, and Hiram P. Tasker, general manager.

CHARLEMONT, MASS.—[illegible]

CHICOPEE, MASS.—[illegible] stalling an additional generator in its power plant, which will enable the company to operate [illegible] seasons of the year as well as [illegible] now being installed. The machines are operated by individual motors, of which 20 have already been installed, and 30 more will be added to the plant.

NEWBURYPORT, MASS.—The Newburyport Gas & Electric Company is installing an additional engine and generator, which will increase the capacity of the plant by 550 horse-power, to provide for the increasing demand for electricity for commercial work. Two new panels will be added to the switchboard and a new auxiliary condenser will be among the other additions made to the plant. It is expected to have the work completed by Nov. 1.

ORANGE, MASS.—Negotiations and plans are under way whereby the Rodney Hunt Machine Company will purchase the water power privileges of E. S. Handy at Eagleville, two miles distant from the company's plant. The company proposes to utilize the water power to generate electricity to operate the machinery in the Rodney Hunt shops in place of steam, which is now being used.

BAY CITY, MICH.—Bids will be received until Oct. 30 by the City Controller for furnishing a steam turbine, generator, exciter, switchboard, boilers, Scotch type, and lamps, to re-establish the city's electric light plant. Albert Boston, Deputy Recorder, writes that specifications have been prepared, and bids will probably soon be called for by the City Controller for dismantling the east side electric light plant and re-establishing same on the west side. William H. Fitzhugh is superintendent.

BIRMINGHAM, MICH.—The Detroit United Railway Company is making arrangements to enlarge the power house to make room to install additional machinery in the plant.

BOYNE CITY, MICH.—The dam of the Boyne River Power Company has been completed and the plant has been put into operation and is furnishing electricity for lighting the streets of the city.

CENTRALIA, WASH.—B. J. Weeks, of Tacoma, is interested in a project to build an electric railway between Centralia and Chehalis, to be known as the Centralia, Chehalis & Western Railway, a distance of eight miles, and a branch line of two miles to a freight centre. It is stated that $150,000 worth of bonds has been subscribed.

GRAND RAPIDS, MICH.—At an election held recently the citizens voted in favor of granting a new franchise to the Grand Rapids-Muskegon Power Company. The company is making plans of extensions to its system in the city.

MANCHESTER, MICH.—A special election will soon be held to vote on the proposition of the village establishing a municipal electric light plant.

COLD SPRING, MINN.—The Minnesota Central Telephone Company is contemplating extending its lines to Avon.

ST. PETER, MINN.—Plans are being considered for extensive improvements to the municipal electric light plant. Several hundred dollars will be spent on repairs to the pole lines, and it is proposed to increase the capacity of the plant by the installation of new dynamos. When improvements are completed a day power service will be furnished to local manufacturers. The plant has proven a paying investment ever since it has been in operation, and it is expected that the adoption of the new plan will materially increase the receipts.

COLUMBUS, MISS.—The Fayette Telephone Company, of Fayette, Ala., has applied to the City Council for permission to erect poles and wires in the streets of Columbus.

PHILADELPHIA, MISS.—The Philadelphia Compress Company is contemplating installing an electric lighting plant. Contracts have not yet been placed for machinery and supplies.

ST. LOUIS, MO.—The Union Electric Light & Power Company, of St. Louis, a subsidiary corporation of the North American Company, will presently increase its capital stock from $10,000,000 to $18,000,000. Stockholders will meet Dec. 2 to ratify the action of the board in recommending the increase.

AURORA, MO.—The Aurora Light, Power & Refrigerator Company, recently incorporated, will erect a new building and install new machinery at a cost of about $25,000. J. R. Woodfill, Jr., is president and treasurer; S. E. Post, vice-president, and J. M. Hawkins, superintendent.

STEVENSVILLE, MONT.—H. C. Hodge, of Tacoma, Wash., is reported interested in the construction of an electric light plant to furnish electricity to light Stevensville and Victor. Mr. Hodge is planning to develop the water power in the Big Creek Canyon west of Victor.

PLATTSMOUTH, NEB.—Earl C. Wescott has been granted a franchise to construct an electric light plant.

NASHUA, N. H.—The Nashua Street Railway Company has applied to the State Board of Railroad Commissioners for permission to issue $25,000 of capital stock.

COLLINSWOOD, N. J.—Application has been made to the Borough Council for franchise privileges for lighting the borough and supplying it with water. The company, which is to be known as the Collingswood Mutual Water Improvement, agrees to furnish eight arc lamps for lighting [illegible] and agrees to extend its lines to any part of the borough. The company also agrees to sell [illegible] of the plants.

CLIFTON SPRINGS, N. Y.—Ford S. Burgett, who is interested in the [illegible] water power and to furnish electricity for lighting this and nearby villages, writes that plans are now being drawn up and will be presented to the Village Board for [illegible]

[illegible] will be received about Nov. [illegible]

FLUSHING, N. Y.—Bids will be received by C. B. J. Snyder, super- [illegible] New York City, until Oct. [illegible] heating and ventilating and electric generating apparatus and electric elevator in the Parental School in Flushing, Borough of Queens.

[illegible] Bids will be received until Oct. [illegible] by C. B. J. Snyder, superintendent of school buildings, New York City, for installing electric equipment in additions to and alterations in School 59; also in connection with alterations in School 171, both in Borough of Manhattan.

ONEIDA, N. Y.—The Board of Trustees of Sylvan Beach has granted Peter Kippal, of Buffalo, a franchise to erect and operate an electric light plant in Carnival Park. Mr. Kippal will furnish electricity for [illegible] at $[illegible] per lamp of 16 cp per month, or $2 for the season. He also proposes to build a scenic railway on the park to be operated by electricity.

ROCHESTER, N. Y.—The United States Independent Telephone Company has sold its holdings in the Home Telephone Company, of Jamestown, N. Y., to a group of Jamestown capitalists, represented by Arthur C. Wade, of Jamestown. It is said that the Consolidated Telephone Company, of Buffalo, and the Jamestown company, through the Inter-Ocean Telephone Company, a long distance subsidiary of the Consolidated, will hereafter hold a close working agreement as a result of this sale.

STATESVILLE, N. C.—The Southern Power Company, of Charlotte, has completed its transmission line to this place and is now constructing a substation. As soon as the station is completed a 24-hour service will be furnished. Several of the manufacturing industries will use electricity to operate their plants.

VALLEY CITY, N. D.—Plans have been made to enlarge the municipal electric light plant, and contracts placed for a new boiler and dynamo.

CINCINNATI, OHIO.—Surveys have been completed for the proposed route of the Cincinnati, Reading & Middletown Street Railway Company from Middletown and Franklin to Bond Hill and Norwood, a distance of 35 miles. It is estimated that the road will cost $875,000.

EUGENE, ORE.—A. G. Hendricks, president of the National Bank of Eugene, and F. L. Chambers, president of the Chambers-Bristow Bank, have filed on 100 miner's inches of water under six inches pressure in the McKenzie River at Haydens Rapids, seven miles northeast of Eugene. The canal will run through solid rock and will be 50 feet wide, 20 feet deep and 700 yards long.

EUGENE, ORE.—The Pacific Light & Power Company has awarded a contract for 100,000 feet of lumber with which to build the flume for a large electric plant which it intends to erect near Triangle Lake, 30 miles west of Eugene. It is the intention to build the flume this winter and erect the plant next spring and summer. The company plans to extend its lines to Eugene, Corvallis and Junction City and other towns in the valley. The company has appropriated 50,000 miner's inches of water of the lake.

PORTLAND, ORE.—The United Railways will soon make application to the county court for a franchise for a broad gauge electric railway from Portland through Linnton to the county line, to construct and operate the same as part of the interurban system which the company is installing.

ALLENTOWN, PA.—The Arbogast & Bastian Company has purchased electrical equipment and machinery from the Lehigh Electric Company to operate its plant by electricity. The machinery consists of a 225-hp Murray Corliss engine direct connected to a 125-kw generator and a new switchboard and other electrical equipment.

ALLENTOWN, PA.—The power house at Broadhead station, which has furnished electricity for operating the Bethlehem & Nazareth Electric Railway ever since it was built, has been abandoned. Electric energy for operating the road is now furnished from the storage plant at Hecktown, which is supplied from the main plant in Allentown.

ALTOONA, PA.—The Citizens' Electric Light, Heat & Power Company is installing two large boilers at its plant at Ninth Avenue and Twentieth Street, and making other improvements to increase the capacity of the plant and increase the service.

BETHLEHEM, PA.—The Town Council of Northampton Heights has awarded the contract for lighting the streets of the borough to the Bethlehem Electric Light Company for 23½ cents per lamp per night. The contract [illegible]

MT. CARMEL, PA.—The Citizens' Company has been organized by local business men to construct and operate an electric light plant.

PHILADELPHIA, PA.—The contract for installing three turbine-driven generators, including condenser, air pump, piping and switchboard complete at Torresdale pumping station, has been awarded to Dravo, Doyle & Company, Philadelphia, for $25,150.

HURON, S. D.—The Dakota Central Telephone Company is seeking a renewal of its franchise and proposes to establish an automatic system.

PIERRE, S. D.—Bids will be received by C. F. Larrabee, Acting Commissioner of Indian Affairs, Washington, D. C., until Nov. 4 for constructing an electric light plant and construction of a brick office building with electric light, steam heat, a brick warehouse with electric light and brick addition to the workshop with electric light and plumbing. For further information apply to J. C. Levengood, superintendent, Pierre.

BEAUMONT, TEX.—The directors of the Beaumont Ice, Light & Refrigerator Company have decided to increase the capital stock of the company for the purpose of enlarging the plant.

BEEVILLE, TEX.—E. J. Kinkler is contemplating installing an electric lighting plant, which will have a capacity of 300 lamps. Contracts for machinery have not yet been placed.

ASHLAND, VA.—The Virginia Light & Power Company has notified the Town Council that it is ready to furnish electricity for both lighting and power purposes. The system will be put into operation as soon as the plans are approved by the street committee.

MANASSAS, VA.—We are informed that all bids opened by O. E. Newman, chairman improvement committee of Council, on Sept. 28 for furnishing material and installing water works and an electric light plant and macadamizing the streets of this town have been rejected on account of the town being unable to sell its bonds. A new election will be held and after bonds are sold new bids will be called for.

ELMA, WASH.—The Elma Light & Power Company is constructing a large dam on Cloquallum Creek to utilize the water power to operate its electric plant in Elma. The present plant, which has been in operation about three years, is operated by steam.

MONTESANO, WASH.—Owing to the unsatisfactory service given by the Montesano Light & Water Company the City Council has revoked the franchise of the company. C. H. Kiehl, of Seattle, is president of the company.

PUYALLUP, WASH.—The Mayor has [illegible] to look into the matter of buying or building a municipal electric light plant.

GREEN BAY, WIS.—The lighting controversy in this city is fast approaching the stage where an appeal to the rate commission will be necessary. The Council has again rejected bids of the Minahan Building Company and the Green Bay Gas & Electric Company, asserting that the figures of both for lighting the city streets are too high. The Minahan company is a new arrival in the field and agrees to furnish electricity for lighting the city at the rate of $69 per lamp per annum, which is $1 lower than the Green Bay Gas & Electric Company's offer. Bids have been rejected three times within the last year and a half, and as a result the city is getting very poor service in the residence district. The Green Bay Gas & Electric Company, present holder of the franchise, stands ready to install new lamps throughout the city and remedy the existing defects if given the franchise. In the meantime it is not furnishing service in the residence portion as a result of the Council refusing to pay in full a bill presented for lighting early in the season.

LAKE NEBAGAMON, WIS.—Owing to the shutting down of the mill the electric lamps have been removed and the streets are in darkness. A plant was installed to light the mill, and also furnish electricity for lighting the streets. The company has removed all the electric light lines and closed down the entire plant. J. P. Weyerhaeuser, former manager of the mill, has removed to St. Paul.

WATERLOO, WIS.—At a special election held Oct. 10 the citizens voted to purchase the electric light plant owned by Elizabeth Nelson, Robert Entwhistle and H. Nelson. The city will issue $10,000 in bonds to purchase the plant and for improvements.

WAUSAU, WIS.—Neal Brown states that his company is now operating five and one-half miles of its line and will ultimately extend from Schofield to Merrill via Wausau and Brokaw, a distance of 25 miles. The grading has been completed the entire distance. The company is planning to construct a water power plant at the Trappe Rapids on the Wisconsin River, about ten miles south of Wausau, where 4000 horsepower is available. Electricity for operating the road is now supplied by the Wausau Electric Company.

SARATOGA, WYO.—It is reported that the Carbon Timber Company is endeavoring to purchase the plant of the Saratoga Light & Power Company, owned by John M. Kuykendall, Harry Brown, J. M. Barker and other Denver men. If they purchase the plant they propose to operate it from the sawmill and will develop enough power to supply the Saratoga Springs bottling plant, a laundry and possibly for the proposed municipal water plant.

CALGARY, ALT.—At a [illegible] it was decided to at once call for tenders for the construction of the municipal street railway system. Address City Engineer Thorold or Mayor Cameron.

OLDS, ALT.—The Board of Trade [illegible] opinion on the development of power at Little Red Deer, 13 miles distant. Address S. Craig, Olds.

KELOWNA, B. C.—The ratepayers have passed a by-law authorizing the raising of $40,000 by the sale of debentures for waterworks and electric light plants. Address J. F. Burne, Kelowna.

VANCOUVER, B. C.—The directors of the British Columbia Electric Railway Company have voted to expend $1,000,000 for extension and improvements to its system during 1908. R. N. Sperling, of Vancouver, is general manager.

CARNDUFF, CAN.—Mr. Stinsell, representing the Minneapolis Street & Farm Lighting Company, Minneapolis, Minn., has [illegible] franchise to furnish electricity for light and power and to install a telephone system in the town.

PORTAGE LA PRAIRIE, MAN.—The [illegible] the Central Electric Light Company have decided to spend $35,000 on enlarging their power plant. The company offers to double the number of street lamps if the town will extend the street lighting contract.

WOODSTOCK, N. B.—The Woodstock Electric Light & Power Company is contemplating changing its plant from direct to alternating current.

CHIHUAHUA, MEX.—It is announced that more than $1,000,000 will be spent in constructing the new electric railway system in this city and the suburban lines to Santa Eulalia and to the new smelter of the American Smelting & Refining Company, 16 miles distant from the town. Enrique Greel is the principal owner of the company.

LINARES, MEX.—José Benilla, of this city, has purchased the local street railway system. It is said that he will greatly improve the lines and will build extensions to two smaller towns in this section.

MEXICO CITY, MEX.—The city of Mexico has decided to operate the water works pumping stations by electricity, and the contracts for the machinery have been awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. The plans call for three large motors of 1200 hp each, which are to be direct connected with centrifugal pumps at the pumping station. The Mexican Light & Power Company will furnish electricity for operating the water works system.

OAXACA, MEX.—Eduardo J. Cummings, of Guanajuato, has secured concession grants to use 30,000 liters of water per second on the Quiotepec River, near Tomellin. A fall of 400 feet is available and 48,000 horse-power can be developed. It is proposed to install a hydro-electric plant and to transmit electrical energy to Oaxaca and the mining camp of Taviche and intervening towns to the north as far as the city of Puebla and south to the towns of San Antonia, Tehuacan, Tlacotepec, Tecamachalco and Tepeaca. The length of the transmission line to Puebla will be 130 miles, and the line to Oaxaca 70 miles, and to Taviche 30 miles.

SALTILLO, MEX.—A number of capitalists, headed by Guillermo Velasco and Rodolfo Garza, have organized a syndicate to construct an electric railway in this city.

SULTEPEC, MEX.—The Sultepec Electric Light & Power Company has completed the installation of its large power plant at Temascaltepec, and also its 25,000-volt transmission line to Sultepec, where a substation has been built. The company furnishes electricity to many mines and mills.

VERA CRUZ, MEX.—The Vera Cruz Electric Light & Power Company has completed arrangements to provide the city with electric traction in addition to its lighting and power service. The power plant is being greatly enlarged and the work of rebuilding the tracks will soon commence.

New Industrial Companies.

THE FOLLETT TIME-RECORDING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $300,000. The directors are: Albert Blackburne, Edward W. O'Meara and Thomas Dowdell, all of New York City.

THE SAVITZKY & GOLOMB COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000 for the purpose of manufacturing gas and electric fixtures. The directors are: Louis Savitzky, Miles Rosenluth and Isaac M. Golomb, all of New York, N. Y.

THE WESTERN ELECTRIC COMPANY, of Cincinnati, Ohio, incorporated recently with a capital stock of $50,000, is said to be successor to the Standard Electric Company. The charter of the new company gives it authority not only to handle and sell electrical equipment, but to operate telephone, telegraph and electric light and power plants. This part of the business will not be taken up, however, according to present intentions. The incorporators are: Eldon R. James, Stanley M. Withrow, Fred F. [illegible] and L. F. Miller.

New Incorporations.

EATON, COL.—The Eaton Electrical Company has been incorporated with a capital stock of $25,000 by W. A. Farr, Roscoe Farr and others. The company proposes to furnish electricity for light, heat and power in Eaton.

CHICAGO, ILL.—A charter has been granted to the Western Illinois Electric Traction Company by the Secretary of State. The company is capitalized at [illegible] and proposes to construct a [illegible] from the town of Lyons to Aurora. The incorporators and the first board of directors are: M. M. Miller, Edmund J. Schmidt, Louis Crollan, Lee Michael and William Klein.

[illegible]

INDIANA HARBOR, IND.—[illegible] operate an electric plant to supply the city of East Chicago and other cities and villages along its lines with electricity for lighting, heating and power [illegible].

MUSKOGEE, I. T.—The Falls Construction Company has been incorporated by [illegible] and J. M. Brogan. The company has been formed to construct the Muskogee Navigation Electric Railway from Muskogee to Fort Smith, Ark. The present plan is to utilize the water power of the Grand River to operate the railway.

CLINTON, IA.—The Wenatchee Valley & Northern Railway Company has filed articles of incorporation with the Secretary of State. The capital stock of the company is placed at $100,000, and the officers are L. Lamb, president; C. R. Lamb, vice-president; Petrel Davis, treasurer, and G. E. Lamb, secretary, all of Clinton.

WEBSTER CITY, IOWA.—Articles of incorporation will soon be filed for the Boone, Webster City & Northern Railway Company. The company will be capitalized at $600,000, which, it is said, will be sufficient to build and equip the road, which will be 31 miles in length and connect Boone and Webster City. The officers of the company will be: E. E. Hughes, of Boone, president; F. A. Sackett, of Webster City, vice-president; J. S. Crooks, of Boone, [illegible], of Boone, treasurer.

ALEXANDRIA, LA.—The Kent Company, Ltd., has been chartered with a capital stock of $100,000. The company proposes to operate electric and other street railways. The officers are: A. Albert, president; William M. Cady, vice-president; Benjamin Weil, secretary and treasurer.

SEMINARY, MISS.—The People's Telephone & Telegraph Company has been organized with a capital stock of $10,000, and will be ready for service within a short time.

AURORA, MO.—The Aurora Light, Power & Refrigerator Company has been incorporated with a capital stock of $50,000 by J. M. Hawkins, C. K. Gimlerling, Mrs. E. J. Martin and others.

EAST WORCESTER, N. Y.—Articles of incorporation have been filed for the Great Bear Light & Power Company with the Secretary of State. The capital stock is placed at $20,000, and the company proposes to operate in the counties of Otsego and Schoharie. The incorporators are: James E. Dante, A. D. Hallenbeck and Lucy Dante, of East Worcester.

MT. VERNON, N. Y.—The Mount Vernon & Eastern Railroad Company has been formed with a capital of $1,000,000 to construct a steam or electric railway from Mount Vernon to Lewisboro, a distance of 35 miles. The directors are: Oakleigh Thorne, William H. Chesbrough, Carleton Bunce, Howard K. Wood and Charles E. Mitchell, of New York, N. Y.; Marsden J. Perry, of Providence, R. I.; George H. Hansel, of Cranford, N. J.; Kennett K. McLaren, of Jersey City, N. J., and Allen Wardwell, of Lawrence, N. Y.

MANGUM, OKLA.—A charter has been granted to the Southwestern Interurban Railway Company to build an interurban railway from Mangum to Hollis by the way of Francis; to Granite and Cordell, with a branch from Granite to Hobart, and from Mangum to Altus, the total mileage being 119 miles. The capital stock of the company is placed at $1,000,000, and the directors are W. T. Funderburk, D. J. Doyle, E. E. Pinkerton, T. P. Clay, H. M. Ferguson and R. C. Echols, all of Mangum.

OKLAHOMA CITY, OKLA.—The Oklahoma City Central Interurban Railway, Telephone, Telegraph, Light & Power Company has been chartered for $5,000,000 with headquarters in this city and at South McAllister, I. T., to build an electric line westward from South McAllister, via Holdenville, Wonoka and Shawnee to Oklahoma City, then to El Reno, Geary and Weatherford to Cheyenne in Roger Mills County. The incorporators are C. D. Freeman, of Denver, Col.; Leon Brown, of St. Louis, Mo.; B. F. Sharp, of Memphis, Tenn.; G. M. Watson, of Nevada, Mo.; Louis Landsman, of Jefferson City, Mo.; Dr. R. N. Wade, J. B. Bloucher, F. M. Stone and H. H. Codington, of Weatherford, Okla.

OKLAHOMA CITY, OKLA.—The Oklahoma City Electric Terminal Company has been granted a charter with a capital stock of $2,500,000. The incorporators are Guy V. McClure, Charles Combs, Warren E. Moore, J. J. Johnson and Fred S. Combs. The company proposes to build a street railway system on both the east and west side of the city; the two divisions of the system will give about 12 miles of service. Application will soon be made to the City Council for a franchise.

NASHVILLE, TENN.—The Rock City Electric Company has been incorporated with a capital stock of $10,000 by John A. Bell, Louis Leftwich, Hamilton Parks and others.

LUBBOCK, TEX.—The Staked Plains Telephone Company has filed articles of incorporation with a capital stock of $60,000 by C. W. Alexander and others.

KENT, WASH.—The Independent Telephone & Telegraph Company has been incorporated with a capital stock of [illegible] by [illegible] West and others.

ELKINS, W. VA.—The Elkins Power Company has been incorporated with a capital stock of [illegible].

WELLSBURG, W. VA.—The Bethany Trolley Syndicate has been chartered with a capital stock of [illegible] electric railway from Wellsburg to Bethany, and to maintain a power plant and water works [illegible] H. O. Moon, B. S. Honecker and C. J. Schuck, all of Wheeling.

MATTOON, WIS.—The Mattoon Telephone Company has been organized [illegible].

PARDEEVILLE, WIS.—Articles of incorporation have been filed for the [illegible] Company [illegible] by Frank H. [illegible] and others. The [illegible].

POYNETTE, WIS.—The Poynette Telephone Company has been incorporated with a capital stock of $10,000 by E. E. Hinkson, J. S. Hink- [illegible]

Legal.

[illegible] by the latter company in running the surface cars operated in connection with the subway. The court also restrained the Interborough Company from delivering electrical energy to the City Railway Company, and the latter company from using, disposing of, or selling the energy so obtained. An interlocutory judgment was also issued on condition that an immediate appeal be taken by the two railway companies from the decision. The action was brought last November by the Board of Rapid Transit Commissioners, who asserted that the Interborough Company, which operated the subway, was violating the provisions of its contract with the city in supplying electricity to a subsidiary corporation which operated surface cars running from the Bronx to the upper part of Manhattan. Justice Fitzgerald appointed ex-Supreme Court Justice Edward Clinch as referee to compute the amount due to the city by the defendant companies for their misuse or appropriation of the electric energy.

RIGHT OF LOCAL TELEPHONE COMPANY TO CONNECT WITH THE LONG DISTANCE WIRES OF ANOTHER COMPANY.—The Billings Mutual Telephone Company, a local concern operating some 350 telephones in the vicinity of Billings, Mont., after attempting to make an agreement with the Rocky Mountain Bell Telephone Company by which it could connect with the latter company so as to be able to transmit messages over its long distance lines, brought an action to compel the Rocky Mountain Company to permit such a connection. The defendant answered by admitting that the connection with and use of defendant's lines by the plaintiff would increase the revenue of the plaintiff and accommodate its customers, but it denied that the use of defendant's lines by plaintiff was necessary to the proper operation of the telephone line of the plaintiff and alleged among other things that such connection was desired by plaintiff to save it the great expense of building its telephone lines through the territory covered by the telephone lines of the defendant. Article 15, Section 14, of the Constitution of Montana provides that any person or corporation organized for the purpose "shall have the right to construct or maintain lines of telegraph or telephone within this state and connect the same with other lines, and the legislative assembly shall by general law of uniform operation provide reasonable regulations to give full effect to this section." Civ. Code Mont., Sec. 1001, after repeating such provision, provides that "in case such persons or corporations cannot agree as to the compensation to be paid for the privilege of such connection, the acquiring of the right by the one to use the line of the other may be had . . . as provided in the Code of Civil Procedure." It was held that under such provisions a telephone company operating a local exchange, such as the plaintiff, on payment of compensation to be ascertained as provided by the statute, could require the defendant company operating long distance lines to permit a connection with such lines and also their "use" by receiving and forwarding messages through such connection from subscribers of the other company substantially as it did messages tendered by its own local subscribers. Billings Mutual Telephone Company vs. Rocky Mountain Bell Telephone Company, United States Circuit Court, 155 Fed. Rep. 207.

DISTINCTION BETWEEN LIABILITY OF ELECTRIC COMPANY FOR MAINTAINING UNINSULATED WIRES AND LIABILITY OF RAILROAD COMPANY FOR RUNNING INTO PERSONS ON ITS TRACKS.—A telephone company employee, who had previously been a foreman, was required in the course of his employment to climb a telephone pole and, while going up the pole, received a shock of 2000 volts from a wire from which the insulation had worn, causing him to fall to the ground, a distance of about 25 ft. In an action against the telephone company it appeared from his testimony that he approached the pole, walking on a stone wall at the side of the road and that from his position it was impossible for him to detect the absence of insulation on the wire or to see a burnt place which the insulated wire had made upon the pole. There was evidence, however, that by going a short distance into the road he might have seen the defective conditions. But the fact that he did not see that there was anything wrong and that, while prior to the accident, he had been in good physical condition, he was thereafter continuously ill, it was held that a verdict of $5,200 was not excessive. It was argued that the case was parallel to certain railroad cases in which a person who goes upon a railroad track without taking the customary precaution of looking and listening is denied damages in event of his being run down by a train, but the court concluded that the cases were essentially different. In railroad cases the dangers upon a railway are so well known that failure to look and listen [illegible] the purpose of the running of railway trains. The man who approaches it has full knowledge that such is its primary and rightful use, and the use of it by him is subject to its dominant use. On the other hand, the man who climbs a telephone pole is not charged with knowledge that its rightful use is for uninsulated and dangerous wires. He knows, on the other hand, that there is a duty to keep the wires insulated, and that, while the purpose for which the structures are used renders some [illegible] expect that the wires will be kept protected. He knows, to be sure, that it is difficult to do this, and that there is liability that there may be a lack of insulation of some wire, but the risk of defective insulation varies with the circumstances and the case is not like that of a railroad track, where the danger is always well known, distinct and incident to its lawful use. Dover vs. Gloucester Electric Company, United States Circuit Court, 155 Fed. Rep. 256.

[illegible] ELECTRICAL PATENT REFUSED.—In a motion for a temporary injunction restraining the infringement of a patent for an electrical safety fuse, it was complained by the plaintiff that one of the defendants had invented a new and useful improvement in fuses, upon which he had obtained a patent, and which he sold to the plaintiff for a valuable consideration. Later, and after having granted to the plaintiff all rights in the invention, the inventor, according to the claim of the plaintiff, organized a corporation for the purpose of manufacturing and selling safety fuses constructed on the same principle as that involved in the invention. The novelty covered by the invention consisted in uniting a wide, thin strip with the filling, so as to envelop completely the fuse and thus best utilize the properties of the ready fusibility and the quick dispersion of the heat of the strip when melted. The fuse consisted of a flat fused strip of metallic ribbon inclosed in a case of non-conducting fiber with metal end caps, usually of brass, to which the ends of the fusible metallic ribbon were joined by terminals, the filling material of the fuse forming a non-conductor about the fusible metallic ribbon. The defendant admitted the sale of the patent to the plaintiff, but claimed a new discovery, namely, the adjustment of a very thin, metallic ribbon with an extended area within the casing of the fuse, so thin and so extended in its area that the non-conducting material encased about it being likewise extended, thus giving such a maximum contact with the non-conducting filling material that the circuit is immediately opened when any portion of the metallic ribbon or strip becomes molten and the electrical continuity is immediately severed while in this molten condition. In fuses previously manufactured the filling material so supported the molten material that the melting of the fuse did not immediately cut the circuit, but would arc or hang, and such failure of immediate interruption of the circuit upon the melting of the ribbon or strip under the old process resulted in inaccuracy and unreliability as to its operation in the presence of "unequal current value." The court was of the opinion that this principle above set forth as the defendant's claim was the real novelty, if any, and the gist, of the invention. [illegible]e defendant had not made and sold a fuse like that covered by the patent. The fuse which he made was like those in general use by other manufacturers, which are understood by the trade generally not to be covered by any enforceable patent. Soon after obtaining the patent in suit it was discovered that fuses of the patent lacked mechanical stability and ease of manufacture and that the advantages secured by it were not sufficiently superior to fuses made under the old means of manufacture to warrant the increased cost which was entailed, and therefore the plaintiff never adopted it in practical use and never marked his fuses as having been manufactured under this patent. For these reasons it was held that the preliminary injunction could not be granted. It is a well-settled rule of the law that where grave doubt arises as to what the final decree upon the merits must be, either as to fact or law, the summary power of the court to grant preliminary injunctions should not be exercised unless it may be to preserve the status quo of the parties under circumstances that will not work serious hardship to the party enjoined. It is also a settled rule of law that in acting upon applications of this sort the court "should regard the comparative injury which would be sustained by the defendant if the injunction were granted and by the complainant if it were refused." John-Pratt Company vs. Sachs Company, United States Circuit Court, 155 Fed. Rep. 129.

Educational.

HARVARD UNIVERSITY.—The electrical department of the Har- [illegible] apparatus to its equipment during the summer months. Among the most valuable is a large electric motor, which will be set up in Pierce Hall for experimental use. Another piece is a mercury arc converter. About $4,000 was expended for the new equipment, which will make a valuable addition to the demonstration work of the electrical engineering department.

Obituary.

MR. PHILIP FITZSIMMONS, [illegible] Fitzsimmons Telephone Company, of Cincinnati, Ohio, was killed Oct. 8 at the home of his daughter in Birmingham, Ala., by falling from the second-story window while walking in his sleep.

MR. CHARLES ANDREW WILSON, of Sussex, N. J., died suddenly Oct. 7, at Sioux City, Ia., in the course of a Western trip. Mr. Wilson, who was born 67 years ago in the borough of Sussex, was prominent in many corporations in that part of the state. He was president of the Farmers' National Bank of Sussex, the First National [illegible] the Unionville Water Works and the Wantage Outing Club. He was an officer in many other corporations and part owner of the Sussex Independent.

Personal.

MR. A. HALL BERRY, of New York, left this week for Europe on an extended trip for both business and pleasure. Mrs. Berry accompanies him.

MR. CHARLES E. WADDELL, Biltmore, N. C., is the author of a paper printed in the September issue of the Franklin Institute, entitled "Southern Appalachian Streams."

MR. LYNN A. WILLIAMS, for the past six years assistant to Mr. Charles A. Brown, patent attorney, Chicago, has been admitted to partnership with Mr. Brown. The firm name will be Brown & Williams.

MR. ERNEST CARSTENS, who has had an experience of many years in this country and in England as an accountant, has opened an office at 56 Rose Street, New York, for practice as a public accountant and auditor.

MR. A. C. BELL, who has been in charge of the patent department of the Stromberg-Carlson Telephone Manufacturing Company, has joined the staff of Brown & Williams, patent attorneys, Chicago. Mr. Bell will give attention chiefly to the work of patent soliciting.

MR. WILLIAM A. JACKSON has resigned from the presidency of the Michigan State Telephone Company and has been elected president of the executive committee, a place left vacant since the death of William C. McMillan. Mr. N. C. Kingsbury, former vice-president, was appointed president to succeed Mr. Jackson. Mr. B. W. Trafford has been made one of the vice-presidents and will also be general manager.

MR. ARTHUR S. MERRILL, who has been in the electrical business for the past ten years, most of the time in New York City, and who has been assistant western sales agent for Pass & Seymour, Inc., Solvay, N. Y., with headquarters at 130 W. Jackson Blvd., Chicago, for over a year, has tendered his resignation in order to carry out plans which he has had in mind for some time. He is a brother of Mr. Wm. W. Merrill, secretary of the Chicago Fuse Wire and Manufacturing Company, Chicago.

MR. J. E. FRIES, of Milwaukee, has found his services in demand since he left the Allis-Chalmers Company, and has now joined the forces of the Canadian General Electric Company as a commercial engineer. When with the Allis-Chalmers Company he was employed as electrical engineer in their contracting department. In his new capacity he will do designing and commercial engineering work for the sales department on electrical as well as mechanical apparatus.

MISS C. BECKWITH.—We note with regret the serious illness of Miss Carmelita Beckwith, who was stricken down at her desk last week while at work in the office of "Profitable Advertising," which she shared with her friend, Miss Kate Griswold, the publisher. The hemorrhage of the brain while slight has left a condition of aphasia, but her rally has been quick and it is hoped that the recovery may be complete. She was removed as soon as possible to her rooms in the Hotel Martha Washington and has since been in the hands of trained nurses. Miss Beckwith's literary-electrical work began when she was with the General Electric Company and was continued on the bulletin of the New York Edison Company. Many of her interesting articles have been contributed to the pages of the ELECTRICAL WORLD, while several of her little brochures, such as the "Electric Jingles" and "When the Sad Iron Smiled," are in wide circulation. Of late her business had grown rapidly and when taken ill she was at work on the new bulletin of the National Electric Light Association. Admired everywhere for her sunny and buoyant disposition, it is the belief of a host of friends that her youth and abundant vitality will restore this amiable and talented woman to full health.

MR. F. E. DRAKE, managing director of the French Westinghouse Company, who will shortly return to Paris, has devoted the past several weeks to conference with the officials of the Westinghouse Electric and Westinghouse Machine Companies, and has made a careful study of the latest developments of both works. He is arranging for the sale in his territory of some of the important specialties now made at the East Pittsburg works of the two companies, notably steam turbines and turbo-generators. Mr. Drake has also arranged to forward to the machine company, which owns the patents for this country, several sizes of the Leblanc condenser, in order to hasten their introduction in this country. The Leblanc condenser, after an extended use, is now considered by leading European steam engineers, because of the almost perfect vacuum secured in so simple a manner, to be one of the most scientific developments of recent years. The French Westinghouse Company, by reason of its control of the Leblanc inventions, is already doing an important business in their manufacture and sale, which is adding to the net profits of the company, which, for August, exceeded the monthly requirements for debenture interest and dividends on the preferred stock. The orders received by the French Westinghouse Company, from Jan. 1 to Sept. 30, being nine months of the fiscal year, indicate that the total business for 1907 will approach [illegible] important one for an installation of [illegible]

Trade Publications.

SELF-CONTAINED ALTERNATORS.—Bulletin No. [illegible], of Fairbanks, Morse & Company, is devoted to belt-driven revolving-field alternators rated at from [illegible] two or three phase [illegible]

ELECTRIC EXHAUST FANS are the subject of Bulletin 3504, just issued by the Emerson Electric Manufacturing Company of St. Louis. Such apparatus associated with Emerson motors is illustrated and described with full details, for both alternating and direct circuits.

RHEOSTATS.—Bulletin No. 4510 of the General Electric Company describes electrically operated, ratchet-driven rheostat switches. The handles of these switches are rotated by a ratchet wheel and pawl movement actuated by solenoids which consume a small amount of power.

RHEOSTATS consisting of a series of cast grids supported on insulated rods between cast end pieces are discussed at length in Bulletin No. 4499 of the General Electric Company. These rheostats are especially suited for railway service on account of their uniformity, strength and reliability.

DIRECT-CURRENT RAILWAY MOTORS.—The Westinghouse Electric & Mfg. Company has issued circular No. 1124 dealing with 90-hp railway motors intended for interurban service. Motors of a simila type, but rated at 75-hp. are described in circular No. 1106 of the same company.

TOBIN BRONZE.—The Ansonia Brass & Copper Company, New York, has issued a pamphlet on the subject of Tobin bronze. The uses for this metal are many, and the America's cup defenders, "Vigilant," "Columbia" and "Reliance" were made of it. The properties of Tobin bronze are defined and the advantages derived from its use are described in many testimonials.

SINGLE-PHASE WATT-HOUR METERS.—The Fort Wayne Electrical Works has issued a new edition of its instruction book for single-phase induction watt-hour meters. Full instructions are given covering every detail of installing and operating this type of meter, including speed adjustment, change in frequency and testing. Thirty-five diagrams are included relating to every matter in connection with the instrument which is ever likely to be required.

BLACK ENAMELED WIRE.—The Western Electric Company has published a little booklet on black enameled wire, which deals with the many direct and incidental advantages to be secured with this type of insulation, viz., an elastic yet resistant and firmly adhering film. The insulation is applied by special machinery, and the plant to produce it has lately been greatly increased. One of the leading merits, it is said, is that as compared with cotton or silk, it is very much less affected by heat, and will carry electrical energy under heat conditions that would cause cotton and silk to become charred and destroyed. The enamel will withstand a temperature as high as 500 deg. Fahr. for a considerable time without injury to its insulating qualities. It is not waterproof, but is proof against the moisture of the air, even in conditions of extremely high humidity over long periods. Data are given on these and other points.

FUEL ECONOMIZERS.—"Fuel Economizers at the Manhattan Power Station of the Interborough Rapid Transit Company, New York City," is a reprint of a paper read by R. B. Tomlinson before the New York Railway Club, showing by a careful analysis of tests and monthly records that the economizers in this plant are paying a net rate of 30.5 per cent upon the initial outlay. This is based upon a price of $3.00 per ton for coal and the average load at the time the economizers were put in. The output of the plant has been increased since the test was made. The plant contains 64 boilers of 520 b.h.p. each and the draft is produced by four brick chimneys. The pamphlet is well illustrated and should be of interest to designers and operators of large steam plants. It may be obtained by addressing the Green Fuel Economizer Company, of Matteawan, N. Y.

Business Notes.

MASSACHUSETTS CHEMICAL.—The Massachusetts Chemical Company, of Walpole, Mass., is exhibiting at the American Street & Interurban Railway Manufacturers' Association at Atlantic City, N. J., this week. Messrs. A. T. Baldwin, L. O. Duclos and A. E. Duclos represent the company with a full line of samples, descriptive literature and souvenirs.

WIRT APPARATUS.—Some months ago the Cutler-Hammer Manufacturing Company, of Milwaukee, announced its purchase of the Wirt Electric Company, of Philadelphia. The Wirt business has now been consolidated into the Cutler-Hammer New York plant at Park Avenue and 130th Street, where its manufacture will be continued. All outstanding Wirt accounts should be remitted to the general offices at Milwaukee.

RIDGWAY TEMPLETS.—The Ridgway Dynamo & Engine Company, of Ridgway, Pa., has [illegible] a set of templets showing the floor space [illegible] inclusive. These templets are made to a scale of ¼ in. to the foot and should be of great value to consulting engineers, architects and others who have occasion to lay out power plants. The company is distributing these templets to all who will have use for them and will gladly send a set on application.

THE BECK PACIFIC LAMP COMPANY, of San Francisco, Cal., has been in business on the Pacific Coast for over a year. It owns the patent rights on the Beck flaming arc lamp for the field west of the Continental Divide. Mr. Threw, president and general manager of the company, states that notwithstanding the chaotic conditions under which all business has been conducted in San Francisco during the past year, his company is well satisfied with the reception it has received from the electrical trade and central station men of the Western Slope, and faces [illegible]

Weekly Record of Electrical Patents.

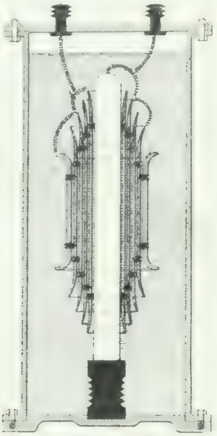
[illegible] PATENTS ISSUED [illegible]

[illegible] Park Row, N. Y.]

867,564. ADVERTISING AND ILLUMINATING DEVICE; James E. [illegible] made with projections and protuberances by which it is self-supporting.

867,575. PROCESS OF REDUCING FORMIC ACID; Carleton Ellis, White Plains, N. Y., and Karl P. McElroy, Washington, D. C. App. filed May 2, 1907. The process of reducing formic acid, which consists in electrolyzing the same in the presence of a stronger mineral acid.

867,579. ELECTRICAL CONDENSER; Leon Gerard, Brussels, Belgium. App. filed June 14, 1905. An oil-bath condenser for high-frequency currents having vertically arranged annular condensing surfaces separated by annular spaces of gradually increasing widths at the ends.



867,579.—Electrical Condenser.

867,624. SWITCH BOX; Harry J. Warthen, Washington, D. C. App. filed July 28, 1906. Form of outlet box designed to be adjustable to accord with the surface of a wall. The front plate has a screw connection with the body of the box.

867,627. INDUCTION COIL APPARATUS; Ernest C. Wilcox, Meriden, Conn. App. filed June 19, 1907. A bridge member for an induction coil vibrator having a pointer and an adjustable member adjacent the pointer and having a plurality of scales from the zeros of which the member is adapted to be moved.

867,629. WIRE HOLDER; Noah L. Wine, Polo, Ill. App. filed Jan. 16, 1907. A device for taking up the mechanical vibrations of a telephone wire where it is exposed to the wind adjacent to a frame house. The wire passes through two rubber blocks held so as to produce a bend in the wire between them.

867,63[illegible]. ELECTRIC SIGN; William A. F. Becker, Chicago, Ill. App. filed Oct. 26, 1906. Relates to various detail features of improvement in an electric sign by which the letters can be applied in any spaced relation, and are offset from the sign in use so as to avoid leaving a dust-imprinted outline on their supporting surface when removed therefrom.

867,659. ELECTRIC CONDUCTOR; William Hoopes, Pittsburg, Pa. App. filed Jan. 16, 1905. An aluminum conductor designed to have considerable tensile strength so as to be capable of use in aerial spans. The aluminum is extruded from a die and reinforced by a core of stronger metal.

867,681. AUTOMATIC FIRE ALARM; Charles Smith, South Broydon, England. App. filed July 9, 1907. Automatic fire alarm of the type having a wire extending throughout the building and wrapped around fusible objects at various points. In case of a fire the extension of the wire closes an alarm circuit.

867,721. ELECTRIC BELT AND APPLIANCES THEREFOR; Michael Hatzenbuehler, Chicago, Ill. App. filed Jan. 7, 1907. A form of medical belt having a pocket to receive three dry cells and a con- [illegible]

867,737. HARD-RUBBER SUBSTITUTE AND PROCESS FOR MAKING THE SAME; [illegible] vegetable material containing a considerable proportion of tannin [illegible] stirred, and finally heated and molded, substantially as described.

867,743. PLUG-IN SWITCH; Henry D. Murdock, New York, N. Y. App. filed March 21, 1907. A block switch of somewhat the type used on telephone circuits and having a tip and a ring connection. The tip connection also serves to interrupt the continuity of the line [illegible]

867,744. MAGNETIC SEPARATOR; James B. McCabe, Buffalo, N. Y. [illegible] having inner and outer magnetic surfaces adapted to serve independently in the separation of the magnetic particles from the ore.

867,809. SERIES-PARALLEL CONTROLLER; Arthur C. Eastwood, [illegible] parallel control, means for connecting the motors in series with a resistance, means for reducing the resistance and finally short-circuiting the same, means for opening the short circuit and simultaneously connecting the motors in parallel.

867,810. AUTOMATIC-ACCELERATING CONTROLLER; Arthur C. Eastwood, Cleveland, Ohio. App. filed Jan. 15, 1907. In an electric controller, sections of resistance, magnetically operated switches for controlling said resistance, and a relay for controlling the action of said switches, said relay having its winding in a circuit connected in a shunt to a portion of said resistance.

867,846. THERMO-ELECTRIC CONTROLLING MECHANISM; Harrie C. Smith, New York, N. Y. App. filed Oct. 7, 1905. Has a thermostat which controls the circuit of an electric motor geared to a hoisting or winding apparatus so as to raise and lower the doors or dampers of a furnace.

867,863. ELECTRIC WATER HEATER; Mendal W. Eillson, St. Louis, Mo. App. filed Dec. 26, 1906. An electrode of the heater comprises a metal rod with a carbon jacket detachably fixed thereto.

867,876. OSCILLATION-RESPONSIVE DEVICE; Lee De Forest, New York, N. Y. App. filed Feb. 2, 1905. An oscillation-responsive device comprising a gaseous medium, electrical means for rendering said medium sensitive to electrical oscillations and means for impressing electrical oscillations upon said gaseous medium.

867,877. ART OF DETECTING OSCILLATIONS; Lee De Forest, New York, N. Y. App. filed June 12, 1907. As an improvement in the art of receiving electromagnetic signal waves, the method herein described which consists in establishing in a circuit a gas having dissociated and conducting ions, altering by the energy of the electrical oscillations resulting from the waves to be received, the conductive properties of said gas, and translating the resulting current variations into signal indications.

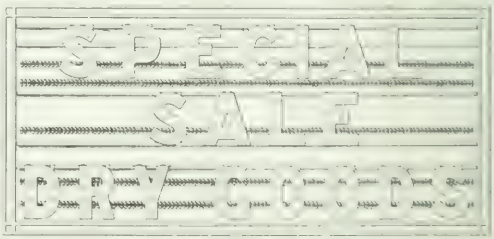
867,878. OSCILLATION DETECTOR; Lee De Forest, New York, N. Y. App. filed June 12, 1907. An oscillation-responsive device comprising a Bunsen burner, an electrode placed in the flame thereof, a local circuit connecting said burner and electrode, a signal-indicating device and a source of electromotive force connected in said local circuit, and means whereby the oscillations to be detected may be impressed upon said flame.

867,892. TELEPHONE SYSTEM; Frank E. Mayberry, Medford, Mass. App. filed Aug. 11, 1902. The combination with the line conductors, of a third conductor, an electro-magnet in a circuit including one of said line conductors and said third conductor, a second electro-magnet in a circuit including the other of said line conductors and said third conductor; a signal controlled by both of said magnets, and means for separately controlling said circuits.

867,895. WIRELESS TRANSMISSION OF SONOROUS VIBRATIONS; Francis J. McCarty, deceased, San Francisco, Cal. App. filed Sept. 20, 1906. An apparatus by which sound vibration may be transmitted without the aid of wires. Has a transmitter in a local circuit including a magnet acting on an arc in the oscillation circuit.

867,896. WIRELESS TRANSMISSION OF SONOROUS VIBRATIONS; Francis J. McCarty, deceased, San Francisco, Cal. App. filed Sept. 20, 1906. Relates to modifications of the above.

867,898. SPACE ELECTROMECHANICAL SYNCHRONIZING MEANS; Austin H. Stewart, Nashville, Tenn. App. filed June 18, 1903. An apparatus for synchronizing clocks by wireless telegraphy, whereby all of the clocks within a predetermined range are controlled by a single station without circuit connections. The apparatus is designed to be independent of ordinary wireless emanations.



[illegible]—Electric Sign.

[illegible] TELEGRAPH TRANSMITTER; [illegible] New York, N. Y. App. filed March 24, 1905. In a telegraph transmitter, the com- [illegible] thereby, and means for driving said carrier comprising a clutch, of [illegible] controlling devices, and a master bar operated by said [illegible] keys and controlling said clutch.

867,901. INSULATOR; John C. Barclay, New York, N. Y. App. filed July 22, 1907. The insulator is provided with the usual groove to [illegible] with by which the insulator can be unscrewed without interfering with the loop of the wire.

[illegible] ELECTRICALLY OPERATED RAILWAY SWITCH; [illegible] J. Johns, Scranton, Pa. App. filed March 20, 1907. Mechanical features of a track switch including solenoid magnets in the railroad [illegible] shoe or tappet on the car.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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During 1906 ELECTRICAL WORLD *printed and circulated* 970,000 *copies, an average of* 18,827 *copies per week. Of this issue* 15,500 *copies are printed.*

NEW YORK, SATURDAY, OCTOBER, 26, 1907.

CONTENTS.

THE MARCONI ACHIEVEMENT.

He must, indeed, be of a grudging temperament who does not congratulate Mr. Marconi on his achievement in establishing commercial wireless telegraphy across the Atlantic. This is one of the great new achievements of the new century, and like other deeds, has been attended by doubt, disaster, delay and difficulty. But the spirit and ability of the inventor have risen superior to every fresh trial, and without any boasting, in quiet persistence and endurance, he has worked onward to his goal, the conquest of the ether for the transmission of intelligence.

It is needless for us to add that all the obstacles in the way of a perfect service have not been removed; nor, on the other hand, have all the advances and perfections yet been attained. Mr. Edison, in his generous endorsement of a great rival, says that Mr. Marconi is likely in ten years to send 1000 words a minute. But there may meantime be interruptions of the service, as there have been with cables. Litigations, or at least international disputes as to "control" of the ether, are sure to spring up. The financial side of the art is not yet clearly defined. The London *Economist* figures out that 3,000,000 words will not pay, but it looks to us already like a much higher transmissive ability than that. After all is said and done, the drift of events and invention is with Mr. Marconi, who has now added so immeasurably to the world's resources, yet in a sense uses nothing up in doing so. We trust that Mr. Marconi will give American electrical engineers an early opportunity of offering him in person their hearty felicitations on his splendid work, just as they did when first he jumped the signal "s" across the broad ocean in 1901.

THE COPPER CRASH.

The long expected crash in copper has come at last, developing other troubles in turn, so that New York has had a most anxious and disturbed week. Stock values have crumbled away, financial institutions have been in trouble, public confidence has been broken, and the whole machinery of banking and commerce has been put out of proper running order. Fortunately the prolonged depression of the past spring and summer had already resulted in a healthy check to speculation or over production. It is distressful to think of what might have happened had such a storm burst two years ago, when every inch of canvas was spread. But for some time past, prudent men have limited their purchases and their commitments, and it is evident that the days of soundness and sanity will soon be here again, when business will be conducted on a normal basis, and honesty will be accepted once more as the best policy—even in high places.

Out of all this hurly-burly comes good, and this week we have heard but one note—that of rejoicing—as to copper. A price of 12 or 13 cents may be low, but it is at least nearer real true values than the absurd price of 25 cents marked up by gamblers and cornerers as the point to which public necessity and endurance could be stretched. It will be a long time before

25-cent copper is seen again, and when it is ever seen it will mark actual relations of supply and demand and not an outrageous exaction by artificial monopoly. The electrical industries as a whole breathe more freely at their escape from such an intolerable tax, and have no sympathy with the men who, in overreaching themselves, have sustained losses reported to be so heavy. Our knowledge of the situation and conditions goes to satisfy us that the larger electrical interests were never exposed to the higher range of price demanded, but we happen to be aware, also, of large orders that were and have been held back for months by purchasers determined not to be gouged. Now, however, it would seem that all can buy freely and safely.

Received Energy in Wireless Telegraphy.

The only hope we have of a systematic increase in our knowledge concerning the quantitative actions involved in wireless telegraphy is by extending the range and number of measurements on the properties of wireless-telegraph waves under a number of different conditions. The theory of the subject is as yet only mapped out in rough outlines and much work must be done before it can be expected to be satisfactorily detailed. A contribution to the subject of the interception of energy in wireless telegraphy by Mr. C. A. Culver appears in the September number of the *Physical Review*. A sending antenna 8 meters high was installed about 50 meters away from a receiving antenna at which the energy intercepted was measured.

A number of experimental results are appended to the paper, some of which are in general accordance with results obtained by wireless telegraph tests, and some of which do not appear to be in agreement with results recorded elsewhere. It is to be remembered that although the wave lengths emitted in the case here considered are given as about 500 meters, the distance between the sending and receiving antennas was only about 50 meters, or about one-tenth of one wave-length. This proximity would be capable of introducing actions that might not be found at a distance of many wave-lengths, such as is ordinarily presented in wireless telegraphy. For example, there might be appreciable direct electrostatic influence between the two antennas at so short a distance. It is also understood that in the neighborhood of a sending antenna there are two radiations, one on electromagnetic radiation with its maximum at the earth's surface and with an energy intensity inversely as the square of the distance; the other an electric force with its maximum in the vertical, dwindling with the inverse fourth power of the distance. Consequently, the phenomena produced within the first few wave-lengths of the sending antenna may differ materially in detail from those presented at a considerable distance.

The Fan for Winter Service.

During the coming two months, there is open to central-station companies in all latitudes where hot-air furnaces prevail a method of increasing revenue from residence customers, without any increase in investment by the use of fans for circulating air. In a hot-air furnace the fan is placed in the cold-air intake before the air enters the furnace. Its function is to assist the natural circulation of hot air around the furnace and up the hot-air pipes to the rooms above. Its chief value is in warming up the house quickly in the morning, and in forcing air to rooms on the windward side of a house where the natural circulation is not sufficient to heat the rooms. A fan so used converts many an unsatisfactory heating system into a satisfactory one at a cost which is far more agreeable to the customer than throwing out his hot-air furnace altogether and putting in steam or hot water. The temperature of the furnace-heated house can be brought up much more rapidly with the artificial circulation produced by the fan than when natural circulation is depended upon, with the result that considerable heat which otherwise goes up the chimney during the hot-fire period in the morning is saved. It is interesting to note that tests recently carried on by the U. S. Geological Survey in connection with steam-boiler efficiency, and described in a paper by Messrs. W. T. Ray and Henry Kreisinger, presented before the Western Society of Engineers at Chicago, Sept. 18, indicate a higher boiler efficiency from accelerated fan draft than from natural draft. If the same principle holds true with regard to air passing over the heated shell of a furnace (and it seems likely that this is approximately true) it can be seen why increasing the velocity of air circulating through a furnace can greatly accelerate the rise of temperature in the house. But theory aside, it is now well established that this little plan works well in practice and gives promise of adding considerable to the total revenue of central-station companies the coming winter if it is properly followed up. There is no worthy appliance for household use that receives so enthusiastic a welcome as this when it comes to a house which is chronically hard to heat. The electric fan can also be similarly used in connection with steam heat, by locating it so that it will direct a current of air against a radiator. In this manner the temperature of the air in a cold room may be raised within ten minutes to that of normal warmth.

Direct-Current Power Transmission.

The very striking discussion of the Thury system of power transmission at constant current which we publish elsewhere in our columns will well repay study. We in this country are so wedded to alternating-current working that it is hard to realize the possibilities of anything else, and harder yet to grasp the fact that on the Continent transmissions on the Thury system have approximated the highest voltages and the longest distances commercially undertaken on the three-phase system. A station working at a full-load voltage of 57,600 over more than 100 miles of circuit must assuredly be taken seriously, however far it may depart from standard American practice. The details of operation seem to have been very carefully worked out and the practical working of all these plants seems to be satisfactory. The success of M. Thury in building high-voltage generators has certainly been remarkable, albeit there seems to be a limit of output which it is at present impracticable to surpass. The generators for the Moutiers-Lyons plant are for 75 amperes and 3060 volts each, about 275 kilowatts; and even for somewhat lower voltage 400 or 500 kilowatts seems to represent the upper limit of output. It is possible that the auxiliary-pole construction may facilitate the building of larger machines, yet there seems to be small [illegible] current machines. It is unfortunate that a system otherwise of especial applicability to very long transmissions which for economy should be for great output, should be thus handicapped in capacity of its individual machines. Group-driving of course simplifies the layout of the station, without, however,

helping much in the matter of cost. The inconvenience is not without compensations since the entire raising transformer equipment is done away with, so that the comparison should be between the small direct-current machines and the large three-phase ones with their transformers. Another gain is the relatively simple switching system as compared with the frightfully intricate and costly switchboard equipment common in large alternating stations. We have several times of late commented on this feature of present construction, which increases the total cost of the station by from a third to a half the cost of the generators and sometimes more. Mr. Thury appears to have worked out his problems of regulation in a very workmanlike manner, so that from an operating standpoint there is little to be feared. Regulation takes various forms according to the result desired, being commonly by reducing the generator speeds or cutting out part of the machines or by a combination of these methods. At full load the efficiency of the high-voltage generators is very creditable, say betwen 93 and 94 per cent, approximately the same therefore as that of alternating-current generators with their transformers. The essential difference comes in the fact that the losses in constant-current machines are nearly independent of load, so that at light output the alternating-current system may have the advantage. Of course, so far as the station is concerned, this difficulty can be for the most part avoided, if the load variations are reasonably slow, by cutting out generators.

It is in the line itself that the strongest claims are made in behalf of the constant-current system. It must be admitted at the outset that a direct current is easier to insulate than an alternating current of the same effective voltage. Further, it has been pretty well established experimentally that the difference is greater than would be indicated merely by the extra height of the alternating-current wave crest. It is not unlikely that a direct-current voltage of 50,000 is not materially harder to insulate than an alternating-current voltage of 25,000; at least recent results point to about this ratio. And this, even, excludes questions of surging and actual resonance which compel a still greater factor of safety on the alternating-current lines. In the article before us, the author works out at some length the economics of direct-current and alternating-current lines, assuming the same maximum voltage between line and earth, leaving out of account abnormal voltages on the alternating-current, three-phase system. The result is a bit startling, showing that with a power factor of 0.8, by means of an unusually low figure the three-phase system requires about three times the weight of copper required for the direct-current systems. At unity power factor the difference would be less, at lower power factors more. And from the standpoint of maintenance there is the further difference that the alternating-current system is under its full insulation strain all the time while the direct-current system reaches it only at full load, under ordinary circumstances but a few hours per day. One of the startling but rather fantastic possibilities of high-voltage direct-current transmission is the use of ground return either regularly or in emergencies. This has, in fact, been proposed for single-phase transmissions, but in this latter case would certainly involve somewhat greater chance of serious interference with other grounded systems.

It is [illegible] transmission gets into difficulties. For a uniformly distributed load its gain over the constant-potential three-phase system in amount of copper required is relatively small, perhaps negligible when distribution in fairly large units is considered, which in alternating-current work are likely to give high power factors through being synchronous or for lighting loads. On the Thury systems power is not infrequently taken off at several points on the line, but the main delivery is *en bloc*. And obviously the receiving machines have the same limitations as to size as in the case of the generating station, which is a very material disadvantage. As regards reliability of service, the Thury plants certainly have not acquired bad reputations. They are free from some of the troublesome characteristics of alternating-current systems, but have difficulties of their own, particularly in the way of insulation of the machines. The oil insulation on the high voltage side of an alternating-current transmission plant is no mean advantage, both as respects general safety and protection against abnormal line voltages. Even in the case of lightning, an oil-insulated transformer is something of a safeguard. In a direct-current station the machines are very much exposed, although by the free use of choke-coils it is possible to reduce the danger very materially. The disturbances classified as lightning probably take all forms from the single mighty wave crest of a direct bolt to oscillation discharges of high frequency in the more common secondary disturbances; and they are bad upon any system whatever, so that perhaps this phase of the question may be laid aside.

The serious way in which the constant-current system has been considered for the Victoria Falls project is evidence that whatever may be the final judgment as to its merits, it certainly cannot be set aside offhand when very long transmissions are under discussion. No alternating transmission has yet been undertaken in which the length of line has been so great as to bring the phenomena of major resonance conspicuously to the front. A line 500 to 1000 miles long will unquestionably bring out some features of alternating-current theory which have heretofore been wholly negligible. Its natural period would be in perilous proximity to the fundamental and low harmonics of the operating frequency. The economical voltage would be so high and the amount of line exposed to trouble so great, that the requisite factor of safety in the insulation would be difficult to maintain. It is for such extreme cases that direct-current transmission must be seriously considered. As a matter of fact, most electrical power transmissions are under conditions very easily met by the three-phase system with simplicity and economy. Voltages of 50,000 to 60,000 and even somewhat higher, are now managed with comparative ease, and give satisfactorily reliable service over long lines. It is when one needs to double these pressures that one reaches a region of unknown and probably troublesome complications. Were it not for the fact that most extremely long transmissions are likely to be those involving also very great amounts of power, the direct-current system would come in for more frequent consideration. A plant of 50,000 kilowatts in 275-kw units, however, looks like anything except a cheap and manageable proposition, particularly when a similar receiving plant is necessary. If by adopting inter-pole construction or other improvements, M. Thury can get, say, a 10,000-volt generator for 100 amperes, he will come somewhere near to a serious competitive basis for large work. He certainly deserves immense credit for building up a system which, despite its apparent eccentricity, has done excellent work.

Regular Wireless Service Between America and Europe.

With larger plant and better apparatus, Mr. Marconi has now resumed the transoceanic wireless service begun two years ago, and the system is now in regular commercial operation between Glace Bay, Nova Scotia, and Clifden, Ireland. On Friday, Oct. 18, no fewer than 14,000 words were transmitted across the Atlantic, and the work is admittedly excellent. Business is being carried on at a notable reduction from cable rates. The London *Economist* estimated recently that the system must transmit 3,000,000 words annually to be a financial success and might be regarded, after all, as equal only to a thirteenth cable under the Atlantic. At the present initial rate, over 5,000,000 words a year are being transmitted, and Mr. Edison informed the writer last week that in his sober judgment, by "hitting it up" Mr. Marconi, within 10 years, ought easily to be able to transmit 1000 words a minute. He stated moreover that in due time dependence on coast stations would not be necessary, but that New York and London could be placed in easy communication. Mr. Edison also ventured the opinion that the courts would, if the question arose, hold Mr. Marconi free from interference as the first man to establish and maintain this great ethereal system of communication between the Old World and the New. He would be protected by both common law and equity. Meantime, Mr. Marconi has been worthily the recipient of a multitude of congratulations directly and indirectly, including those from President Roosevelt, King Edward, Earl Grey, governor of Canada, Sir W. Laurier, Premier Clemenceau, of France, Lord Strathcone, etc.

The engineers of the system state that at present they can readily send 20 words a minute, or 1200 words an hour. Dispatches, as received, are "O. K.'d" back as in cable work. While the cable rates are 25 cents a word, the wireless rates from this side are 15 cents and from Great Britain 13 cents. Press cable rates are usually 10 cents a word, but the wireless rate is 5 cents, plus land tolls, and in Canada 7½ cents. It is understood that further facilities will soon be afforded by putting the Cape Cod plant again in commission with new and more powerful apparatus.

It is natural that a great deal of interest should attach to the effect of this great success of a rival method, on submarine cables and on cable securities. The quotations for cable stocks have been weaker, but in reality not more than the general decline in the market would explain. The opinions of cable and telegraphic experts have been difficult to obtain, as they all consider it too early to form a fair estimate of permanent conditions. The most prominent cable manager on both continents, however, is Mr. George G. Ward, the able vice-president and general manager of the Commercial Cable Company, who gave out the subjoined statement last week: "We would not be understood as minimizing Marconi's achievements, but submarine cables, being more reliable, we do not believe that wireless will ever prove a serious rival to them. As proof of our estimation of the commercial future of the wireless, I might say we have this minute completed a new direct cable from New York to Havana. In other words, cable companies which are free to adopt wireless methods, if they see fit to do so, continue to invest in new cables. Furthermore, while it is expected that the Marconi system will be improved in the course of years, we anticipate that any such advances will have the effect of stimulating telegraph business generally. History will undoubtedly repeat itself in this case, as it has in many other kindred enterprises."

Mr. Marconi and Mr. W. W. Bradfield, chief electrician of the American Marconi Wireless Telegraph Company, are expected in New York next Friday from Glace Bay, the distinguished inventor proposing to return to England as soon as possible and resume work there. It may be well, meantime, to recapitulate briefly the stages of advance that have brought the system to the present point of perfection. On Jan. 23, 1901, Mr. Marconi established wireless communication on his system between St. Catherine's, in the Isle of Wight and the Lizard, in Cornwall, a distance of 183 miles, thus proving the principle of the non-interference of the curvature of the earth, an interference anticipated by many men of learning, and predicted by cable experts.

These results justified Mr. Marconi in recommending the erection of a high-power station, with the object of telegraphing wirelessly across the Atlantic. Such a station was erected at Poldhu, in Cornwall, and on Dec. 12, 1901, the first clear and intelligible signals sent across the Atlantic were received from Poldhu at a temporary station located near the city of St. Johns, in Newfoundland. To commemorate this event, an official complimentary luncheon was given to Mr. Marconi by the then Governor of Newfoundland, Sir Cavendish Boyle. Soon after this, he was given a memorable banquet on his arrival in New York, by the American Institute of Electrical Engineers, at the Waldorf, when Mr. Marconi made his first appearance before an American gathering, and his first statement of his work and aims to an American audience.

This splendid achievement, about which there was a good deal of scepticism at the time, so disturbed the Anglo-American Cable Company that they commenced a suit against Mr. Marconi, and asked for an injunction to prevent his continuing his operations in Newfoundland. In July, August and September of 1902, Mr. Marconi, at the invitation of the Italian Government, made a cruise in the warship *Carlo Alberto,* and during the voyage carried out important tests in wireless telegraphy. During these experiments messages transmitted from Poldhu were received across land and water (1) nearly as far as Kronstadt, in the Gulf of Finland, Russia, a distance of 1400 miles, (2) at Gibraltar across the whole of Spain, over a distance of 1000 miles, and (3) in the Mediterranean, off the coast of Corsica, over a distance of 1000 miles, although the whole of France and part of the Alps intervened between the two stations. Messages in nearly all positions and places visited by the cruiser were received either on Mr. Marconi's receiver, working a tape instrument, or by means of his magnetic receiver. The reports of these tests were signed by Admiral Mirabello, the present head of the Italian Navy.

As a result of the success of these tests, the Italian Minister of Marine, at the request of the King of Italy, issued orders that the *Carlo Alberto* should be placed at Mr. Marconi's disposal for the purpose of assisting him in the establishment of communication between Canada and England. On the 20th October, 1902, the *Carlo Alberto* left Plymouth and sailed for Sydney, Nova Scotia, and messages were received from Poldhu throughout the voyage to Sydney, a distance of 2500 miles. After a few weeks' preliminary work at the station, which had, in pursuance of arrangements made between the Canadian Government and Mr. Marconi, been erected at Glace Bay, Cape Breton, messages were transmitted on Dec. 16, 1902, to the London *Times* by Dr. Parkin, its own special correspondent and other work was done. It was soon decided, however, that for general and sustained work, more powerful and more sensitive apparatus was necessary, and to that end Mr. Marconi has worked with the results now noted.

Entertainment at Atlantic City Convention.

The program arranged by the entertainment committee of the American Street & Interurban Railway Association provided for many and varied receptions, entertainments, divergences from routine work, etc., when business sessions were not pressing, for the delegates and ladies in attendance during the week of the convention.

On Monday evening Miss Kitty Cheatham entertained in the solarium in the Marlborough-Blenheim Hotel. Informal dancing followed. On Tuesday evening the annual reception in honor of the presidents and other officers of the various associations with their ladies was held in the solarium of the Marlborough-Blenheim.

Tea was served for the ladies at the Country Club of Atlantic City on Wednesday afternoon, where golf and tennis were also

played. In the evening theater parties were held at the Savoy Theater and at Young's Pier Theater. During the day many of the ladies availed themselves of automobile trips.

On Thursday evening the annual supply men's amateur vaudeville performance was given at Young's Pier Theater. The performance was followed by an informal dance at the Marlborough-Blenheim. For Friday evening the entertainment committee provided an informal affair in the solarium of the Marlborough-Blenheim. There was dancing until midnight and between the dance numbers a quartet sang a number of selections. The arrangements made for the use by delegates of roller chairs was greatly appreciated.

American Electrochemical Society Meeting.

The twelfth general meeting of the American Electrochemical Society was held in New York City on Oct. 17 to 19. The programme of the professional papers, as well as that of the excursions and social functions, had been carefully arranged and the attendance was very large. Not less than 284 members and guests registered, which number surpassed the best records of any previous meeting. For most of the preparatory work done to insure success, the president, Prof. Charles F. Burgess, and the secretary of the National Society, Prof. J. W. Richards, as well as the New York section and its indefatigable secretary, Mr. Alois von Isakovics, deserve the cordial thanks of the society.

PROF. C. F. BURGESS, PRESIDENT.

The Chemists' Club and Columbia University acted as hosts of the society during the professional sessions. The meeting was opened with a reception of members, guests and friends by the president and officers of the society at the Chemists' Club on the evening of Thursday, Oct. 17. A special feature of this occasion were two illustrated lectures.

Dr. George F. Kunz, the well known gem expert, spoke on diamond and moissanite—natural, artificial and meteoric. The lecture was well illustrated by lantern slides, and an interesting exhibit was shown. Mr. E. G. Acheson, of Niagara Falls, lectured on "deflocculated" graphite, or what is the same, colloidal graphite, and its use for lubricating purposes, with demonstrations and experiments. This subject has already been covered in our columns in connection with Mr. Acheson's paper at the Niagara meeting of the American Institute of Electrical Engineers.

For the afternoons, various exceedingly enjoyable excursions had been arranged. On Friday afternoon a visit was paid to the laboratories of Mr. Thomas A. Edison, in Llewellyn Park. Mr. Edison received the party most cordially and the visitors highly enjoyed the pleasure of being presented to Mr. Edison and being shown around the various laboratories. For Saturday afternoon the choice was left between visits to the new Pennsylvania Railroad power plant in Long Island City, or to the New York Electrical Testing Laboratories, or to the U. S. Metals Refining Company, at Chrome, N. J. The latter plant, which has recently been much enlarged, is one of the finest examples of modern practice in copper refining. All the various processes of copper smelting, converting and electrolytic copper refining and the subsequent electrolytic parting of the ore bullion into silver and gold were shown to the visitors.

On Friday evening a most enjoyable subscription dinner was held in Liederkranz Hall. The attendance was about 130, among them quite a number of ladies. Dr. Charles F. Chandler was a most jovial toastmaster. A smoker tendered by the Chemists' Club to the society, on Saturday evening, formed the happy conclusion of probably the most successful meeting which the society has ever held.

In the following we give abstracts of the papers presented in the professional sessions, of which the Friday morning session was held at the Chemists' Club and the Saturday morning session in Earle Hall, Columbia University.

ELECTROMETALLURGY OF IRON.

Two papers dealt with the reduction of iron ore in the electric furnace. The first, by Messrs. A. E. Greene and F. S. MacGregor, described experiments made by the authors at the Massachusetts Institute of Technology. They used an experimental furnace of about 60-kw capacity (an illustrated description of which may be found in an article of the same authors in *Electrochemical and Metllurgical Industry*, September, 1907). They used three samples of ore, two of which were iron sands from the Pacific Coast, and the other was a titanium-iron ore from New York State. In tests of the latter the special object looked for was to determine the character of the charge and the temperature limits for which no reduction of titanium takes place. Some figures as to efficiency were given. Details may be found in the article above referred to. The paper was briefly discussed by Dr. Whitney and Dr. Richards.

The second paper on iron reduction in the electric furnace was presented by Dr. J. W. Richards, and was a critical discussion of the well-known experiments made at Sault Ste. Marie with the Heroult furnace under the auspices of the Canadian Government. Dr. Richards reviewed the various runs made. Concerning the manufacture of silicon pig by simultaneous reduction of iron oxide and silica in the electric furnace in the same operation, he thought that this complicates matters and that it is preferable to restrict the operation to iron reduction and introduce as much silicon as desired, afterwards in the form of ferrosilicon.

The chief point brought out by Dr. Richards was that in some of the runs too much carbon had been used in the form of charcoal in the charge. There is in the iron oxide only so and so much oxygen which can combine with the carbon. The less carbon is used, the more CO_2 will be formed. If more carbon is used than is necessary to form CO_2 with the oxygen in the iron oxide, then carbon monoxide will also be formed and the percentage of it will be the higher the greater the amount of carbon in the charge. If even more carbon is used in the charge than is taken care of by the oxygen in the ore in the formation of carbon monoxide, complications will result, since in the elec-

tric furnace there is no oxygen from air to combine with the excess of carbon as in the blast furnace. More ore must then be added. Analyses of the furnace gases (ratio of CO to CO_2) would go a long way to indicate how the furnace is running. Within certain limits the less carbon is used the higher the electrical efficiency of the furnace. Of course, if too little carbon is used, one gets a pig high in sulphur.

SILICON MONOXIDE.

Dr. H. N. Potter presented a very interesting paper on silicon monoxide. Clemens Winkler had formerly tried to get a reaction between silicon and silica (silicon dioxide), but had failed. The reason of this failure, as Dr. Potter showed, was the low range of temperatures within which Winkler had worked. When working between 1700 and 1800 deg. C., Dr. Potter found quite a brisk reaction. But, of course, it is quite possible that the silicon monoxide which is formed dissociates at cooling.

The chief part of Dr. Potter's paper was an account of very elaborate researches offering strong evidence that the author's brown powder "monox" (see abstract of a second paper of the author below) contains silicon monoxide mixed with silicon and silica. The paper was discussed at some length by Messrs. Burgess, Richards, Whitney, Tucker, Hering and Zimmerman.

A paper by Mr. A. B. Albro dealt with the analysis of silicon compounds. He showed that the usual method is not reliable in so far as it does not permit distinguishing sharply between free and combined carbon. Mr. Albro described a new method which overcomes this difficulty and discussed the precautions (for example, the use use of platinum) which must be taken in the analysis of silicon compounds.

BOILING POINTS OF METALS.

A paper by Dr. O. P. Watts was then presented in abstract dealing with the metals in order of their boiling points, as arranged from Moissan's experiments in the distillation of metals and alloys. From Moissan's published results, Dr. Watts has constructed the following series:

Zinc, 940 deg. C.; cadmium, 1025; lead, 1250; silver, 1850; copper, 2100; tin, 2170; manganese, 2200; nickel, 2450; chromium, 2500; iron, 2600; platinum, 2650; titanium, 2700; rhodium, 2750; ruthenium, 2780; gold, 2800; palladium, 2820; iridium, 2850; osmium, 2950; uranium, 3100; molybdenum, 3350; tungsten, 3700.

All the figures represent degrees C. But only the figures for zinc and copper are measured boiling points. The figure for tungsten must be some unknown temperature above the melting point (3200 degrees) and 3700 has been assumed arbitrarily. All other figures are not claimed to stand for the exact boiling points, but only to indicate the relative position of the metal in the series.

Dr. Richards remarked that the volatilization point of a pure metal is different from its volatilization point from an alloy and that this fact must be taken into consideration in the use of the above table, which was determined from experiments with alloys.

CHLORINE IN METALLURGY.

A paper on a new application of chlorine in metallurgy was presented by Mr. C. E. Baker. It dealt with the treatment of sulphide ores. The author argues that in the electrolytic production of chlorine and caustic soda from common salt the caustic soda pays for the process and the chlorine costs nothing. The chlorine gas is supplied to a rotating tube mill containing pulverized dry sulphide ore and acts on the ore, producing the chloride of the metal and sulphur, or at a higher temperature sulphur chloride. The sulphur or sulphur chloride distils off and is condensed outside. In case of lead-zinc sulphide ore, when the chlorination is finished, the contents of the tube mill are supplied to leaching tanks, the soluble chlorides are removed, leaving behind in the gangue with the free gold any insoluble silver or lead chlorides remaining. The gold is recovered from the gangue by cyanidation or wet chlorination or amalgamation in barrels. The solution, after proper purification, contains zinc chloride, which is electrolyzed. The products are zinc and chlorine, which is used over again. The applications of analogous methods to other metallurgical problems was also discussed.

HEAT CONDUCTIVITY OF CARBON.

The comparative heat conductivity of amorphous carbon and graphite was the subject of a paper by Mr. F. A. J. FitzGerald. This is an important matter for the question whether graphite or amorphous carbon electrodes should be used in electric furnace work. Graphite has four times the electric conductivity of amorphous carbon; hence with the same ohmic loss it is possible to double the current density by substituting graphite for amorphous carbon. But if this is done one has to consider that the heat conductivity of graphite is also greater than that of amorphous carbon. This results in increased heat losses. In any case, one has to consider the total effect. Mr. FitzGerald's tests show that graphite conducts the heat 18 times as well as amorphous carbon.

DETERMINATION OF SILICA.

A paper by Mr. W. R. Mott dealt with electrochemical methods for the qualitative and quantitative determination of free silicon in the presence of silica, silicates, oxides, free carbon and carborundum. The author states that a direct process for determining free silicon consists in the treatment of the material to be analyzed with metallic fluorides, such as copper fluoride, silver fluoride, etc. In one step the solid metallic silicon electrochemically replaces the metal in solution, which metal is deposited and may then be weighed, or may be dissolved and determined in any regular way. These methods are direct and are not interfered with by the presence of silica, silicates, metallic oxides, free carbon or carborundum.

GRANULAR CARBON RESISTORS.

The first paper of the Saturday morning session was presented by Prof. S. A. Tucker, with Messrs. A. Doty and R. W. Canchois as joint authors, on the use of granular carbon resistors. Various mixtures of carbons of different grades were tried both with direct and alternating current. While most of the results are given in form of tables, the general conclusions which may be drawn are as follows.

Alternating current seems as suitable as direct current; moreover, a change of frequency with alternating current does not appear to make any essential difference. The more frequently the coke is used as resistor, the smaller appears to be the temperature which is obtainable for the same expenditure of energy. Throughout the experiments it was found that the coarser the grade of coke, the greater its conductivity. Further, any single grade of coke is more efficient than a mixture of all grades.

INDUCTION FURNACE.

A paper by Mr. Gustave Gin on the theory of the induction furnace was read very briefly in abstract, since it consisted almost completely of formulas. In the discussion the necessity of having the primary sufficiently remote from the secondary was dealt with. Mr. Carl Hering said that the effect of the high temperature in the secondary on the insulation of the primary might be overcome by using asbestos-covered wire. But a more serious difficulty is that if the iron core gets heated to a high temperature, its permeability goes down seriously. Dr. E. F. Roeber stated that the well-known formulas of the induction motor would represent a good starting point for the theory of the induction furnace, since both are special cases of the general alternating-current transformer and both have in common the characteristic feature of high leakage.

ELECTROMETALLURGY OF ZINC.

A second paper by Mr. Gustave Gin discussed the use of the induction furnace for zinc metallurgy. He proposes to use the induction furnace, but in a somewhat modified form so as to get efficient circulation. For this purpose the crucible which forms the secondary of the induction furnace is made of a series of channels, the bottoms of which are inclined longitudinally, the deepest part of each being connected by a conduit with the more shallow part of the next channel. This crucible contains a bath of molten iron, on the surface of which is spread a mixture of oxide of zinc and carbon or of zinc sulphide, lime and carbon.

When the proper temperature is reached, the distillation of zinc begins and zinc vapor and oxide of carbon are carried off to the condensing chambers. An estimate of cost is added. The author is convinced that such countries, like Sweden, in which are united in the same regions considerable quantities of complex ores with powerful waterfalls, are well suited for the adoption of electrothermic methods. In the discussion of the paper Messrs. Johnson and Richards criticized some special points in the author's estimate of cost of the process, while Mr. Hering remarked that by his particular construction of the furnace Mr. Gin invites the "pinch phenomenon."

SILVER COULOMETER.

Dr. George A. Hulett and Dr. L. H. Duschat presented a preliminary paper on the silver coulometer. It was an account of an exceedingly careful research giving conclusive proof of the existence of a certain amount of impurities in the silver deposit. In the discussion Mr. Carl Hering suggested using gold instead of platinum as electrode material so as to overcome any troubles which may come from occluded gases.

MONOX.

A second interesting paper presented by Dr. H. N. Potter described the furnace for making monox. It is an electric furnace with an attached chamber for condensing the material.

ELECTROLYTIC THEORY OF THE CORROSION OF IRON.

The last paper was presented at the meeting by Dr. A. S. Cushman on the corrosion of iron as an electrolytic phenomenon. The fundamental idea is that when an iron surface is in contact with moisture (acting as electrolyte), differences in the composition of the iron will result in making some parts of the iron surface anodes and the other parts cathodes. At the anodic spaces the iron will pass into solution, assuming the ferrous ionic state, while hydrogen is evolved at the cathode. The ferrous ions are subsequently oxidized to ferric by the oxygen of the air, resulting in the formation of rust. Dr. Cushman, in cooperation with Dr. Walker, has succeeded in making the anodic and cathodic zones on iron visible in different colors by means of a chemical indicator. Several exceedingly pretty samples were exhibited.

A paper by Mr. H. W. Gillett on the electrolytic separation of silver and copper was read in abstract by Prof. Tucker, while Mr. E. E. Free presented a paper on the electrolytic separation of silver and copper. The papers by Dr. Henry S. Carhart on the theory of concentration cells, Dr. H. E. Patten on electrolytic reduction of nitric acid, Dr. Herman Schlundt on the electroscopic determination of radium, were read by title.

Store Lighting.

The announcement that Mr. Frederick J. Pearson, electrical engineer of Marshall Field & Company, would present a paper on the "Lighting of a Large Retail Store" brought out an attendance of over 70 at the meeting of the Chicago section of the Illuminating Engineering Society, Oct. 10. The experiments which have been carried out on a large scale in Marshall Field & Company's great store in Chicago the past 18 months had aroused the interest of all having to deal with illuminating problems. Mr. Pearson's paper [illegible] large amount of valuable information of practical importance to illuminating engineers. Mr. Pearson stated that two years ago [illegible] the entire lighting system in its store. At that time the connected lighting load of the establishment amounted to the equivalent of 32,000 16-cp lamps. Recent additions and enlargements have brought up the connected load to 57,000. Tests of various lighting systems were carried on over a period of 18 months. Mr. Pearson stated that while illumination calculated from the photometric curves of individual lamps, as well as measurements of illumination at the counter level in the actual installations, were made use of in comparing results, he attached [illegible] comparing the general appearance of large rooms or sections of rooms lighted in different ways.

There were 25 acres of floor space. To show the multiplicity of requirements, he stated that there were 350 sections in the store, nearly every section having a different class of goods, and therefore presenting somewhat different requirements. It was therefore necessary, if uniformity throughout the store was to be secured, to select a compromise system which would serve fairly well all requirements. The general plan of testing the different illuminating systems offered by the different manufacturers was to take a large room about 150 x 250 ft., equipping one-half with one lighting system and the other half with another. This he thought the best way to bring before the non-technical public and the sales managers the relative effects and efficiencies of the various systems.

Test No. 1 was on four sections, each 22 x 22 ft., containing 1936 sq. ft. Each section had five 125-watt Gem incandescent high-efficiency lamps placed pendant near the ceiling in prismatic bowl reflectors. Walls, pillars and ceilings were white; the store fixtures are of mahogany, and there is dark carpet on the floor of the room devoted to dress goods. Lamps were 11 ft. 8 ins. above the counters. Tests were made at five stations in each panel with three observers, each taking a reading at each station, making 60 observations in all. The watts per square foot were 1.296, and the average foot-candles at stations tested, 3.96.

Test No. 2 was made under the same conditions as Test No. 1, but with two three-glower alternating-current Nernst lamps to each 22 x 22-ft. ceiling panel. The watts per square foot were 1.1 and the average foot-candles at points tested, 3.42.

Test No. 3 was made with lamps 14 ft. 6 ins. above the counters in a room with maple floor and mahogany store fixtures, containing miscellaneous merchandise. The test covered four sections 22 x 22 ft. in which were located 24 test stations at which 72 observations were made. The lamp equipment consisted of five 250-watt Gem lamps for each section, placed near the ceiling pendant in prismatic bowl reflectors. The watts per square foot were 2.56, and the average foot-candles at stations tested, 5.63.

Test No. 4 was made in the same room with the same number of sections as test No. 3 and with the same number of observations and test stations. The equipment consisted of two six-glower alternating-current Nernst lamps for each 22 x 22-ft. section. The lamps were at the ceiling enclosed in sand-blasted globes. The watts per square foot were 2.17, and the average foot candles at stations tested, 5.04.

Test No. 5 was made on the same floor as test Nos. 1 and 2, and included 2288 sq. ft. There were 24 50-watt 16-cp lamps, lamps rated at 3.1 watts per mean horizontal candle, in each panel, grouped in six-light fixtures with the lamps hung at an angle, in 6-in. ground glass shades. Lamps were 7 ft. 2 ins. above the counter level. Sixty observations were taken. The watts per square foot were 2.48, and average foot candles at test stations, 3.11.

Test No. 6 was made on the same number and size of sections and with the same number of observations and location of test stations as test No. 1. The room had dark walls, and contained glassware and china merchandise. Eighty-five-watt tantalum lamps with Holophane reflectors were placed 11 ft. 8 ins. above the counter level, near the ceiling. The watts per square foot were 1.12, and the average foot-candles at test stations, 3.15.

In test No. 7, a 600-watt arc lamp with light-balancing selective diffuser was placed in a section 22 x 22 ft. The lamp was 8 ft. 2 ins. above the counters. The watts per square foot were 1.23, and the average foot-candles at the five test stations, 2.95.

[illegible] Five Gem lamps were placed on ceiling fixtures with bowl reflectors 11 ft. 8 ins. above the counters. Four of these were 125-watt lamps and one 187 watts. The watts per square foot were 1.42, and [illegible]

[illegible]

had dark walls. The lamps were 85-watt tantalum, with Holophane reflectors. The watts per square foot were 1.12, and the average foot-candles at stations tested, 3.15.

Test No. 10 was made with two three-glower Nernst lamps to each 22 x 22-ft ceiling panel. These lamps were at the ceiling in 8-in. alabaster globes. The watts per square foot were 1.09, and the average foot candles at stations tested, 3.42.

Mr. Pearson then gave a few figures on life tests of the various lamps. The Nernst lamp on short chain pendants was finally selected for the lighting of the establishment. It was decided that the following average illumination in foot candles was desirable for the various floors: The first floor, 4.5 to 5-ft. candles; all above the first floor, 2.5 to 3; first basement, 3.5 to 4; second and third basements, devoted to packing and shipping, 2.25 to 2.5.

In the discussion, Mr. J. R. Cravath called attention to the probable reasons for the great difference in efficiency of the old low chandelier arrangement as compared with the ceiling arrangements tested. While part of the difference was due to the higher efficiency of the Nernst, Gem and tantalum lamps, much of the saving was due to the fact that with the ceiling lamps, reflectors were used which delivered a large percentage of the total light on the counter level. If proper reflectors were used to deliver most of the light down on the working plant, the height of the lamp had little influence on the efficiency in a large installation.

Mr. Albert Scheible inquired whether the blackening of the reflecting surface above the Nernst glower had been considered in connection with these tests. Mr. Pearson said that all tests were made after lamps had been used 200 hours.

Mr. W. R. Bonham asked as to the different lamps mentioned in the paper. Mr. Pearson stated that the selection of the Nernst lamp was made because of low maintenance cost and because of the color and good general effect of the Nernst lamp as indicated by the preference of the management and the various section managers in the store.

Mr. G. H. Stickney advocated the arc lamp for lighting such stores because of its high efficiency and approach to daylight color values. Mr. Pearson replied that the arc lamp was not seriously considered in this case for the reason that out of the 350 section managers in the store not ten of them would say that the arc lamp was what they wanted to sell goods under.

Mr. George C. Keech called attention to the fact that inasmuch as the test stations were not located at regular intervals throughout the area tested, the average foot-candle values given were not the true average illumination in the section under consideration.

Mr. Stickney said that he had conducted many tests on illumination in stores of this kind and had frequently adopted the plan of measuring the illumination on a line of counters across the room.

Mr. G. W. Barlow asked why the tungsten cluster of four lamps in series would not have been better than Nernst lamps. Mr. Pearson replied that between now and the time when it seemed likely that tungsten lamps would be available in large quantities, the saving over the old system of lighting would pay for several installations.

Fixture Designing.

The October meeting of the New York section of the Illuminating Engineering Society was held on Monday, the 12th, at which time a paper having the title "Fixture Design from the Standpoint of the Illuminating Engineer," by Messrs. V. R. Lansingh and C. W. Heck was read and discussed. The paper pointed out some methods of obtaining satisfactory illumination, without in any way sacrificing the artistic requirements. The authors attempted to show that the requirements of illumination and artistic effect are not incompatible. By means of numerous illustrations taken from dealers' catalogues, Government specifications, books on illumination and original sketches, the authors pointed out certain general principles of design which should be carried out.

Mr. Bassett Jones, Jr., opened the discussion upon the paper by commenting upon the authors' designation of certain fixtures as artistic and others as inartistic, pointing out that a fixture which with certain environments might qualify as artistic in design and workmanship, under other conditions might prove very inartistic. In the design of the fixtures used to illustrate the paper there is much to be criticized in the way of inappropriate structural lines, failure to carry out consistently the original motif in the design and the use of supports of unsuitable size and weight which would offend the trained eye of an architect.

Mr. Beauchelle, referring to Mr. Lansingh's statement that statistics showed 34 per cent of the Vermont school children to have defective eyesight, attributed much of the difficulty to the high intrinsic brilliancy and unsuitable color values of modern gas and electric illuminants.

Mr. Wahle endeavored to defend much of the unsatisfactory fixture design, citing instances where cost limitations practically prohibited artistic design. The fixture man was seldom consulted until all matters of cost and location of lamps had been decided. Improvement in design means usually increased cost, which renders abortive the fixture designer's efforts to secure artistic effects.

Mr. A. J. Marshall referred to the recent change in the attitude of many architects who now manifest a disposition to welcome conferences with illuminating engineers regarding lighting installations.

Mr. E. Y. Porter concurred in the previously expressed opinion that high intrinsic brilliancy of modern electric illuminants is responsible for much defective eyesight. The necessity for concealing or modifying such illuminants cannot be too highly emphasized.

Mr. P. S. Miller observed that while the trend of modern incandescent electric lamps is toward higher intrinsic brilliancy and higher light intensity toward the violet end of the spectrum, the tendency is reversed in the development of modern types of electric arc lamps. The authors of the evening had made an unfortunate choice of a title, because their paper dealt almost entirely with the value of reflectors as adjuncts to other glassware on ceiling fixtures. Considering the paper as a discussion of fixture equipments, it was suggested that improved effects might be obtained by the substitution of opaque for prismatic glass reflectors in ceiling fixtures.

Mr. Lansingh, in closing the discussion, concurred in the opinion that an inappropriate title had been selected for the paper of the evening. He questioned the choice of opaque rather than glass reflectors because the former are often not available in desired forms and sizes, and because they are liable to change and deteriorate after a time.

American Street & Interurban Railway Association Officers.

At the convention of the American Street & Interurban Railway Association and its allied organizations held at Atlantic City, N. J., last week, the following officers were elected:

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION

President, C. G. Goodrich, Minneapolis; vice-presidents, Messrs. James F. Shaw, Boston; Arthur W. Brady, Anderson, Ind., and Thomas N. McCarter, Newark, N. J. Prof. B. V. Swenson, 33 West Thirty-Ninth Street, New York, is secretary of the parent organization.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

President, Mr. F. G. Simmons, Milwaukee; vice-presidents, Messrs. Paul Winsor, Boston; F. H. Lincoln, Philadelphia, and W. H. Evans, Buffalo; secretary and treasurer, Mr. J. W. Corning, Boston.

[illegible] CIATION.

President, Mr. F. R. Henry, St. Louis; vice-presidents, Messrs. R. [illegible] Wallis, [illegible] W. [illegible] Jr.

Anderson, Ind., and S. C. Rogers, New Castle, Pa.: secretary and treasurer, Mr. E. M. White, Birmingham, Ala.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION.

President, Mr. H. R. Goshorn, Philadelphia; vice-presidents, Messrs. A. J. Farrell, Buffalo; W. F. Weh, Cleveland, and J. S.

C. G. GOODRICH, PRES. AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION.

Harrison, Jacksonville; secretary and treasurer, Mr. B. B. Davis, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION.

The officers of this association are elected by the executive committee, which consists of Messrs. W. H. Heulings, Jr., Philadelphia; A. S. Partridge, St. Louis; E. M. Williams, Cleveland; H. F. Martin, Philadelphia; Otis Cutler, New York; James H. McGraw, New York; Frank C. Randall, New York; J. R. Ellicott, New York; Henry C. Evans, New York; K. D. Hequembourg, Syracuse; C. K. Knickerbocker, Chicago; C. C. Peirce, Boston; A. H. Sisson, St. Louis, and H. H. Wilson, Chicago.

CURRENT NEWS AND NOTES.

OUR JAPANESE FRIENDS.—U. S. Consul-General H. B. Miller, of Yokohama, says: "Much of the trade coming to the United States in electrical appliances can be traced to Japanese, who have had training in that line in America."

NEW YORK ELECTRICAL SOCIETY.—The next meeting of the New York Electrical Society will be held at Columbia University, Wednesday, Oct. 30. Mr. E. G. Acheson will give a lecture entitled "A New Departure in Lubrication."

A NEW SUBWAY.—The Public Service Commission now proposes that instead of giving out a contract, New York City itself shall build the new subway for Third Avenue, and possibly operate it when constructed. It will connect with the Brooklyn subway.

EARLY ENCLOSED ARC LAMP.—The *Sibley Journal of Engineering* for October contains an interesting account by Mr. L. B. Marks of his early work on the enclosed arc lamp. The various difficulties he had to overcome to produce a commercial lamp are detailed. The result of Mr. Marks' investigations showed that the solution lay in a long arc of abnormal voltage with a suitably restricted and regulated air inlet to the enclosing globe.

CLOCK FOR ALL PARIS.—A special cable dispatch from Paris, of Oct. 19, says: "The Eiffel Tower now tells the time to Parisians and suburbanites for miles around. Far up on the tower this week was installed a set of electric numerals which change every minute. These are visible at night far beyond the city limits, and record the official time of Paris in order to obviate the old complaint that no two public clocks agree."

PRIVILEGED TELEGRAMS.—The U. S. War Department has passed upon an important point regarding the right of a civil court to call upon military telegraphers for copies of messages which figure in lawsuits. The decision is that when properly subpœnaed the operator may produce private telegrams in court, but that in the case of Government messages he must report the call to higher authorities before responding.

A HEAVY DEATH ROLL.—The New York City Public Service Commission has compiled a table of accidents taking place on the surface, elevated and subway lines of the city for the month of September, as made up from the reports which, under the new law, all companies operating under its jurisdiction, are obliged to submit. Fifty-six persons were killed and 208 seriously injured. Of casualties of all kinds there appear to have been no fewer than 4906, but this was smaller than in August.

WIRELESS TELEPHONY.—Advices from Washington state that the wireless telephones which have been on trial on the battleships *Virginia* and *Louisiana*, of the Atlantic fleet, for several weeks have been given formal indorsement of the Navy Department by the purchase of 27 sets of instruments. The cost of this equipment, outside of the expense of its installation, will be more than $35,000. Extension of the wireless system has also been authorized in an order issued for its installation on the supply ships *Glacier* and *Culgoa*, which will accompany the Pacific fleet, and on the *Panther*, now being fitted out at the New York Navy Yard as a repair ship. The wireless installation will also extend to the supply ship *Celtic*, now being overhauled at the Boston Navy Yard, although the *Celtic* is not expected to accompany the fleet. Wireless has also been ordered installed on the *Arethusa*, the supply ship now fitting out at Norfolk to accompany the flotilla of torpedo boat destroyers to the Pacific coast. The apparatus will be supplied by the Radio Telephone Company, being built under patents granted to Dr. Lee De Forest.

NATURAL RESOURCES.—In a speech at Memphis, Tenn., on his recent Mississippi River trip, President Roosevelt laid great emphasis on the preservation of natural resources, and said: "I have asked the Waterways Commission to take account of the orderly development and conservation, not alone of the waters, but also of the soil, the forests, the mines, and all the other natural resources of our country. Coal mines, oil and gas fields, and iron mines in important numbers are already worked out. The coal and oil measures which remain are passing rapidly, or have actually passed, into the possession of great corporations, who acquire ominous power through an unchecked control of these prime necessities of modern life; a control without supervision of any kind. We are consuming our forests three times faster than they are being reproduced. To allow the public lands to be worked by the tenants of rich men for the profit of the landlords, instead of by freeholders for the livelihood of their wives and children, is little less than a crime against our people and our institutions. As I have said elsewhere, the conservation of natural resources is the fundamental problem. Unless we solve that problem it will avail us little to solve all others. As a preliminary step, the Inland Waterways Commission has decided, with my full approval, to call a conference on the conservation of natural resources, including, of course, the streams, to meet in Washington during the coming winter. This conference ought to be among the most important gatherings in our history, for none have had a more [illegible]

[illegible] has recently been reorganized under Dean David Kinley and given substantial support by the legislature, has now 145 students enrolled, more than three-fourths of whom are doing their work in residences. There are now 27 candidates for the degree of Doctor of Philosophy.

FUTURE OF CANADA.—Mr. J. A. Osborne, a well-known editor, has just returned to Winnipeg after exploring the Hudson and James bays regions. He located several huge mountains of iron ore which abounds in almost inexhaustible quantities to the east of Hudson Bay, and only needs railroad facilities to become one of the richest countries on the American continent. Near these huge iron ore deposits are immense rivers, from which thousands of electrical horse-power can be developed. Copper, silver, nickel, asphaltum, oil, coal, molybdenum and other riches of the soil were discovered by Mr. Osborne in varying quantities. Here and there small particles of gold were found, but not in paying quantities.

THE STRIKE THAT FAILED.—The recent strike of commercial telegraphers is ending rapidly, and more and more men are going back to work if they can secure it. Every day sees a number seeking reinstatement. The New York City superintendents of the Western Union Company have all been notified that the bonus paid to all its present employes in this city would cease on Saturday, Oct. 18, but the present system of double pay for overtime will continue until further notice. Sunday work will be on a basis of seven hours for a day's work; all Sunday work after regular tour of duty will be paid for at double the hourly rate. Last week, the Postal system withdrew its "subject to delay" notice from all offices and messages. The Western Union [illegible]

DISPUTE AT CHESTER.—The selectmen of Chester have asked the Board of Gas and Electric Light Commissioners in Massachusetts to hold a public hearing in the town on the question of the local central station rates. The plant is owned by Mr. E. Leroy Gardiner. A committee of citizens requested this action in the hope of securing lower rates than those obtaining. A public hearing will shortly be assigned in the town, and the arguments for and against changes in rates will be considered by the board. It has been stated that a new plant will be installed by the fire district in the event of an unsatisfactory adjustment of the problem, but as the town rather than the fire district has the necessary authority to petition the commission, it is unlikely that matters will take this turn. A more probable solution would be the purchase of the existing plant, but the hearing will determine the resulting situation.

AUTOMATIC LONG DISTANCE TELEPHONY.—Some interesting experiments are now being tried by Manager Johnston, of the Citizens' Telephone Company, Columbus, Ohio, in handling long-distance messages through the automatic exchange. A line has been arranged between Columbus and Dayton, which also has an automatic exchange, and it has been found that an operator in Columbus is able to call any subscriber in Dayton without difficulty. This result had already been accomplished in the case of very short lines with apparent success, but as far as known no experiments have been made at as great a distance as this. If it is found that operating directly through the exchanges is practicable, a great saving of time and trouble will be made, as the work of calling a subscriber to an automatic exchange on long-distance lines will be little more than calling on local lines, and there will be no delay at the other end, unless the line called should be busy, in which case the fact will be indicated to the caller.

[illegible]—During the [illegible] American Electrochemical Society to his laboratory at Orange, [illegible] models for cheap cement houses for the million, to take the place of wood and brick. His inventions in this line, he said, will make it possible for a three-story dwelling to be built in 12 hours of actual labor at a cost not to exceed $1,000. Models have been prepared from designs by prominent architects, and during next summer, the inventor said, he will build the first of these ideal homes. "The house of the future is to be made of concrete, in cast-iron moulds that will be formed in sections and fitted together so they can readily be removed as soon as the concrete has hardened," he stated. "These moulds, for a three story house, such as I shall build first, will cost $30,000, but an infinite number of houses can be made from one set of moulds. When the house is finished, the bathtubs, stairs and everything of that sort will be in it, all integral parts of the building. The only wood necessary will be the doors and window sashes. I own the largest cement factory in the world, and of course am interested in promoting the sale of cement. I shall permit the use of my invention, however, to any contractor who will undertake to mix his concrete according to my formula, whether he uses Edison cement or not. I have found that a concrete made of one part of cement, three of sand and five of crushed stone gives perfect results, and I believe the workingmen of the future will be housed in dwellings constructed of that material."

SENT A REAL CALF.—The following story is told as authentic of a recent electrical incident: A young man employed as a construction superintendent by one of the large Bell companies operating in the south, received as his first assignment, the job of restoring service in Mobile, in a certain section of the city where cable would be required immediately for temporary repairs. The company had none in stock and the railroad officials would not promise delivery from Chicago inside of three weeks. The young man, after some study, telephoned his order to the Western Electric Company and instructed the salesman to go to the stock yards and purchase a calf. It was some time before the idea penetrated the cranium of the W. E. representative, but when it did, he tumbled hard. Three days later, a large reel of cable, with a calf tied to it, arrived at Mobile, addressed to the telephone company, bearing a large placard, "Livestock!—Please Rush!" This is the best use ever made of watered stock in the electrical field.

POSTAL TELEGRAPH EMPLOYES.—Mr. Clarence H. Mackey, president of the Mackey Companies, has made the following important announcement: "The Postal Telegraph-Cable Company, appreciative of the loyal spirit displayed by the employes who remained faithful and by those who came to its aid when so many old employes abandoned their duties, believes that this loyal spirit may be strengthened by association into a powerful agency for maintaining good relations between the company and its employes, and the prevention of such movements as culminated in the occurrences of last August, and it has, therefore, in conjunction with its employes, decided to form an association of those employes who have a faith in the disposition of the company to deal equitably with them, who are opposed to strikes, commotions or coercive measures, and who recognize the plain truth that their own prosperity is bound up in the prosperity of the company. Such an association will be called the Postal Telegraph Employes' Association, and its object will be to secure to the company a loyal working force and to its members employment undisturbed by factions seeking to coerce or embarrass or harass the company or its employes; and its further object will be to render financial aid to its employes when sick or disabled, and also in case of death. The directions in which such an association may extend its activities for the benefit of its members may easily be seen. The company contemplates that this association may be made the means [illegible] which such complaints may be properly considered, and also, that it may be turned to the purposes of self-help and the advancement of its members, socially, educationally and materially [illegible]

The Supply of Electrical Energy for Industrial Purposes by the Manchester Corporation.

UP to within the past six years, Manchester, England, was considered a bulwark for multi-wire direct-current distribution. Since that time, however, the Manchester corporation, with commendable enterprise, has established one of the largest municipal alternating-current stations in the United Kingdom, and is now supplying polyphase currents for motors direct to consumers' premises. The Stuart Street station of the corporation was primarily designed to furnish a large number of sub-stations with three-phase currents which are converted and distributed as direct current for railway, lamp and motor circuits. During the past year or two, a large number of consumers of electrical energy has been supplied directly from the three-phase mains through step-down transformers.

At present the Stuart Street station contains low-speed vertical engines and flywheel alternators with an aggregate rating of 27,000 horse-power. In addition, a 6000-kw turbo-generator is nearing completion and will shortly be connected to the lines. Approximately 10,000 horse-power is required by the motors connected to the corporation's lines, the remaining portion termines approximately the size of the sub-station. An interior view of a typical sub-station for alternating-current supply exclusively is shown in Fig. 4. The building contains high-tension and low-tension switch-gear, together with groups of transformers. The high-tension switch-gear and transformers are separated from the low-tension board by an iron grating. The high-tension connections are carefully shielded, and the bus-bars are placed out of reach at the top of the panels. The feeder panels, of which there are two, one incoming and one outgoing, are fitted with three-pole oil-break switches, ammeters, and voltmeters. Each switch has a lock-on-and-off bolt, the switch handle projecting through a slot in the panel. The supply for the feeders is carried through bus-bars to the transformer panels, on each of which are mounted three double-pole, oil, circuit-breakers for controlling the circuits to the three transformers, forming a complete three-phase unit. Each circuit-breaker has an overload relay and a time-limit device, and the tripping coils are mounted below the operating handles. The handle in each case is free of the switch release so that a circuit-breaker cannot be held closed on an overload or short circuit.

The transformers used are of the air-cooled, radiating, single-phase type. One of these having a rating of 200 kilowatts is

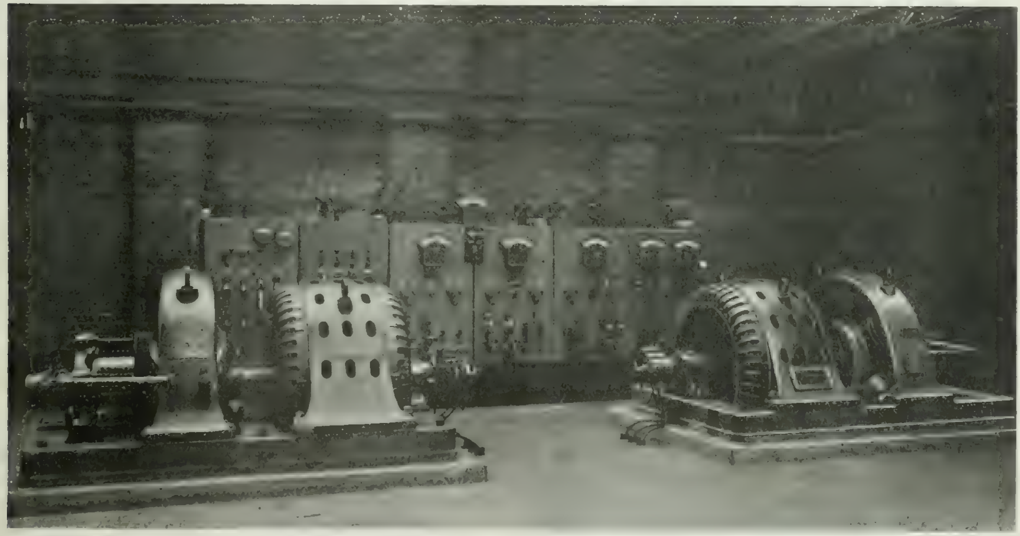


FIG. 1.—INTERIOR OF SUB-STATION AT WORKS OF MATHER & PLATT.

being used on railway and lighting circuits. Thirty-two high-tension feeders are run from the generating station at present, and it is interesting to note the methods adopted for supplying energy to consumers with a view to economy of main feeders.

Where consumers are on the route of the high-tension feeder lines from Stuart Street to the sub-stations, one cable is looped into the consumer's sub-station. Duplicate cables for lighting and traction circuits are always run between the main stations and sub-stations to separate [illegible]. Selector switches at the sub-station connect either cable to either traction or lighting bus-bars, the buses being also fitted with coupling switches so that a number of changes may be made in the supply of energy to the customer through the looped feeder. The supply is therefore well safe-guarded against interruption.

The consumers' sub-station equipment in the case of new installations is supplied with polyphase currents exclusively. Where direct-current [illegible] and the motors are too numerous to replace with alternating-current motors, provision is made for converting the alternating to direct current. The ultimate capacity of the installation de- shown in Fig. 2. This is 3 ft. 4 ins. high, 3 ft. in diameter, and has an extreme height over the high-tension terminals of 4 ft. 2 ins. The transformers make very compact units and being free from oil insulation require little or no attention. Each transformer is mounted on four wheels so as to facilitate transportation, and also to keep the case clear of the ground. The windings are not exposed at any point, and the high-tension terminals on the top are recessed deeply in porcelain hoods. A porcelain cap is cemented on as a cover to the incoming high-tension cable terminal so that there are no loose insulating parts to be dropped or incautiously removed. The high-tension cables are taken underground in trenches in the floor from the transformers to the switchboard outside the high-tension enclosure. The sub-station illustrated contains apparatus having a rated capacity of approximately 2400 kilowatts. The floor [illegible] per horse-power installed.

The low-tension switchboard is located in a narrow portion of the sub-station, outside the high-tension enclosure. The cables from the transformer secondaries supply the low-tension [illegible]

[illegible] switches and fuses. The transformers are connected up in delta on both the high-tension and low-tension sides, so that three-phase currents may be supplied from any two transformers of one set, should one break down.

When direct current is to be supplied from the polyphase mains, some form of converter is used. The [illegible] of a

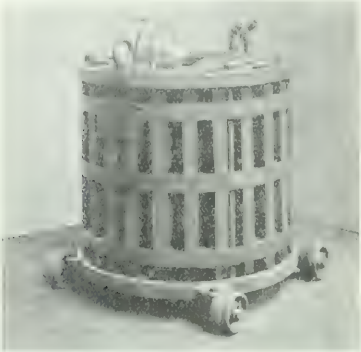


FIG. 2.—200-KW. BERRY SINGLE-PHASE TRANSFORMER.

typical sub-station for supplying direct current is shown in Fig. 3. The building in this case was specially erected and contains three motor-converters rated at 500 kilowatts each, together with the necessary switch gear. The floor area is approximately 870 sq. ft., and assuming the capacity of the sub-station at 2000 horse-power, this requires about 1.2 sq. ft. per horse-power. The motor-converters are bolted to concrete foundations, the center of which is recessed for air circulation to the windings and for the cable connections. Trenches are cut into these recesses at each end of the machine, and in these are placed the low-tension cables and the high-tension cables running from their respective switchboards.

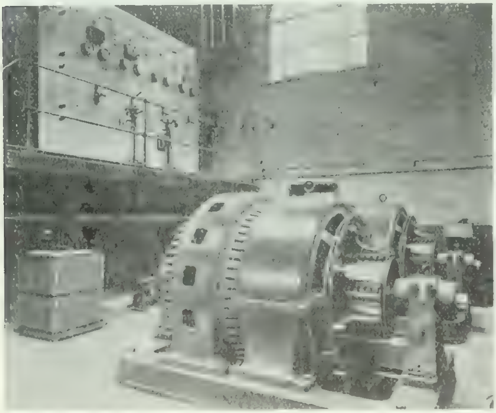


FIG. 3.—INTERIOR OF SUB-STATION AT WORKS OF ARMSTRONG, WHITWORTH & CO.

The use of motor-converters dispenses with the necessity of step-down transformers, as the transmission voltage can be applied directly to the stator of the motor. Where space is valuable, this tends to economize it considerably. The converters in this particular case are run in parallel with a large private plant. The resistors for the converters are placed under the switchboard gallery facing their respective machines and the synchronizing voltmeter is placed on a bracket so situated that the attendant can watch its movements when he short-circuits the [illegible] ends of the rotor windings with the switch provided for the purpose on the machine. The efficiency of the motor-converter is very high, so that from the standpoint of the consumer the use of such apparatus will be attended with losses much lower, in comparison, than those with a steam or gas-driven installation.

In certain installations, both alternating-current and direct-current supply are needed from the polyphase mains, so that both stationary transformers and converting apparatus are required. In one sub-station of this type, fed from the corporation's mains, the apparatus is placed in one of the bays of an existing engine room containing a number of steam-driven generators now out of commission. The high-tension switchboard is arranged to divide the transformers from the rest of the station at one end, and the motor-converters occupy the other end. There are six transformers with an aggregate rating of 900 kilowatts and two motor-converters with an aggregate rating of 400 kilowatts. The floor area of the station is about 460 sq. ft., so that the space occupied per horse-power is about 0.27 sq. ft., assuming an installation of about 1700 horse-power. In this instance, no provision is made for extensions, and the space referred to does not include the low-tension switchboard, which is placed in another bay of the station. Each of the feeder panels has a hand-operated, oil-switch and the transformers are connected through double-pole, oil, circuit-breakers fitted with overload relays. The tripping coils are supplied with alternating current, since direct current is not always available for these and the other circuit-breakers. The motor-converter panels provide for a single, triple-pole, circuit-breaker on each panel, an ammeter and an overload relay. The cables connecting the high-tension switch-panels and the transformers are placed in trenches, as are also the cables connecting the motor-converter panels and the machines.

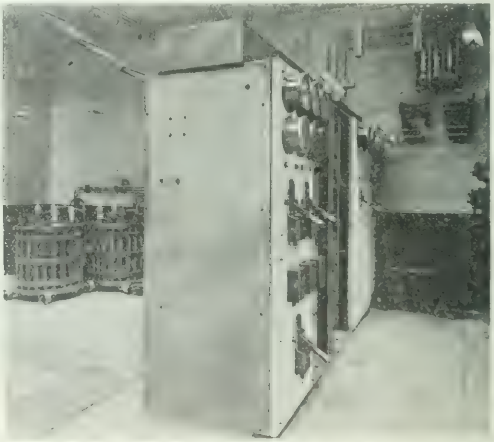


FIG. 4.—INTERIOR OF SUB-STATION AT WORKS OF R. JOHNSON & NEPHEW.

The transformers are of the Berry pattern, similar to those shown in Fig. 2.

Not infrequently, it is difficult to find a building in which to accommodate the sub-station equipment so that a separate building must be erected for this purpose. In one sub-station specially erected the area is very much restricted and the floor space per horse-power is 0.6 sq. ft. In this instance, motor-converters occupy a corner of the station and between them is placed the high-tension switch gear. The apparatus installed is rated at 500 kilowatts and consists of two motor-converter units and the necessary switch mechanism for both the high and low-tension circuits. The motor starters and switches are placed adjacent to their respective machines and space is provided behind the high-tension board for access to the connections. This space is enclosed by an expanded metal door kept under lock and key.

In contradistinction to the foregoing example, Fig. 1 illustrates the arrangement of a sub-station where ample room is available. The equipment consists of induction motor-generators for the conversion of the polyphase supply to direct current. The floor area in this station is about 1650 sq. ft., and inasmuch as space is not at a premium, the floor area per

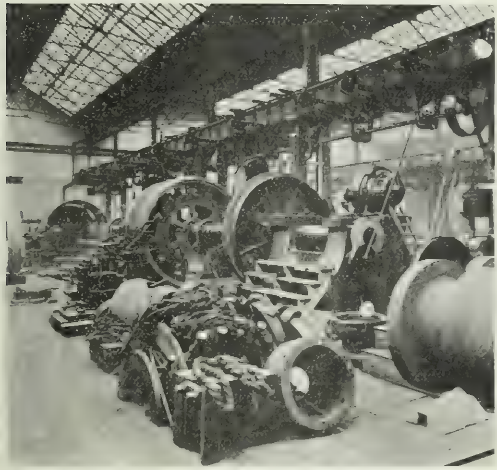


FIG. 5.—LARGE LATHE DRIVEN BY DIRECT CURRENT MOTOR.

horse-power installed is somewhat high. With a rating of 1080 horse-power, 1.5 sq. ft. per horse-power is the amount of space allotted to the plant and switch gear. Substantial concrete foundations are provided for the motor-generators and an abundance of space is available below the floor level for the cable connections. The switch gear consists of a three-pole, oil, circuit-breaker with a water resistor, the former being mounted on the main switchboard and the latter in a corner.

The agreements made by the Manchester corporation with consumers of electrical energy supplied in the manner indicated, provide that the sub-station building shall be supplied by the consumer. Unless special provision is made, the corporation

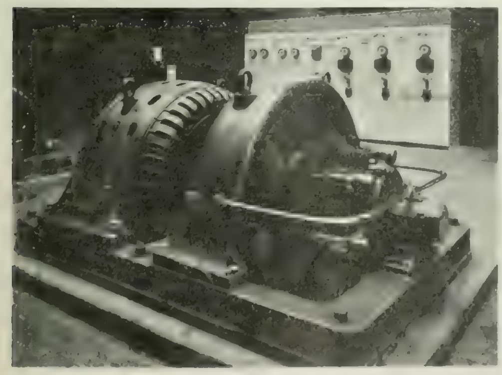


FIG. 6.—MOTOR-CO[illegible]

furnishes the transformers, converters, the high-tension and the low-tension switchboards, and the cable connections between these and the plant. The sub-station building when specially built must comply with the plans of the corporation, and when existing premises are utilized the consumer provides cable trenches, enclosed gratings, doors, etc. The heavier capital outlay is borne by the corporation, and it is understood that the cost per kilowatt installed is approximately $10 with transformers, and $16.20 including [illegible] high-tension mains

with motor-converters for installations of 500 kilowatts. The rate per unit of electrical energy is a matter for settlement between the customer and the corporation and depends mainly upon the demand, character and time of the load and special capital expenditure incidental to each supply.

The number of consumers of energy for industrial purposes on the three-phase mains of the Manchester corporation at present is 10, and the total rating of the sub-station plants installed is 7160 kilowatts. Motor-converters make up about 3800

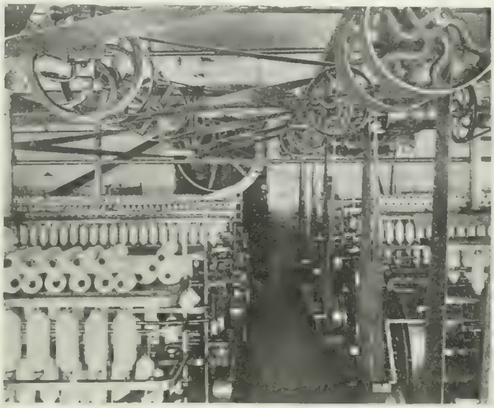


FIG. 7.—SPINNING MILL OF SHAW JARDINE.

kilowatts of this, and transformers the balance. The combined annual consumption of the ten consumers of energy is over 12,000,000 kw-hours

The varied character of the load sustained may be gathered from the industries supplied with electrical energy. Connected to the corporation's lines are two spinning mills, a wire works, a locomotive works, armor-plate works, chain works, electric motor factories, machine tool factories, chemical works, etc. The motors installed in these works range in size from 7½ horse-power to 150 horse-power, the largest induction motor supplied from the mains having the latter rating. Fig. 7 shows a spinning room in a cotton mill which is driven by ropes from a large induction motor. The main driving pulley can be seen in the background against the wall. The motor is supplied from a transformer sub-station in the basement of the mill. In Fig. 5 a large lathe is shown, driven by a direct current motor supplied

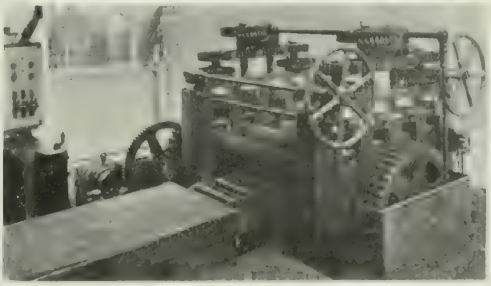


FIG. 8.—THREE-PHASE MOTOR, DIRECT GEARED TO PLATE STRAIGHTENING MACHINE.

from the motor-converter station shown in Fig. 3. Fig. 8 shows a three-phase slip-ring motor geared to a plate-straightening roll in the Peacock works of Messrs. Beyer. The illustration shows the convenient location of the switchboard and drum-type reversing controller.

It is anticipated that in another year the demand for polyphase electrical energy for industrial purposes will exceed 20,000,000 kw-hours per year.

The Thury Direct-Current Transmission System.

[illegible]

T[illegible] erally known,[1] its very special character and the importance of some of its applications in Europe may justify a discussion of its principal features as developed to date and its possibilities.

This system was first practically operated in 1889 in Genoa (Italy), since which time various other transmission plants have been added with constantly increasing voltages. The two best known examples are the St. Maurice-Lausanne (Switzerland) transmission, with 22,000 volts, and the Moutiers-Lyons (France) transmission, with 57,600 volts. In the last mentioned plant there are in the generating station four hydraulic turbine-driven units, each consisting of four generators. The individual generator e. m. f. is 3660 volts, the e. m. f. of the system being 57,600 volts. By grounding one line the voltage can be doubled later on. The transmission line consists of 180 kilometers of copper overhead wire circuit, with conductors of 9 mm diameter and 4 kilometers of underground cable circuit, the cable having a cross-section of 75 sq. mm. Hence, the total resistance of the entire circuit is 100 ohms, and the line drop amounts to 7500 volts, the constant current being 75 amperes. The loss at full load is 13 per cent.

A more ambitious project is to provide Paris with power from the rapids of the Rhone, near the Swiss frontier. A voltage of 140,000 is being contemplated, with the neutral point grounded. Taking equal maximum potential from wire to ground as a basis of comparison, this is the equivalent of 85,000 volts (wire to wire) three-phase, a value slightly exceeding recent practice in this country. As far back as 1901, an experimental direct-current generator was built and used for testing purposes in connection with the St. Maurice-Lausanne plant, which generated 22,000 volts.

REGULATION.

Generating Station

The distinguishing feature of the Thury system is that the current is kept constant, which is accomplished by motor-operated regulators, cut in or cut out by relay, consisting of electromagnets through which a certain fixed part of the current flows, and which operates as soon as the current varies either way from its normal value. The torque necessary to produce a current in a series generator is proportional to the current and the magnetic flux, which latter again is a function of the current. Thus, considering a prime mover with constant torque under all speeds and no speed regulation, when the current increases through some decrease of the load in the receiving stations, the prime mover must slow down. This will result in a lower e. m. f. of the generator and consequently in a lower value of the current, which will again reach its normal value. When the current decreases the prime mover will speed up, and so restore its original value. Consequently, there exists a tendency toward self-regulation which, of course, must be assisted by a regulating device, operated by the current itself, that will change the speed of all prime movers simultaneously so as to give such an e. m. f. as will produce again the required constant amperage.

Instead of changing the speed, one can also change the flux, the e. m. f. being proportional to the product of the two. The flux may be changed by weakening the field current through a shunt device, or, as was done in the first Thury installation in Genoa, by providing a separate common exciter, the speed of which is controlled by the regulating device. This last solution is the simplest of all, but would be too difficult for real high-tension work, because the exciter circuit must be connected to all of the generators with their very different voltages from ground, which would result in exceedingly expensive insulation of the field coils from the frame.

[illegible] weakening below 66 per cent of the maximum value, on account of sparking difficulties, so that further reduction must be accomplished by moving the brushes along the collector, or by cutting part of the generators out of the circuit.

With hydraulic turbines there is no need for these things because the solution involving speed regulation has been worked out in a satisfactory way for this class of prime movers. At lower speed the efficiency decreases considerably, but this is not disadvantageous for hydraulic plants without a storage reservoir.

There is only one regulator for all the turbines, or two in case the central point is grounded, as the loads on the two halves may then differ from each other. The Thury regulator is a complicated piece of machinery, but so are all waterwheel governors; and the fact that only one (or two) must be used, results in a great saving as compared with a plant of many units, where each turbine has its own expensive governor. As the Thury system, moreover, requires very few apparatus, all of which are of surprising simplicity, and thus does away with bus-bar galleries, endless rows of oil switches, numerous switchboard panels with complicated apparatus and wiring, and also with transformers and accessories, the saving should more than balance the greater cost of direct-current generators, with their relatively expensive insulation and greater sub-division, and with several generators for one turbine, as compared with three-phase generation. Moreover, there is a saving in the size of the station building, which is, of course, much smaller in the absence of the things above mentioned.

In the matter of governor economy, it must be understood that only the governor proper is meant, as every turbine requires preferably, though not necessarily, its own servomotor; it is necessary to mention this because one sees frequently, especially in American manufacture, water-wheel governor and servomotor incorporated in a whole. It might also be added that in transmission plants with the central point grounded, one single governor might suffice, provided only one such point is grounded, for instance, in the generating station. The other neutral point must remain without physical connection to earth and will be more or less shifting, according to distribution of load. Furthermore, it is not essential, though desirable, that all generators should have exactly the same voltage, no more than that generators in parallel should all have the same amperage. In either case this means only that the load is not equally distributed among the different machines, and it is this very fact that allows in either system the connection and disconnection of generators to and from the system. But if such an individual regulation is resorted to, the switchboard attendant will have to see that each unit gets its proper share of the load, just as in any parallel system.

In case there is more than one generating station in the circuit, corresponding to the case of several alternating-current systems getting their power from widely distributed power houses, each power station must necessarily have its own regulator, which may be common for all the turbines in that station. A reserve steam plant may be built somewhere on the line, and it is even possible to use the generators as motors if desired. In this case both generator and motor regulating devices must be installed and the regulation must be done by changing the flux and not by changing the speed.

[illegible] house compares very favorably with the ordinary alternating system in the case of water power without a storage reservoir. When water power with a storage reservoir is used, conditions are less favorable on account of lower efficiency with lower speed. With steam, probably the same objection will hold, and another design for regulation would have to be made, unless the un-[illegible] flux were chosen. Moreover, vertical turbines could probably not be used, because one prime mover must be coupled with several generators (unless future designs will allow a greater

[1] [illegible]

e. m. f. per generator and the choice is narrowed down to turbines of the horizontal type.

SUB-STATIONS.

For the motors in the receiving stations, constant speed is in most cases required. There is no tendency toward self-regulation in the motor itself. The torque of a series motor is proportional to the current and the field flux, and hence with a constant current is constant save for variations in the efficiency with different speeds. Consequently, when the motor load is decreased, the motor tends to run away, and when the load is increased, it tends to come to a standstill.

Of course, if the load is a generator supplying a secondary system with energy, an increase of speed would mean an increase of both the secondary e. m. f. and current, and consequently an increase of the motor load, which would speedily create a new condition of equilibrium. A decrease of speed will decrease the motor load in a similar way. At any rate, it may be expected in this case that the secondary voltage will fluctuate heavily. The regulating device for motors is also motor-driven, but its relay is operated by an ordinary centrifugal governor, receiving its speed from the motor-shaft. The only possible method of regulation is to change the field flux, which is mostly done by shunting the field current until the counter e. m. f. is reduced to 66 per cent of its full value, and after that by changing the brush position. It will be seen that the motor cannot be overloaded, even for a short time, which is a serious disadvantage, especially for electric railway work.

The necessity of motor regulation is a great drawback to the Thury system. The writer of this article had occasion, a few years ago, to visit frequently one of the older and smaller Thury plants (in Batoum, Russia)* and was surprised to find the plant running reasonably well with all the regulating apparatus in both generating and receiving station disconnected, the operators not knowing how to repair them. As far as the generating system is concerned, this is not surprising after the theoretical considerations given above, but the motors in the receiving station, driving direct-current generators, which supplied current for a 2 x 110-volt lighting system without a battery in parallel, operated with some hand regulation by the attendant. The secondary voltage was not very constant, but still it was tolerable and by no means worse than what one sees in many small towns. With better operators, the result might have been even better.

In most of the large Thury systems, the secondary systems are three-phase for motor and lamp service, and the regulator seems indispensable. When the motor is used to drive a generator employed for battery charging, the regulator is unnecessary. Probably for any direct-current system with a battery in parallel, the regulator could also be dispensed with. When the direct-current system is used solely for railway purposes, where the voltage need not be so very constant, it might be practicable, in case of an emergency, to operate without the regulating device, even when there is no battery, but the heavy and sudden fluctuations [illegible] may be expected in this case would make the outcome doubtful.

[illegible]

It is intended in what follows [illegible] systems, namely 1. Direct-current [illegible] with neutral point grounded. 2. Direct-current series system with ground return. 3. Three-phase system.

The following symbols will be used:

W = transmitted power in watts.

w = loss in watts.

$p = \frac{w}{W}$ = relative loss of transmission.

I = current per wire in amperes.

E = e. m. f. from ground [illegible]

[illegible] resistance in ohms per foot [illegible]

D = length of the transmission line (one way) in feet.

[illegible] refers to the first system, [illegible] to the second, etc.

[illegible]

The loss in watts of a transmission line of the first type is simply:

$$w = 2I_1^2 r_1 D$$

$$\text{Hence, } r_1 = \frac{w}{2I_1^2 D};\ I_1 = \frac{W}{2E_1}$$

$$r_1 = \frac{2pE_1^2}{DW} \qquad (1)$$

For direct-current transmission with ground return, the sum of the loss in wire and ground return is taken as $(1+a)$ $I_2^2 Dr_2$. In this case $I_2 = \frac{W}{E_2}$ and

$$r_2 = \frac{pE_2^2}{(1+a)DW} \qquad (2)$$

where a is a very small fraction. For instance, experiments with ground return on the St. Maurice-Lausanne plant showed the resistance through ground to be two ohms. This was probably only the constant resistance of the ground plates, and the resistance in their immediate vicinity; by making better connections to earth the resistance was reduced to 0.5 ohm. In such installations as Moutiers-Lyons, where the resistance of the line is 50 ohms (one way) a would be respectively .04 or .01.

These experiments have also shown that, as far as could be ascertained, perfect service is possible in this way and that it does not injure the interests of third parties.

For the three-phase system we have

$$W = 3I_3^2 r_3 D$$

$$r_3 = \frac{w}{3I_3^2 D};\ I_3 = \frac{W}{3E_3 \cos\theta}$$

$$r_3 = \frac{3pE_3^2 \cos^2\theta}{DW} \qquad (3)$$

where E_3 is the potential from the wire to the ground.

The basis for comparison of the three systems is an equal maximum e. m. f. from the wire to the ground,

[illegible]

For one wire the copper volume is inversely proportional to the resistance per foot for the same length of transmission D. Bearing in mind that the first system has two wires, and the second only one, we have, calling the total copper volumes V_1 and V_2, the following ratio for transmission of the same power over the same distance with equal loss.

[illegible] or nearly [illegible] 1, which might be expected

because the first system is practically a duplication of the second, there being no flow of current through the ground. With three-phase, there are three wires against two with the first system, and

[illegible]

Hence, in case the three-phase transmission has a power-factor of 0.8, either one of the direct-current systems considered would require only [illegible] .64 [illegible] 32 of the line copper necessary for the three-phase system. Strictly speaking, it would be still a trifle less, because none of the extra losses peculiar to alternating current (skin effect, dielectric hysteresis, etc.) will occur.

The number of insulators required, compared with three-phase, is one-third for direct current with ground return, and two-thirds for direct current without ground return. This makes also the pole construction simpler, especially when, as in accordance with very recent practice, suspended insulators for very high voltages are used, since it is simpler to make a cheap pole construction for two wires than it is for three. Both these

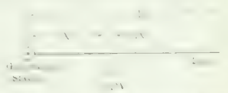
factors mean a great additional superiority in line economy of the Thury system. As there is less liability of excessive voltages caused by surges in a direct-current system, the factor of safety can properly be taken less than that which is customary for alternating-current lines, which would mean cheaper insulators; the usual factor of safety of insulators for high-tension lines being often criticized as being somewhat low, it is perhaps better not to do so, but that would mean again greater safety against insulator trouble, when direct current is used. The line loss of the Thury system is the same in watts for all loads, and, consequently, the loss in per cent is inversely proportional to the load. With an ordinary alternating-current parallel system, the line efficiency is, on the contrary, better instead of worse when the loss is less than full load, the line loss being proportional to $\frac{[illegible]}{EI \cos \Theta}$ or to I; in other words, to the load EI, supposing E and Θ to be constant. This is a great argument against the Thury system when steam or water power with storage is used; for water power without storage it does not make any difference.

The foregoing considerations, which tend to show the superiority of the Thury system, apply only to such cases where all the power is transmitted in bulk to the extreme end of the line. When it is intended to distribute the energy over many sub-stations, it will be seen that the advantages disappear to a certain extent. In a series system it does not make any difference whether the power has to be transmitted to the extreme end or part of it to intermediate points, the loss in watts remains always the same I^2R, because all of the current has to go through the entire line. In order to be able to make a comparison with the parallel system, we assume a line which distributes its power equally along its length, *i. e.*, the sub-stations are supposed to be equidistant and of equal size. The volume of copper necessary to transmit the power W over a distance D with a loss of P per cent is

$$V = K \frac{[illegible]}{[illegible]}$$

where K is a constant depending upon system and power-factor.

The corresponding volume of copper, when the power is equally distributed along the line, is found as follows: In Fig.



[illegible] BUTION.

1 a quantity of power, dW, is to be delivered at dx at a distance of x from the generating station. Having equal distribution $dW = \frac{[illegible]}{D} W$. If the loss [illegible] P per cent, we [illegible] at the end of the line $2P$ per cent. As the loss in the beginning of the line will be zero, the average loss will be, for equal distribution and constant density of current along the line, equal to P per cent. and dW will be transmitted with a loss of $\frac{2Px}{D}$ per cent.

The amount of copper necessary to transmit dW is:

$$dV = \frac{[illegible]}{[illegible]} = \frac{[illegible]}{2PE^2}$$

$$\int dV = \frac{[illegible]}{[illegible]}$$

[illegible]

loss P in the second case equal to the loss P in the first case [illegible]

Hence, for approximately equal or uniform distribution of power along a line, only about half the copper is necessary that would be required for transmission of the total power to the end of the line.

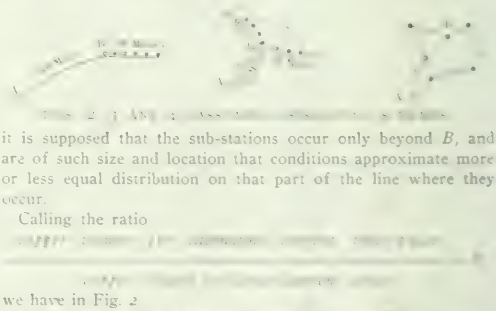
For transmission in bulk the ratio of line copper required respectively by the three-phase and the Thury system was found to be $\frac{[illegible]}{[illegible]}$ in favor of the Thury system; for equal distribution it is only $\frac{[illegible]}{[illegible]}$.

The following table gives values for different power-factors. The ratios in the cases considered will be seen to vary from 1 to 4.08 in favor of the Thury system.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ratio for transmission [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ratio for equal dis- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

With equal distribution and a high power-factor the advantages of the Thury system in respect of copper economy are very slight. If the greatest part of the power is taken on the first part of the line, three-phase is decidedly superior. The direct-current series system, on the other hand, will give good results when most of the energy is delivered at the farther end. In the European Thury installations, almost invariably nearly all the power is delivered to the extreme end, but small blocks of power are taken off en route. The popular objection to the Thury system that it is only practicable for transmission between a generating station and one receiving station is unwarranted. But it is only desirable to use this system when the substations are more or less concentrated near the end of the line.

A few illustrations out of the many possibilities may be given below. In Figs. 2, 3 and 4, A is supposed to be the generating station and the black dots the sub-stations. In Figs. 2 and 3



[illegible]

it is supposed that the sub-stations occur only beyond B, and are of such size and location that conditions approximate more or less equal distribution on that part of the line where they occur.

Calling the ratio

[illegible]

we have in Fig. 2

[illegible]

$R_{bc} = 1.38$ for a power-factor of .85.

[illegible]

equal total loss in the line.

In Fig. 3 we have again

[illegible]

On the stretches BC and BD, three-phase would require as much copper as when all the sub-stations occurred on BC, because there are simply two parallel lines of equal power rating and distance.

When using the Thury system, it is clear that when a physical connection is made between C and D, twice as much copper will be required as compared with the case when all these substations occur on the stretch BC. Applying the ratio 1.38 we must allow 100 miles for the Thury system and 50 miles for the three-phase system, to get the comparison correct. This gives the following ratio for the entire line:

$$R = \frac{300 \times 2.77 + 50 \times 1.38}{[illegible]} = 2.25$$

However, it is entirely unnecessary to have a line between C and D in the special case assumed, because the power was supposed to be evenly divided over the two branches $B\,C$ and $B\,D$, so that C and D may be grounded. The current will flow through ground between C and D, as indicated by a dotted line, with negligible resistance. In that case 50 miles must be allowed for both systems, which gives $R' = 2.57$.

In Fig. 4 the transmission line is a ring. It is supposed again that the sub-stations are such that equal distribution is approximated. By following the same right of way we could build two three-phase lines from A to B along two different routes (a link between two of the sub-stations may be left out in either system), and the ratio R for the entire line would be 1.38 for a power-factor of .85.

But in general, it will be feasible to build a three-phase line in an entirely different way, by using a main line with branches, as indicated by dotted lines, which may give a much better economy, so that R might be even less than 1, *i. e.*, in favor of three-phase.

A diagram, giving the potential between the two wires and ground, is shown in Fig. 5 for a direct-current series distribu-

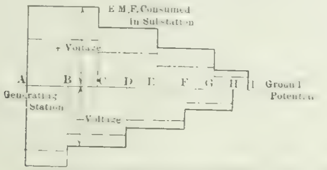


FIG. 5.—POTENTIAL DIFFERENCE BETWEEN TWO WIRES.

tion with neutral points grounded. The line AI represents the transmission line; C, E, G and I are sub-stations on the positive wire; B, D, F and H are sub-stations on the negative wire. Between H and I one wire is grounded. The ordinates on either side of the ground potential line give the positive and negative voltages of the respective wires. It will be seen at a glance that only a limited stretch has full voltage between wire and ground. Near the end of the line the voltage is quite low, and between H and I there is no voltage at all on one of the two wires. The diagram is supposed to be drawn for full load on all stations; if the load of any or all decreases, this can only result in a still lower voltage, as indicated by a dotted line. Consequently, high-voltage insulators are only necessary on part of the line, and various cheaper kinds, designed for lower voltage, can be used on each succeeding section. This illustrates in an indirect way that for wide distribution the full benefits of the Thury system cannot be realized. The line is only a high-tension line at the start, but degenerates into a low-tension line towards the end.

Under such circumstances, the advantages of direct current are more or less neutralized by the use of the series system. A direct-current parallel system would take in all advantages, but as each sub-station would necessarily require a sub-division of the voltage over many motors, it would be hardly practicable, save in the case where there are only one or two large receiving stations. With one receiving station only, it is, of course, identical with the series system.

It might also be possible to regulate the series system on constant voltage instead of constant current. This would bring the system on a par with the ordinary method as regards line efficiency for lower loads than normal. It is, however, immaterial for water power without storage, and the system would lose much of its simplicity. Moreover, none of these alternate schemes has been worked out, and if this would be done, many difficulties in solving the regulation and other problems would have to be overcome. As this has already been achieved for the Thury system, it has at least for the present, commercially speaking, the direct-current field for itself.

CONTINUITY OF SERVICE

Lightning Troubles.

Quoting from an article on the Thury system in the ELECTRICAL WORLD of Aug. 27, 1907, page 352: "A principal source of trouble with the direct current transmission system is from lightning on the overhead lines. This is, however, a source of trouble with almost all transmission lines in Switzerland, and there seems to be no reason for supposing that the trouble is increased in the case of a direct-current system."

However, it would seem that a static discharge may be much more destructive when it finds its path through a motor of the Thury system, than when it lands in an oil-filled high-tension transformer. In a grounded station, the discharge finds its way to earth through a series of generators or motors, where it is liable to work much havoc, but in the alternating-current station it would have to work its way through a strong insulation, while the oil will smother any arc which might occur if it succeeded. Consequently, it would seem that much more care should be given to protection of Thury stations than is customary for alternating-current stations. Choke coils can be introduced in a direct-current system without any other loss than that caused by ohmic resistance. The main source of trouble, the line itself, offers the same opportunity to lightning, no matter whether direct current or alternating current is used.

Other Protective Apparatus.

Where the alternating current has its overload relays, reverse-power relays, etc., the Thury system has its overvoltage short-circuiting switch, excess speed short-circuiting switch, and inverse rotation short-circuiting switch. The latter should be more reliable than the reverse-power relay, because it is actuated by direct current and hence there is no possibility of becoming inoperative in case of trouble, because there is no angle of lag which can suddenly jump to nearly 90 deg. Furthermore, there can be no surges on account of resonance and other troublesome alternating-current phenomena.

A more or less prevailing opinion that the Thury system should be less reliable, because all of the current has to go through each individual sub-station and through each individual motor in those sub-stations, is of course not correct. If in a parallel system a sub-station or transformer is troubled by a short circuit, it will have to be disconnected, for instance, by an automatic circuit-breaker, or otherwise the whole transmission system will suffer. In the same way, when the current is interrupted in a Thury sub-station or one of its motors, the automatic short-circuit device must operate to let the current pass by. Supposing the automatic circuit-breaker and the automatic short-circuiter to be of equal reliability, it can hardly make any difference whether all of the voltage or all of the current is admitted in each sub-station, as is respectively the case in the two systems.

Breakdown of Line.

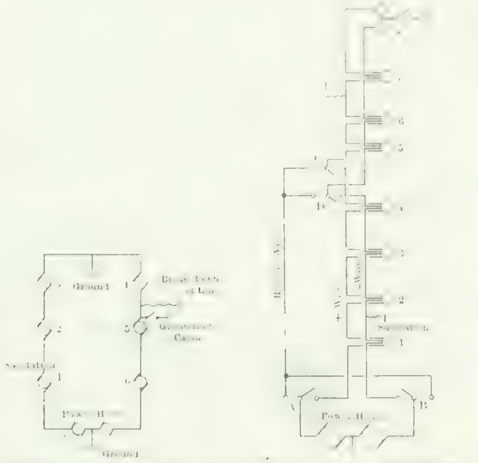
In respect to line breakdown, the three-phase system with grounded neutral has very little that is commendable. If one of its three wires breaks or gets grounded, the entire service is interrupted until repairs can have been made. To be sure, operation with two wires and ground is theoretically possible, but this is seldom attempted and it is of slight practical value. As a rule, where continuity of service is an important factor, a duplicate line is provided. Mr. E. J. Young* proposes for that reason a single-phase transmission with grounded neutral, which for the same voltage between ground and wire obviously has the same line economy as the three-phase system, and by means of a system of double-pole, double-throw switches for every transformer, continuity of service is assured when one of the line wires breaks down. If the two wires were carried on separate poles or structures, continuity of service would be almost certain, as it would take two coincident accidents to cause an interruption.

Such favorable conditions cannot be realized with the Thury system. If only one wire and ground are used, a breakdown will give a complete interruption, at least in that part of the line which is beyond the break. If there are any sub-stations between the power house and the point of trouble, the line should be grounded at the last sub-station on the generating station side of the break, in a grounding cabin, which should be installed in every sub-station. Pending repairs, that first part of the system could continue to give service. Where con-

*Proceedings A. I. E. E., May, 1907.

tinuity of service is of great importance, a duplicate line must be installed over the entire stretch, entailing 100 per cent extra line investment. When two wires and a grounded neutral point are used, conditions are better, as only one extra line, or 50 per cent extra line investment, would be required to insure continuity of service.

In the Lyons-Moutiers installation as yet no grounded central point is used, the present plant being considered one-half of the future plant, or at least has been laid out with that possible end in view. At present when one of the two wires breaks



FIGS. 6 AND 7.—SCHEMES FOR TRANSMISSION OVER A WIDE AREA

down, the return can be made through ground, so that no extra provisions are necessary to insure continuity of service. But at the same time, it is practically equivalent to a 30,000-volt installation and has 60,000-volt insulation.

In the Paris transmission scheme, which involves the grounded central point, it is considered sufficient that one-half of the power supply can be continued if one wire breaks down. The two wires will be carried on separate pole lines, to exclude the possibility that the two wires might be disabled at the same time.

In case no transmission in bulk, but transmission over a wide area is involved, Fig. 6 represents the conditions arising after a breakdown, which is supposed to occur between sub-stations 4 and 5 on the negative wire. It will be seen that in this case only sub-station 4 is shut off until repairs are made. It will be necessary to close the switch in the grounding cabin, shown in sub-station 5. If the line were capable of withstanding a higher voltage, the two permanent grounds could be disconnected, a second grounding switch in sub-station 4 (not shown) closed and the whole system could, pending repairs, be operated again, though with excessive voltage on the positive wire.

If the break occurs between the power house and either 1 or 6, the line would be subjected to 100 per cent extra voltage. Hence the first suggestion is of very limited applicability, in general only when the break occurs very near the end of the line.

A second suggestion may prove to be of more general interest, though entailing some additional copper and switching apparatus. It is indicated in Fig. 7. There are in this particular case eight sub-stations, and it is supposed that the first four take together as much power as the last four. Each sub-station, and if desired each of its individual motors, can be switched either on the positive or on the negative wire. The details of this arrangement will be shown later on. Double-throw switches, *A*, *B*, *C* and *D*, permit either the positive or the negative current to be conducted to a point just beyond sub-station 4 through the reserve wire, instead of through its regular wire.

Suppose a breakdown occurs at the point *E*, on the positive wire between 6 and 7. The ground in sub-station 8 must now be disconnected and the positive section 6-7 grounded in both sub-stations 7 and 6 (the ground switches are not shown). Consequently, *E* is the new grounded neutral point, and sub-stations 7 and 8 must be connected to the negative wire, while in sub-stations 1, 2, 3, 4, 5 and 6 connections must be made in such a way that four of them run on the positive side and the remaining two on the negative side. It will be seen that when the breakdown occurs beyond sub-station 4 (or, in the case of approximately equal distribution, on the last half of the line) no reserve wire is required. If, however, a break occurs between the power house and sub-station 4, the loads cannot be divided evenly on the two polarities and the reserve wire becomes necessary. If the break takes place, for instance, at *F*, between 1 and 2, on the negative side, the negative current must be made to flow through the reserve wire between the power house and *D*, while sub-stations 1, 2, 3 and 4 must be switched on the positive side, and sub-stations 5, 6, 7 and 8 on the negative side. The ground connection at 8 could remain if this sub-station is of comparatively small size, or otherwise the connection made on its positive side. In this particular case, each of the sub-stations 5, 6 and 7 would require four grounding switches, the sub-station 8 two (not including the one that is shown), while 1, 2, 3 and 4 need not have any grounding devices.

For equal distribution this scheme requires 25 per cent extra copper and insulators. For distribution in bulk, as shown previously, 50 per cent extra is necessary in order to give complete protection against possible shutdowns. As the transmission in bulk requires half as much copper as equal distribution, it is interesting to note that the extra amount of copper necessary in both cases for continuity of service is, therefore, exactly the same, being respectively 50 per cent for one-half, and 25 per cent for one.

The possibility of switching each sub-station or motor on either the positive or negative side gives the additional advantage of always being able to balance the system correctly. On the other hand, savings in insulators (as outlined under line economy) cannot be made. The details of switching at each sub-station are shown in Fig. 8. The switches *G* are grounding switches, only necessary in sub-stations beyond the junction with the reserve wire, as previously explained, and the switches *A* are over-voltage, short-circuiting switches.

Two double-pole, double throw switches are necessary for every motor or group of motors. These two switches must be either mechanically (as shown) or electrically interconnected, so as to operate simultaneously. According to what may be

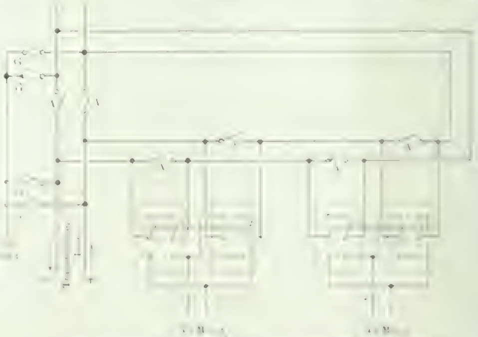


FIG. 8.—[illegible]

desired in each individual case, such a pair of switches may operate the entire sub-station, or again, the sub-station may be divided into several groups—if need be as many as there are motors. Fig. 8 shows a division in two groups.

When a ground occurs somewhere on the line, voltmeters in two of the sub-stations will show by their zero-indication which section is affected. Someone on the system, for instance the power-house operator, must perform the duties of "load [illegible] is, must telephone orders to the different sub-station operators.

There is available yet another method which is analogous to the one used in ordinary three-phase practice. In a Thury system with ground return, it is possible to divide the system into two halves, each having its own line to the receiving station. In case of trouble on one of these two lines, the two halves can be connected in multiple, using together the remaining line. Similarly with a Thury system using two wires and a grounded neutral, the switching equipment can be made so as to permit, in case of an emergency, a connection of the generators in the same way as mentioned above, using the intact line only with ground return. For this multiple connection it is necessary to subdivide each turbine-driven unit into two semi-units, one of which is to be connected in one half and the other one in the other half of the system. This feature insures the practicability of operating in parallel two groups consisting of series generators in series. In the receiving station similar arrangements must be made; two motors for one dynamo. It is to be noted that each of the two lines must have sufficient current-carrying capacity for twice its normal current and that the line loss will be doubled, as compared with operation over two wires. It will be seen that this is exactly like the standard practice for three-phase transmission, where two lines are provided, each one being able to transmit the entire power. For distribution to several sub-stations, one of the additional disadvantages is that even the smallest sub-station must have two motors instead of one, in order to make series-parallel connection possible.

Lightning Protection in Colorado.

At the convention of the Colorado Electric Light, Power & Railway Association, at Denver, in September, Mr. Leonard Wilson, engineer of the Denver office of the General Electric Company, gave an address on "Lightning Protection in Colorado," dealing especially with high-tension transmission lines. Mr. Wilson stated that protection against lightning is one of the chief problems to be met in connection with successful high-tension transmission in the state of Colorado, because it is lightning that puts the maximum strain upon line insulators The Central Colorado Power Company is planning to deliver power at 90,000 volts. Such lines will be successful if the lightning protection is able to keep the maximum voltage down to within 90 per cent above normal. The effect of interrupting a short-circuit is to cause an abnormal rise of voltage on the line, this depending on the natural frequency of the line, which in turn depends on its length. The natural frequency of the line in cycles per second is equal to 47,000 divided by the length of the line in miles. Measurements on lines in Colorado show that frequencies of lightning discharges measured varied between 2000 and 10,000. The low-frequency discharges were measured photographically by the oscillograph, while the high frequencies were measured by tuned coils after methods employed in wireless telegraphy. The arresters in use in Colorado are mostly of the multi-gap type. The connections of the two principal types were shown diagramatically on the blackboard. One has a number of spark gaps in series and with non-inductive resistance in series with the gaps between line and ground. The other has a number of spark gaps in series between line and ground with non-inductive resistances shunted around a part of the gaps in order to assist the initial discharge in jumping gaps. These arresters give good protection for line oscillation, but discharges of high frequency and high energy will jump through insulation from five to ten times that represented by the arresters, rather than go through the arresters.

He then described two types of electrolytic arresters which had been tried in Colorado the past season. The liquid-electrode arrester consists of two terminals supported a short distance above the surface of a jar of electrolyte. One of these jars was used for every 1500 volts line pressure. The discharge passed from the terminal to the electrolyte and from the electrolyte to the other terminal. The action of this arrester is dependent on the air gap between the terminal and the surface of the liquid and on the mechanical action of the liquid, which is borne away from the terminal by the discharge. The other type of arrester tried was the aluminum cell, making use of the well-known action of aluminum electrodes in opposing the discharge of current in a certain direction. These aluminum arresters were made for 300 volts per cell. He seemed very confident that either of these liquid arresters would take care of any discharge, and that they will be introduced for lightning protection in Colorado. In the east, he said, little difficulty was experienced with lightning protection on low-voltage circuits, but in Colorado there was considerable. He cited a lot of 500-volt arresters which on test would not discharge on a pressure of less than 20,000 volts. He thought the solution of the difficulty in this case was also the aluminum cell.

Mr. Clark, of Victor, said that on the Pueblo & Suburban Company's 20,000-volt line, both the liquid-electrode and the aluminum-cell arresters had been tried the past season, but that the season had been a very mild one for lightning. Mr. E. P. Dillon said that at Colorado Springs there had been no bad storms this year. Combination shunted-resistance and multi-gap arresters had worked well. He asked as to the drying out of the aluminum cell. Mr. Wilson replied that the aluminum cell was sealed in a case to prevent drying out. It would probably need overhauling once a year to renew the plates. Mr. Wallace, manager of the Canon City to Cripple Creek transmission line, said that his company, after much trouble with lightning, had put in two sets of arresters—one inside the power station and one outside. In the last three years practically no damage had been done by lightning. This season there had been 20 or 25 storms. Previous seasons there would be one along the line nearly every afternoon. Mr. Corbett, of Georgetown, said he had taken down the overhead ground wires from his company's lines because of their inclination to get tangled up with the transmission line. Mr. Clark, of Leadville, reported operating a 6600-volt line at an altitude of 10,000 ft. Most of his lightning trouble was with meters on the secondary circuits on low portions of the line.

Experience with Gas Engines.

At the recent Atlantic City meeting of the American Street and Interurban Railway Association, Mr. Paul Winsor, chief engineer of motive power and rolling stock of the Boston Elevated Railway Company, read a paper on the experience during the past year with the gas-engine generating plant at the Somerville Park station. This paper supplemented one on a similar subject presented at the meeting last year of the Association.

The Somerville station is equipped with two 600-hp Crossley gas engines supplied by a pair of Loomis-Pettibone gas producers, the engines being direct-connected with 350-hp Crocker-Wheeler generators. The plant was started in May, 1906, and since then there have been no shutdowns, accidents or failures.

Ignition current is supplied by 14-volt generators in connection with floating storage batteries. The igniters originally had platinum tips which were expensive and gave considerable trouble, but during the past four months they have been operated without platinum and with less trouble. The average coal consumption during the period from January to August of this year was 2.034 lbs. per kw-hour, or 1.404 lbs. per brake hp-hour. This showing is larger than that of last year, when 1.45 lbs. per kw-hour was reported. The paper states that the smallness of this figure was due to errors in weighing and checking coal. During the same period of seven months, the coal consumption of the steam plants average 3.477 lbs. per kw-hour, thus showing a superior efficiency of 41.5 per cent for the gas-engine plant.

In conclusion, Mr. Winsor said he believed that a gas-engine plant making its own producer gas will operate at least as reliably as a steam plant and will use from 30 to 60 per cent less fuel, depending somewhat upon the size of the steam plant with which it is compared. The drawbacks of the gas plant are, first, cost, which approximates $200 per kw when rated

so as to have a 33 1/3 per cent overload capacity; and second, the small size of units, the statement being made that the largest gas engine now built is only of 3000 kw capacity.

Technically Trained Men for Electric Railway Service.

Professor H. H. Norris, of the Cornell University, in a paper presented before the Atlantic City meeting of the American Street and Interurban Railway Association, brought out the advantages of the technical graduate to the electric railway industry. "The technical school," he said, "is intended to educate young men in the best sense of the word, and the education which does not make young men better business or professional men is not a satisfactory education. A few years ago there were three classes of employers; one placing too high, the second too low, and the third, a correct estimate upon the value of a technical education. The first class of employers placed too much responsibility upon the young men at first, supposing that they were already engineers. As a consequence many failed to meet the expectations, and gave apparent reason for criticism of their technical training. The second class of employers, not realizing the purpose of technical education, failed to take advantage of it, and did not give the young men suitable opportunity to rise. The third class of employers fortunately realized both the shortcomings and the merits of technically trained young men. Opportunity was given for overcoming the former, and the latter were utilized by placing such responsibilities upon the shoulders of young men as they were able comfortably to carry.

"The manufacturers were the first, and have been foremost in utilizing the product of the technical schools. They have carried this to such an extent that apprentice courses are offered by all of the large companies, and the young men are given every possible opportunity to develop normally and quickly. They are taken through all departments of the works, learning in each enough of the detail to enable them to appreciate the reasons for the development of existing forms of apparatus, and for the employment of present methods of construction. They test the finished product and so learn what to expect of the various classes of machines.

"The operating companies are now taking this matter actively in hand, and a few lighting companies have developed courses similar in purposes, but necessarily different in plan from those of the manufacturers. The Denver Gas and Electric Company was a pioneer in this direction, and their example is being followed by other companies.

"The men who are now controlling the electric railway companies have largely grown up with the industry. The experience of many dates back before the early nineties, when the horse was supplanted by the electric motor. These officials are now training young men to take their places when they retire, and they naturally desire to find for this purpose individuals with the necessary characteristics and training. For many reasons they have the right to expect the technical schools to supply the class of men required. The first of these is, that the technical schools should, and probably do, attract a large proportion of industrious, active and capable students. A young man who has the nerve and ability to conquer the difficulties of a technical training, especially if he is financially handicapped, ought to be one who is needed in business. In the second place, the mental and physical discipline tends to bring out his good qualities and make him self-reliant and original. It increases his initiative power, the most important business qualification which he can possess.

"It is surprising that such a comparatively small number of the technical graduates find their way in the electric railway business. Of the more than two thousand graduates of Sibley College, probably not more than fifty are directly or indirectly engaged in this line. Of these, quite a proportion are in the supply business, and only a small number are actually in the field. This is probably not because railway work is not attractive, but other lines have been so much easier to enter that they have attracted the bulk of the graduates. Some kind of an apprentice course would be welcomed by technical students. They enjoy any work in this direction that is given in the schools, and they show great aptitude for it."

Professor Norris suggested the following arrangement for such a one and one-half year's course:

(1) Three months in Master Mechanic's Department. This time should be largely spent in the car barns and repair shops. The apprentice can serve as helper on car inspections and repairs, construction of special parts, tests, etc.

(2) One month in Purchasing Agent's Department, partly as assistant to the store-keeper, and partly as general assistant to the purchasing agent.

(3) Three months in Motive Power Department. This time should be spent as general helper, oiler or in any other capacity in which the apprentice could be made useful. He could also assist on tests, designs for repairs and inspections. He could also act as emergency supply for sub-station attendance. A short time in the superintendent's office would familiarize him with the details of administration.

(4) Two months in Transportation Department. The apprentice could be given miscellaneous work in connection with the preparation of time tables, familiarizing himself with the train despatching system, and, in general, making himself useful to the superintendent. In many ways he could assist in this department as emergency supply in ticket office, on express cars, etc.

(5) Two months on outside line work. The apprentice could be employed as assistant with the repair gang, and he could also make himself useful in construction of new work, testing, repairs to instruments, etc.

(6) Three months in Way Department. This time should be spent in office work, laying out details of new construction of track, bridges, etc. The apprentice should also assist in surveying and other field work.

(7) Two months in Comptroller's Department. This time should be spent as general office assistant, and in conducting special investigations for the financial officers of the company. A technically trained man would be well equipped by this time to be of great assistance in compiling statistics. These cover not only the operation of the company itself, but of other companies. The appretice would thus become familiar with the methods of accounting used, and of the relation of this department to the others.

(8) Two months in General Manager's Office. The apprentice should now be in a position to be of practical use to the manager, and could be detailed to special duties which happened to demand attention.

One and a half years have thus been scheduled and subdivided among various departments with a view to preparing the apprentice for any line of work in the railway field, which may happen to be open to him. He has had the opportunity to demonstrate his peculiar abilities and disabilities, and if he has "stood by" for the full period, he has shown his appreciation of the opportunity. It is obvious that a very large company could handle a number of such apprentices without serious difficulty, if the officers in charge of them were in hearty sympathy with the idea. The plan requires the coöperation of the heads of all departments, and there are numerous objections which appear as soon as the scheme is suggested. The young men are in the various departments such a short time that they are not able to work at maximum efficiency. Further, it requires a little effort on the part of the superintendents of the various departments to lay out the work for the apprentices. The young men are apt to leave, and thus the company loses the benefit of the effort expended. On the other hand, opportunities are constantly arising in every company, demanding loyal, well-trained employes. These are difficult to obtain and could be picked out instantly from the apprentice corps. Smaller companies by

slight modifications could use the same general plan, and with the same results.

The matter of pay for the apprentices is one of practical importance. It is not to be expected that they will be able to earn as much as men regularly employed in the departments. On the other hand, they should be expected to earn for the company as much as possible. Their wages should be based more upon a reasonable living expense, than upon their earning capacity. This will depend upon the cost of living in various communities. Probably from 10 to 12 dollars per week at the start, with a reasonable increase at the end of each six months' period would be reasonable and satisfactory to all concerned.

This paper is not intended to recommend that companies go into the apprentice business on a wholesale scale. If each year one or two men could be employed by the smaller companies, and half a dozen or so by the larger companies, there would be a sufficient supply of new material always in processes of development. Of the men hired probably one-half would drop out before the end of the period, and those who remain would naturally be the ones best fitted for the work.

Freight Service on Electric Railways.

Two papers dealing with the handling of freight by electric railways were presented at the recent convention of the American Street & Interurban Railway Association. A paper by Mr. P. P. Crafts gave a brief description of the freight business conducted by the Iowa & Illinois Railway Company. Within the first year, with only one freight car engaged in the business, and the use of passenger coaches for carrying some freight, the income reached a total of more than $10,000. On package freight the railway is able to lessen the time of the steam railroads by 24 hours between Davenport and points on the Chicago & Northwestern Railway. A specialty is made of rush orders by telephone. The earnings from the freight business amount to 15 per cent of the total income of the electric railway.

The second paper was presented by Mr. H. H. Polk, who stated that farmers, merchants and manufacturers prefer to ship freight over the electric railway rather than the steam railroad. Moreover, the steam railroads prefer to handle freight in car-load lots rather than package freight. The less-than-car-load shipments on the Colfax division of the Interurban Railway Company (Des Moines, Ia.) are handled in express cars, at freight rates. Car-load shipments on this division are handled by an electric locomotive when necessary. On the Beaver Valley division a way-freight leaves Des Moines at 4 o'clock in the morning. This train is composed of an electric locomotive, merchandise cars, car-loads, and a caboose. It picks up all car-loads and does all the switching at the various stations, out and back, setting loaded cars and empties at the various elevators, stock-yards, coal mines, etc. The author suggested that each station along the electric railway should have a freight-room in charge of the station agent, who should receive and issue train orders, sell tickets, and solicit passenger as well as freight business. Data were given to show that the energy consumption of freight trains making a speed of 15 m. p. h. between stops varies from 19 watt-hours per ton-mile at the locomotive for a gross weight of 500 tons to 28 watt-hours for a weight of 100 tons. The energy consumption of interurban cars reaching a maximum speed of 45 m. p. h. varies from 67 watt-hours per ton-mile for a 50-ton car making one stop per two miles to 92 watt-hours per ton-mile for a 20-ton car making one stop per mile. The cost of repairs and maintenance of a 40-ton locomotive equipped with direct-current motors when hauling a [illegible] about 100 miles [illegible] will average about 1.5 cents per locomotive mile. This includes repairs to motors and control equipment and the care of the locomotive. The cost of repairs and maintenance of interurban cars will average about 1.5 cents per car-mile. This value includes cost of repairs to motors and control equipment and the cost of cleaning the car bodies.

The Atlantic City Street Railway Convention.

The convention of the American Street and Interurban Railway Association and its affiliated bodies at Atlantic City, N. J., Oct. 14 to 18, was the largest ever held by that body. Certainly the exhibits made under the auspices of the Manufacturers' Association exceeded in number, character and interest any exhibit ever made in the history of the composite organization. The character of the papers presented and the interest manifested in them, especially in the report of the committee on standardization, indicate that the American Street and Interurban Railway Association is taking its place among the other great national organizations. The list of incoming officers of the various associations included in the American Street and Interurban Railway Association is published elsewhere in this issue.

Last week's issue contained abstracts of a number of the papers presented, together with the discussions on these to the close of Tuesday's sessions. Below are given abstracts of papers not previously published, and of the discussions which followed the reading of them and of the papers read at the Wednesday sessions.

The annual report of the secretary and treasurer of the American Street and Interurban Railway Association presented at the opening session of that body on Wednesday, showed that the number of active members in good standing is 227, the associate membership numbers 148, and the total receipts were $31,701.

The report of the standardization committee of the Engineering Association was presented at this meeting and was adopted by unanimous vote. The first paper presented was entitled "The Technically Trained Man and the Electric Railway Profession," by Prof. H. H. Norris. The abstract of this paper was inadvertently omitted from last week's issue and will be found on page 810 of this issue.

TECHNICAL GRADUATES FOR ELECTRIC RAILWAYS.

The discussion on Prof. Norris' paper was opened by Mr. H. W. Blake, of the *Street Railway Journal*. Mr. Blake referred at length to the compilation of universities, colleges and technical schools of this country published in the July 27 number of the Electrical World, and said that while no statistics were obtainable as to how many graduates had entered the electric railway field, it was safe to say that many of them are prepared to do good service in this branch of electrical engineering. The mental discipline received enables the graduate to adapt himself quickly to practically any department in which he may be placed. He said that the paper suggests a concrete plan by which the results secured in other branches of the electrical industry in utilizing the college graduate may be carried out by street railway companies. The proposed course of 18 months should form an excellent method for learning the practical application of the principles acquired at the university, and the establishment of a trained corps of men in the way suggested should be of great future assistance to the railway companies.

Mr. Blake was followed by Prof. Richey, of the Worcester Polytechnic Institute, who related his experience with graduates when he was connected with the Indiana Union Traction Company, and also spoke of the course in electric railway engineering at the Worcester Polytechnic Institute. C. S. Sergeant, while believing in rotation from one department to another as outlined in Prof. Norris' paper, criticized the brevity of the course in each department. There is danger, he said, that the young man who flits about from a couple of months in one department to a month and a half in another will think he knows it all in a year or two. Mr. Wyman said his firm was fortunate to secure from 10 to 20 graduates, who were instructed along the line of investigating statistics derived from the operation of its various companies. After being given a broad and general view of the principal lines of work, they were willing and anxious to undertake practical work with some of the different companies

[illegible] managers or presidents of the various companies.

W. H. Evans said much depended on the apprentice. He had employed four apprentices and felt that they would fail unless they got down to the level of those with whom they associate. They must disabuse their minds of the fact that they are there to gain all and give nothing. W. Saryl Ely said that it was a mistake to think that a man has to be born with a red flannel shirt on him to enable him to get down to good, hard, common work that greases his hands and smuts his face. C. L. S. Tingley thought the time allotted to the apprentice in the accounting department was too short.

Ralph Sweetland, of the New England Insurance Exchange, then read his paper, entitled, "The National Fire Protection Association and Its Work in the Street and Interurban Railway Field." Mr. Sweetland stated the objects of the National Fire Protection Association, the character of the work performed by it, and closed by inviting the street railway association to take an active interest in the wok of the fire protection association so that the enormous fire waste, amounting in the United States this year to nearly $185,000,000, may be diminished. At the suggestion of Mr. McClellan the paper by Mr. Campion and himself, entitled, "The Influence of the Design of Railway Structures on Economy of Operation," was read by title, the hour for adjournment of the morning session having passed.

At the closing session of the Engineering Association on Wednesday afternoon the first paper presented was the one by Paul Winsor, an abstract of which will be found on page 809. In opening the discussion G. W. Farmer enquired if 3.447 lbs. of coal per kw-hour was the average of all the Boston elevated steam plant consumption. J. W. Corning said it was the average of all but an old non-condensing plant operated only on peak loads. In reply to Mr. Farmer's question asking if comparisons were available as to the total cost of energy per kw-hour delivered from the gas plant and the average steam plant, including supplies, repairs, etc., he said that such figures were undoubtedly available. J. R. Bibbins said he had in mind two plants giving practically the same figures.

DISCUSSION ON THE STEAM TURBINE

Mr. Chilton then read his paper entitled "Some Practical Points in Steam Turbine Construction, with Particular Reference to the Parsons Type," an abstract of which appeared in last week's issue. This paper was followed by one prepared by A. H. Kruesi, entitled, "Operation of Curtis Turbines in Railway Service," an abstract of which was also published in last week's issue.

Mr. Roberts, referring to the last part of Mr. Kruesi's paper, relating to the guarantee of the boiler makers of 200 lbs. for a boiler practically guaranteed for 150 lbs., thought that in so far as superheated steam is concerned the increase of 50 lbs. was advisable; but whether the boiler makers would stand by the tubes or not under those conditions was questionable. With increased pressure he felt there should be some different construction in the boiler. Mr. Kruesi, he said, failed to point out that the great increase of maintenance means a great drawback to the use of both economizers and superheated steam. One thing, he maintained, should be pointed out to those contemplating the purchase of turbines, and that is that under varying loads at varying steam pressures the turbine can be depended on to do work that a reciprocating engine cannot. He mentioned a recent incident where his company had seven 300-hp boilers working over natural gas, and the remainder of the boiler equipment, five 300-hp boilers, was being fired up. The steam pressure dropped to 85 lbs., and yet the turbine was operating at that pressure and carrying all the load possible, while a 1500-hp and an 800-hp reciprocating engine were working with their valves wide open and were inclined to "lay down." He advised the avoidance of water step-bearings for turbines, and the substitution of oil step-bearings. The trouble with water step-bearings is that though they have practically pure water, eight gallons of water are used per minute on the step bearing, which at 6 cents per 1000 cu. ft. amounts to about $7 in 24 hours, and this would pay for a large amount of oil. Besides very slight impurities in the water seriously affect the face of the bearings so that frequent renewals are necessary. With regard to auxiliaries, he said, he would not use a steam-driven circulating pump and would have a barometric condenser. His company is operating its condenser with a dry vacuum pump and is getting from 28 ins. to 28½ ins. of vacuum at 1080 ft. above sea level. This is practically 29 ins. The trouble is to get the water over without a dry vacuum pump; but once the water is over, the vacuum is assured. The pumps should be electrically driven.

Mr. Mitchell said that his company has two turbines with water step-bearings in operation, and that the water from the bearings is used for boiler feed purposes. Mr. Roberts said that the water from the step bearings ordinarily goes into the discharge end of the turbine and is wasted; but Mr. Mitchell said his ran into the service connections. He also stated that surface condensers are more satisfactory and give the best boiler water. The cooling water often is very dirty and he was obliged to use a surface condenser to get good feed water.

Charles Hewitt doubted if there was much to choose between water step-bearings and oil step-bearings, or between surface condensers and barometric condensers. He had no trouble with water step-bearings for two years. F. E. Henshaw thought it might be interesting if Mr. Roberts, who advocated electrically-driven auxiliaries, would expound a little further on that point since there were many who regarded them with disfavor. He thought steam drive was preferable to any secondary source of power. He had seen boiler-feed multi-stage pumps driven by steam turbines in the Waterside Station of the New York Edison Company.

Mr. Roberts in reply stated that the pumps in his station are driven by a vertical engine. The speed his company desires to operate at is 480 r. p. m., which is a natural speed for an alternating-current motor. The speed of the engine has to be increased to 430 r. p. m. occasionally to get the water over the head. That is why he favored motors. His company has another plant in which the pump is motor-driven and the plant was not shut down four hours a year because of any trouble with the motor-driven pump.

Mr. C. F. Baker thought the troubles mentioned by Mr. Roberts could be overcome by increasing the size of the rotor in the pump so that the engine speed would be sufficient.

Dudley Farrand said that the Public Service Corporation of New Jersey had changed from water step-bearings to oil step-bearings, and had found the change advantageous, although the water step-bearings gave the company no serious trouble. The use of oil step-bearings enabled the turbines to run with greater clearance. His company is using surface condensers on all its turbines. As to first cost, Mr. Farrand said he did not see how any company can afford to put in any other than turbine units in large installations.

Mr. Mitchell said that the Edison station in New Orleans had supplanted all its electrically-driven auxiliary apparatus by steam-driven units. Mr. Farmer stated that the Old Colony Street Railway Company had a similar experience. In Quincy all the auxiliaries were electrically driven, and while they expected great results from electrically-driven apparatus, they found it advantageous to change from electric drive to steam drive. The operation of the plant was much more flexible with steam-driven units, and besides exhaust steam was needed for heating the feed water. His company was forced to use surface condensers at Quincy because the feed water had to be purchased and salt water was used for circulating in the condensers. The water from the step-bearing discharges directly into the condenser at the Quincy station. Oil step-bearings are used at the Newport station, and in each case the operation is such that no change is contemplated.

Mr. Farmer asked Mr. Kruesi if the figures quoted for the percentage in gains in economy for steam pressure, vacuum and superheat are those which apply generally for all sizes of machines, to which the latter replied that they did; so did the 1 per cent for every 12.5 degrees of superheat.

Mr. Kreusi, in replying to Mr. Roberts, said in regard to water-step bearings that he was safe in saying there are over 100 machines operating satisfactorily in various parts of the world with water-step bearings. Similar reports have been made of satisfactory operation with oil. He thought Mr. Roberts' trouble was due to the deposit of salts on the lower wheel, caused by the spraying of the water in passing the turbine which would throw the latter out of balance. A similar case arose where good water was not available in Cuba and one or two other places, and it may be necessary to design oil-step bearings for these machines, such a case being cited in his paper. With reference to Mr. Roberts' difficulty with boiler tubes, he said, any number of instances might be cited where satisfactory operation has been had with boilers at 175 lbs. and 190 lbs. pressure in connection with steam turbines. In the same way he believed it to be an error to condemn engine-driven circulating pumps, because in one particular instance the pump was designed for too high speed. A circulating pump for the conditions such as Mr. Roberts had to deal with can be designed for a wide range of speed and there is no reason why it could not be designed for 75 r. p. m.

The question of motor-driven or engine-driven auxiliaries was too large to be entered on. Motor-driven auxiliaries are open to the same objections as motor-generator exciter sets. Sufficient steam could be had for motor-driven auxiliaries by taking steam from the first and second stage. All Curtis turbines are furnished with openings so that if any one desires to heat water in that way it can be done. The turbine uses the steam down to the point where all of its energy is abstracted, and has a higher efficiency than most of the engines which would be used for driving auxiliaries so that it would be economical to use no steam-driven auxiliaries. There are other objections on the score of reliability with motor-driven auxiliaries which would off-set that. He thought the turbine-driven auxiliaries are absolutely reliable. They have been used in several instances, and he expected very rapid increase in their number. Many troubles due to the auxiliaries are laid to the turbine just because they went in at the same time as the turbine. He thought many of Mr. Roberts' troubles were really condenser troubles. With reference to the point raised by Mr. Roberts on steam consumption, he quoted a statement from the last report of the turbine committee of the Edison Association to the effect that engines are no longer in the same class with turbines as to steam consumption.

With regard to the figures of superheat, pressure and vaccum, Mr. Kreusi said such statements as he had made must naturally be general unless he gave tables applying to each particular turbine, showing the percentage of improvement to be gained from a given amount of superheat. This would depend upon the size of the turbine, because a 1000-kw unit, for example would have a water rate of about 20 lbs., whereas a 5000-kw turbine would have a water rate of 17 lbs., and naturally 1 per cent on 17 lbs. is different from 1 per cent on 20 lbs. He could make statements as to the gains obtained from superheat, which would naturally be different from that guaranteed. There must be a margin in the guarantee. No conservative manufacturer will guarantee up to the full limit of gain which he knows will be realized, and that might account for the difference between 12 and 14 degs.

J. R. Bibbins then read an abstract of his paper entitled "Recent Developments in Steam Turbine Power Station Work," and in conclusion presented some results of the test on the turbine installed in the New York Edison Company's Waterside Station No. 2. The details of this test appeared in our issue of Oct. 12, and an abstract of Mr. Bibbins' paper was published last week. After the reading of Mr. Bibbins' paper, officers for the ensuing year were elected, and the sessions of the American Street & Interurban Railway Engineering Association were brought to a close.

At the Thursday morning session of the American Street & Interurban Railway Association, the committee on "Rules for the Government of Motormen and Conductors" presented its report of progress. Following the report Mr. P. P. Crafts read his paper entitled "Light Freight Handling by Electric Lines." He added that a 20-per cent reduction in tariff required by the railroad commission of Iowa has resulted in an appreciable increase in the amount of freight carried. Mr. Crafts also described the blanks and sheets used in conducting the freight business.

The paper, "Freight Service on Electric Railroads," by Mr. H. H. Polk, was next read and both papers were opened for discussion at the same time. Abstracts of these two papers are given on page 811. Mr. C. E. Emmons said that his company's last year's accounts show that the freight business was responsible for about 60 per cent of the gross receipts. In the territory covered by his company, the freight business is a large factor in the development of the company's properties. Mr. E. F. Peck stated that the Schenectady Railway Company is operating a freight and express business to its profit. Mr. J. H. Pardee said the matter of a paying or non-paying freight business depends on the locality. He felt, however, that there was profit in the freight-handling business. Mr. C. L. Allen was of the same opinion. Mr. Hippee said he would rather have the freight business than the passenger business, if for no other reason than the question of hazard. Mr. W. S. Dimmock stated that his company has in service between 300 and 400 freight cars and that the business handled is such that he wished he had 200 more cars.

The paper on "A Department of Publicity," by Mr. J. H. White, was then presented, followed by one on "Advertising from the Street Railway Standpoint," by Mr. A. W. Warnock. The former paper described the work of the publicity department of the Boston Elevated Railway Company, and the latter paper was devoted to the admirable publicity work of the Twin City Rapid Transit Company. There being no discussion offered on these two papers, the paper prepared by Mr. H. S. Cooper, entitled "Problems of a Small Road," was then presented. Mr. Cooper's paper dealt with the organization of the various departments, the direct and personal relations with its patrons and the problems connected with employes and materials. After commenting on the excellence of the paper, President Beggs adjourned the meeting.

The first committee report presented on Friday was on "Insurance." The report pointed out that a large part of the cost of conducting insurance business consists of commissions paid to agents, brokers, etc. This item of expense could be eliminated either by cooperation among traction companies to mutually insure their own properties, or by direct arrangement with existing insurance companies without the intervention of middlemen. H. N. Staats gave the names of three insurance companies organized to permit electric railway companies to carry their insurance at cost.

The report of the committee on "Rules for the Construction of Modern Car Houses" was then presented and on motion was adopted and its recommendations earnestly commended to companies about to build or overhaul car houses.

The report of the committee on "Municipal Ownership" was accepted. It was followed by the reports of the committee on "Heavy Electric Traction" and on "Compensation for Carrying Mail." Mr. C. G. Reel's paper on "The Use of the T-rail in Cities" was then read. The author pointed out that the T-rail can be used and is used in many cities without in any way interfering with the condition of the street pavement.

A paper entitled "Public Policies of the Past and Future," by Mr. C. L. Allen, was then read by title. A paper entitled "Interurban Railway Fares," by Mr. T. Stebbins, was next presented, followed by one on "Municipal Ownership in Great Britain and in the United States," by Mr. W. J. Clark. The committee on "Public Relations" then presented its report for acceptance.

Before the association adjourned *sine die* Mr. W. C. Ely presented the following resolution, which was adopted:

"Whereas, Experience has demonstrated the desirability and usefulness of our existing affiliated organizations; and

"Whereas, It has appeared from discussion that another organization of similar character should be organized, to which

should be committed lines of work pertaining to transportation, traffic and general operation, now, therefore, be it

"Resolved, That the executive committee be, and hereby is, requested to take such steps as it may deem desirable to encourage the formation of such an organization."

New Telephone Patent.

MULTIPLE SWITCHBOARD BUSY TEST.

The busy test for multiple switchboards has almost always been made by the introduction of a sudden slight current upon the operator's set. At first the best current flowed through the receiver directly, but of late a tertiary has been provided upon the induction coil to receive the test impulse and inductively repeat it in the receiver circuit. In many systems, where the test circuit is entirely independent of the talking circuits, the test current is fed to the tertiary direct. Where with the two wire systems, however, the test and line contacts are common, the diversion of a sufficient amount of current to cause a satisfactory busy sound, will disturb the busy line. With such systems it is usual to provide a very sensitive relay of high resistance to receive and be operated by a very minute diverted current. Then the contacts of this relay apply a secondary audible current to the operator's tertiary. It is readily seen that with this arrangement an appreciable time elapses between the contact of the testing plug and the click which, if the test contact be brief, may result in a false move by the operator. Mr. W. W. Dean has endeavored to reduce this time interval by reversing the action of the test relay. He causes the test relay to maintain the secondary circuit through its back or normal contact. This circuit becomes severed at the first move of the armature, thus quickening the test. The secondary circuit is not closed except when the supervisory relay of one or more cards is pulled up. The patent for this system is assigned to the Kellogg Switchboard and Supply Company.

Recent Electrochemical Developments.

BATTERIES.

A recent improvement in the old Edison-Lalande cell has just been patented. In the original cell, zinc and copper oxide electrodes are used in potassium hydrate as the electrolyte. Mr. Edison has now found that by adding silicate of potash to the electrolyte, its solvent power or the capacity of the solution for zinc is more than doubled. The best composition is to add to a 20 per cent hydrate solution about 15 per cent of potassum silicate.

This cell may be modified and used as a secondary battery by employing nickel hydroxide as depolarizer, while a plate of metallic magnesium is used to receive the zinc deposit plated out of the alkaline zincate solution by the charging current. In this modification the proportions of potassium hydroxide and of the alkaline silicate can be increased conveniently, because there is less likelihood of the solution freezing than with primary batteries which are frequently employed in exposed places.

FERRO-ALLOYS.

We have already referred in these columns to the extensive work which is being done in the production of ferro-alloys in the electric furnace by Messrs. F. M. Becket and E. F. Price, of the Electro Metallurgical Company. Numerous patents recently granted to these inventors give much information concerning a number of interesting electrochemical relations.

One is the extensive use they are making of silicon as a reducing agent. It is, of course, now well understood that steel manufacturers want ferro-alloys free from carbon, and that aluminum has been used successfully as a reducing agent for making such alloys. Messrs. Becket and Price use silicon in various forms, mostly in the form of a high-percentage ferro-silicon. They have also found carborundum, that is carbon silicide, to be quite suitable. Mr. Becket states that in this case high yields of a product low in carbon may be obtained, since the portions of the metal first reduced do not come into contact either with free silicon or free carbon and, therefore, do not absorb the same to any injurious extent.

An interesting special application of silicon as a reducing agent is the direct reduction of vanadium sulphide to metallic vanadium, S_iS_2, being formed.

A basic flux is, of course, used in these processes to take care of the silica which is being formed during the process and of that which may be already contained in the ore under treatment.

Silicon, however, is a comparatively expensive reducing agent, and it is, therefore, advisable to restrict its quantity as much as possible. As is often true in metallurgy, this may be accomplished by breaking up the process into various steps. For instance, the reduction of vanadic oxide, V_2O_5, is best carried out in two successive operations; first the vanadic oxide is reduced to a lower oxide, V_2O_3, by means of carbon in a gas furnace, and then the V_2O_3 is reduced to elimentary vanadium by means of silicon in an electric furnace. This method results in a considerable saving of electric energy and of silicon, which are two expensive items in the cost sheet.

Finally, it is a fact that even if silicon is used as the reducing agent, some carbon will come into the reduced metal, chiefly from the carbon electrodes. To obviate this as much as possible, Mr. Becket proposes to make the carbon cross-section as small as possible, and, since this renders a high current density necessary, he protects the carbon ends against premature deterioration by special water cooling devices.

Letter to the Editors.

Distortion in Telephonic Transmission.

To the Editors of Electrical World:

Sirs:—The writer has read with great interest the article by Mr. Louis Cohen and the editorial in your issue of Sept. 21, on "Distortion in Telephonic Transmission." The increase in attenuation due to "skin effect" in the large wire under consideration, is interestingly shown, and is of value as not having usually been considered by previous mathematical investigators. That this causes any noticeable proportion of the distortion in telephonic transmission, however, does not follow.

The case considered by him is one which would show the greatest possible distortion due to "skin effect," as to the best of the writer's knowledge the line cited is of the largest diameter in commercial use for telephonic transmission. Ninety-nine per cent of telephonic connections are over wires of smaller diameter than this, where the "skin effect" is far less.

A 500-mile length of a line of the constants mentioned, with no auxiliary apparatus or cable at either end, will give as nearly perfect speech transmission as is ever found in telephonic service. Such a connection would be many times clearer than the average short-distance conversation in a city where cable is used, and it would be impossible to detect the small percentage of distortion indicated by the attenuation calculations. Indeed, it might be shown by carrying the calculations further, that the distortion due to the essential apparatus of the telephone instruments themselves is greater than that of the line in question.

Each piece of auxiliary telephone apparatus, such as a relay, repeating coil or condenser, produces greater distortion than that of the line mentioned. The combination of such apparatus with a number of miles of No. 19 or No. 22 B. & S. gauge cable, such as is largely used for telephonic transmission, may give a difference of attenuation of several thousand per cent between the frequencies of 200 and 2000, and still give good commercial transmission.

As an example, take the simple case of a 25-mile length of 19 gauge cable, loop resistance 90 ohms, and mutual capacity .08 m. f. per mile, with a local battery instrument at each end. If the instruments are equipped with cut-out buttons to short-circuit the secondary winding of the induction coil, they

may be considered as equivalent, when listening, to having the receiver bridged across the line.

The self-induction and skin effect of such a line may be shown to be practically negligible, and the receiving and impedance is represented by the formula:

$$Z_r = Z_l \sinh ax + Z_a \cosh ax\ ^*$$

where Z_l is the line impedance, Z_a the impedance of apparatus at the terminal end, and $a = \sqrt{jrc\omega}$. Assuming for the receiver, $R = 60$, $L = .1$ [illegible] $g = 0$, [illegible] we have for the frequencies of 200 and 2000 p. p. s.

200 p. p. s. $Z_r = 2518\ /58°\ 30'$ ohms.
2000 p. p. s. $Z_r = 111,000$ [illegible] $88°$ ohms.

This result is rather startling, and shows the full effect of distortion, both as regards attenuation and phase relation of wave components. It is still more striking when one considers that this hypothetical circuit does not represent the extreme limit of possible conversation. Fair conversation is possible over such a length of cable and through all the auxiliary apparatus of a modern exchange system, although the distortion would be much greater than the above, and poor conversation is possible over 10 or 15 additional miles of cable.

This simple example will show that the distortion occurring in cable circuits is very many times greater than that due to "skin effect," even where the largest commercial telephonic conductors are used.

In a mixed circuit composed partly of aerial wire and partly of underground cable (a typical long-distance connection), it is readily seen that the distortion in the aerial line is very small compared to that in the cable and apparatus at either end; so that the distortion due to "skin effect" in telephonic transmission is usually a negligible factor in the total distortion of a telephone connection, and is always an unimportant one.

The case calculated is also interesting as indicating that a frequency of 2000 p. p. s. is higher than the maximum which it is necessary to transmit to give intelligible speech.

CHICAGO, ILL. W. C. YEATMAN.

*Kennelly. *Transactions* Int. Elec. Cong., 1904, Vol. 1, p. 73.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Train-Lighting Dynamo.—M. OSNOS.—A description of a new train-lighting dynamo built by the Felten & Guilleaumme-Lahmeyer Company. The voltage is maintained automatically constant within wide limits of speed, and the current has always the same direction whatever the direction of rotation. The dynamo itself has no special features; the novelty rests in the exciter. The voltage of the exciting machine decreases with the speed and reverses its direction with the direction of rotation of the machine. The principle is shown in Fig. 1, in which

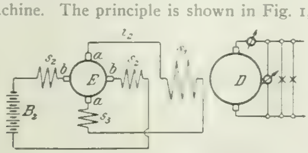


FIG. 1.—TRAIN-LIGHTING DYNAMO.

D is the dynamo, which gives the current for lighting the lamps; s_1 is the exciting winding of this dynamo, and is supplied with current from the brushes, aa, of the exciter, E. The exciter has another pair of brushes, bb, in series with the winding s_2. The exciting current is furnished by the battery B_2. The turns of the winding s_3 are adjusted when testing the machine so as to get the correct intensity of the armature "quadrature field." The battery B_2 is charged from the dynamo D. The principle of operation is as follows: The current i_2 which is taken off from the brushes a produces an armature field in the direction of these brushes. In this "quadrature field" the armature rotates and there is, therefore, at the auxiliary brushes bb an e. m. f. e_2 which counteracts the battery voltage e_1 so that the exciting current of the exciter is $i_2 = k_1\ (e_1 - e_2)$ where k_1 is constant. Since e_2 is produced by the rotation of the armature in the field generated by i_2, $e_2 = k_2 i_2 n$ where n is the speed and k_2 is another constant. Thirdly, i_2 is produced from the e. m. f. between a and a which is due to the rotation of the armature in the field produced by i_1 so that $i_2 = k_3 i_1 n$. From these three equations it follows that the exciting current i_2 of the main dynamo D bears the following relation to the speed n.

[illegible]

where a and b are constants. Since n is in the numerator and n^2 in the denominator it follows that i_2 decreases with n beginning with a certain value of n. By a suitable choice of the constants a and b, which determine the magnetic properties of [illegible] versed, the voltage of the exciter and, therefore, the exciting current of the main dynamo D, changes in direction. The voltage of the main dynamo D, therefore, has always the same direction whatever may be the direction of rotation. In order to get good results, the exciter must be saturated in a peculiar way. The author finally shows how it is possible to use the exciter itself as a train-lighting machine.—*Elek. Zeit.*, Sept. 19.

Alternators in parallel.—F. EMDE.—Goerges has formerly pointed out that in the operation of alternators in parallel the damping winding does not always diminish the oscillations of power, but makes matters worse if the frequency of the free oscillations of the pole wheel is below 0.707 times the frequency of the forced oscillations. Rosenberg has also discussed the matter in great detail. The present author endeavors to discuss the same subject from a new and simple point of view by means of diagrams.—*Elek. u. Masch.*, Sept. 22.

Compound Alternators.—J. REZELMAN AND J. PERRET.—A mathematical note illustrated by diagrams on a method of compounding alternators.—*L'Eclairage Electrique*, Sept. 7.

Testing Dynamos.—C. F. GUILBERT.—The first part of an article illustrated by diagrams on practical methods of determining the characteristic curves of dynamos and motors. The author first discusses direct-current dynamos.—*L'Eclairage Electrique*, Sept. 14.

Lamps and Lighting.

Metallic-Filament Lamps.—A note on a recent British patent of the British Thomson-Houston Company according to which in the manufacture of metallic filaments for incandescent lamps water-gas is used as an inert or reducing atmosphere in which to treat the filaments. Its advantages are low thermal conductivity and cheapness.—Lond. *Elec. Eng'ing*, Oct. 3.

Quartz Lamp as Competitor of Arc Lamps.—O. BUSSMANN.—His full paper on the quartz lamp of Küch, which is a high-efficiency mercury-vapor lamp with a life of 1000 hours, and is intended to compete with high candle-power arc lamps.—*Elek. Zeit.*, Sept. 19. A long illustrated abstract of this paper was given in last week's issue on page 769.

[illegible] Pure tungsten was melted in a vacuum tube and the melting point found to be between 2800 deg. C. and 2850 deg. C. (between 5072 deg. F. and 5162 deg. F.).—From *Berichte*, 1907, v. 40, p. 3287, abstracted in *Jour. Soc. Chem. Industry*, Aug. 31.

Power.

Electricity in the Austrian Iron Industry—W. KESTRANEK.—An Iron and Steel Institute paper, in which the author states that the most extensive application of electricity is found everywhere in Austrian iron and steel works, mostly in con-

[illegible] for the generation of power. [illegible] Witkowitz [illegible] of 5700 horse-power exists. At the Austrian blast furnaces which yield 790,000 cu. meters of gas per hour, 263,000 cubic meters are used for blast heating, so that 527,000 cubic meters are available. Of this quantity, at the present time, 358,000 cubic meters, or 68 per cent, are utilized for boiler heating, and 34,000 cubic meters, or 6.5 per cent, representing 12,000 horse-power, in gas engines, whilst the remainder of the gas is used partly for ore-roasting or in drying kilns, and partly drawn off unutilized. The Böhmische Montangesellschaft, which at present is utilizing blast-furnace waste gases on the most extensive scale, utilizes 23 per cent of the available gas in gas engines. In the Austrian coke works, the coke ovens yield 86,000 cubic meters of gas per hour, of which quantity the coke ovens themselves absorb 62,000 cubic meters, so that 24,000 cubic meters are available. Of this quantity 5700 cubic meters, or 24 per cent, are utilized in gas engines, whilst the remainder is used for boiler heating. The most complete application of electricity to the driving of rolling mills is in Teschen, where, not only the finishing, intermediate and roughing trains, but also the reversing rolling-mills are driven by electric motors. High-grade alloy steels, especially tool steels, are now being made in various Austrian plants in the electric furnace, the Kjellin process, Keller process and the Heroult process being used. The author also speaks of the importance to the iron industry of sufficiently high protective import duties, of the association of iron works into a syndicate, and of the concentration of smaller works into larger units.—*Electrochem. and Met. Ind.*, October.

Italian Transmission Plant.—An illustrated description of the transmission system from Caffaro to Brescia. The energy is furnished to a caustic soda factory in Brescia, and is also used for lighting and power purposes in the cities of Manerbio, Brescia, Cremona and Ponte Viggio. There will be five sets of machines, each of 2500 horse-power, of which four are already in operation. The generating e. m. f. is from 9000 to 10,500 volts. The e. m. f. is raised in transformers to 40,000 or 46,000 volts for transmission to a large distribution and transformer station in Brescia, where the e. m. f. of part of the energy is transformed down to 3600 volts, while the balance is transmitted at 36,000 volts to the other cities mentioned above.—*Schweiz. Elek. Zeit.*, 1907, pp. 2, 13, 27 and 37, abstracted in *Elek. Zeit.*, Sept. 26.

Power Plant.—J. R[illegible].—A Swiss company is erecting at present two new hydro-electric plants of large capacity. The first is located in the district of Glaris, in Switzerland, and will have a maximum output of 36,000 horse-power, furnishing energy exclusively for lamps and motors to this very active industrial district. It will be electrically connected with the generating station at Beznau. The second plant utilizes the falls of the Tessin River, in the Biaschiana district. Various data are given on the hydraulic development of the latter station.—*L'Eclairage Electrique*, Sept. 14.

Peat as Fuel.—A net work of canals, of a total length of 24 miles, has been built in an extensive peat district in northern Germany, and a large electric station is to be erected which will furnish primarily energy for the operation of electric ploughs and other machinery needed for rendering the peat district available for farming. Energy is also to be transmitted for lighting and power purposes to various cities within a distance of 13 miles. Peat will be used exclusively as fuel in the station.—*Elek. Zeit.*, Sept. 26.

Charging Apparatus for Blast Furnaces.—G. Meyer.—A fully illustrated detailed description of the electric equipment of the charging apparatus for the blast furnaces in a German works. It is stated that the Ward-Leonard system of control has proved very successful for such work.—*Elek. Kraftbetr. u. Bahnen*, Aug. 3.

[illegible] in Mines.—[illegible] Becker.—A very long mathematical article discussing the advantages of the Ilger system and endeavoring to refute the objections which have been raised against it. The author discusses in detail the different mechanical and electrical losses, and shows how to determine the most favorable slip necessary to allow the flywheel to take up the variations of load.—*Elek. Kraftbetr. u. Bahnen*, Sept. 4, 14 and 24.

Traction.

Municipal Tramways Association.—A full account of the Manchester convention of the (British) Municipal Tramways Association. In A. L. C. Fell's paper on "rail corrugation" the importance of the initial condition of the rail was insisted on, and the weight of the discussion which followed also emphasized the predominance of the rail as a factor in producing the evil, although the usual contradictory variety of opinions was expressed. J. Dalrymple in his paper on "Staff Organization" placed particular emphasis upon the necessity of the head officer of a tramway department having effective control over all parts of the work, even though the actual execution might be entrusted to other officers, and he laid down a scheme of organized development which is designed to leave the general manager free to manage, whilst the detail executive work is distributed among subordinates responsible to him. An advocacy of "Long Wheel-base Trucks," by Acland, revealed much difference of opinion on the subject of truck design, the present English practice in which is generally felt to be unsatisfactory in several particulars. In the course of the discussion, an account was given of a new type of truck now under trial at Burnley. Baker contributed a paper summarizing the conditions of employment in municipal tramways throughout the United Kingdom, provoking a discussion on rates of pay and other labor conditions generally, the greater part of which was held in private. The subject of the maintenance of the paving of tramway tracks and margins was brought forward by F. Spencer, and relegated to the executive committee to consider collective action. The new president is Aldworth, of Nottingham.—Lond. *Elec. Eng'ing*, Oct. 3.

Rail Corrugation.—A. L. C. Fell.—His paper read before the (British) Municipal Tramways Association. After study and investigation on various tramway systems, the author has come to the conclusion that corrugations are not due entirely to one cause. The following are, in his opinion, some of the chief producers of the trouble: (1) Original roughness of rail after rolling; (2) cold rolling of rails by the car wheels; (3) soft rails and heavy cars; (4) sand and grit on head of rail; (5) defective and open joints; (6) tight or wide gauge of track or wheels; (7) loose or springy rails and points; (8) defective trucks being out of square and buckling; (9) slip of wheels at curves; (10) wheels not being of same diameter; (11) flats on wheels; (12) rapid acceleration and retardation, causing wheels to slip; (13) defective brake mechanism, or by too rapid application of the brakes, causing chattering and a series of short skids. Any of the above matters may be responsible for the trouble, but the author still considers that the "original sin" is produced when the rails are rolled, and it will quickly develop into corrugation unless the surface of the rails is ground immediately after they are laid. On the Vauxhall to Victoria route of the L. C. C. tramways the rails were rubbed with carborundum blocks before electric cars began to run. Distinct signs of corrugation then appeared, and were ground out. A heavy service of cars has been in operation over these lines during the past 14 months, and there are only very slight signs of corrugation, except on the Vauxhall Bridge crossing the Thames, where the corrugation is more serious. This is, no doubt, due to the spring of the rails on the bridge. In another case where fully developed corrugations along the Clapham Road were rubbed out in a similar manner at the same time, the rails are now badly marked again, the service of cars and the speed in each case being practically the same. An important question which has to be answered before the root of the evil can be discovered is: Why are corrugation waves the same length with varying speeds within certain limits, say, from 4 to 16 miles per hour? One possible explanation is that corrugation may be in some instances caused by the cold rolling of the rail by the car wheels. With a light car, such as a horse car, the rolling is almost imperceptible. With a heavier

electric car the weight is sufficient to start cold rolling, and a wave starts at the softest part of the rail and travels forward until the weight of the car is not sufficient to carry the wave further; the wheels then ride over the top of the wave and violent oscillation is set up and the corrugation gradually extends. This theory will possibly partly account for the non-appearance of corrugations on heavy railways. In this case the weight of the train would be sufficient to roll the rail throughout its whole length, especially as the whole of the wheels under the carriages are simply acting as rollers.—Lond. *Electrician*, Oct. 4.

Three-Phase Locomotives.—G. JACOBY.—With respect to the locomotives in the Simplon Tunnel, the author discusses in a simple way the general principles of speed control by means of changing the number of poles.—*Elek. Kraftbetr. u. Bahnen*, Sept. 14.

Single-Phase Traction.—H. M. HOBART.—An illustrated description of the Heyland "cascade single-phase railway system," which was recently described in the Digest.—Lond. *Elec. Eng'ing*, Oct. 3.

Installations, Systems and Appliances.

Electric Installation of Department Store.—R. ZAUDY.—A fully illustrated description of the electric installation of a new department store in the western part of Berlin, which consumes per year about 1,000,000 kw-hours. The number of carbon-filament and metallic-filament lamps is 5200, the number of Nernst lamps 2925, the number of arc lamps 635. There are also in use 59 motors having a total rating of 654 horse-power. On account of lack of space it was impossible to erect an isolated plant, and the energy is bought from the electricity works of Charlottenburg, the motors being directly connected to the supply network. On the other hand, in order to get an acceptable tariff from the station, it was necessary to install storage batteries for lighting in the evening, and for this reason direct current had to be chosen. The three-phase currents supplied from the central station are converted into direct current by three motor-generators, the direct-current machines of which have ratings of 300, 300 and 165 kilowatts, respectively. These motor-generators change the 3000-volt, three-phase current into direct current of 25 volts. Details are given of the construction of the switchboard and the method of wiring. On account of the lack of walls within the building the cables are placed in the floor. For three floors, arc lamps are used, while the floor devoted to ladies' wearing apparel is lighted by Nernst lamps. Emergency lamps are fed by means of a separate network from the storage battery.—*Elek. Zeit.*, Sept. 26.

Hamburg.—An account of the development of the Hamburg Electricity Works. The first plant was erected in 1888, but there are now four different plants, with a total rating of 35,100 horse-power or 22,700 kilowatts. Besides this the storage batteries which are placed in the power stations and in the substations, have an aggregate rating of 8125 kilowatts, so that the total electrical rating of generators and storage batteries is 30,825 kilowatts. For the whole lighting network the three-wire system at 2 x 110 volts is used. With the exception of the network in the St Pauli district, the neutral conductor is insulated.—*Elek. Kraftbetr. u. Bahnen*, Sept. 4.

Electrophysics and Magnetism.

[illegible] has formerly investigated the amount of radium present in specimens of rocks obtained from sources differing widely in [illegible] age result of his investigation there is 1.4×10^{-12} gram of radium in every gram of earth. From this it follows that near the earth's surface there is about 28 times as much radium present as will account for the existing temperature gradient within the earth. Since, however, Strutt did not select a single specimen for investigation from America, the present authors [illegible] in the immediate neighborhood of Montreal and have found that the amount of the content of radium is of the same order of magnitude as that found by Strutt. Three explanations may be offered. Either the interior of the earth is different in constitution from the earth's crust, or the disintegration of radium is retarded or stopped under the extreme pressure in the earth's interior, or radium may have reached the earth from external sources.—*Phil. Mag.*, August.

A New Radioactive Element.—B. B. BOLTWOOD.—A note pointing out that strong evidence has been obtained of the existence in uranium minerals of a new radioactive element, which emits both alpha and beta radiations, which produces no emanation and which resembles thorium in its chemical properties. It is without doubt a disintegration product of uranium, and is in all probability the immediate parent of radium. The name "ionium" is proposed for this new substance, a name derived from the word "ion." This name is believed to be appropriate because of the ionizing action which it possesses in common with the other elements which emit alpha radiations.—*American Journal of Science*, October.

Rays.—C. D. COOKSEY.—An experimental investigation of corpuscular rays produced in different metals by roentgen rays. Some of his results do not appear to agree well with the explanation suggested by J. J. Thomson, according to which the energy of the corpuscular secondary rays is due to an explosion of the atom and not directly to the energy in the primary rays. The author found, for instance, that the more penetrating primary rays give rise to corpuscles of higher velocity than the softer rays do, while the intensity of the primary rays makes no difference in their velocity.—*American Journal of Science*, October.

The Disappearance of Magnetism.—M. GILDEMEISTER.—When iron is placed in a magnetic field whose intensity decreases or increases suddenly, it does not immediately assume the corresponding magnetic state, but only after a few minutes. The change occurring seems to consist of two parts, one of which takes place very rapidly, and the other slowly, with a pause between them. The present investigation is concerned with the cessation of magnetization after the removal of the magnetizing field, within 1/2000th second after break. The conclusions from the author's experimental research are as follows: In 1/300,000th second the magnetization falls to less than half its initial value. If only the best results are counted, the time may be reduced to two-thirds or one-half the above. In 1/150,000th second the magnetization falls to less than one-tenth of its initial value, and after 1/150,000th second it has totally disappeared. In the interval between 1/50,000th and 1/2000th second the magnetization does not fall perceptibly. The slow demagnetization evidently does not set in until 1/2000th second has been exceeded.—Lond. *Electrician*, Sept. 27.

Magneto-Optics.—J. BECQUEREL.—A long paper in which the author first describes experiments on magneto-optical phenomena in crystals. Xenotim and tysonit crystals were experimented with, and the author investigated the propagation of light in directions perpendicular to and parallel with the lines of magnetic flux, and also magnetic rotation polarization. In the second part of his paper he modifies Voigt's theory to explain his observations.—*Phys. Zeit.*, Oct. 1.

Units, Measurements and Instruments.

Measuring Electrolytic Resistance.—W. S. FRANKLIN AND L. A. FREUDENBERGER.—Since in determining the conductivity of electrolytes it is important to eliminate the influence of electrodes, the authors have developed a method in which no electrodes are used at all. The principle may be best seen from their first arangement, which is shown in Fig. 2. The two primary coils, P and P^1, are connected in series across 110 volts, 133-cycle mains; producing, with open secondaries, a magnetic flux in the transformer, as shown by the dotted line. The reluctances of the various legs of the transformer are adjusted so that no flux passes through the test coil, M, which is connected to a telephone receiver or alternating-current galvanometer. If now a load is thrown on the transformer by filling the glass vessel with an electrolyte, the balance of m. m. f [illegible] M,

producing sound in the telephone receiver. If the other secondary coil is now closed through an adjustable resistance, R_2, a balance of m. m. f. may again be obtained, and no sound heard in the telephone receiver; then R_2 is equal to the resistance of the electrolyte in the glass vessel. This arrange-

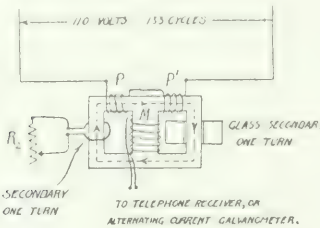


FIG. 2.—MEASURING ELECTROLYTIC RESISTANCES.

ment and the second one described by the authors were not sensitive and finally the arrangement shown in Fig. 3 was used for the actual tests. It represents a Wheatstone bridge in which the electrolyte is connected electromagnetically to one of the arms of the bridge. A slide wire, AB, consisting of 120 ft. of No. 16 B. & S. German silver wire, is wound back and forth on a flat wood surface of convenient size. With secondaries open-circuited the slider, P, is adjusted for zero galvanometer deflection. With the galvanometer used (20 ohms) and a sensibility of 10^{-6} amperes per cm of scale deflection, a movement of P of 1/16 in. in the 120 ft. of slide wire caused a galvanometer deflection of 10 cm (scale divisions.) With a telephone receiver the balance point on the slide wire could only be located within 6 ins. The secondary coil actually used con-

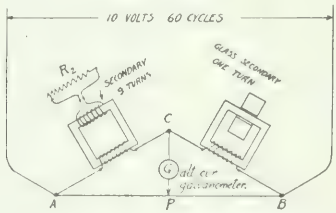


FIG. 3.—MEASURING RESISTANCE OF ELECTROLYTE.

sisted of nine turns (instead of one turn) so that the resistance (R_2) necessary to balance the electrolyte of one turn must be divided by 81 (the square of the ratio of turns) to obtain the actual resistance of the electrolyte contained in the glass vessel. The slider P being set so as to give zero galvanometer deflection, 10,000 ohms (R_2) produced a deflection of 2 cm (scale divisions). This method was applied to the determination of the conductivity of various salt solutions, and in all cases a close agreement within experimental error was found between the results of this electrodeless ring method and the results of Kohlrausch and Holborn.—*Physical Review*, October.

Condensers.—F. W. Grover.—A long paper on the simultaneous measurement of the capacity and power-factor of condensers. Four bridge methods (one of them due to Wien) for simultaneously obtaining the ratio of two capacities and the difference of their power factors are described, and the equations for calculating these quantities from the observations are derived. Various sources of error and methods of eliminating them are discussed. By the use of an auxiliary condenser, two condensers may be compared by substitution. This procedure [illegible] electrostatic effects are eliminated, and only the relative values of the resistances and inductances of the bridge arms need be accurately determined. These four methods are compared with one another, and are shown to give results in good agreement. When used as substitution methods, the capacity ratios of condensers of 0.1 mf and greater may be measured to a few parts in 100,000 or better, and a phrase difference of only a few seconds of arc, due to a difference in the absorption, may be detected with certainty. The small temperature coefficients of good mica condensers may readily be determined with accuracy. By the use of a variable air condenser, reliable comparisons of the capacities and power factors of condensers of 0.001 mf or less, such as short lengths of cable, may be easily made. Methods are given by which the power factor of the condensers to be used as standards may be measured. The Bureau of Standards makes such determinations when requested. Examples are given to show what values of the power factor may be expected in condensers by leading manufacturers. A knowledge of the power factor of a condenser gives reliable information as to the order of magnitude of its absorption effects. The determination of the power factor is the best single test of the quality of a condenser which can be made.—*Bull. Bureau of Standards*, Vol. III, No. 3, August.

Coefficient of Self-Induction.—G. Athanasiadis.—An illustrated note on the use of the differential electrometer for determining the coefficient of self-induction.—*Phys. Zeit.*, Sept. 15.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—C. R. Fountain and F. C. Blake.—An account of an experimental investigation of the relative amounts of energy radiated in various directions about a Righi vibrator. In computing the total energy in the field about a Righi vibrator it is necessary to consider the radial component of the electric force as well as the transverse components of the electric and magnetic forces. The electromagnetic waves spread out from the spark-gap in such a manner that the energy at any point is approximately proportional to the square of the cosine of the angle between the radius vector and the equatorial plane and inversely proportional to the square of the distance from the spark-gap. The energy due to the radial component of the electric force varies approximately as the square of the sine of the angle between the radius vector and the equatorial plane and inversely as the fourth power of the distance from the spark-gap. In order to receive the maximum energy the thermal element of the Klemencic type should everywhere be perpendicular to the radius vector except near the poles, where it should be parallel to the radius vector. The thermal element used in these experiments when placed in the equatorial plane with its axis parallel to the direction of propagation of the electromagnetic waves absorbs more than 14 per cent as much energy as when it is in the resonating position. This type of receiver absorbs a small amount of energy when it is on the polar axis and perpendicular to it, and, therefore, perpendicular to the radius vector. Two such receivers in the same field greatly influence each other. A Righi vibrator does not continue to give out wave-trains of the same strength or character as shown by its "deterioration" with use. The waves from a Righi vibrator appear to become less plane polarized as they proceed from the vibrator. A theory based upon the assumption that the waves from a Righi vibrator are identical with those from a vibrating "electric doublet" and also that the thermal element of the Klemencic type acts as a "point receiver" holds with a fair degree of accuracy up to within three-quarters λ for the vibrator.—*Physical Review*, October.

Electric Oscillations.—K. E. F. Schmidt.—In laboratory experiments on electric oscillations produced by the spark method he found that when the spark was produced in air the results were not uniform from day to day, but that when the sparks were produced in an atmosphere of hydrogen, very uniform and constant results could be obtained. When he tried, however, [illegible]

less telegraphy he found that the results were by no means satisfactory. With the hydrogen spark-gap the oscillations are of much less intensity and considerably more damped than with an air-gap. The same issue contains another paper by the author on damping in transmitting and receiving stations for wireless telegraphy. Methods of connection are described which reduce the damping of the oscillations. The author also gives results of measurements which show the great influence of the atmosphere on the propagation of the electric wave. He also shows that the receiving effect is a maximum for earthed systems, and discusses the influence of the position of the earthed wire on the intensity of the received wave. He describes an experiment in which a differential action between the oscillation in a vertical and in a horizontal antenna is obtained.—*Phys. Zeit.*, Oct. 1.

Electric Oscillators.—J. A. Fleming.—A continuation of his serial on the elementary theory of electric oscillators and the production of electric waves thereby. The first part deals with the action of a Hertzian oscillator, and it is shown how to obtain expressions for the electric and magnetic forces at any point in space around it. The second part, in like manner, discusses the closed or magnetic oscillator, and expressions are obtained for the forces and radiative power. In the third part combinations of open and closed oscillators are discussed, and the elementary theory of the bent oscillator, which radiates unsymmetrically, is given. The article is to be continued.—Lond. *Electrician,* Oct. 4.

BOOK REVIEWS.

Hendricks' Commercial Register of the United States for Buyers and Sellers. By Samuel E. Hendricks Company, of New York. Sixteenth edition. 1224 pages. Price, $10.

This directory contains over 350,000 names and addresses, with upwards of 15,000 business classifications. It is perhaps the most complete directory of its kind in existence. The present edition requires 76 pages for its index, which will give some idea of the comprehensiveness of its classifications. The policy of the publishers of this directory is to make no charge for fully classifying a firm's business, and in this way a complete representation is obtained. The electrical headings are particularly complete, and the book will undoubtedly be of great value to any one who has occasion to look up the addresses of manufacturers or to learn who are the manufacturers of different devices.

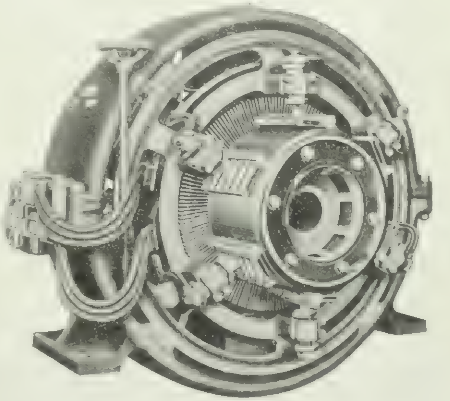
Elements of Electric Traction. For Motormen and Others. By L. W. Gant. New York: D. Van Nostrand Company. 217 pages, 38 illustrations. Price, $2.50.

The author in his preface states that this book is based upon a short series of lectures and practical demonstrations given to a class of motormen and others at the Leeds Institute Technical School, and is put forth to serve as an introduction to the more advanced works on electric traction, and to supplement the information given in various handbooks for motormen and others. The first five chapters deal with the elements of electricity and magnetism, and the principles of the dynamo and direct-current motor. Chapters 5 and 6 are, respectively, on power and power measurement, and the mechanics of traction, and Chapters 8 and 9 on the characteristic properties of the direct-current motor and its application to traction. The book ends with Chapter 10, devoted wholly to brakes. Examples have been added to some of the chapters, showing the numerical application of the formulas and practical principles developed. We fear that the book is far beyond the mental grasp of motormen, excepting the rare ones who wish to acquire knowledge which will enable him to pass from the car platform to the car house or repair shop. On the other hand, the book will be found of much value by all men employed in technical work on electric railway systems, and also by the student as a preliminary of the reading of the literature of electric traction engineering.

New Type of Direct-Current Generator.

To meet the increasing demands for direct-current generators direct connected to the prime mover, the Sprague Electric Company, 527 West Thirty-Fourth Street, New York City, has recently brought out a new line of generators, ranging in rating from 25-kw upward. A distinctive feature in the design of these generators is the use of soft steel instead of cast iron for the magnet yoke. Their compactness, shown in the accompanying illustration, is specially advantageous in modern central stations, hotels, office buildings and apartment houses where economy of floor space is important. Low armature reaction and low armature resistance are other special features of the generators, making them, it is said, highly efficient, of excellent regulation, and of good commutation on overloads without shifting the brushes. The machines are compound-wound and have laminated poles. This latter feature, it is claimed, permits both elevators and lamps to be supplied from the same generator without troublesome blinking of the lamps.

The armature core is also laminated. The punchings are made of sheet steel having a low hysteresis loss and are clamped



DIRECT-CURRENT GENERATOR.

between cast-iron end plates which have a projecting flange for supporting the end winding, on a substantial cast-iron spider to which they are securely keyed. Space plates and a large opening through the center of the core permit of ample ventilation. The copper armature conductors have a rectangular section and are shaped on a former. On machines of standard speed they are retained in the slots by heavy bands over the end windings, but treated wooden wedges are also used. The commutator is insulated throughout with micanite and clamped by a cast-steel ring to a cast-iron shell rigidly supported by the armature spider. The brush holders, brushes, rocker arm and hand wheel are of the simple and substantial construction used for years on Sprague generators.

Seventy-Two-Ton Electric Locomotive.

One of the most interesting exhibits at the Atlantic City convention of the American Street & Interurban Railway Association was the 15-cycle, single-phase locomotive built by the Westinghouse Electric & Manufacturing Company, and shown on the switch on Virginia Avenue, near the Board Walk. This locomotive was built for demonstration purposes under an agreement with the Pennsylvania Railroad, as described on page 117 of our issue for July 20, 1907. We are able to give below an outline of certain details not covered in our earlier note.

The locomotive shown is of the articulated type, and it consists of two separate halves, each of which, however, is complete

in itself. Each half has a maximum draw-bar pull of 20,000 lbs. Only one of these halves has been built and that one formed the exhibit at Atlantic City and is illustrated in the accompanying engraving.

The underframing of the locomotive is of the Atlantic type, of cast steel, with cast steel end sills and cross girders, and provides for two driving axles with wheels 72 ins. in diameter and a pilot truck with wheels 36 ins. in diameter. The total wheel base of the half-locomotive illustrated is 20 ft. 7 ins.; the rigid wheel base is 7 ft. 6 ins., and the wheel base of the pony truck is 6 ft. 2 ins. The motors are mounted on the driving axles with the same sort of suspension as employed in the New Haven locomotives but are more powerful, having a one-hour rating of 500 horse-power, with a maximum of 800 horse-power and a continuous rating of 375 horse-power. This gives a tractive effort for total locomotive, maximum, 40,000 lbs., or on the one-hour rating of 14,700 lbs., or a continuous draw-bar pull of 9,200 lbs.

An inspection of the interior of the locomotive shows great simplicity as compared with the New Haven locomotive, owing principally to the fact that no provision is made for direct-current operation. Moreover, the main transformer, the most bulky of all the auxiliaries, is carried under the floor on the bolster over the pony truck, where it is entirely out of the way. The rest of the auxiliaries are mounted on a raised platform extending down the center of the car with passage ways on each side, and at this height are capable of easy inspection. The end of this raised platform nearest the motorman's position is given up to the unit switches, 15 in number, for the transformer taps, and directly in the rear of these switches are the three compensating coils used in passing from one tap to another. These are followed by the electric blower with air ducts leading to the transformer and motor casings. Directly in the rear of the blower are the air reservoir and reverser, the latter provided with four pneumatic switches. These switches are of the standard pneumatic type but larger than those used in ordinary car control. The rest of the apparatus on the platform consists of a pneumatic track sander, a [illegible]

[illegible] Single-Phase Locomotive.

[illegible] and a [illegible] storage battery with a small motor-generator for charging.

The following are some general data of the complete locomotive:

Total weight, tons	140
Weight on each driver, pounds	50,000
Weight on each of the two pony trucks, pounds	40,000
Weight of each motor, pounds	19,500
Length over all (half locomotive)	31 ft.
[illegible]	[illegible]
Width of locomotive	10 ft.

The center of gravity of the locomotive is about 55 ins. above the heads of the rails.

The locomotive is designed to operate with an e. m. f. of 11,000 volts on the trolley wire and 275 on each motor.

A sign mounted on the locomotive shown at Atlantic City stated that during the past two and a half years 630 Westinghouse single-phase locomotives had been shipped to 18 railway companies in America and Europe. These motors range from 40 to 250 nominal horse-power, and make a total of 79,380 nominal horse-power. There are now on order 310 Westinghouse single-phase railway motors for shipment to 11 different railway companies, totalling 34,135 nominal horse-power. This makes a grand total of 940 Westinghouse single-phase motors delivered to or on order for 25 different railway companies, and aggregating 113,515 nominal horse-power.

Soft-Drawn Steel Instrument Cases.

The American Instrument Company, Newark, N. J., has developed an effective form of magnetic-shielding case for its electrical instruments. The case is made of soft-drawn sheet steel of uniform texture and thickness. There are no hard spots in the material, and no sharp corners, and it is stated that the case cannot become permanently magnetized.

The magnitude of the influence of a strong external field upon the readings of a permanent-magnet moving-coil instrument, when housed in the type of case described above,

Fig. 1.—[illegible]

may be learned by comparing Fig. 1 with Fig. 2. Fig. 1 shows an instrument in which the current had the value indicated by the pointer. While the current was maintained constant a magnet such as is used inside of the instrument was placed on the case directly over the poles of the inside magnet. A

Fig. 2.—[illegible]

very slight change in indication of the instrument took place, as noted in Fig. 2. When the position of the outside magnet was reversed so as to change the polarity [illegible] upon the indication of the instrument was even less than shown. The tests indicate the efficacy of the case [illegible] to cables in which large values of currents exist

The "American" instruments are being placed on the market by James G. Biddle, 1114 Chestnut Street, Philadelphia, who is general sales agent for the manufacturer.

Large Gas-Engine Generating Station.

On account of the excellent results obtained from gas engines the Indiana Steel Company has adopted this type of prime mover for its mills at Gary, where gas engines are to be used exclusively.

The entire electric generating equipment of this plant is being supplied by Allis-Chalmers Company. The portion now under contract consists of 17 4000-hp gas engines, 15 of which are direct connected to 25-cycle, three-phase alternators, which will operate in parallel and supply energy to more distant portions of the mill; two serve for driving direct-current generators supplying energy for portions of the plant immediately adjacent to the generating station.

The Allis-Chalmers Company is also building eight blowing engines with the same sized gas cylinders as the electrical units for the same plant, making 25 engines, or a total of 100,000 hp in gas engines which the company is supplying for this power house alone.

It will require approximately 1000 carloads to complete the shipment of these engines. The electrical power house, in which will be installed the 17 electrical units, is 1000 ft. long and 105 ft. wide. It will be one of the largest power houses in the world, and the electrical generating station at this plant alone will be twice as large as any previous gas-engine installation either at home or abroad.

The power house containing the blowing-engine units is of the same width as the electrical house and is 600 ft. long.

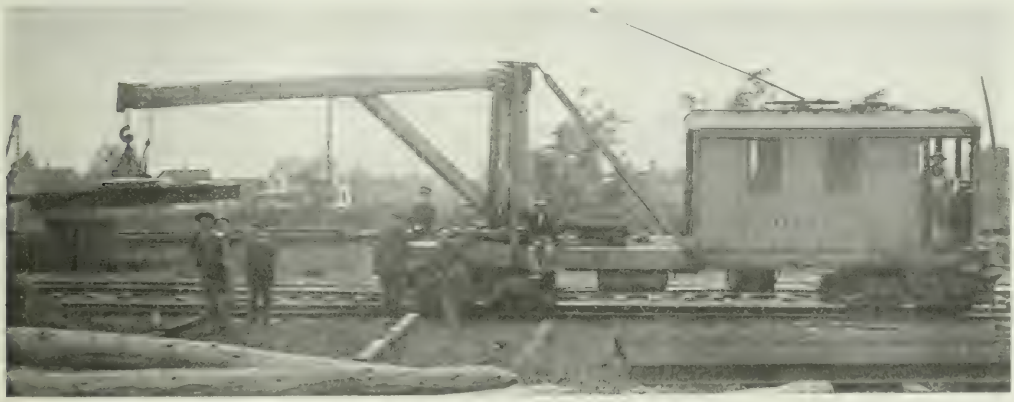
Gas Engine Generating Unit

These figures give some idea of the magnitude of this gas-engine installation and of the confidence which the designers of the great plant repose in the Allis-Chalmers gas engine as a prime mover. The realization of this is, in large measure, responsible for the interest in gas engines shown by power users in general.

With gases being wasted which were suitable for use in gas engines, it was but natural that the iron and steel industries should be the first to adopt the use of gas engines on a large scale. The saving in the first cost of fuel, however, is to a certain extent offset by the interest charges on the cleaning apparatus which is necessary in order to remove from blast furnace gas the abrasive dust with which it is charged; this extensive cleaning apparatus, however, is not necessary where producer gas is used. It is manifest that the gas engine using producer gas is now to take its place permanently as a prime mover in situations where the cost of fuel makes economy in this direction especially desirable.

Lifting Magnets.

Two different forms of lifting magnets for lifting purposes have recently been placed on the market by the Cleveland Armature Works, Cleveland, Ohio. The magnets are designated as the "inter-pole bell" and the "inter-pole flat." The former consists of heavily annealed steel casting which, as the name implies, is bell-shaped. There are two magnetizing coils, so placed in relation to each other that they form a solenoid in two steps separated by an iron ring and the so-called interpole. The outer shell of the casting extends below the under face of the outside coil, and a heavy shield of non-magnetic material bridges from pole to pole to protect the magnetizing coil. Various sizes of the bell magnets are made. The largest size is 52 ins. in diameter and weighs 4900 lbs.; it requires 4400 watts. This magnet will lift from 1000 to 1350 lbs. of sand-cast pig iron or about 1200 lbs. of plate scrap. It is able to lift 15 tons in a single piece.



Lifting Magnet for Electric Railway Construction Work

The inter-pole flat magnets are designed on the same principle as are the bell magnets, but they are intended especially for handling large pieces of material, such as heavy castings, billets, or corded pig iron, etc. The accompanying illustration shows such a magnet in use on a derrick car in electric railway construction work.

Speedy Erection of Turbo-Generators.

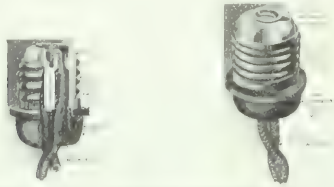
What is probably a record for the shipping and installing of steam turbines was made by Allis-Chalmers Company in connection with two 1000-kw steam turbines and accessories which that company built for the South Works of the Illinois Steel Company, at South Chicago, Ill. The contract was signed on May 13, 1907; shipment commenced from the factory on May 25, and finished on May [illegible]; the erection of both units was completed July [illegible] and commercial load was put on the machines July 22. Since that time they have operated almost continuously, carrying loads up to 1500 kilowatts each; that is,

[illegible] turbines ran over three weeks day and night without being stopped. The turbines are installed in a temporary wooden building and, as no crane or the usual facilities were available during the erection, the record given above is remarkable. Since starting the turbines have given no trouble whatsoever, and the manufacturer's engineers left them in charge of the Illinois Steel Company's operators within a few days after load was first carried.

The installation consists of two units, each comprising a 1000-kw steam turbine coupled to a 1000-kw, 25 cycle, three-phase, 2300-volt turbo-alternator, together with necessary surface condensing apparatus, pipe connections and switchboard. The speed of the turbines is 1500 r. p. m.; each is provided with a direct-connected exciter. The steam turbine is of the horizontal, full annular flow, reaction type, and is provided with a number of special features, such as improved methods of holding and protecting the blades, improved balance pistons, etc.

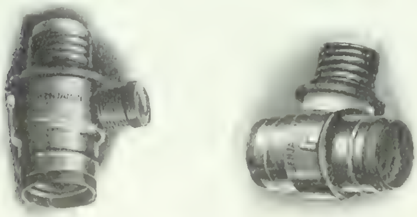
Some New Electric Lighting Specialties.

The Benjamin Electric Manufacturing Company, of Chicago, is bringing out this fall a number of useful socket and receptacle devices. Figs. 1 and 2 show a very neat swivel attachment plug which is much smaller and more compact, as well as in some ways more substantial than the attachment



FIGS. 1 AND 2.—SWIVEL ATTACHMENT PLUG.

plugs heretofore offered. The plug has a porcelain body with a rotating sleeve, in which sleeve the screw thread is stamped. This rotating sleeve is provided with a fibre flange with a milled edge for the fingers to take hold of when screwing it into a lamp socket. The binding screws and terminals are fastened on the porcelain inside this screw sleeve. The plug is provided with a cap in which either standard or reinforced cord can be used. The wire passes through a soft rubber ring in the cap, and when the cap is screwed down tight it presses this ring so as to form a cord grip. The plug has very little



FIGS. 3 AND 4.—CURRENT TAP AND TWIN ATTACHMENT PLUG.

porcelain exposed. Parts which would naturally receive blows are of brass, fiber and composition. This, together with the small size of plug, renders it not as liable to injury as many other plugs.

Fig. 3 shows a new current tap, by means of which an extension cord can be led off from the socket in addition to the regular lamp at that socket. This has a threaded sleeve which turns in the same way as that of the extension plug, so that the whole device does not have to be rotated in screwing it into a socket. One of the improvements in this current tap over others previously brought out is that it permits the use of any standard shade holder, so that the proper reflector can be used over the lamp if desired. The omission of this important feature has made many current taps almost worthless for a large percentage of the locations where they might be used. This current tap is also made with a series connection, so that the device tapped off may be in series with the lamp in the socket.

Fig. 4 shows a new twin attachment plug, whereby two receptacles can be obtained from one socket. It is not necessary to turn this device to screw it into the socket, and it will remain at any angle at which it is placed after it is screwed in. It is believed that this will prove useful in such locations as show windows, where a merchant already has border lights which he would like to change to lamps carrying parabolic half reflectors. This twin attachment plug can also be supplied for lamps to be operated in series, so that two 110-volt tantalum or other high-efficiency lamps can be operated on a 220-volt cir-

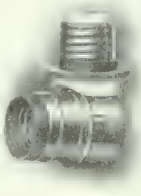


FIG. 5.—TWIN RECEPTACLE.

FIG. 6.—RECEPTACLE.

FIG. 7.—PORTABLE HAND LAMP HOLDER.

cuit. Fig. 5 shows the twin receptacle modified so as to afford one receptacle at right angles to the socket in which it is screwed.

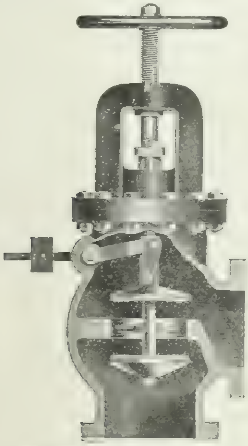
Fig. 6 is a receptacle which, besides taking the place of the ordinary wall receptacle, also permits the use of a Benjamin shade holder. This makes a neater and stronger device for use with a shade holder than the standard wall socket which it would otherwise be necessary to employ if a shade holder were needed. This receptacle in its improved form has its shell held in place by screws and not by the porcelain bushing, as in the older forms.

Fig. 7 is a portable hand-lamp holder and guard made entirely of insulating material. This is intended especially for the use of wiremen working around switchboards in power stations and for pitmen in electric railway shops. The guard parts are placed edgewise radially to the lamp. The guard is of hard fiber and the handle of composition.

Automatic Cut-Off Valve.

There are many devices on the market which prevent steam from flowing back into the boiler, but which make no provision against accident to the steam piping; the steam escaping in the latter case until the boiler is emptied. The valve shown herewith is claimed to act not only as a non-return valve, but as an automatic cut-off valve as well. It does not depend upon difference of pressure for its action, but upon the flow of steam through it. The operation of the valve may be followed by the aid of the illustration. The upper valve normally rests upon the seat and prevents steam from the main entering the boiler. When the steam pressure in the boiler exceeds that in the main, the valve lifts and steam passes from the boiler to the main. The valve is nearly counterbalanced by a weight, the leverage being adjustable to different rates of flow. With the normal flow of steam, the discs are in the mid-

position shown. In case of emergency, such as a break in the line, the excessive rush of steam carries the lower valve up against its seat and steam is shut off. The upper valve, in case of a reverse flow, drops to its seat with a similar effect. The balancing lever is provided with light, adjustable springs,

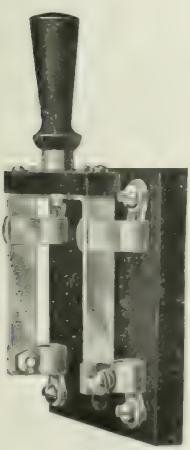


AUTOMATIC CUT-OFF VALVE.

which are said to prevent the chattering or closing of the valve under ordinary conditions, but which are not strong enough to prevent closure in case of accident, although permitting momentary rushes of steam. The maker of the valve is the Lagonda Manufacturing Company, Springfield, Ohio.

New Knife Switch.

The accompanying cuts show a new knife switch recently put out by the Trumbull Electric Manufacturing Company, of Plainville, Conn., and known as the "Kappa" switch. It is made in 25-ampere size only, single, double and three pole, un-



KNIFE SWITCHES.

fused and fused, for both enclosed and open link fuses. The switch, which has been approved by the underwriters, is designed for light work and is intended to meet the demand for an inexpensive switch which is at the same time thoroughly reliable.

Exhibits at the Atlantic City Convention of the American Street & Interurban Railway Association.

The exhibits on the Steel Pier, at Atlantic City, during the convention of the American Street and Interurban Railway Association eclipsed any heretofore made under the auspices of the American Street and Interurban Railway Manufacturers' Association. At the meeting of the Manufacturers' Association on Thursday afternoon, Oct. 17, the report of the president, Mr. James H. McGraw, showed that since the matter of exhibits was taken up by that association, the arrangement had proved more advantageous than heretofore. The report of the treasurer revealed the fact that there were now 315 members in the association, 210 of whom made exhibits at Atlantic City. Space limitations preclude our describing all of these exhibits, but the accompanying notes, although brief, may convey an idea of their extent and variety.

Dossert & Company, of New York, exhibited their line of solderless connections and couplings.

The Sherwin-Williams Company, of Cleveland, Ohio, displayed samples of its various paint and varnish products.

The Heany Fireproof Wire Company, York, Pa., had specimens of its fireproof tape, wire and other materials on exhibition.

The A. & J. M. Anderson Company, of Boston, presented many specimens of its Aetna insulation, together with a line of switches, etc.

The D. & W. Fuse Company, Providence, R. I., showed an interesting line of fuses and other of its specialties, including deltabeston wire.

The Van Dorn Electric & Manufacturing Company, Cleveland, Ohio, showed armature and field coils, commutators, pinions, drills, etc.

A. Grothwell, of New York, had several cans of Mogul paints and varnishes on exhibition, together with specimens of work done by them.

The Ridgway Dynamo & Engine Company, of Ridgway, Pa., while making no exhibit, distributed literature relating to its engines and dynamos.

The Gould Storage Battery Company, Depew, N. Y., made a telling display of storage batteries and elements, together with photographs of installations.

The Chicago Pneumatic Tool Company, of Chicago, showed a full line of its pneumatic and electric tools, many of which were shown in operation.

The Union Electric Company, of Pittsburg, had several boards with samples of bonds, headlights, fuses, lamps, pinions and trolley stands on exhibition.

The Ball & Wood Company, Elizabeth, N. J., had some interesting photographs of recent installations to show, as well as specimens of its piping work.

The Buckeye Engine Company, of Salem, Ohio, exhibited a collection of photographs of its engines, and gave away flowers and buckeyes as souvenirs.

The France Packing Company, of Philadelphia, displayed metallic and fibrous packing, such as is used in many of the largest power houses in the country.

The Western Electric Company had headquarters at the Hotel Islesworth, and made an exhibit on the Steel Pier covering a full line of electric railway supplies.

The Rail Joint Company, of New York, displayed its "base supporting" type joints, known to the trade as the "continuous," the "Weber," and the "Wolhaupter" rail joints.

The American Sewer Pipe Company, of Pittsburg, Pa., exhibited a number of vitrified clay conduits with single and multiple ducts for underground electrical work.

J. G. White & Company, Inc., of New York, had several representatives from the New York office present, as well as a number from the company's operating properties.

[illegible] Cleveland, Ohio, [illegible] carbon products, including brushes for motors and dynamos, dry batteries and arc carbons.

[illegible] ING COMPANY, allied companies of Pittsburg, made a joint exhibit of varnishes, protective coatings and insulated linens.

THE LOCKE INSULATOR MANUFACTURING COMPANY, of Victor, N. Y., had a number of its new 100,000-volt suspended type insulators on exhibition. These attracted no little attention.

THE SOUTHERN EXCHANGE COMPANY, of New York, had on exhibition samples of long-leaf pine octagonal poles, Southern white cedar round poles, and Georgia long-leaf pins and cross-arms.

THE GEORGE W. LORD COMPANY, of Philadelphia, maker of boiler water purifying compound, was on hand to welcome its guests and persons interested in water purification for boiler feed purposes.

THE STANDARD PAINT COMPANY, of New York, had on exhibition a complete line of varnishes, insulating tape and preservative paints. Apparatus was shown treated with the company's products.

THE PEERLESS RUBBER MANUFACTURING COMPANY, of New York, manufacturer of the celebrated Rainbow packing, exhibited a full line of mechanical rubber goods, including hose, packing, step treads, etc.

THE YALE & TOWNE MANUFACTURING COMPANY, New York, made a fine exhibit of chain blocks, hoists, overhead trolleys, a model of a jit crane, etc. The hoists shown were both motor-driven and hand-operated.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., included in its exhibit an 80-in. steel plate fan, a pressure and a volume blower, a bank of heating coils, a model dry kiln, and a small direct-connected generator.

THE ELECTRIC SERVICE SUPPLIES COMPANY, of Philadelphia, Chicago, etc., entertained its guests in a tastefully arranged parlor and exhibited samples of various lines handled by the company, too numerous to mention.

THE HOLOPHANE COMPANY, of New York, showed a number of its scientific and prismatic reflectors for car lighting. These included reflectors for general car illumination and also reflectors for individual lamps over seats.

THE AMERICAN FERROFIX BRAZING COMPANY, of Philadelphia, showed a line of brazing torches and miscellaneous apparatus for performing the work of mending broken and cracked machinery by the Ferrofix process.

THE DEARBORN DRUG & CHEMICAL COMPANY, of New York, showed different boiler compounds, as well as tubes betraying pitting and corrosion due to impure water. Oils and greases for elevators also formed part of the exhibit.

THE FRANKLIN ELECTRIC MANUFACTURING COMPANY, of Hartford, Conn., demonstrated the qualities of its "Novi" street railway lamps by means of a vibrating machine. Various forms of high-efficiency lamps were also a feature.

THE STROMBERG-CARLSON COMPANY, Rochester, N. Y., had as the chief feature of its exhibit a telephone dispatching system connected up for service. Portable telephones and several telephones of standard type were shown in addition.

THE MASSACHUSETTS CHEMICAL COMPANY, of Walpole, Mass., manufacturer of friction tape and insulating compounds, had a full line of samples displayed, together with descriptive literature and souvenirs for distribution.

THE ALLIS-CHALMERS COMPANY displayed an extensive line of air-brake apparatus, together with photographs of turbines, reciprocating engines, rotaries, motors, etc. An interesting feature was a new emergency valve for air-brake equipments.

THE LORD ELECTRIC COMPANY, of New York and Boston, exhibited a rotating-type lightning arrester and abnormal potential discharger. The Shaw lightning arrester, soldered rail bonds and an automatic car seat heat deflector were also shown.

THE SAMSON CORDAGE WORKS, of Boston, Mass., showed samples of its products. Prominent among these was the mahogany wire center cord, which is made up with a galvanized steel wire cable center, ensuring durability and absence of stretching.

THE STANDARD VARNISH WORKS, New York, had samples of solid compounds for use in connection with vacuum drying and impregnating apparatus on exhibition. Among the compounds shown was "Voltalac," which is well known to the electrical fraternity.

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, N. J., had a rather unique display in the shape of an old horse car bearing Dixon signs. The various graphite products of the company were shown and pencils, dice pails and aluminum trinkets were distributed as souvenirs.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., showed photographs of installations containing its well known generators for railway service, as well as photographs of the plant of the California Gas & Electric Corporation, where three 4000-kw alternators driven by gas engines are installed.

THE BLAKE SIGNAL & MANUFACTURING COMPANY, of Boston, Mass., had a complete working exhibit of standard signal apparatus, together with a competent train dispatcher for explaining its operation. Various types of railway telephones and standard blanks, etc., for telephone train dispatching were shown.

THE H. W. JOHNS-MANVILLE COMPANY, of New York, had an attractive exhibit. Victor combination meters, overhead line material, "Noark" fuse devices, asbestos lumber, molded mica sockets, arc lamp hangers, high-tension insulators, rail bonds, friction tape, doors for transformer stations, controller linings, etc., were all shown to advantage.

THE OHIO BRASS COMPANY, Mansfield, Ohio, occupied a large space at the exhibition. The various sales divisions under which the extensive products of the company are classified were well represented, including the high-tension division, rail bond and third-rail insulator division, overhead line material division, car equipment division, and mining division.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, had an interesting exhibit. Among the products shown were one element of type 71-R in a containing tank large enough to hold 83 plates of this type; a 12-pole carbon regulator, recording hydrometer, automatic cell filler and compensating hydrometer, and examples of positive and negative plates of all types.

THE MCGRAW PUBLISHING COMPANY occupied a prominent position facing the entrance to the pier and directly opposite the registration booths. Here copies of the souvenir issue of the *Street Railway Journal* were distributed, as well as copies of the ELECTRICAL WORLD, *The Engineering Record*, and the "Directory of Electric Railway Material." Engineering books covering every branch of science were also shown.

THE GENERAL ELECTRIC COMPANY'S exhibit occupied one of the largest spaces on the pier. The parts of a 100-kw, 12,000-volt Curtis turbo-generator were shown, as well as a complete installation of an emergency straight air-brake outfit. For the first time at any convention a commutating pole motor was shown in operation. A collection of contactors and similar devices used in railway equipment were exhibited, together with a new controller designed for four 500-volt, 50-hp motors. Arc lamps for railway service, incandescent lamps, bonds, line material, etc., were displayed to advantage. The whole space was arranged to facilitate easy inspection.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY showed a large single-phase electric locomotive described elsewhere. The control equipment was also exhibited, showing the method by which the voltage is reduced. The [illegible] also shown, as well as the pantograph trolley. There were also on exhibition direct-current line material, full repair parts for motors, several direct-current railway motors, two interpole railway motors, arc lamps, etc. In conjunction with the Westinghouse Machine Company, a 500-kw steam-turbine generator set was displayed for close inspection.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The favorable weather stimulated trade and collections showed improvement. While reports were almost unanimous regarding the satisfactory volume of retail distributions of seasonable goods, in other sections of commercial and industrial activity there was some irregularity, attributed in most cases to high rates for money, which induces conservatism in preparations for the future. The crop news of the week was not favorable. Killing frosts were reported to have destroyed the probability of any important quantity of top crop in the northern half of the cotton belt, while the effect of frosts at the north will be to increase the quantity of soft corn beyond that of recent years. The car-shortage trouble is reported still affecting the movement of grain, coal and lumber, but gross receipts tend to become more moderate, while net returns show a swallowing up of earlier gains in increased operating expenses. The features of the foreign trade returns for September are the shrinkage shown in the imports of merchandise as compared with the preceding month of August and the decrease shown in leading lines of export (such as breadstuffs, cotton and provisions) and in all exports as compared with September a year ago. Thus imports in September were 15.5 per cent smaller than those of August, though 3.6 per cent larger than in September a year ago, while leading exports fell 6 per cent behind September a year ago, and all exports were 2.2 per cent smaller. Business in iron and steel was very quiet, but prices on the whole are well maintained at recent declines. The industry, however, is very active in general on old orders. Business in steel rails was light and demand for structural steel small. Copper was again weaker and more competition for small orders developed. Lake copper for future delivery is quoted on the basis of 12¾ to 13 cents per pound, while the figures on electrolytic range from 12¼ to 12½ cents. Outputs have fallen off considerably and the price has been cut in half within the past five or six months, from which two facts some argue that business must soon develop. On the other hand, there are many who look for a lower level than 12 cents.

ORDERS FOR PLANT.—Judge Lacombe, of the U. S. Circuit Court, has issued an order giving the receivers of the Metropolitan Street Railway Company permission to spend $3,000,000 for new cars and other equipment to take the place of that destroyed by fire and needed for increasing business. Although the New York City Railway Company had ordered new cars to take the place of those destroyed, but thirty of them have been delivered up to date. The petitioners are advised, they say, that nine new cars can be purchased, ready for delivery, and eighty additional cars of the closed or winter type contracted for, with deliveries on or about Jan. 15 next. It is also possible, the two receivers state, for 155 additional cars of special type and of large capacity to be bought for delivery from time to time before the close of the year. Properly to operate the system, the receivers also ask permission to replace the destroyed car barns at 146th Street and Lenox Avenue, where repair shops were located. Since the fire the system has been seriously crippled in its operation, it is alleged, because of the lack of these shops.

THE B. F. STURTEVANT COMPANY reports the following sales of electric generating sets by Mr. F. R. Chinnock, of the electrical department of its New York office, Engineering Building, 114 Liberty Street, New York City: Kiernan & Hughes Company, Jersey City, N. J., one 9x8 vertical engine, 30-kw generator; Millard & McLean, New York City, one 4½x4½ vertical engine, 5-kw generator; Henry Steers, Inc., New York City, one 4½x4½ vertical engine, 5-kw generator; two 6x5 vertical engines, 7½-kw generators; Sonora Company, New York City, three 10-hp motors; Washburn Brothers Company, Saugerties, N. Y., 13x12 horizontal engine, 50-kw generator, 20-hp motor; [illegible] Company, Brooklyn, N. Y., 16x14 horizontal engine, 100-kw generator; Department of Water Supply, Babylon, L. I., 9x8 vertical engine, 40-kw generator; Samuel Smith & Sons Company, Paterson, N. J., 16x14 horizontal engine, 100-kw generator; Isidor Fajans, New York, 9x8 vertical engine, 30-kw generator; Charles Hakemeyer Company, Paterson, N. J., 17½-kw generator, three 5-hp motors.

TELEPHONY IN CHICAGO.—It is stated from Chicago that the Armour interests will develop the telephone possibilities of the Chicago Subway Company themselves, and the plan to lease telephone rights to independent interests has been abandoned.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a violent break in prices, led by the copper shares, and two suspensions of stock exchange houses. A reduction of the Amalgamated Copper Company dividend from an 8 to a 4 per cent basis; a disastrous manipulation of United Copper—a curb stock; increased firmness in money, and apprehensions about the position of speculative institutions, were among the leading unsettling factors. At the same time, the general stock list developed extensive liquidation in all directions, resulting in a general decline, with the lowest quotations for the year in the greater part of the active stocks. United Copper on Tuesday was forced up from 35 to 60, and on the following day it collapsed, falling to 20. On Thursday the stock fell as low as 10, but assurances that the unsoundness of the situation did not extend beyond the clique directly concerned in an attempt to corner United Copper stock, had a steadying effect upon the market, which continued the rest of the week. All of the electric and traction stocks declined with the rest of the list, all falling to the lowest levels for the year, with the exception of Allis-Chalmers common which kept steady at 6½. Following are the highest and lowest quotations of the year for the principal electric stocks, showing the great shrinkage in values:

	High	Low
Allis-Chalmers, common	[illegible]	4
Allis-Chalmers, preferred	[illegible]	15
American Telephone & Telegraph	133	100
Brooklyn Rapid Transit	[illegible]	37¼
General Electric	163	[illegible]
Interborough Metropolitan	39	[illegible]
Interborough Metropolitan, preferred	[illegible]	18
Mackay Company	[illegible]	[illegible]
Mackay Company, preferred	[illegible]	[illegible]
Metropolitan Street Railway	[illegible]	[illegible]
Western Union	[illegible]	[illegible]
Westinghouse	[illegible]	[illegible]

The week's curb market was attended with heavy liquidation, with suspensions resulting from sensational declines in United Copper and with the sacrifice of many speculative accounts. The trading was the heaviest of the year, being some ten times the volume of the ordinary week. Following are the closing quotations of Oct. 22:

NEW YORK.

	Oct. 15	Oct. 22		Oct. 15	Oct. 22
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	[illegible]	[illegible]
Allis-Chalmers Co. pfd.	[illegible]	[illegible]	Hudson River Tel.	[illegible]	[illegible]
Am. Dist. Tel.	[illegible]	[illegible]	Interborough Met. com.	[illegible]	[illegible]
American Locomotive	[illegible]	[illegible]	Interborough Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	[illegible]	[illegible]	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable	[illegible]	[illegible]	Mackay Cos. pfd.	[illegible]	[illegible]
American Tel. & Tel. Co.	[illegible]	[illegible]	[illegible] Tel.	[illegible]	[illegible]
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	[illegible]	[illegible]
Electric Boat	—	—	N. Y. & N. J. Tel.	[illegible]	[illegible]
Electric Boat pfd.	—	—	Western Union Tel.	[illegible]	[illegible]
Electric Vehicle	—	—	Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd.	—	—	Westinghouse pfd.	[illegible]	[illegible]

BOSTON.

	Oct. 15	Oct. 22		Oct. 15	Oct. 22
American Tel. & Tel.	[illegible]	[illegible]	Mass. Elec. Ry. pfd.	[illegible]	[illegible]
[illegible] Telephone	[illegible]	[illegible]	[illegible] Telephone	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	New England Tel.	—	—
General Electric	[illegible]	[illegible]	Western Tel. & Tel.	[illegible]	[illegible]
Mass. Elec. Ry.	[illegible]	[illegible]	West. Tel. & Tel. pfd.	[illegible]	[illegible]

PHILADELPHIA.

	Oct. 15	Oct. 22		Oct. 15	Oct. 22
American Railways	[illegible]	[illegible]	Phila. Electric	[illegible]	[illegible]
Elec. Co. of America	[illegible]	[illegible]	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery	[illegible]	[illegible]	Phila. Traction	[illegible]	[illegible]
Elec. Stor. Battery pfd.	[illegible]	[illegible]			

CHICAGO.

	Oct. 15	Oct. 22		Oct. 15	Oct. 22
Chicago City Ry.	[illegible]	[illegible]	National Carbon	[illegible]	—
Chicago Edison	[illegible]	—	National Carbon pfd.	[illegible]	—
Chicago Subway	[illegible]	—	Union Traction	—	—
Chicago Tel. Co.	[illegible]	—	Union Traction pfd.	—	—
Metropolitan Elev. com.	[illegible]	[illegible]			

* [illegible]

TRACTION INVESTIGATION.—Commenting on the traction inquiry in New York, the *Philadelphia Ledger* says: "The story of the sale of the Wall & Cortlandt Street Ferries Railway Company to the Metropolitan Securities Company, of New York, as developed in the Public Service Commission's inquiry, has a significance much beyond the sum involved in this particular 'deal.' It is a typical example of 'high finance' in traction affairs that commands attention by its simplicity and completeness and because of the light it throws upon other and larger transactions that have not been so explicitly set forth. Parties in this city said to be involved in the transaction make emphatic denial that they shared in the illicit profits, alleging that the moneys received by them were for money loaned. However that may be, the fact remains that a franchise worth $250,000 was foisted upon the unsuspecting investing public by promoters at a cost to the investors of nearly a million dollars. It does not relieve the baldness of this 'graft' to plead that such transactions are customary. That is the mischief of it. The very worst of it all is that these methods have actually become so common, or have been so long tolerated, that any one who publicly denounces them is thought to be 'knocking' corporations generally. The crowd, unfortunately, is not discriminating. It is all too ready to generalize and to put the broadest interpretation upon statements that are meant to be specific. This should teach caution to those who can discriminate, for reform can never be wrought through destruction. But if there were not an obvious necessity for reform; if reckless and dishonest finance did not flaunt itself; if the pressure of sound conservatism were brought to bear for the suppression of wrong rather than for the suppression of all mention of it, the 'knocker' would have no audience and the voice of the agitator would be unheard in the land."

ST. LOUIS INDEPENDENT TELEPHONY.—The Kinloch Long-Distance Telephone Company by circular to its stockholders has announced that the company would pass its regular quarterly dividend of 1¼ per cent due this month on its capital stock of $2,800,000. The circular informs the shareholders that in order to carry on new construction work the company has been using its profits, as the directors deemed it unwise to sell bonds of the company during the present depressed condition of the money market. The statement is made that the company will continue to use the surplus profits to pay for this work and will temporarily discontinue payment of dividends until bonds can be sold at a satisfactory price. Accompanying the circular the company's statement and balance sheet for the year to date was sent out with the following comment over the signature of President W. D. Orthwein: "The company is in strong financial condition and its surplus earnings applicable to dividends after payment of all interest charges exceed 7 per cent per annum on its outstanding stock. The net earnings after paying interest on bonds were more than $40,000 in excess of last year or an increase of 29 per cent. The number of telephones in service has increased 4939, or over 25 per cent during the twelvemonth ending Sept. 1." The Kinloch Long-Distance Company has paid a 5 per cent annual dividend since shortly after the formation of the company in 1899. About two years ago it absorbed the Kinloch Telephone Company, of St. Louis, which operated the St. Louis plant. The bonded indebtedness of the two companies is $3,314,000.

ABNER DOBLE COMPANY, of San Francisco, has found itself embarrassed for want of funds and has placed itself in the hands of its creditors, chiefly one or two large local banking interests and some Eastern steel concerns. A meeting of 35 or 40 of these creditors was held in New York on Oct. 22. A plan proposed for carrying on the business is for the Hibernia Bank to hold a first mortgage for its claims, on the factory, etc., now being finished, and for the other large creditors to take preferential bonds to the full amount of their accounts. Smaller creditors below $500 would be liquidated with cash at 50 cents on the dollar. Such a plan, it is believed, in view of the energy and ability of Mr. Doble, and the productive character of his business, will protect and satisfy everybody in the long run, while a peremptory closing of liens would do the reverse. The current assets are placed at $854,695, and the liabilities at $426,646, leaving an apparent net of $428,048. The land occupied is inventoried at $426,000, and the various buildings at slightly over $200,000. Accounts receivable net at $45,311, and the merchandise inventory shows $70,000.

DIVIDENDS.—Directors of the Commonwealth Edison Company have declared a dividend at the rate of 8 per cent on the first installments paid on Chicago Edison Company stock covering a period from Sept. 10 to Nov. 1. Directors of the Automatic Electric Company have declared the regular quarterly dividend of 2 per cent, payable Nov. 1. Directors of the Montreal Light, Heat & Power Company have declared the regular quarterly dividend of 1½ per cent, payable Nov. 15. Directors of the Amalgamated Copper Company have reduced the dividend from a quarterly payment of 2 per cent to 1 per cent, making the annual rate 4 per cent in place of the 8 per cent hitherto paid. This action followed a reduction of the Boston & Montana Mining Company dividend of $2 a share and $4 extra in place of the $2 share and $10 extra formerly paid. The Twin City Rapid Transit Company has declared a quarterly dividend of 1¼ per cent on the common stock, payable Nov. 15. The International Steam Pump Company has declared a regular quarterly dividend of 1½ per cent on the preferred stock, payable Nov. 1.

GENERAL ELECTRIC BUSINESS.—It is understood that the General Electric Company has put in operation a new credit system which, when fully worked out, is expected to increase the available working capital from 15 to 20 per cent, making it possible for the company to do from $10,000,000 to $12,000,000 more gross business than at present without any increase in capitalization. Under the company's old credit system settlement for goods was made on the basis of one-third of the face of the bill at the time of shipment, one-third in thirty days and the balance in sixty days. Under the new system, settlement is made as follows: Fifty per cent of the face of the bill at time of shipment, 40 per cent in thirty days and the balance in sixty days. In other words, the company now receives 25 per cent more cash inside the first thirty days than under the old system and thus has greater command over its own large cash resources.

AMERICAN TELEPHONE STOCK.—Advices from Boston state that the listing of American Telephone & Telegraph stock on the London Exchange carries out the plan which the company announced in July after the close of subscriptions to the $22,000,000 of new stock, when 30,000 shares of stock were taken by a prominent London financier to be distributed to investors in England and Scotland. The American Telephone Company has had for several years a considerable number of stockholders in England. The listing of the stock on the London Exchange will give a near market to these holders as well as afford a means for distribution of the stock sent abroad in July.

BELL TELEPHONE BONDS.—The underwriters of the American Telephone & Telegraph Company's $100,000,000 of convertible 4 per cent bonds will be called upon within the next few days for a 10 per cent payment on the underwriting subscription due Oct. 15. This will make a total call of 90 per cent upon the underwriters. In July, 1907, the call was for 10 per cent, and in April, 1907, 30 per cent. The remaining call of 10 per cent will be made on Jan. 1, 1908. Last March the underwriters received a check for 10 per cent from the syndicate managers which is said to have approximated the amount of bonds sold to the public.

INTERNATIONAL GRAPHOPHONE.—A motion has been granted by Justice McCall for the appointment of a receiver of the International Graphophone Company, a New York corporation, in an action brought by Attorney-General Jackson to dissolve the company, which has ceased to transact active business. Its plant and property were transferred to the Edison United Phonograph Company, a New Jersey corporation. James F. Lynch will be appointed receiver. The company was incorporated in 1889, with an authorized capital stock of $5,000,000.

ECCLESTON LUMBER COMPANY.—The Eccleston Lumber Company, of 44 Broadway, New York, with an office at Hackensack, N. J., made an assignment this week to Arthur A. Michell. The company deals in lumber, railroad ties, cross arms, and poles for electrical purposes. It has a capital stock of $50,000. John B. Eccleston is president and Samuel C. Eccleston treasurer. Most of the lumber came from the South. The company did a large business, it is said, for the actual working capital.

WESTERN ELECTRIC.—It is stated from Boston that the gross business of the Western Electric Company up to Oct. 1 showed a decrease of 15 per cent, compared with the same period of 1906. This means that for the first nine months of this year the company has been doing at the rate of approximately $60,000,000 of gross business, as compared with $70,000,000 for 1906.

ALLIS-CHALMERS ANNUAL REPORT.—At the moment of going to press we are in receipt of the sixth annual report of the Allis-Chalmers Company dated Oct. 21 and signed by President W. H. Whiteside. It is an interesting and encouraging document and embraces the transactions of the year ending June 30, 1907. The figures show steady and substantial improvement since April, 1907, at which time the company first began to receive benefits from the newly developed lines of machinery built in its enlarged West Allis plant, provided therefor; the net earnings in excess of all fixed charges for that period have been $489,267.86. The figures follow for the June and September quarters:

JUNE

Gross profit	[illegible]
Less general and selling expenses, interest on bonds, etc	579,919.21
Net profit	$2[illegible],357.97

SEPTEMBER

Gross profit	[illegible]
Less general and selling expenses, interest on bonds, etc	563,926.60
Net profit	[illegible]

The report includes the consolidated balance sheet for the year, showing Allis-Chalmers and Bullock affairs for the year and giving a value of $37,028,120 for the real estate and factories and $15,337,200 in current assets, including $5,004,032 in notes receivable and $8,739,354 in stocks of merchandise. The company has $10,456,000 5 per cent bonds issued, $16,150,000 in preferred stock and $19,820,000 in common stock. The balance sheet, consolidated profit and loss account is as follows:

Balance June 30, 1906, as per last annual report			$157,481.19
Profit on operations of the last fiscal year after deducting expenses of manufacturing and selling, interest, dividends on preferred stock of The Bullock Electric Manufacturing Company, and provision for doubtful accounts		$1,226,242.00	
Charges for maintenance, repairs and renewals on buildings, machinery, plant, tools, etc	$854,503.32		
Depreciation on buildings, machinery, plant, tools, etc	253,987.42		
Interest on bonds, loans and notes payable	[illegible]		
		[illegible]	
Operating deficit for the year			387,298.14
Deficit June 30, 1907, as per balance sheet			$229,816.95

With regard to the balance sheet it is stated: "Following the established practice of the company, all expenditures during the year for repairs to and replacement of standard patterns, also for the general up-keep of the plants, amounting to $854,503.32, together with $253,987.42 for depreciation of property, a total of $1,108,490.74, have been deducted in arriving at the net manufacturing profits. In addition to this substantial sum we have also reserved in the accounts and charged against the operations during the year $73,000 for bad and doubtful accounts, etc. Losses for the year on account of bad debts amount to about one-twentieth of 1 per cent. The most important transactions of the year reflected in the balance sheet relate to the bond issue. Of the $15,000,000 authorized, $12,854,000 have been issued, $854,000 of which were to reimburse the company for expenses incurred by additions to the West Allis extensions, being a part of the $3,000,000 of bonds reserved for specific purposes. Of the $12,854,000, $2,398,000 are Treasury bonds, leaving a net amount of $10,456,000 taken by stockholders and the syndicate. The stockholders' subscriptions had been fully paid at the close of the fiscal year, but there were still outstanding the last two installments of the syndicate, both of which have since been paid, thus fully discharging the syndicate's obligations to the company." It may be added that the company on June 30 had on hand orders aggregating $15,478,000.

It is in the power apparatus items that interest next lies, and with regard to these President Whiteside may be quoted as follows: "Probably the most important work which has been brought to a commercial consummation has been in the development of our steam turbine units, the unique features of which are fully protected by various patents owned by the company. In 1903 we designed and built our first turbo-generator, and its detail has required no material change—a strong testimony to the scientific accuracy of the principles first adopted. It is asserted with confidence that our turbo-generators are the best designed and most efficient machines on the American market. Sizes ranging from 500 to 7500 kilowatts have been completed and tested, and the success of these units under actual operating conditions is thoroughly established. Notwithstanding our recent advent into this field our sales of steam turbines have already reached nearly 100,000 kilowatts normal capacity, and compared with the previous year show in orders booked an increase of $800,000.

"In the important gas engine branch of our business substantial progress has been made. Each of our standard sizes has been designed, constructed and installed during the year, and our first gas engines are in successful operation. Orders to Aug. 1, 1907, for the horizontal, twin-tandem and double-acting type of gas engines, ranging in capacity from 500 to 5000 horse-power, aggregate 189,350 horse-power. One of our notable contracts covers the electrification of a steel plant requiring gas engine electrical units of an aggregate capacity approximating 60,000 horse-power. This order is believed to be the forerunner of a great many others of similar character, because of the great saving effected by this means in the utilization of gases produced in the manufacture of steel and hitherto wasted. Another important contract, which has been awarded us by an electric railway company, is for traction purposes the largest installation in America of electrical units driven by gas engines to operate on producer gas. The equipment comprises three horizontal, twin-tandem gas engines of 1500 horse-power each, direct-connected to 1000-kw, 3-phase, 25-cycle alternators of our manufacture and includes all sub-station apparatus.

"Although we have but recently undertaken the manufacture of hydraulic turbines, we installed and placed in operation during the year ten complete hydro-electric plants, having a combined output of 105,000 horse-power, and it is gratifying to report duplicate orders from the largest companies interested in these plants. Particular reference is made to the highly satisfactory performance of a 32,000-hp installation furnished one of the largest water power developments in the South, for which we have recently contracted to supply six additional units of identical design.

"The air-brake department was organized about July 1, 1906, to exploit the sale of air-brake equipments, pursuant to an arrangement made with Mr. N. A. Christensen, inventor, whereby your company possesses the exclusive patent rights to manufacture and sell the 'Christensen' air-brakes to urban and interurban electric railways. The 'Christensen' brake has been extensively used for years, and its merits are widely recognized. A reasonable degree of success has already rewarded our efforts to establish ourselves in this line of business.

"During the past year we have completed the development and manufacture of a considerable number of large alternating-current and direct-current generators, rotary converters, induction and direct-current motors in all sizes and capacities, transformers for both power and lighting service, street railway motor equipments and electric hoists, all of which are in successful operation.

"It is worthy of note that notwithstanding the large inroads made by the steam turbine and gas engine, our Corliss engine business continues in steady volume, particularly for the medium and smaller sizes."

This important annual report shows that the finance and executive committees have been abolished; this places the management of the company in the hands of Elbert H. Gary and W. H. Whiteside. The newly elected directors are: Elbert H. Gary, Edmund C. Converse, Charles MacVeagh, general solicitor of the United States Steel Corporation, and Alexander F. Banks, president of the Joliet Eastern Railroad, which is operated by the United States Steel Corporation. This materially strengthens the board and places the financial affairs of the company in excellent hands. The company has ample funds now to carry on its operations in an efficient manner. The full list of directors is as follows: Term expiring 1907—William W. Allis, Milwaukee, Wis.; Lahman F. Bower, Milwaukee, Wis.; Elbert H. Gary, New York; Charles MacVeagh, New York; William A. Read, New York; Cornelius Vanderbilt, New York. Term expiring 1908—Edward D. Adams, New York; Alexander F. Banks, Chicago, Ill.; Edmund C. Converse, New York; Mark T. Cox, East Orange, N. J.; Joseph S. Neave, Cincinnati, Ohio; Henry Woodland, Milwaukee, Wis. Term expiring 1909—Charles Allis, Milwaukee, Wis.; George Bullock, New York; Herman W. Falk, Milwaukee, Wis.; William V. Kelley, Chicago, Ill.; Max Pam, Chicago, Ill.; Walter H. Whiteside, Milwaukee, Wis.

GENERAL NEWS

Construction News.

[illegible]

[illegible] tain L. F. Garrard for construction of building for pump house, installing two horizontal tubular boilers (50 hp), two compound duplex pumps, ice plant and cold storage plant.

MONTGOMERY, ALA.—Extensive improvements and additions have been authorized to be made to the plant and system of the Montgomery Light & Water Power Company, which will involve an expenditure of over $100,000. The new work consists of an additional transmission line from Montgomery to the water power plant on the Tallapoosa River, 30 miles distant. In connection with the new transmission line additional transformers and the latest methods of lightning arresters will be installed. The company will extend both the gas and electric lighting service to the suburbs, and also make extensive improvements to its gas system in this city. R. J. Chambers is general manager.

GLOBE, ARIZ.—The city has entered into a contract with the Globe Electric Light & Gas Company for arc lamps for street lighting. The company will put in an entire new system for this service. The dynamo ordered has a capacity of 50 lamps, new poles will be erected and the entire city rewired for the arc system.

EARL, ARK.—The Earl Light & Power Company has been organized with a capital stock of $10,000. The directors are: L. J. Machen, W. E. Duffus, C. C. Bird and others.

SMITHVILLE, ARK.—The Arbuckle Mining & Milling Company is reported to be interested in the construction of a dam on Strawberry Creek, near Smithville, to be 300 feet long and 13 feet high. The power will be used to generate electricity for use in crushing ore at the various zinc mines at Smithville and Calamine. The company also proposes to construct another dam on Spring River to furnish power for operating an electric car line.

SULPHUR SPRINGS, ARK.—Plans are being prepared by Smith & Powers, of this city, for an electric light plant and water works combined, to cost about $25,000.

BODIE, CAL.—The Green Creek Electric & Water Power Company has been incorporated for the purpose of furnishing electrical energy to Bodie, Masonic, Bridgeport and Aurora.

CHICO, CAL.—The application of Guy R. Kennedy in behalf of L. D. Macy for a franchise to construct and operate an electric lighting and power plant in this city was granted in amended form by the City Council.

COMPTON, CAL.—Work has been discontinued by E. Riveroll & Company, contractors, on the construction of the plant for the Compton Electric Light & Power Company, and an investigation is demanded by W. D. Gould, acting as an attorney for the stockholders of the company, who declare that they were mulcted in building the plant.

FRESNO, CAL.—Bids will be received at the office of the Treasury Department, Washington, D. C., until Oct. 30, for furnishing lamp fixtures for public buildings at Fresno, under the control of the Treasury Department.

LOS ANGELES, CAL.—The Los Angeles-Pacific Railroad has made application to the City Trustees for a franchise commencing at the end of its Franklin Avenue franchise, Hollywood, running west on Franklin [illegible]

OAKLAND, CAL.—The Oakland Traction Company has petitioned for a franchise for an electric railway from the city limits to North Piedmont Heights.

PALO ALTO, CAL.—The Pacific Telephone & Telegraph Company is remodeling its telephone plant in this city at a cost of between $60,000 and $75,000. The company is placing its wires in underground conduits in the business section of the city, and the common battery system is to replace the system now in use.

PLACERVILLE, CAL.—The city clerk writes that the city has not taken any steps in regard to establishing a municipal plant and is only seeking information relative to the plant. He also states that the city has an excellent opportunity to install a plant, but must first submit the proposition to the vote of the people.

PASADENA, CAL.—Superintendent William Glass, of the Municipal Lighting Department, has discovered that the city can save $320,000 by entering into an arrangement with the Sunset Telephone Company, whereby the company will permit the municipality to have free use of its poles and certain ducts in conduits, provided the city does not insist upon the telephone company paying anything for the privilege for doing business in Pasadena. If the scheme is carried out there may be no need for an additional bond issue to enlarge the plant.

REDDING, CAL.—The Northern California Power Company will have [illegible]

particularly valuable for the water rights on connection, and means the beginning of construction work on a fifth power plant of the company. [illegible] Battle Creek, five miles south of the twin power plants now in operation and located at Volta, near Shingletown. The company has a third plant in operation at Kilare on Cow Creek. The fourth plant, the largest of all, is under construction on Battle Creek at Horseshoe Bend. This plant will generate 16,000 hp, or as much as the other four combined. The dam for this plant is 110 feet high.

[illegible] franchise from the city of Newport to cover a gas, electric and water plant, which the syndicate desires to establish there. The company proposes to have one central power plant and pump water by electricity. The surrounding places will be taken in.

RIVERSIDE, CAL.—A franchise has been granted for the construction of an electric railway from Riverside to the new town of Crestmore, but owing to the expense of poles, the Crescent City Railroad Company, which was incorporated to build the road, will endeavor to have the franchise changed to allow the use of gasoline motor power to run the cars to the connection with the main street car line.

SAN DIEGO, CAL.—The San Diego Electric Railway is contemplating the construction of a power plant to cost about $25,000.

SAN DIEGO, CAL.—The San Diego Electric Railway Company is building an extension to the boiler room of its power plant. Three new boilers will be installed, one of 250 hp and two of 400 hp each. This improvement will involve an expenditure of about $25,000.

SAN FRANCISCO, CAL.—The Century-Klein Electric Company has applied to the Superior Court to change its name to the Sterling Electric Company.

SAN FRANCISCO, CAL.—The franchise of the Parkside Traction Company has been passed by the Board of Supervisors, the company agreeing to sell the road to the city at a fair valuation any time during the last 10 years of its 25-year franchise, and also to build its main line on Twentieth Avenue instead of the present boulevard.

SAN JOSE, CAL.—Charles H. Pieper, city engineer, has presented his report on the construction of a municipal electric light plant for the city to the Mayor and City Council, and recommends the selection of an electrical steam driven unit of not less than 300-kw capacity, arranged to permit of future extension; the total cost of the proposed plant, together with pole lines, underground conduits, lamps, apparatus and appurtenances, would cost about $200,000.

SAN LUIS OBISPO, CAL.—The San Luis Obispo Gas & Electric Company's electric plant was damaged by fire Oct. 13, caused from an explosion of oil under the boiler. The city will be in darkness for about a week. The loss is estimated at about $2,500. B. Call is superintendent.

SANTA ROSA, CAL.—The Snow Mountain Water & Power Company has petitioned the Board of Supervisors for permission to erect 25 additional lines through Sonoma County, to be feeders from the main wires. Among the places to be touched by these wires will be Sebastopool, by the way of Forestville; Trenton, Fulton, the Todd district, Guerneville and all the country adjacent thereto; Sonoma, Windsor, Occidental, Molino, Duncan's Mills, Bodega Corners, Bloomfield, Valley Ford, Two Rocks, Penngrove, Danman's Station, Tomales, Marin County and other places.

VENTURA, CAL.—Application has been made to the Board of Supervisors by F. M. Packard and Julian Jones, of Los Angeles, for a franchise for an electric railway to the cement rock mines in the Matilija Canyon. They have asked for a franchise through Ventura, along Oak Street to Ventura Avenue to the city limits.

NEW HAVEN, CONN.—The New York, New Haven & Hartford Railroad Company is contemplating making some changes in the machinery at its power house in Danielson, known as Dyer Dam, to consist of [illegible] volt, 60-cycle, three-phase equipment now in use. The substitution is being made for the purpose of operating the power house in connection with the 25-cycle system of the Norwich power house, some miles distant.

TERRYVILLE, CONN.—At the town meeting held recently a committee was appointed and authorized to make a contract for lighting the streets of the town with electricity for five years at an annual cost of $700.

WASHINGTON, D. C.—[illegible] partment of Agriculture, for an underground conduit between the Bureau [illegible]

WASHINGTON, D. C.—[illegible]

$23,970. The contract was also awarded for the switchboard apparatus for the Salt River project to the General Electric Company, of Schenectady, N. Y.

KEY WEST BARRACKS, FLA.—Bids will be received until Nov. 9 by the quartermaster at this post for furnishing a steam boiler of 125 hp with all accessories complete. Bids to state price f. o. b., both Key West, Fla., and Mallory Steamship Line, New York City, N. Y.

ALBANY, GA.—It is reported that the Albany Power Company will soon call for bids for the construction of a dam and power house and electrical machinery for generating electricity at Porter Shoals on Flint River, near Albany. The company plans to develop 12,000 horse-power. Alexander W. Smith, Frank L. Meufville and E. M. Underwood are interested in the enterprise.

AMERICUS, GA.—The Americus Railway & Light Company, recently incorporated, will soon commence work on the construction of the new power plant. The new company has already purchased the old gas and electric lighting plant in Americus, but will erect the new buildings in another part of the city and install new and more powerful machinery.

ATLANTA, GA.—Sealed proposals and specifications in duplicate will be received by the Board of Water Commissioners and special committee of the Council until Nov. 25 for furnishing and erecting complete, within the building and on foundation furnished by the city, and making necessary connections to 36-inch suction and 30-inch discharge mains of water works, and also 10-inch steam main, at the pumping station No. 2, Atlanta water works, about three miles from the city, on the Southern Belt Railroad, for one 20-million and one 25-million gallon centrifugal pump, to be operated by electric motor, compound triple expansion condensing engine or steam turbine, and for direct pumpage against a head of 120 lbs. domestic and 160 lbs. fire pressure. Said proposals to state the number of million foot-pounds duty guaranteed per 1000 lbs. steam, and no propositon to furnish anything but pump complete with power to operate it (this not to include boilers), and to make connections to mains, as above specified, both water and steam, will be considered. F. P. Rice is chairman of joint committee.

BAINBRIDGE, GA.—It is reported that a Chicago corporation, through Col. W. H. Krause, T. E. Greer and others, has made application to the City Council for a franchise to construct and operate a street railway system on several streets of the city.

FORT VALLEY, GA.—The Fort Valley Telephone Company has filed application with the Railroad Commission for its approval for an issue of $10,000 in bonds, the proceeds to be used in refunding present indebtedness and making certain extensions and improvements.

GAINESVILLE, GA.—The management of the North Georgia Electric Company on Oct. 15 was taken from the hands of the receiver and placed under the control and management of its officers, by order of Judge Newman, of the United States District Court.

MACON, GA.—The Macon Power Company has applied to the State Railroad Commission for permission to issue $150,000 in capital stock.

MACON, GA.—The new company owning the property of the Macon Railway & Light Company has been organized and has assumed the control of the railway and lighting system in the city. The officers of the company are as follows: W. J. Massee, president; Jacob S. Collins, of Savannah, vice-president; J. E. Jaudon, secretary and treasurer; J. W. McFarland, of Chattanooga, general superintendent.

SAVANNAH, GA.—The City Council on Oct. 16 opened the bids submitted for lighting the city. The Savannah Electric Company submitted several propositions for lighting the streets. The company offered as an economical measure to the city to continue the present contract for a period of two years for the sum of $25 per lamp per year. This would mean a saving of [illegible] a year, and the lamps would cost [illegible] for all-night and every night schedule, $28 per lamp per year. Another proposition offered by the company is to furnish the city with service for an additional five or ten years at the city's option at actual cost, which will include the cost of operation, depreciation and a return upon the investment devoted to the city lighting of 8 per cent. In case the city accepts, then after the company offers to install such a system as a competent board of engineers shall determine best suited to the needs of the city at the time of their recommendation. Under a five-year contract, with privilege of renewing for another five years, for [illegible] lamps or more, the company offers to furnish magnetite lamps manufactured by the General Electric Company, the Westinghouse Company, or any other standard manufacturer, as follows: [illegible] with privilege of renewal for additional five years, moonlight schedule, $66 per lamp per year; all-night, $68 per lamp per year. Ten-year contract: [illegible] five years, were as follows: Moonlight schedule, 25-cp lamps, $22.50 per lamp per year; [illegible] tract, moonlight schedule, the following prices were given: 25-cp lamps, [illegible] during the year ending Sept. [illegible] All electricity used in excess of this to be paid for by the city at the rate of [illegible] cents per kw-hour.

The proposition submitted by the Savannah Lighting Company for lighting the city is as follows: For the first five years for all-night service, $65 per lamp per year; moonlight schedule, $64 per lamp per year; for the second five years, $60 each per year. For incandescent lamps for the five and ten years as follows: For 20-cp lamps, $17 per lamp per year; 50-cp lamps, $30; 65-cp lamps, $37. The Savannah Lighting Company guaranteed to commence operations within five months after the contract was awarded.

LEWISTON, IDA.—The Washington-Idaho Light & Power Company has recently closed contracts with the City Councils of Uniontown and Colton for furnishing the towns with electric energy for lighting and for pumping the city water. The company has secured a 25-year franchise to erect transmission lines on the streets of the towns. The extension of the company's lines will involve an expenditure of about $25,000. The addition of Uniontown and Colton makes ten cities in the Inland Empire that are served with electricity by the Washington-Idaho Light & Power Company. These towns, with Genesee, Moscow and Pullman, receive power from the water power plant of the Lewiston-Clarkson Company, of Asotin, while Palouse, Garfield, Oakesdale, Farmington and Tekoa receive their service from the Post Falls plant.

ASHLEY, ILL.—The City Council has granted a franchise to Charles W. Lafferty, of Casey, to erect and maintain a telephone and telegraph system in this city.

CAIRO, ILL.—The Cairo Electric & Traction Company is planning to make extensive changes and improvements to its power plant, and will soon place orders for the following equipment: Two turbine generators, 500 kw; one 300-kw motor generator set, 2300-volt alternating current to 550-volt direct current; one 200-kw motor generator set, 2300-volt alternating current to 550-volt direct current. O. C. Macy is manager.

BRIDGETON, ME.—The Bridgeton Water & Electric Company has notified its patrons that the meter system will be used exclusively in the consumption of electricity for lighting purposes, as soon as the meters can be installed. The reason of the change is due to the installation of a day service, which was not contemplated when the present flat rates were established.

BALTIMORE, MD.—The United Railways & Electric Company has not yet prepared plans for the reconstruction of its power plant, which was recently destroyed by fire.

ADAMS, MASS.—The Selectmen have granted the Berkshire Street Railway Company permission to erect poles for its high-tension line from Pittsfield to the Zylonite power station. The contract for the work has been awarded to Fred T. Ley & Company, of Springfield, for $65,000.

CLINTON, MASS.—The Bigelow Carpet Company is making arrangements to erect a new power plant.

MIDDLEBORO, MASS.—The management of the municipal electric lighting plant is making arrangements to establish a day service in the near future.

STOCKBRIDGE, MASS.—The Stockbridge Electric Light Company has petitioned the State Board of Gas and Electric Light Commissioners for authority to issue $25,000 of capital stock to be used in building a new plant.

BERRIEN SPRINGS, MICH.—Bids will be received by the village of Berrien Springs until Nov. 4 for the construction of a municipal electric light plant. The street lighting system will consist of 25 street lamps and about five miles of wire, etc. A. B. Ayers is president of the Board of Trustees.

CORUNNA, MICH.—The Shiawassee Light & Power Company is preparing to raise its dam at Shiatown from eight to fifteen feet.

GRAND RAPIDS, MICH.—We are informed that the Grand Rapids Electric Railway Company will place contracts during the next 30 days for the construction of two new electric lines; one from Bay City to Grand Haven and the other from Grand Rapids to Montpelier, Ohio.

MANCHESTER, MICH.—W. J. Hoffer, village clerk, writes that the citizens have voted in favor of purchasing the electric light plant owned by J. H. Kingsley, to be operated as a municipal plant.

PAINESDALE, MICH.—W. A. Rankin, engineer, writes that no contracts will be let until spring for the proposed power plant to be constructed about five miles from Painesdale.

SAGINAW, MICH.—The contract for building the new exchange building of the Valley Telephone Company has been awarded to Kerns & Spindler. A complete equipment for lighting and heating the building will be installed in the basement. The company is extending its conduit system as rapidly as possible and an additional force of men will be put to work as soon as available.

AKELY, MINN.—The Red River Lumber Company has placed an order for a [illegible] and a new dynamo to double the capacity of the electric light plant.

CROOKSTON, MINN.—The City Council has granted W. A. Marin a franchise to operate a street railway system in the city.

ELK RIVER, MINN.—The Mississippi River Electric Power Company, which already owns undeveloped water power on the Mississippi River at this place, Monticello and Clearwater, has purchased another dam site near Anoka. Flowage rights along the river from Anoka to this village have also been purchased.

LUVERNE, MINN.—Extensive improvements are being made to the plant and system of the Luverne Telephone Company in this place.

[illegible]
with incandescent attachments. Bids will also be invited for furnishing gas, and also for electric and gas incandescent lighting.

[illegible] E. A. Lydiard, city clerk, until Nov. 8, for lighting the streets and avenues of this city with gas and electricity for the year 1908; also for supplying gas for the street lamps of the city for the year 1908; bids will also be received for furnishing about 7000 incandescent gas street lamps.

ST. CHARLES, MO.—The City Council has sent a notice to J. T. W. Rudsill, of East St. Louis, Ill., and other promoters, signifying its willingness to consider granting a 50-year street railway franchise. The Council last spring refused to grant Mr. Rudsill a street railway franchise for 50 years, but the demand of the people for a street railway system has led the Council to reconsider its action.

ST. JOSEPH, MO.—It is said that the St. Joseph Railway, Light & Power Company will begin work on the construction of the extension of the Krug Park line between St. Joseph and Savannah within 60 days. J. H. Van Brunt is manager of the company.

ST. MICHAEL'S, MD.—Walter L. Butler, of Philadelphia, Pa., has applied to the Town Commissioners for a franchise to establish an electric light plant.

BEAR CREEK, MONT.—It is reported that an electric light plant and water works system will be installed in this town.

VIRGINIA CITY, MONT.—An electric light plant will be installed here, and the water power of Blaine Springs Creek will be developed [illegible]

ARLINGTON, NEB.—The Arlington Electric Light & Power Company is contemplating improvements to its power plant, which include the building of an additon to the power house and installation of a 130-hp boiler and an engine of 90 hp.

CENTRAL CITY, NEB.—The City Council on Oct. 11 passed to its second reading an ordinance granting an electric light franchise to L. S. Jenkins and H. D. Forrest, of Omaha. The ordinance provides at the end of five years the city may, if it desires, purchase the plant at a fair market value to be determined by appraisers. Messrs. Jenkins and Forrest will put in a plant at a cost of about $15,000 and will erect a power house on a site near the city roller mill. The city on Oct. 8 severed all relations with the gas company, and since that time the streets have been in darkness.

EXETER, NEB.—W. W. Kimberly, village clerk, writes that bids will be received until Nov. 1 for the construction of a power plant to cost $15,000. The National Construction Company, of South Bend, Ind., has charge of the construction work.

PLATTSMOUTH, NEB.—The Plattsmouth Telephone Company is contemplating increasing its capital stock to $300,000.

PLATTSMOUTH, NEB.—The Omaha Electric Light & Power Company has secured the contract for lighting the city of Plattsmouth.

PLATTSMOUTH, NEB.—Earl H. Wescott, of Plattsmouth, writes that he proposes to build a transmission line eight miles in length to connect with the power plant of the Omaha Electric Light & Power Company, at Omaha, and will need sub-station equipment including transformers.

ST. PAUL, NEB.—The question of issuing $10,000 in bonds for an electric light plant is under consideration.

SCOTTS BLUFF, NEB.—The construction of an electric light plant is now under consideration.

TECUMSEH, NEB.—Work has commenced on the rebuilding of the municipal electric lightning plant and surveys are being made for the location of street lamps. An addition will be built to the old power house to make room to place the new machinery. Arc lamps will be placed in the business section of the city. The Mayor and Council are now considering establishing an all night service when the new plant is installed. J. E. Marx is superintendent.

TEKAMAH, NEB.—The City Council has awarded the contract for installing the electric light plant to Bortenlanger & Company, of Omaha. The contract calls for a 125-hp engine, two 70-hp boilers and a dynamo of 75-kw capacity.

WAHOO, NEB.—Edward Lehnkuhl, Mayor, writes that the proposed water works and electric light plant will cost between $50,000 and $60,000. The engineer has not yet been selected.

CASTILE, N. Y.—James C. Horning, of Lamont, writes that the proposed dam to be constructed across East Koy Creek to develop power for electricity to supply Castile, Silver Springs and Gainesville will cost from $15,000 to $20,000. The company has not yet been organized, but it is hoped to have the work completed by next spring.

GLENS FALLS, N. Y.—The International Paper Company is contemplating building a large dam about two miles south of Spier Falls to furnish power for a pulp mill or an electrical plant. William Curtis, Jr., is superintendent of construction.

[illegible] way Commissioners have granted the South Shore Traction Company a street railway franchise.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, New York City, until Oct. 28, for installing [illegible]

[illegible]
material and installing electric conduits and wiring in new dormitories, first and second cabin rooms and balcony, third floor main building, at the United States Immigration Station, Ellis Island.

WATERTOWN, N. Y.—Justice Andrews has made an order returnable Nov. 2, directing the stockholders of the Citizens' Telephone Company to show cause why it should not be dissolved, it having been declared bankrupt. Oliver Watson is receiver for the company.

WOLCOTT, N. Y.—O. M. Curtis, proprietor of the Wolcott electric light plant, is contemplating the construction of a dam across Wolcott Creek.

SMITHFIELD, N. C.—The Town Commissioners have appointed a [illegible] Brooks, to investigate the cost of constructing an electric light plant, water works and sewerage systems.

CINCINNATI, OHIO.—Bids will be received until Nov. 14 by the board of trustees, Memorial Association of Hamilton County, at the office of Samuel Hannaford & Sons, architects, for furnishing material and installing light fixtures for the Soldiers' and Sailors' Memorial Building at Grant and Elm streets. Elias R. Montfort is president of the board.

CLEVELAND, OHIO.—The Cuyahoga Light Company has petitioned the City Council for an electric lighting and steam and hot water franchise in the downtown business district. The lighting committees of the Board of Public Service and the Council on Oct. 16 voted to recommend the granting of a franchise to the Cuyahoga Light Company. A maximum price of 5½ cents per kw-hour was agreed upon for electric lighting and other important provisions were embodied in the proposed franchise. Municipal ownership was provided for, and at any time, on six months' notice, the city may purchase the plant for the cost of reproduction, less depreciation, plus 10 per cent. The franchise is to be revoked in case of consolidation or working agreement with the Cleveland Electric Illuminating Company. The company agreed to accept, should the city demand it at any future time, an extension of the franchise requiring it to extend its service to the city limits. Heating will be charged for at the rate of 27½ cents per sq. ft. of radiation. This charge is to be readjusted at the end of two years.

COLUMBUS, OHIO.—Bids will be received until Oct. 30 by the Board of Public Service (E. F. McGuire, secretary) for furnishing material and doing the following work at the municipal electric light plant, Dublin Avenue: Boilers, blow-off tunnel, foundation for additional boilers, continuation of ash pit tunnel, retaining wall and driveway.

EUGENE, ORE.—The Pacific Light & Power Company, of Junction City, is considering the construction of a power plant at Triangle Lake, about 30 miles west of Eugene, and will extend its transmission lines to Eugene, Corvallis and Junction City.

BRACKENRIDGE, PA.—The Saxonburg, Tarentum & Butler Street Railway Company has accepted the franchise granted some time ago by the Town Council for a right of way through the town.

CORRY, PA.—C. P. Northrop, president of the Corry & Columbus Street Railway Company, writes that 15 miles of track will be built during the next season. The company is also considering the purchase of a generator and gas engine and a double truck combination passenger and baggage car. He also states that the company will install a lighting plant in the future.

EASTON, PA.—The Warner Arc Lamp Company, manufacturer of the lamps now in use in the city of Easton, which have caused the management of the municipal electric light plant so much trouble, has notified C. S. Neiman, superintendent, that it will replace the present lamps with another type of lamp without any additional expense to the city.

GREENSBURG, PA.—The West Penn Railways Company has secured a right of way for a new electric railway between Hunker and Scott Haven, connecting with West Newton.

KANE, PA.—The new plant of the Kane Electric Light, Heat & Power Company is nearly completed and will soon be put into operation. A 125-hp Struthers & Wells engine has been placed and a generator installed; another 250-hp engine of the same make will be installed as soon [illegible] capacity of 500 hp.

NEWTOWN, PA.—The Newtown Electric Street Railway Company has been authorized by the State Department to change its corporate title to the Bucks County Electric Railway Company. The old Buck County Electric Railway has passed out of existence, its property having been purchased by the Doylestown & Willow Grove Railway Company.

PEN ARGYL, PA.—Arrangements are being made to improve the electric lighting system in this place. A new dynamo has been recently installed at the power house and also other equipment. The present transmission lines will be replaced with new and heavier wire than that now in use, and new poles will be erected.

SHAMOKIN, PA.—The Shamokin & Edgewood Electric Railway Company has filed notice at the State Department of 53 miles of extensions, which will be constructed as soon as possible. Monroe H. Kulp is president.

SHEFFIELD, PA.—The Youngsville & Sugar Grove Street Railway [illegible]

from $34,000 to $500,000; also of an increase in capital stock from $80,000 to $200,000, for the purpose of extending the line from Youngsville to Warren.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has increased its indebtedness from $300,000 to $600,000 and its capital stock from $300,000 to $600,000. The company has commenced work on an extension from Greencastle to and beyond Chambersburg and over certain streets in Chambersburg. The work is being done by the company itself, and it is expected to have the new line in operation in about eight months. The company will add another engine and generator to the Waynesboro plant, and boosters and transformers will be placed along the new line.

PASCOAG, R. I.—A new Dillon boiler of 125 hp has been purchased for the municipal electric light plant. The old boiler will be taken out and the boiler house enlarged.

PROVIDENCE, R. I.—The Board of Aldermen has adopted a resolution recommending that the Narragansett Electric Lighting Company be permitted to install, at its own expense, a system of underground wires, conduits and appurtenances on the premises of the City Hospital on Eaton Street. The electricity to be used for light and power will then be purchased at meter rates, effecting a saving of $14,000 for an electric light plant, exclusive of the wiring and appurtenances, and nearly $500 per annum over the cost of maintaining the plant. The estimated cost of an electric plant for the City Hospital is $14,000, exclusive of the wiring and appurtenances, and the cost of operating such a plant would be $5,325 per annum, while the cost of purchasing electricity from the Narragansett Electric Lighting Company will be $4,900 per year. The heating and ventilating system recommended by the consulting engineers and architects and adopted by the committee provides for a plant in which no changes will be necessary outside of the engine and boiler room in case an electric plant is installed later.

UNION, S. C.—J. A. Brown, of this city, acting as agent for other parties, has applied to the Town Council for a perpetual franchise to construct and maintain an electric light and power plant, guaranteeing to construct the plant within 12 months.

ABERDEEN, S. D.—The Wagner, Lake Andes & Armour Traction Company has petitioned the City Council for a franchise for an electric light and power plant. The company proposes to install a plant at a cost of about $150,000, and will furnish an all-night service to business houses and residences.

MITCHELL, S. D.—The City Council has granted another extension of time on the electric light franchise proposition in order to give the Mitchell Gas Company an opportunity to get through with the receivership and start out on a new basis. When the business is settled in the federal court the plant will be purchased by a new company, which has just made application to the Council for a franchise, which will probably be granted.

CLEVELAND, TENN.—J. W. Adams and associates, of Chattanooga, have received a franchise for an electric light and power plant.

COLUMBIA, TENN.—Owing to the inefficient service furnished by the Columbia Water & Light Company the city of Columbia, through its attorney, has entered suit in the chancery court against the company to have the contracts between the city and the company annulled and also the franchise of the company annulled. The city has frequently been in darkness, especially during the past few months, and has for days at a time been without water.

JOHNSON CITY, TENN.—The Johnson City Traction Company will soon place contracts for the one-half mile extension of track to the National Soldiers' Home. It is reported that the company is also contemplating building an addition to its car sheds and will purchase a 200-kw, 2300-volt, three-phase alternator.

McKENZIE, TENN.—Edward Moseley, cashier First State Bank, and others are considering the matter of installing an electric light plant here in conjunction with an ice plant.

NASHVILLE, TENN.—William E. Hamilton, of Columbus, Ohio, is reported to be interested in plans for extensive water power developments and the erection of an electric light and power plant in Tennessee.

NEWPORT, TENN.—The city has voted to issue $50,000 in bonds for the construction of an electric light plant, water system and sewer system.

ABILENE, TEX.—The Roberts Telephone & Electric Company has been placed in the hands of receivers appointed by Judge J. H. Calhoun.

EL PASO, TEX.—L. D. Gilbert, secretary of the Cement Engineering Company, of Los Angeles, Cal., engineers in charge of the construction of the cement plant for the Southwestern Portland Cement Company to be erected in El Paso, wrote under date of Oct. 12 that machinery had not yet been purchased at that date, but that requests for prices have been sent out for most of it, and he expects to let contracts for the machinery in about four weeks. There will be 14 buildings erected, with an aggregate floor space of 80,000 square feet. The equipment of the proposed power plant will consist of two 750-kw, 440-volt, 25-cycle, three-phase generators, either direct connected to cross-compound Corliss engines, or steam turbines, to operate on 175 lbs. gauge steam pressure and 125 degrees superheat. The plant will be motor driven throughout, motors being direct connected [illegible]

SALT LAKE CITY, UTAH.—The City Council has granted the Utah Light & Railroad Company a franchise to lay additional tracks from the intersection of [illegible]

FAIRHAVEN, VT.—The Fairhaven Electric Company has recently installed additional machinery in its plant and is arranging to improve the service by increasing the voltage.

CHEHALIS, WASH.—B. E. Clement has been granted a franchise to erect and operate an independent telephone exchange in this place.

CHEWELAH, WASH.—The City Council has awarded the contract for the electric plant, wire and electric fixtures to the Fairbanks & Morse Company; the 12-in. water pipe to the Washington Pipe & Foundry Company. The Council has rejected the bids on the power house, which, with the excavation and refilling for the pipe line, will be done under the supervision of the Council.

PASCO, WASH.—The capital stock of the Pasco Light & Water Company has been increased from $25,000 to $50,000.

ASHLAND, WIS.—The City Council on Oct. 11 voted to accept the proposition of the Chippewa Valley Construction Company to transmit electricity to this city from its plant at Copper Falls, the city to lease the power plant of the Chippewa Valley Electric Railway for three years, with the option of purchase at that time. A. E. Appleyard, of Boston, Mass., is president of the company, and promises to supply 6000 hp from its plant at Copper Falls, 18 miles south of Ashland, by next June. The contract is for a period of 15 years.

EAU CLAIRE, WIS.—The Northwestern Lumber Company has decided to build a high dam on Eau Claire River to develop power for manufacturing purposes.

ONALASKA, WIS.—The La Crosse Water Power Company has applied for a franchise to erect its lines through this village.

OSCEOLA, WIS.—Harry C. Harding and others are arranging to establish an electric lighting system here by a connection with the plant of the General Electric Company at St. Croix Falls.

RIPON, WIS.—A committee of the Common Council has been appointed to secure the services of the State Railway Commission for an investigation of the Ripon Light & Water Company's charges. A new schedule was put in operation recently and it is alleged that the charges for light and water are excessive in comparison with other cities similarly situated.

STRATHCONA, ALB.—A by-law to grant a franchise to the Strathcona Radial Terminal Tramway Company will be submitted to the people on Oct. 30.

REVELSTOKE, B. C.—The contract for the addition to the electric power plant has been awarded to the Canadian General Electric Company, of Montreal, for $25,762. The addition will consist of a 60-cycle, 150-kw type generator, making 600 revolutions per minute. Superintendent Holden will have charge of the construction on behalf of the city.

MORDEN, MAN.—The town has taken over the electric lighting plant here operated by a local company known as the Winnipeg Electric Company. Address S. Scott, of this town.

GRESHAM, ORE.—A surveying party is out on Oak Grove Creek, above Estacada, on the Clackamas River, surveying for a new power plant. A canal will be built for a distance of eight miles, which will give a fall of 1000 feet and will generate 40,000 horse-power. The railroad is to be extended up the Clackamas before actual construction work will commence.

HAMILTON, ONT.—At a meeting of the Board of Works held Oct. 15 Engineer Sothman, of the Hydro-Electric Power Commission, submitted a report of the cost of installing an electric light system in Hamilton, with a conduit system in the center of the city. Mr. Sothman estimated that a four-duct system would cost $57,148, and the total cost of four-duct system and 500 magnetite arc lamps with the necessary equipment was estimated at $175,580. A two-duct system would be $900 less. The cost per lamp, according to the former system, was $51.03 a year, and for the two-duct $49.70 a year. He also submitted figures showing the cost of six, eight, twelve and sixteen ducts. Mr. Southman estimated that a plant could be placed in operation within one year, and also said that the Hydro-Electric Power Commission would be in a position in a few days to state when power could be delivered from Niagara Falls.

KENORA, ONT.—The ratepayers have passed a by-law providing $75,000 for completion of the power development and water works system. Address C. S. Draper.

MANILA, P. I.—Plans and specifications are on file at the office of the Electrical World, 239 West Thirty-ninth Street, New York, N. Y., for furnishing and installing electrically driven pumps and motors for the new sewerage system for the city of Manila, bids for which will be received at the office of the Municipal Board (John M. Tuther, secretary) until Jan. 15. There will be one main station and five sub-stations, each equipped with two pumps and corresponding motors, making a total of 12 pumps and motors.

MONTREAL, QUE.—The City Council has decided to advertise for tenders for supplying gas and electricity for illuminating and for heating for the city and citizens, and also for manufacturing purposes. The tenders will be received until Dec. 1 and are to be submitted separately for gas and electricity.

HUMBOLT, SASK.—Ratepayers of this town are organizing a company for the purpose of installing an electric lighting plant and telephone system and have applied for a franchise. Address Telfen Brothers.

SASKATOON, SASK.—The Saskatchewan Telephone & Electric Supply Company has been taken over by the Northwestern Telephone Company.

Company Elections.

ASHLEY, ILL.—At the annual meeting of the Ashley Telephone Company [illegible] the following officers were elected: [illegible], president; W. H. Seibert, secretary, and Henry Gilbert, treasurer.

WORCESTER, MASS.—At a meeting of the Worcester Electric Light Company, held Oct. 9, the following officers were elected: Gen. A. B. R. Sprague, Herbert H. Fairbanks, treasurer and clerk. The directors are: A. B. R. Sprague, Theodore C. Bates, Josiah Pickett, George T. Dewey, Otis E. Putnam, W. H. Coughlin, Frank L. Goes, Herbert H. Fairbanks and John C. MacInnes.

VICTOR, N. Y.—The Ontario Mutual Telephone Company, recently organized, has elected the following officers: Dr. D. S. Partridge, of East Bloomfield, president; C. R. White, of East Bloomfield, vice-president; Robert F. Shay, of Holcomb, secretary; O. M. Dibble, of Holcomb, treasurer. The company will be capitalized at $30,000.

New Industrial Companies.

THE CENTRAL TELEPHONE & SUPPLY COMPANY, of Springfield, Ill., has been incorporated with a capital stock of $25,000 by Edward J. Novak, Sidney S. Pollack and Otto Kerner. The company proposes to manufacture telephone supplies.

THE DAVIS ELECTRIC COMPANY, of Parkersburg, W. Va., has been incorporated with a capital stock of $350,000 by J. Mentor Caldwell, Henry W. Dils, Jesse R. Davis and others. The company proposes to manufacture and deal in dynamos, batteries and other electrical machinery.

THE GLOBE ELECTRIC SPECIALTIES COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $25,000. The directors are: Harry Bessing, Robert Oppenheim and George H. King, all of New York.

THE WORKUM COMPANY, of Augusta, Maine, has been incorporated with a capital stock of $100,000 to manufacture and deal in electrical apparatus, etc. J. Berry is president and treasurer and L. A. Burleigh, clerk, both of Augusta.

New Incorporations.

RIALTO, CAL.—The Rialto Light & Power Company has been incorporated with a capital stock of $10,000 by L. E. Newcombe, A. B. Paddock, A. H. Morgan, J. C. Boyd, F. Slade, W. P. and J. F. Martin, all of Rialto.

BROWNSTOWN, IND.—The Home Telephone Company has been incorporated to build, equip and operate a telephone system and exchange in this city. The capital is $20,000. C. E. Brown, W. H. McPherson and C. F. Robertson are the directors.

BUTLERVILLE, IND.—The Harlan Telephone Company has incorporated to establish and equip a new exchange and system in this place. J. T. Sharp, E. H. Smith and E. D. Jones are the directors.

CLINTON, KY.—The Electric & Manufacturing Company has been incorporated with a capital stock of $20,000 by A. C. Moss, R. L. Johnson and Mrs. M. E. Watson, all of Clinton, Ky., and L. N. Pollock and M. D. Moss, of Campbell, Mo. The company proposes to operate electric light and power plants at Clinton, Campbell, Mo., and other places, and furnish electricity for lighting and power and establish ice and cold storage plants.

PORTLAND, ME.—The Bromfield Electric Company has been incorporated with a capital stock of $500,000. C. M. Drummond is clerk.

LOUISVILLE, MISS.—The Louisville Light & Water Company has been incorporated with a capital of $20,000 by W. L. Strong, J. L. Mc[illegible]

BURLINGTON JUNCTION, MO.—The Burlington Junction Electric Light & Power Company has been incorporated with a capital stock of $6,000 by D. T. Garrett, Jesse F. Robertson, T. E. Fordyce and others.

EAST BLOOMFIELD, N. Y.—Articles of incorporation have been filed for the Ontario County Mutual Telephone Company with the Secretary of State. The company is capitalized at $30,000 and the incorporators are B. A. Partridge, O. Dibble, of East Bloomfield, and C. R. White, of Ionia.

NEW YORK, N. Y.—The Regal Electric Company has filed articles of incorporation with a capital stock of $5,000. The directors are: Albert L. Sansville, John M. Willingham and Paul Jeffrey, all of New York City.

HONESDALE, PA.—The Honesdale, Hawley & Seelyville Automobile Company has been incorporated with a capital stock of $15,000 to operate an automobile service between Hawley and Seelyville via Honesdale. Henry Buerket is president, and E. E. Fowler, George W. Conners, Fletcher Bunnell and William Taylor, directors.

MIDLAND, TEX.—The Midland Light Company has been incorporated with a capital stock of ——— by E. R. Bryan, F. F. Cary, George D. Elliot and C. Harbaur.

PADUCAH, TEX.—The Paducah Telephone Company has been incorporated with a capital stock of $15,000 by J. T. Richardson and others.

PARIS, TEX.—The Texas-Oklahoma Telephone Company has been incorporated with a capital stock of $5,000 by T. A. Johnson and others.

SEATTLE, WASH.—Articles of incorporation have been filed for the Seattle-Tacoma Short Line by [illegible] and F. J. Eitel. The company is capitalized at $6,000,000 and proposes to build a new interurban line between Tacoma and Seattle. The new company will acquire the franchises obtained in Seattle, Tacoma, Pierce and King counties for the road by Merle J. Wightman and C. E. Muckler.

PARKERSBURG, W. VA.—The Davis Electric Company has been incorporated with a capital stock of $350,000 by J. Mentor Caldwell and others.

Legal.

THREE-CENT FARES.—Judge [illegible] of the Common Pleas Court, handed down a decision last week holding illegal all franchises granted by the Council for so-called 3-cent fare lines on the East Side, except a small section constructed in East Fourteenth Street, which covers about two blocks. The court rules that the franchises for 3-cent lines on the West Side are valid, because they were granted prior to the date upon which Mayor Johnson is alleged to have become financially interested in the roads.

SOFT COAL.—Last month the Brooklyn Rapid Transit Company was made defendant in an action to stop the use of soft coal at the big power house at Kent and Division Avenues, Brooklyn. The residents of the Eastern District [illegible] nuisance, and last week the jury which has been hearing the case before Judge Fawcett in the Kings County Court brought in a verdict of guilty. Judge Fawcett granted a postponement before passing sentence. The penalty for maintaining a public nuisance is $500 fine and the absolute discontinuance of the cause of annoyance.

LIGHTING MORRISTOWN.—Chief Justice Gummere, in the Supreme Circuit Court, has granted to the Public Service Corporation a writ of certiorari to review the ordinance passed by the Morristown City Council granting a franchise to the Morris & Somerset Electric Company for furnishing the municipality with electric light. Application had been made for a writ to review not only the ordinance passed by the Council, but also the contract made by the members of the Council with the Morris & Somerset Company. The court denied the right to review the contract.

Educational.

COLUMBIA UNIVERSITY, N. Y. [illegible] year 1907-1908 twenty evening courses specially adapted to the needs of technical and professional workers. This includes work in applied mechanics, architecture, electricity, fine arts, industrial chemistry, mathematics, surveying and structures. The work begins Oct. 28 and continues for twenty-five weeks. A full description of the courses is contained in the "Announcement of Extension Teaching," which may be obtained on application to the director of extension teaching.

Obituary.

MR. E. H. WILLIAMS.—Mr. [illegible] City, died on Oct. 20 at his residence, 574 Bergen Avenue. He was 59 years old, and had lived in Jersey City for nearly half a century. He was president of the A. A. Griffing Iron Company and the E. A. Williams & Son Brass Foundry, both of Jersey City. He was a member of the American Society of Mechanical Engineers, the Engineers' Club, the [illegible]

Personal.

MR. H. B. IVERS has been appointed treasurer of the Bangor Railway & Electric Company, of Bangor, Maine.

MR. ALBERT UHL, formerly of Memphis, Tenn., has joined the sales forces of the Nernst Lamp Company, being attached to the St. Louis office.

MR. F. D. SMITH, formerly superintendent of construction for the Stevens-Hewitt Engineering Company, has resigned that position and has opened offices at 123 Liberty Street, New York, where he will carry on an electrmical contracting and specialty business.

MR. WILLIAM T. TAYLOR, M. I. E. E., superintendent Compañia Industrial Mexicana, Chihuahua, arrived in New York on the "St. Paul" [illegible] extend his personal interests in Peru, South America.

MR. J. E. MONTAGUE.—We regret to note the serious illness of Mr. J. E. Montague, general manager of the Buffalo & Niagara Falls Electric Light & Power Company [illegible] appendicitis. A host of friends will welcome the news of his recovery.

REAR ADMIRAL G. W. MELVILLE, former engineer-in-chief of the navy and a famous hero of Arctic exploration, was married last week to Miss Estella B. Polis, of Philadelphia. The admiral has received many congratulations from the electrical field, where he has a great many friends.

MR. C. J. FIELD has been for the past two years building and operating a large sugar centrale, railway, etc., in Porto Rico and has introduced more or less electrical apparatus in connection therewith. He is now taking up similar work at Bartle, Cuba, while retaining his Porto Rico connections.

MESSRS. D. C. AND W. B. JACKSON, consulting engineers and experts, announce that they have removed their Western office from Madison, Wis., to the Commercial National Bank Building, Chicago. They have also opened an Eastern office in Boston. Mr. W. J. Crimpton is in charge of the Chicago office.

MR. HARRY PICKHARDT, who was formerly occupied in electrical construction work with the Eidlitz Company, has become associated with the Holophane Company and will devote his attention to the sale of its well-known glassware specialties. His headquarters will hereafter be with the Western sales department of the Holophane Company, Wabash Avenue, Chicago.

DR. LUCKE, professor of mechanical engineering at Columbia University, New York City, delivered a lecture on Oct. 18 before the Mechanical Society of the College of the City of New York, on "The Various Engineering Professions and the Preparation Necessary for Each." This interesting lecture was delivered in the physics lecture room in the main building.

COL. R. C. CLOWRY has just been re-elected president of the Western Union Telegraph Company—a mark of confidence in him after the recent strike. Col. Clowry was born in Will County, Ill., on Sept. 8, 1838. He received an ordinary public school education and early took up the telegraphic art. Mr. Clowry married Miss Caroline A. Estabrook on Aug. 29, 1865, at Omaha. She died in April, 1896. He is one of the powers in the telegraph and telephone corporations not only in the United States but abroad. Mr. Clowry served in the Union Army and made a gallant record during his service.

MR. WALTER B. SNOW, who has been connected for nearly 25 years with the B. F. Sturtevant Company, of Hyde Park, Mass., and has done some very successful publicity work in its behalf, has now opened offices as a "publicity engineer" at 170 Summer Street, Boston, Mass. His regular service will cover the conduct on a salary basis of the publicity departments of a limited number of non-competitive clients. Service will also be rendered to others in the form of general advertising, catalogue work, technical articles, etc. He has issued an interesting little pamphlet as to himself and what he proposes to do.

Trade Publications.

H. W. JOHNS-MANVILLE COMPANY [illegible] bulletins. One of them deals with the "Leak-No" metallic compound for stopping all manner of leaks in pipes or fittings. The great value of "Leak-No" to the user is because of its peculiar chemical action in metallizing and its power of amalgamation. During its metallizing process it expands so that it perfectly fills the leak, and as it expands equally with iron and steel, it makes a permanent repair. It is a chemical metallic compound, prepared in powder form and used by mixing with water to a stiff putty. When in this state it is a chemical plastic [illegible] casting to which it is applied. When hard it has the same color as cast iron. The other circular deals with the "J. M." cross overs and section insulators of special design and construction.

HEATING BOILER FEED.—"Heating Boiler Feed Water Where the Main Engine Is Run Condensing" is the title of a treatise recently published by the Harrison Safety Boiler Works, Philadelphia, Pa. It is shown that by using the exhaust steam of boiler feed pumps, circulating pumps and air pumps for preheating the boiler feed water the efficiency of these pumps becomes much higher than that of the best triple-expansion, condensing engine. At the same time, steam-driven machines of this character are much less expensive in first cost and the cost of attendance, are less liable to get out of order and may be operated when the main engine is standing idle. The illustrations and text cover the engineering phases of the subject, including methods of operating barometric and surface condensers, the effect of air in the condensers of steam turbine plants, description of a typical street railway power plant, etc. Copies of this booklet will be supplied upon application.

THE CENTRAL ELECTRIC COMPANY, of Chicago, Ill., is mailing out to the trade a price list dated October, 1907, which applies to the company's 1906 and 1907 general catalogue No. 24. This price list has been revised to date and contains the very latest market figures in force at this time on all electrical appliances shown in the company's catalogue. It will therefore be of considerable interest and benefit to all purchasers of electrical material, and the company requests that all holders of its catalogue who have not received a copy should write for one. In the back of the price list considerable space is devoted to the W. U. steel bracket, which is intended to replace the ordinary oak wood brackets. Attention is also called to the Central Electric Company's fixture department, a cut of a very attractive reading lamp is shown, and the company states that this department is carrying a large assortment of the most up-to-date lamps and lighting fixtures and will be glad to submit designs and quotations upon request.

Business Notes.

KEUFFEL & ESSER COMPANY, the well-known maker of scientific instruments, drawing materials, etc., has opened its new building in San Francisco at 48-50 Second Street, where it will carry a very large and complete stock. A special feature of the new branch will be the fine blue printing establishment.

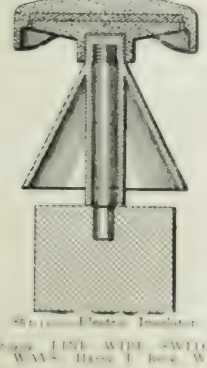
THE CHICAGO SHOW.—In order to assist in the general publicity plans for the third electrical show in Chicago a number of the exhibitors have promised Manager Niesz to insert in their advertisements in the trade papers a line referring to their exhibit. This is a new and novel scheme of co-operation that ought to do good.

THE HELIOS MANUFACTURING COMPANY, of Philadelphia, is now ably represented in New York City by Messrs. F. S. Gassaway and L. W. Brownrigg, who have opened offices at 18 East Forty-second Street. Mr. Gassaway is very widely known among the supply men, and Mr. Brownrigg is devoting his attention particularly to the export trade. The combination is a strong one, and not only promises to be a decidedly advantageous arrangement for the Helios company, but also a great convenience to the New York dealers and contractors who desire the Helios [illegible]

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. [illegible]

[[illegible]cted by Ro[illegible] & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]



[illegible] Electric Insulator

[illegible] Electric Lamp

[illegible] LINE WIRE SWITCH [illegible] FOR ELECTRIC RAILWAYS [illegible] Has a [illegible] vided with a pivotal connection with the body part. Provides for shifting at will the angle of inclination of the main line splice-piece with respect to any branch line.

868,110. ELECTRIC LAMP; Alexander P. McArthur, Orange, N. J. App. filed Oct. 9, 1905. Form of incandescent lamp having a reflector fixed within the usual globe so as to be kept in the most efficient relation to the filament at all times.

868,122. ELECTRIC INSULATOR; Francis J. Poinan, Rochester, N. Y. App. filed July 30, 1906. In order to prevent puncture of an in- [illegible] including a layer of laminated mica.

[illegible] geles, Cal. App. filed Nov. 30, 1906. Has a plurality of plates adapted to receive the necessary medicaments, and means for adjust- [illegible]

868,128. ELECTRICAL MEASURING INSTRUMENT; Frank W. Roller, Plainfield, N. J. App. filed April 25, 1906. Has a movable ele- [illegible]

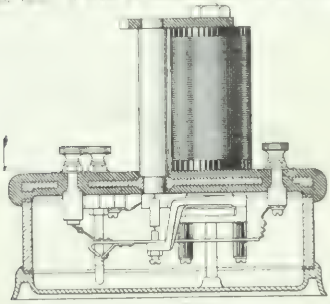
868,141. FUSE BOX; John O. Stivers, Denver, Col. App. filed Oct. 26, 1906. A plurality of fuses are carried on the periphery of a rotatable block which is propelled by a ratchet device so as to place the different fuses successively in circuit closing relation.

[illegible] ALTERNATING-CURRENT MOTORS [illegible] method of controlling an alternating current motor having a com- [illegible] netization of the stator winding, which consists in connecting the [illegible]

[illegible] MACHINE [illegible]

[illegible]

868,233. ... RELAY; ... [illegible]



868,... —Relay.

graph relay, including sheet metal plate with a hard rubber covering, the metal being cut away at the location of the various screws, etc.

868,233. ELECTRIC IGNITER FOR GAS STOVES; Alfred M. Tunkington, Berkeley, Cal. App. filed Sept. 25, 1906. A lever is mounted to be moved by the turning of the valve for the gas so as to swing into contact with a fixed blade or pin included in the sparking circuit.

868,245. AUDIPHONE; John A. Baker, Seguin, Texas. App. filed Aug. 1, 1904. Details of apparatus having a plurality of horns and diaphragms vibrated by electromagnets.

868,... MANUFACTURE OF LITHOPONES BY ELECTROLYSIS; [illegible] ... precipitating the sulphate of soda.

868,254. WATER ALARM APPARATUS FOR VESSELS; Francis Daniel, West Somerville, Mass. App. filed June 10, 1907. An apparatus located in the hold of a vessel to indicate the presence of water therein. Includes a float which rises to engage a push button [illegible]

868,... SUPPORT FOR ELECTRICAL RESISTANCES; [illegible]

868,... ELECTRIC INCANDESCENT LAMP BASE; [illegible] ... is insulated from the threaded shell.

868,300. TERMINAL OR CONNECTING CLIP FOR ELECTRIC WIRES; Harry E. Sohmer and William H. Benjamin, Montclair, N. J. App. filed April 13, 1906. A metallic hook designed to form the terminal of a wire [illegible]

868,302. SIGNALLING SYSTEM FOR RAILWAYS; Louis H. Thullen, Edgewood Park, Pa. App. filed May 28, 1906. Signal system having sectional track rails, the separate rails of a pair at a section being connected by inductive bonds. Has alternating current and polarized relays.

868,345. PROCESS OF TREATING FERRUGINOUS BLENDE; Woolsey McA. Johnson, Iola, Kans. App. filed Jan. 11, 1904. The process of producing zinc which consists in passing an electric current through a charge containing a compound of zinc and metallic iron, thereby heating the charge and reducing the compound of zinc.

868,348. HOOK-OPERATED ELECTRIC SWITCH FOR ELECTRIC LIGHT CIRCUITS; John Kramer, Syracuse, N. Y. App. filed [illegible] ... lamp circuit.

868,354. SIGNAL SYSTEM; Bernard F. Merkel, Salida, Col. App. filed May 1, 1907. Mechanical and electrical features of a construction by which a signal is displayed directly in advance of the train [illegible]

868,368. WIRE SUPPORT; Louis Steinberger, New York, N. Y. App. filed Oct. 5, 1906. A form of hanger for trolley wires having a form of bayonet joint fastening between the insulator and its connected parts.

868,376. RAIL BOND; Darwin Ulke, Chicago, Ill. App. filed July 28 [illegible]

[illegible]

868,... SYSTEM OF ELECTRICAL DISTRIBUTION; [illegible]

868,... SYSTEM OF ELECTRICAL DISTRIBUTION; [illegible] ... modifications of the above.

868,... [illegible] SYSTEM; Harold E. White, Schenectady, N. Y. [illegible] ... press motors designed to ... [illegible] rality of points and to operate slowly when desired.

868,... APPARATUS FOR INCLOSING AND ELECTRICALLY [illegible]

868,... SIGNAL SYSTEM; [illegible] ... for steam railroads where a ... [illegible] than the usual block signal. Has semaphores along the track which [illegible] operated from a despatcher's station over a single [illegible]

868,... COUPLING FOR ELECTRIC CABLES; [illegible]

868,464. CONTROL SYSTEM; Arthur S. Mann, Schenectady, N. Y. App. filed Dec. 18, 1905. An apparatus for pumping the condensed steam in the pipes of a heating system back to the boiler whenever a predetermined amount is accumulated. Switch is closed by mechanism actuated by the weight of the water.

868,... BRUSH HOLDER; [illegible]

868,... ELECTROMAGNETIC APPARATUS; [illegible]

868,... ARC LAMP ELECTRODE; [illegible] N. Y. App. filed Dec. 7, 1904. [illegible] light electrode consisting of a mixture of a powder with granules of a more refractory material than the powder.

868,... CABLE HANGER; Thomas A. Walsh, Yonkers, N. Y. App. [illegible]

868,5... TELEGRAPH AND TELEPHONE INSULATOR; [illegible] porcelain with a narrow groove for the insertion of the wire and formed interiorly on somewhat the lines of a mousetrap so as to prevent the wire from escaping through said groove.

868,... CONTROLLER OPERATING MECHANISM; [illegible] ... so as to prevent a too rapid movement.

868,544. TELEPHONE ATTACHMENT; Joseph A. Gordon, Shawnee, Okla. App. filed Feb. 1, 1907. An auxiliary mouth-piece for telephones comprising a disc formed with a central opening and with a [illegible] ment with the wall of the opening, a screen covering ... [illegible] ... carried by the margin edge of said inclined flange, and locking levers carried by the mar[illegible]

868,... SHAFT OSCILLATOR; [illegible] A magnet is periodically energized [illegible] breaker having carbon points and moved by a reducing gear [illegible]

868,... CONTROLLER; [illegible] Aug. 30, 1905. Controller for electric motor having an interlocking mechanism between the main switch and the cut-out switch of a [illegible]

868,... POLE CHANGER; [illegible]

868,... DYNAMO ELECTRIC MACHINE; [illegible] frames of a generator [illegible] the same and lock the parts in any particular adjustment.

868,... SELF-WINDING CLOCK; [illegible]

868,... SELF-WINDING ELECTRIC CLOCK; [illegible]

868,... ATTACHMENT FOR PARTY LINE TELEPHONES; [illegible] H. Byrne, Denver, Col. [illegible] for cutting lines not in use out of circuit and operable from [illegible]

868,... POTENTIAL STARTER ATTACHMENT; [illegible]

868,... TELEGRAPHIC INSTRUMENT; [illegible] Ill. App. filed Feb. 4, 1907. Relates to a complete telegraph [illegible] strapped to the sleeve of the operator and operating to deliver the [illegible]

Electrical World

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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During 1906 ELECTRICAL WORLD *printed and circulated* 970,000 *copies, an average of* 18,827 *copies per week. Of this issue* 23,000 *copies are printed.*

NEW YORK, SATURDAY, NOVEMBER 2, 1907.

CONTENTS.

DIRECT-CURRENT MOTORS.

While the design of electrical machinery is abundantly covered in books, the operating characteristics of such machinery has had meagre treatment, notwithstanding the fact that for 1000 men who operate dynamos and motors, there are perhaps not a dozen engaged in their design. There are, it is true, a number of so-called "practical books for practical men" which profess to treat of the operation of electrical machinery, but these when not merely perfunctory compilations, are usually based only on the limited personal experience of the writer. A notable exception as a practical treatise is "The Management of Dynamos and Motors," by Crocker and Wheeler, which owes its great success to the fact that the information conveyed is associated with the principles of the apparatus considered, whereby the reader's understanding of the subjects presented is broadened and practical deductions are firmly impressed on his mind. With this issue we begin the publication of a series of articles written by Prof. F. B. Crocker, one of the authors of the book above mentioned, in collaboration with Prof. Morton Arendt, which work is also exceptional in its method of treatment as compared with other treatises on the direct-current motor. This treatment consists in emphasizing the action and control of the motors rather than their design. Heretofore, writers in dealing with the electric motor have not given to the matter of control the attention which it appears to deserve. Sometimes one or two methods are set forth practically, but many of the important ones are merely referred to or omitted altogether. Another fault characteristic of writing on this subject is the employment of imaginary machines as examples. The armature and field circuit resistances are assumed, the change of resistance by temperature rise probably overlooked, and the voltage drop occurring at the brush contacts is included in the armature resistance, notwithstanding that it does not vary with the current. In the present series of articles, every factor entering into the action of motors is taken account of and given its due weight, and all examples and the conclusions based upon them are real and with relation to the standard machines of to-day. The first article deals with general principles of the direct-current motor, and in succeeding articles the various types of motors and methods of control will be taken up and thoroughly considered in detail.

THE BERLIN CENTRAL STATION.

In the Digest will be found an abstract from the *Elektrotechnische Zeitschrift* of a very complete and instructive account of the station, or rather group of stations, supplying Berlin with electrical energy. As in the case of every great city, the electric supply service of Berlin has been an evolution, proceeding somewhat timidly and slowly at first, and then with splendid rapidity. At the start the distribution was over the usual three-wire network at 2 x 110 volts, and the result was, as in most large cities, a futile reduplication of stations in

the vain endeavor to keep up with the game. In various places different temporary expedients were adopted to extend the radius of distribution. Paris went to a five-wire system, most American stations ran up their feeder losses to amounts which they would now hardly care to confess, and Berlin built more stations. Eventually everybody had to step up and take his medicine, laying aside the ancient prejudice against alternating current and adopting polyphase distribution from large and economical generating plants and using the output in the form best fitting existing conditions. In Berlin the inner city is supplied with direct current as before, while the outlying districts are supplied with a three-phase, 3 x 220-volt service, with all primary, and most secondary, mains underground. The transforming stations are mostly in little kiosks where the apparatus is very accessible.

The evolution of the system is as yet far less complete than in Chicago, for instance, which has not far from the same population. The American city has worked out more fully the centralization of the generating plant and the organization of the service. Berlin still has six stations in which energy is generated, besides eight more in which there is transformation from alternating to direct current. All save the two great generating stations, Oberspree and Moabit, and a single smaller station, have storage batteries. Yet the Berlin plant has taken the step at which several of the big American cities have hesitated and put in its three-phase equipment at 50 cycles. Both motor-generators and rotary converters are used at this frequency, the latter being generally provided with an auxiliary regulating armature, a feature substantially unknown in American practice. The transformers are generally of the combined three-phase type, which, while long standard in Europe, we on this side of the water are just beginning to make acquaintance with. The equipment of the Berlin plant is still far from reaching the unity of apparatus common here; the machinery is more diversified and the progress towards consistent development has been less rapid than here. In the large features the American stations are certainly ahead; in some of the technical details they are as certainly behind, owing less to lack of enterprise than to over-hasty standardization. In point of efficiency, the German apparatus compares very favorably with that of the best makers here. A three-phase transformer is mentioned, for example, which, although of but 1200 kilo-volt-ampere output, has a full-load efficiency of 98.7 per cent.

Some interesting details of the steam practice are given, which should furnish food for thought. As in this country, the steam turbine is making rapid progress in Germany and has been introduced in all the recent work in Berlin. Not only is its importance in saving space fully recognized, but it seems to have been well established that it gives materially higher economy. It also appears, however, that the reciprocating engines in the Berlin stations beat out not only all their class here, but the vast majority of American turbines of anything like the same output. A 3000-hp-reciprocating-engine set, for example, giving the kw-hour on 14¾ lbs. of steam should make the American engineer sit up and take notice. This performance is a little better than that of a 7500-kw-turbine set recently tested in one of the largest central stations here, and considerably better than the figures reached by the usual American turbine of similar output. The Berlin turbines, however, have this engine performance badly beaten, since for a 3000-kw unit they have reached the low figure of 13.2 lbs. of steam per kw-hour, and on occasion they have knocked 10 per cent off even this result. This beats the best recorded figure for American turbines even of three times the output. To do our turbine builders justice, the extraordinary German results are due mainly to the use of liberal superheating. Most American engineers are mere tyros at this game, plodding along 10 years behind the times, putting up long-winded excuses instead of superheaters. When they once pluck up courage and get into the business with the energy they have displayed in some other things, the records will get a shaking up. But to-day, afloat and ashore, they are lagging, as witness one of the big foreign freighters plodding on her daily course with a consumption of less than one pound of coal per hp-hour, thanks to superheat and high expansions. Perhaps a few years of such teaching by example will produce results where precepts have failed.

Direct-Current Arc Lamp for Testing Purposes.

It is well known that the direct-current arc lamp may be made to produce high-frequency alternating currents, by applying to the arc a branch or shunt circuit containing a suitable condenser and inductance coil in series, the phenomenon having first been recorded by Prof. Elihu Thomson. The arc and the branch circuit tend to form a closed local alternating-current circuit. The arc is traversed by the exciting direct current and also by a locally superposed alternating current. The resultant current through the arc is, therefore, pulsating. The rapid pulsations of current give rise to corresponding pulsations of vapor pressure, that set up sound waves in the surrounding air, and the arc tends to sing, or emit a musical note, of a pitch corresponding to the frequency of the alternating current. The properties of the singing arc have been investigated by Duddell. A rough mechanical analogue of the singing arc is presented by various prenomena of friction. If we rub a finger over the moistened surface of a massive solid, such as a wooden table, we do not readily elicit therefrom a musical note. The frictional pressure along the table is steady. If, however, we similarly rub the finger over the surface edge of a small body which is adapted to vibrate, such as a small bell, a glass tumbler, or a glass bowl, we may readily throw the body into vibration, and make it sing. Owing to the elasticity of the body, the frictional pressure along its edge exerted by the finger, is not steady, but becomes vibratory in conformity with the natural rate of vibration of the tumbler. In the same way, the ordinary direct-current arc lamp may be regarded as a simple frictional resistance which does not present any elasticity, or tendency to oscillate, under the stimulus of a steady current; but when shunted by an elastic circuit containing a condenser and induction coil, the stimulus of a direct current may throw the arc and elastic circuit into vibration. The frequency of the alternating current set up in the elastic local circuit of the arc will depend upon the natural frequency of that circuit as determined by the magnitudes of the capacity and inductance jointly, with a correction for the resistance of the circuit. If the capacity and inductance are both small, the frequency of oscillation will be relatively high, and the arc will tend to sing a high note. If the capacity and inductance, or either of them, is enlarged, the frequency of oscillation will be lowered.

The oscillating arc in air has been used in Germany for producing oscillations in a wireless telegraph air-wire at the sending station, and Poulsen has applied the oscillating arc in hydrogen to the same purpose. An article by Mr. C. Heinke, of Munich, as noted in our Digest, appears in a recent number of the *Elektrotechnische Zeitschrift* on the application of the singing arc to alternating-current measurement. The article shows that an ordinary small direct-current arc, taking about 2 amperes with 50 volts at carbons or condensing, say, 100 watts from a direct-current circuit, may excite an alternating current of about 5 amperes at an alternating e. m. f. of some 35 volts or say 175 volt-amperes of apparent power, the frequency being perhaps from 30,000 to 50,000 cycles per second. These frequencies are above the limit of audibility, so that the arc does not emit under these conditions any audible note. If an attempt is made to take power from the arc, the elasticity of the shunt circuit is destroyed after a certain amount of load is included, so that only a relatively small amount of alternating-current power can be taken from the oscillating circuit, say 30 watts in the case of a single little arc lamp. This, however, is sufficient for many testing purposes, where the alternating-current power required is trivial. The interesting fact is thus emphasized, and illustrated in a variety of experimental ways, that an ordinary direct-current arc lamp may be looked upon as a possible laboratory generator of sinusoidal alternating currents. Whereas, an ordinary alternating-current generator has a fixed frequency, the arc-lamp generator can be made to give any frequency from a few hundred up to hundreds of thousands of cycles per second, by adjusting the capacity and inductance in its circuit. As against the advantage of this flexibility of control in frequency there is, of course, some offsetting disadvantage in unsteadiness of frequency if any change be made in the alternating-current circuit.

Small Isolated Plants.

It is well understood in the present state of the art that electric lighting from isolated plants is being hard pushed by the central stations. The day of special rates for the purpose of knocking out isolated plants is perhaps waning, yet the secret rebate or its equivalent in case central station service is taken and the obnoxious dynamo removed from the basement is a well-known though none too respectable member of electrical society. Some day the public will get tired of paying the basic price to help central stations extinguish competition and there will be rigorous regulations established to prevent this unjust discrimination. But even so, the central station can profitably replace isolated plant service in a singularly large number of cases, considering the ease with which an isolated plant can be built and operated. Of course, the station has the advantage of generation on a very large scale, but to offset this it has a very heavy general and distribution expense and is usually trying to pay dividends on the capitalized depreciation of the last decade, so that in total cost of product its advantage is less than would at first seem probable.

The reports of operation of isolated plants are generally too imperfect to allow a fair judgment of the real cost to be made and the quality of the service is not taken into account, so that the actual competitive figures on cost are for the most part very uncertain. It seems, therefore, worth while to examine some of the common failings of isolated plants with a view to examining their causes and possibly the appropriate remedial agents.

In principle an isolated plant of moderate size, say a hundred kilowatts or so, should generate energy if the load factor be reasonably high at a figure that would make the central station man groan. It is not that the generating costs themselves are high in the latter's practice, but that the incidental and distribution expenses run to necessarily large figures. Yet we think that the reputed economy of the isolated plant is very often rendered illusory by bad load factor and a relatively very large cost of labor. Of late it has been the fashion for the gas companies in hustling for business to put out statements of a very roseate character concerning the cost of producing energy by gas engines. Now there is no manner of doubt that given steady load at a good load factor, a gas engine plant judged by the fuel bill alone, can deliver energy at a very low figure, say at the rate of a quarter of a cent per lamp-hour or some such figure. On the other hand, the usual attendance, repairs and depreciation account at the present time make so large an increase in the cost of output per kw-hour as to give a very sorry looking balance sheet in the majority of cases. And unless there is skilled attendance the regulation of the gas engine plant is likely to be shockingly bad. Even in the case of comparatively large steam driven isolated plants the service is frequently very bad, as we showed in several articles recently published. An engineer who looks after an electric plant incidentally generally delivers a merely casual voltage. When an isolated plant, say in a big hotel, rises to the dignity of a proper operating force and a large load it can give thoroughly first-class service and can and does make the central station hustle to cut under it in price.

The fact is that up to the present time no one seems to have made a specialty of fool-proof isolated plants. A generator of the kind that comes handy is coupled to any gas engine that the glib tongued agent unloads, a cheap switchboard is put in and the affair starts off. The possibility of a compact direct coupled engine set with really good automatic regulation, and the safety appliances that will enable it to run practically without more than casual attention, has not yet been realized. However, if one bears in mind the really wonderful work of gasoline engines in the "sealed bonnet" automobile competitions, and realizes that a stationary gas engine should do much better, it seems reasonable to suppose that a self-contained automatic lighting set is well within the range of possibility, not to say probability. Such apparatus could very well be produced up to fairly large capacities—large enough to replace steam-driven sets in all but the largest installations. Or supplied with gasoline it could be used without the least dependence on the gas companies, anywhere. To be really in competition with gas lighting and acetylene, the isolated electric plant must be reduced to some such simple terms. *Per se* electric light is far more desirable than any other illumination, but it is still too costly to compete with gas on anything like even terms save where cheap hydraulic power is available. Improvement must come through improved lamps and cheaper generation on a modest scale, or else by a reversal of policy and the cultivation of the

smaller consumers by the electrical supply companies. Tantalum and tungsten lamps and automatic lighting sets would form a combination able to put electric light in thousands of places where it is not now used. In the long run even the central stations would reap the benefit, since every electric lamp installed helps on the general demand.

Free Residence Wiring.

In the early days of electric lighting many central-station companies, in order to get the electric light introduced, did a large amount of free wiring for their customers. This practice rapidly disappeared, however, because it came to be generally recognized that electric wiring, like gas piping and plumbing, is an integral part of the house, and that it should therefore be paid for by the owner of the structure rather than by the company supplying the service. To some old-time central-station men who were glad enough to get rid of the electric wiring burden, the article elsewhere in this issue on the wiring of 1200 houses free at Pueblo, Col., may cause somewhat of a shock. It seemed like a rather radical proposition to the central-station men at the Colorado convention when Mr. J. F. Vail, of Pueblo, told what he had been doing. Further investigation of the conditions under which it was done shows that the method of getting business is not quite as heroic as it would seem at first thought. In fact, it probably cost less to get these residence customers in this way than if the company had spent several years soliciting them. In the meantime they are on the lines and paying the regular revenue. It is not every place that conditions are as favorable to a movement of this kind as at Pueblo. Its success depends on the presence of a large number of small houses which can be cheaply wired and which are occupied by tenants earning good wages who will spend money freely for electric light after once it is installed. In a community where the cost of wiring per house would be 8 or 10 times that under the peculiar conditions at Pueblo, and where the revenue per house would probably be no greater, the plan of course would not be successful. The plan is one which should work best in manufacturing and mining communities, and there are doubtless many places besides Pueblo where it is the cheapest way to get this fairly profitable class of business. This business is more profitable than that from large scattered residences, as it has a better load factor, and more revenue can be obtained from a given investment in transformers and lines. In fact, the load factor of this class of business is frequently better than of store lighting, which pays a lower rate.

Data on City Water Pumping.

The data given by Mr. H. P. Gunnison on the Grosse Pointe waterworks' electrically operated centrifugal pumps at the Michigan Electric Association convention, published elsewhere in this issue, are of considerable interest to companies which contemplate entering into pumping contracts with their city waterworks. The present instance represents about what can be done with centrifugal pumps of very good efficiency operating under the rather adverse condition of a suction lift of from 15 ft. to 20 ft. Such high suction lifts are not favorable for either the economy or best operation of the centrifugal pump, but, as shown by the Grosse Pointe experience, the economy and reliability are far better than those of the steam pumping station which such a plant usually supersedes. For ideal operating conditions centrifugal pumps should be so located as to be below the water level at starting. When this is done the necessity for attendance is reduced to a minimum and they can be operated with automatic starting appliances, as are many reciprocating waterworks pumps at the present time. Another interesting feature about the Grosse Pointe plant is the terms of the contract with the city, payment being based upon a certain amount per million gallons of water pumped. This is probably the most satisfactory form of contract to both parties, as city officials naturally prefer to contract for gallons of water delivered rather than kw-hours supplied to the pump motors. The information on cost of pumping with steam and electric pumps and on kw-hours per 1000 gallons given by Mr. Gunnison, while not laying any claims to extreme accuracy, nevertheless gives central-station companies figuring on city pumping contracts much data that may prove of value. The results show roughly that about 1 gal. per watt-hour can be counted on with 41 lbs. average water pressure and 16 ft. to 20 ft. of suction lift.

Unprogressive Gas Users.

Unquestionably, a gas mantle burner operating on cheap gas or gasoline can produce a large amount of light for little money if fuel expense only is considered. Nevertheless, gas and gasoline lighting are rarely found in the most progressive stores. When a central-station company's rates are right and service good, gas and gasoline competition should not be very serious in any town, provided the central-station company puts the matter before merchants in the proper light. The opinion of a successful merchant, quoted elsewhere in this issue in the "Sale of Current" department, expresses very concisely the opinion of a community generally as to the unprogressiveness and inferior standing of a merchant who persists in using gas or gasoline for lighting. Gas is recognized as out of date by the public generally, and the merchant who insists on using it for the sake of an apparent saving of a few cents is likely to fall in the public estimation the moment he does so unless the general policy and the illuminating engineering ability of the central-station company are so atrociously bad that the gas lighting seems good by comparison with the electric installations in the town. The best way of bringing home to a merchant the bad position in which he puts himself before his customers when adopting gas lighting is to call his attention to how absurd it would seem to think of the most successful merchants in the larger cities using gas for lighting. The unthinkable nature of such a proposition and the personal pride of the merchant in his business will do more to throw out gas and gasoline competition than anything else, provided, of course, as we said before, the electric service and rates are what they should be.

Increasing Revenue from Present Customers.

Some information of direct commercial value to central-station companies is contained in the account published elsewhere in this issue of the experience of the central-station company at Denver with a class of solicitors called service supervisors. It is the duty of these service supervisors to look after increasing the revenue from the company's present customers. They make no effort to get new customers. The

work so far at Denver has been confined to the residence districts. No central-station man worthy the name needs to be told that an increase of revenue from existing residence customers is one of the most profitable forms of increased business there is. It is the kind of business that shows up on the right side of the ledger at the end of the year, for it usually involves no additional construction cost and little, if any, increase in the maximum demand. The majority, however, before reading the Denver experience would probably much underestimate the amount of increased revenue which could be secured with a given amount of solicitation in this class of business. When a dollar spent in solicitation means an increased yearly revenue of from $2 to $3, and when the revenue from existing customers can, in a short time, be increased 28 per cent without any investment on the company's part other than that invested in solicitation, the proposition is worth looking into. Of course, Denver conditions are decidedly different from those which prevail in the majority of Eastern cities of the same size. The great majority of residences already use electric light. Growth of business in the residence district is therefore dependent on the natural growth of the city and the possibilities of increasing revenue from existing customers. As our readers well know, the Denver field has been very thoroughly worked by a large and efficient central-station commercial department for five years past. The recent changes in that company's soliciting organization which provide for a much larger percentage of soliciting effort to be devoted to increasing the revenue of old customers, is a natural outgrowth of the activities displayed in Denver. It is also an evidence that under Denver conditions the service supervisor is able to show greater results per dollar expended in his work than a man who is looking after all classes of business. The conclusion must not be reached, however, that in other cities where the field is much under-developed as compared with Denver, the time is yet ripe for devoting so large a proportion of the attention to existing customers. In the residence districts of the majority of cities there are so many residences which are on or near existing secondary lines and which could be connected at very small cost, that a great deal of attention should be paid to getting this class of customers. If a company has been at all wide-awake about its distribution system, nearly every residence in town is within reach of the service and every new residence customer connected, means an increase in the percentages of gross and net revenue earned on the investment.

The Lighting of a Large Retail Store.

Illuminating engineers, as well as merchants, have been watching with much interest the past eighteen months the practical tests on a large scale of several modern competitive systems of store lighting which have been carried on in Chicago's largest retail dry goods establishment. The presentation of Mr. Frederick J. Pearson's paper on the lighting of that store before the recent meeting of the Chicago section of the Illuminating Engineering Society was, therefore, an affair of more than local interest. Probably never before in the history of illumination have comparative tests been carried out on such a large scale as in this case. Large areas of a large store were given over to trial installations, and fortunately these installations were so located that direct visual comparisons could be made by any observer. Such visual tests were supplemented by engineering calculations and by measurements of the illumination in foot-candles at certain points on the store counters. Mr. Pearson is undoubtedly right when he lays emphasis on the fact that a direct comparison by inspection made by any ordinary person and by the sales managers of the store is more to be considered than the results of measurements of illumination open to more or less error, although such tests were given due weight. While the tests of several competing modern highly efficient installations are of much interest, even more interest attaches to the striking difference between the old inefficient arrangement and the modern, well-designed installation. Those who have frequently visited the store during the progress of these tests know full well that the improvement in general appearance and good impression on the public is fully as marked as the improvement in efficiency shown by the engineer's figures. Roughly speaking, almost any of the well-designed modern systems tried in this store gave better illumination on the counters than the old system with one-half the power used by the latter, and this too with an immense improvement in the general appearance of the store. Could anything more strikingly illustrate the practical importance of good illuminating design? The difference in efficiency is by no means to be credited entirely to the better efficiency of the recent high-efficiency lamps. It is due fully as much to the fact that the new methods make use of a larger percentage of the total light given out from the lamps.

The old method of lighting was by chandeliers hung low with lamps in glassware which allowed the light to escape about equally in all directions, with the result that a large percentage never reached the counters. All of the well-designed modern systems tried consisted of units in which a large percentage of the useful light was directed toward the counters, thus securing high efficiency even though the units were placed high up near the ceiling where they were out of the line of vision. Thus, the new systems allowed the customer to look far across the store and see well-lighted goods rather than an array of blinding lamps on low chandeliers. Furthermore, the units placed high near the ceiling obviate the many annoying shadows from store fixtures and goods hung up for display that were present with the old system. As to the relative efficiency of the various modern installations tried, it was a very close battle, judging both from the figures given by Mr. Pearson and by the every-day observation of a number of illuminating engineers who have been watching the game. The final selection seems to have hinged on color, general impression created on sales managers and others and on the guarantees manufacturers were willing to make on cost of lamp maintenance covering a considerable period. As Mr. Pearson remarked during the discussion, such guarantees embodied in a contract looked very different from the off-hand figures given as to the probable life of lamps. Another interesting thing brought out during the discussion was that even though we are in the midst of great improvements in lamp efficiency, and a decision reached to-day may not be the decision which would be reached to-morrow in deciding upon the lamp use in a large installation, it was, nevertheless, entirely safe in this case to change the entire system of illumination without hesitation, for the reason that enough operating expense could be saved in a short time with the new, as compared with the old installation, to pay for the change, even though the new system were thrown out for something more efficient within a relatively short time.

Economic Changes in a City Charter.

The Merchants' Association of New York, through its board of directors has made a number of suggestions to the Charter Revision Commission as to desirable changes in the city charter. One of the most important of these is that a special commission be appointed to analyze the functions of every branch of the city government, and formulate a proper system of accounting and statistical record for each, in order that the annual outlays of each may be effectively scrutinized and the annual requisitions presented in such form that the Board of Estimate and Apportionment can act thereon with full knowledge. The association contends that at present the city budget is largely voted upon requisitions in bulk without adequate exhibits of expenditures in detail, and without the statistical records necessary to intelligent judgment upon the proposed outlays. In consequence many of the appropriations for various purposes are largely in excess of the amounts actually needed, and cover great waste.

The association believes that such a commission should be composed principally of business men with large experience in directing the accounting, reporting and auditing of large business enterprises with a view to economical administration by means of concrete and readily understandable reports in such form as to fully exhibit all transactions; and that the comptroller should be ex-officio a member. The commission should have at its command an adequate force of expert accountants, engineers and clerical assistants.

To do away with present conflicts of jurisdiction and concentrate responsibility, the association recommends that the borough presidents be divested of the control of highways, sewers and incumbrances; that the Department of Street Cleaning be abolished, and that the Department of Water Supply, Gas and Electricity be divested of the control of gas and electricity, of lighting of the streets, and of the restoration of pavements removed for the laying of water pipes. It further recommends the creation of a new Department of Street Control, to have sole jurisdiction throughout the city, (a) of regulating and grading highways; (b) of construction and maintenance of pavements and sidewalks; (c) of openings in streets, pavements or sidewalks and the restoration of the pavement or sidewalk disturbed by such openings, including pavement removed by the Department of Water Supply; (d) of cleaning the streets, and disposal of street wastes; (e) of building materials and other incumbrances in the streets; (f) of the operations in the streets of gas, electric lighting, telephone, steam and other public service corporations; (g) of lighting the streets; (h) of the construction and maintenance of sewers; (i) of the construction and control of vaults under sidewalks, openings into vaults, protection of areas, hoistways, etc.; (j) of showcases, awnings, obstructions on sidewalks, structures within the stoop lines, and similar street encumbrances.

It is suggested that when a new pavement is to be laid or a pavement opened for any large constructive work, notice be sent to all public service corporations to the effect that the pavement will be opened at a specified time and that such underground structures as they desire to make must be made forthwith; and that no public service corporation be permitted to make any opening for the installation of mains in such street for a period of one year thereafter. In the case of residence streets it might be desirable to require that when water and gas pipes and electric wires are laid in the street, service connection for each lot be extended from the mains to the curb line, in order that when connection with any residence is thereafter desired, such connection may be made without breaking the pavement. An official map of underground structures in the streets is recommended, the absence of such map causing great delay in the construction of underground works, the removal of needlessly great expanses of pavement, thereby resulting in the unduly long continuance of openings in the pavement.

Association of Iron and Steel Electrical Engineers.

The recent meeting in Pittsburg (Oct. 9 and 10) of the Association of Iron and Steel Electrical Engineers was unusually successful for the first meeting of a body so recently organized. The object of the association is the advancement of the application of electrical machinery in the iron and steel industries, and membership is limited to electrical engineers and electrical superintendents in that industry and to those who have done original work of recognized value to the industry. Representatives were present at the meeting from the leading iron and steel companies of the United States. At an election held during the meeting, the following officers were elected:

President, Mr. James Farrington, superintendent of the electrical department of LaBelle Iron Works, Steubenville, Ohio; first vice-president, Mr. J. C. Reed, electrical engineer of Pennsylvania Steel Company, Steelton, Pa.; second vice-president, Mr. G. W. Sturgess, electrical superintendent of the Lackawanna Steel Company, Buffalo, N. Y.; secretary, Mr. G. H. Winslow, electrical engineer of the National Tube Company, Pittsburg, Pa.; treasurer, E. W. Yearsley, electrical engineer of Midvale Steel Company, Philadelphia, Pa.

At the meeting the first day, papers were read by two members, as follows: "Auxiliary Control and Automatic Acceleration of Electrical Motors," by Mr. E. W. Yearsley; "Heavy Duty Load Starting Direct-Current Motors in Steel Plants," by George W. Richardson.

Contributions to the proceedings in the form of papers or informal talks were made by the following representatives of manufacturing companies: Messrs. B. A. Behrend, Gano S. Dunn, D. B. Rushmore, D. S. Kendall, R. B. Treat, E. Heitmann, Jr., F. R. Fortune, R. D. Wright, C. T. Henderson, R. P. Jackson, Paul M. Lincoln and H. D. James.

On Tuesday evening, the Crocker-Wheeler Company gave a dinner to the members, at which there was a discussion of mill motors in continuation of Mr. Dunn's talk in the morning. On Wednesday evening the Allis-Chalmers Company gave a dinner at the Duquesne Club to the association, at which also there was a continuation of the discussion of the day. At the end of the session of Wednesday morning, the members visited, by invitation, the Westinghouse works at East Pittsburg, and after a luncheon given there by the Westinghouse Company, they made a tour of inspection of the various shops.

Electrical Purification of Water.

Prof. Leon Gerard, the eminent Belgian scientist, past president of the National Society of Electrical Engineers of Belgium, gave a lecture before the Western Society of Engineers at Chicago, Oct. 25, on "The Use of Electricity in the Purification of Water." The lecturer dealt entirely with the electrical production of ozone and the effects of treating water with ozone to burn out the organic matter. By way of introduction he reviewed briefly the three methods of treating water to destroy bacteria. The chemical method consists of adding free agents which may, to a certain extent, poison the water while destroying the organic matter. The mechanical method, or filtration, attempts to strain out the bacteria. The electrical method, or treatment of the water with ozone produced electrically, burns, or oxidizes, the bacteria without producing any injurious changes in the water. He described apparatus for producing ozone devised by various investigators, and also, after the lecture, described the apparatus devised by himself by special request. He stated that with this apparatus 50 watt-hours would produce enough ozone to purify, entirely and surely, 1000 gallons of ordinary water.

In the discussion, Mr. L. A. Ferguson, vice-president of the Commonwealth Edison Company, Chicago, stated that such processes are of great interest to central-station companies looking for work which would utilize generating capacity during

hours of light load, and he inquired into the commercial feasibility of such purification systems. Prof. Gerard showed that the cost of treating water even for such a large per capita consumption as exists in Chicago would be so small a proportion of the total cost of supply that it would be entirely feasible, being probably not over two per cent of the present cost. Mr. Ferguson also asked as to the feasibility of purification apparatus in small sizes for schools, large hotels and apartment buildings. Prof. Gerard said that apparatus as low as 10 watts capacity is feasible from an engineering standpoint, but that the cost of such a small apparatus is too great. The working voltage of the apparatus is from 9000 to 13,000. About 11,000 volts is best. A frequency of 60 cycles is admirably adapted to the work.

The Osmin Tungsten Lamp in Austria.

Below are given the results of some official tests made in Austria of osmin tungsten lamps, manufactured by the Westinghouse Metallfaden Gluhlampenfabrik, of Vienna. The factory occupied by this company is the one in which Dr. Auer von Welsbach made his experiments some years ago which resulted in the osmin incandescent lamp; and it was here that Dr. Anton Lederer, one of the former assistants of Dr. Welsbach, developed the osmin tungsten filament lamp. Dr. Lederer started as far back as 1902 to experiment with tungsten filaments, the original osmium process having clearly indicated the way to the use of similar metals for lamp filaments. It was from these works that the German Welsbach Company

WESTINGHOUSE LAMP WORKS, VIENNA

(Deutsche Gasgluhlicht Gesellschaft) originally received information on which it started the manufacture of tungsten lamps in Germany. The factory passed under the control of the Westinghouse Company July 1, 1906, together with all of the rights for the manufacture there of osmin lamps.

The Technical Commercial Museum of Vienna (Technologisches Gewerbe-Museum) has tested a number of osmin lamps with the result given below

Lamp No.	Initial Watt per Hefner	Watts per Hefner After [illegible] Hours
[illegible]	1	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	1.03	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

A hefner is about 0.9 candle-power. Of the six lamps tested, one burned out at the end of 1776 hours, which ended the test.

The osmin lamp has been tested by the Vienna Municipal Central Station for variation of candle-power with life. The falling off in candle-power at the end of 2239 hours was found to be [illegible] per cent, the watts during the same period increasing from 1 to [illegible] per hefner. The [illegible] candle-power [illegible] hefners increased to [illegible] hefners at the end of [illegible] hours, at 600 hours it became [illegible] hefners, [illegible] hefners at the end of 1000 hours, and 26.6 hefners at the end of 2239 hours.

At the present time osmin lamps are made at the Vienna factory as follows: 100-130 volts, 25, 30, 40, 50 and 100 hefners; 150-160 volts, 40, 50, 60 and 100 hefners; 200-220 volts, 50 and 100 hefners; 50-60 volts, 20, 30 and 40 hefners. Storage battery lamps are also made for the following voltages: 1.8-2.0, 3.5-4, 5.4-6, 7.2-8, 10, 12, 14, 16, 20 and 24, and in hefners ranging from 0.5-1.6 for the smaller voltages to 12-24 for 24 volts.

Electrical Advances in Mexico.

The electrical development of Mexico is attracting worldwide attention. The fact that the hydraulic plant of the Mexican Light & Power Company, at Necaxa is developing more than 50,000 horse-power gives some idea of the magnitude of electrical enterprises in this country. The Mexican Light & Power Company is a Canadian concern which has invested more than $40,000,000 gold in the installation of electrical plants in Mexico. The energy which is generated at its Necaxa plant is transmitted to Mexico City, Puebla and El Oro, where it is used for lamps and to operate street railway systems and various industrial plants. The system has been fully described in the pages of the Electrical World. The German government sent a commission of electrical experts to Mexico to inspect and investigate the great electrical power plants of the country. This German commission is headed by Geheimrat Gustav Wittfeld. It consists of six other members. They have been in Mexico for some time and much of their time has been spent at Necaxa. The original concession which the Mexican government granted to the Mexican Light & Power Company called for the development of 30,000 horse-power within 10 years. This was in the spring of 1903. Now, in a little less than one-half the time, 20,000 horse-power more than the required amount of 30,000 horse-power has been developed, while with the improvements at the plant which have been under way for some time, this capacity will be increased to about 110,000 horse-power. The German commission will also inspect the El Dura hydro-electric plant of the Guanajuato Light & Power Company, which furnishes many of the mines of the Guanajuato district with energy for motors as well as lamps for the cities of Guanajuato, Irapuato and other places of that region. A number of electrical men from Germany are accompanying the government commission on their trip.

The improvements and enlargements which the Compania Electrica é Irrigadora is making to its hydro-electric plants and transmission system in the state of Hidalgo will have cost more than $3,250,000 when completed. Plans have been adopted for the erection of a new hydro-electric plant at Tetepango. Bids have been received from manufacturers of electrical machinery in the United States and Europe for electrical and turbine equipment for the proposed plant. It will have a capacity of 6000 horse-power. The new Tetepango plant will cost more than $2,500,000. The company is also installing a new plant at La Canada at a cost of about $750,000. This plant will have a capacity of 1250 horse-power. The two plants which the company already has in operation at Juando and Elba have a total of 7000 horse-power. The water for the turbines of La Canada plant will be piped through pipes 90 ins. in diameter for a distance of nearly 1000 ft. It is said that these pipes are the largest in diameter ever attempted. The contract for them was awarded to an American manufacturer in open competition with Europeans. La Canada plant will supply the great cement works and other industrial enterprises of Dublan with energy.

Manuel Cuesta Gallardo, of Guadalajara will install a hydro-electric plant at Puente de Tololotlan, on the Santiago River, about 15 miles from Guadalajara. It will have an initial capacity of 2050 horse-power. He has entered into a conditional contract to supply the mining districts of Etzatlan and Hostotipaquillo, state of Jalisco, with electric power. He will build transmission lines into those districts and expects to have the plant completed and in operation within 18 months. A proposition is also pending from the Compania de Tranvias, Luz y Fuerza, of Guadalajara to furnish the mines of the Etzatlan

and Hostotipaquillo districts with electric power. This company estimated that a double transmission line, with the necessary sub-stations and branch lines would cost $960,000, and a single transmission line $650,000. The mining interests were asked to advance one-half the cost of the proposed transmission line. The prices quoted were $120 per horse-power a year in the Etzatlan district and $135 in the Hostotipaquillo district. Mr. Gallardo has asked an advance of $200 per horse-power contracted for or a total of $410,000, the amount to be paid back in power. He promises to invest not less than $1,000,000 in the project.

A syndicate of men from Montreal, Canada, which owns a concession to install a hydro-electric plant on the Conchos River, in the state of Chihuahua, has contracted with mine owners of the Parral district to supply them with 20,000 horse-power. It is stated that the syndicate has planned to build transmission lines to the cities of Parral, Chihuahua, Santa Rosalina and Jiminez. The proposed plant will have a capacity of 30,000 horse-power. The plans for the plant are now being drawn and its construction will soon be begun, according to recent advices.

A hydro-electric plant of 1000 horse-power is to be installed on the Ameca River in the San Sebastian district, state of Jalisco, by the Natividad Mines & Reduction Company. The plans of the company call for the driving of a tunnel 700 ft. long, and the construction of a canal one mile in length. These works will give the water a fall of more than 100 ft. It will furnish power for other mines of the district as well as its own.

Edward J. Cummings, a capitalist of Guanajuato and associates, are preparing to install a large hydro-electric plant on the Quiotepec River near Tomellin, state of Oaxaca. The plant will have a capacity of 48,000 horse-power. The electrical energy will be transmitted to Puebla, a distance of 130 miles; Oaxaca, a distance of 70 miles, and Taviche, a distance of 100 miles. Energy will also be supplied the intermediate towns of Cuicatlan, Etla, Huitzo, Ocotlan and other smaller places. It is expected that this cheap power will greatly stimulate the mining industry of a number of districts of the state of Oaxaca.

Narcotic Effects of Electricity.

Mr. Nikola Tesla in a recent communication to the New York *Times* says: "I have read with interest the reports referring to Prof. Leduc's discovery of causing sleep by electric means. While it is possible that he has made a distinct advance there is no novelty in the effect itself. The narcotic influence of certain periodic currents was long ago discovered by me and has been pointed out in some of my technical publications, among which I may mention a paper on 'High Frequency Oscillators for Electro Therapeutic and Other Purposes,' read before the American Electro-Therapeutic Association, Sept. 13, 1898. I have also shown that human tissues offer little resistance to the electric flow and suggested an absolutely painless method of electrocution by passing the currents through the brain. It is very likely that Prof. Leduc has taken advantage of the same general principles, though he applies the currents in a different manner.

"In one respect, however, my observations are at variance with those reported. From the special dispatch in the *Times* of the 13th inst. it would appear that sleep is induced the moment the currents are turned on, and that awakening follows as soon as the electrodes are withdrawn. It is, of course, impossible to tell how strong a current was employed, but the resistance of the head might have been, perhaps, 3000 ohms, so that at 30 volts the current could have been only about 1/100 of an ampere. Now, I have passed a current at least 5000 times stronger through my head and did not lose consciousness, but I invariably fell into a lethargic sleep some time after.

"I have always been convinced that electric anæsthesia will become practical, but the application of currents to the brain is so delicate and dangerous an operation that the new method will require long and careful experimentation before it can be used with certitude."

The Use of the Name "Edison" as an Advertisement Restrained.

It may not be generally known that Thomas A. Edison is the originator of a formula for the alleviation of physical pain. It seems that early in his career he compounded a medicinal preparation intended to relieve neuralgic pains by external application. It was first made for the personal use of Mr. Edison and his assistants, and not for sale. In the year 1879, a Mr. Lewis and a Mr. Jacobs went to his laboratory in Menlo Park to examine his inventions. While there, Mr. Edison happened to mention the fact that he had been a sufferer from facial neuralgia, and that he had made a preparation which he had called "Polyform," and which he had found to be a good pain killer. Lewis and Jacobs were so impressed with its merits that they asked him to sell it. He finally agreed to sell for $5,000. The arrangement was that he would apply for a patent and execute an assignment. The patent does not appear to have been issued, but a written assignment of his right to it and to the preparation was made on Sept. 2, 1879. Several different companies were organized to exploit the preparation and each, in turn, failed. Finally the Edison Polyform Manufacturing Company, the present defendant, was incorporated and took up the business. On each bottle was a picture of Mr. Edison and the following words: "Edison's Polyform. I certify that this preparation is compounded according to the formula devised and used by myself. Thomas A. Edison."

Recently an action was brought for the purpose of restraining the use of the name and picture of Mr. Edison in connection with the sale of the medicine. Mr. Edison testified that he never authorized the use of his picture and that he never made nor authorized this certificate. An injunction was granted restraining the defendant from holding out, either in the name of the company, or by pictorial representation, that Mr. Edison was in any way connected with the business. The decision is based upon the theory that a man has a "property" right in his features. This right seems to have originated in an article appearing in the *Harvard Law Review* in 1890, and has come to be known as the right of privacy. Prior to that time, if a man's picture was made use of by commercial pirates for the purpose of advertising their goods, he had no cause of action for damages. Several States, however, have since held that the unauthorized use of one's picture as an advertisement is a proper ground for legal damages. The well-known case of the Rochester Folding Box Company has a similarity to the present action. There the New York Court of Appeals held that a young woman, whose likeness had been printed upon posters advertising flour, was not entitled to damages. The decision was made by a bare majority of the court, former Judge Alton B. Parker writing the opinion, and it has been disapproved of in other jurisdictions. The matter is now controlled by statute in New York State, and the use of the picture of any living person for advertising purposes without the consent of that person is prohibited.

Electrochemistry in France.

Some details as to recent electrochemical advances in France are given by Mr. W. H. Hunt, U. S. consul at St. Etienne. With regard to the electrolytic refining of copper he says that there are several plants in France, and notably at Eguilles, near Sorgues, in Vaucluse, belonging to the Société de Cuivre de France, producing 2 tons a day; Givet, in Ardennes, with a production of 7 tons daily. There are also several minor factories scattered through the territory. All these factories produce copper in a very pure state, but it has to be always melted beforehand, on account of its physical conditions. At Dives, in Calvados, however, this operation is rendered unnecessary by the Elmore process, producing directly plates and tubes of copper by electrolysis, 12 tons daily.

The decomposing of water into hydrogen and oxygen is exploited by the following concerns: Manufactory of St. Vrain, near Ballancourt, employs the Hazard-Flamand process, and produces 200 cubic meters of hydrogen and 100 cubic meters of oxygen per day. La Société Oxydrique Française utilizes in its factories at St. André, near Lille, and Villeurbanne, near Lyon, the Garuti process, in which the cathodic and anodic compartments are separated by an iron partition pierced with a multitude of small holes. The daily production of these works is about 400 cubic meters of hydrogen and 200 cubic meters of oxygen.

The Electro Chemical Company furnishes hydride of lime (CaH), which gives off hydrogen in contact with water. This body, which sells at present at $1.93 per kilo (2.2 pounds), is commercially known under the name of "hydrolith." In the manufacture of soda by the electric process, the Volta Company, whose works are situated near Moutiers, utilizes the Outhenin-Chalandre process, and turns out 800 tons of soda and 2000 tons of chloride of lime per year. About 4000 tons of caustic soda manufactured annually by this method in France. Chlorate of potash is manufactured at St. Michel de Maurienne by the Gall process, and at Chedde, near Chamonix, by the Corbin and Lederlin method. The total production is about 7000 tons annually.

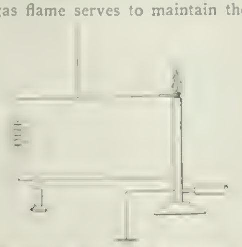
Aluminum is produced principally by three companies, that of Chemical Products, of Alais and the Camargue; at Calypso and St. Felix, near St. Jean de Maurienne; the French Electro-Metallurgic Company, at St. Michel and Chedde, near Chamonix. The total annual production is estimated at 6000 tons.

Carbide of calcium is already manufactured on a very large scale in France. It furnishes not only acetylene gas, but also cyanide of calcium as a fertilizer and as an agent for producing ammonia. Numerous companies employ electricity in the production of ozone, used in the preparation of certain organic products—vanaline, heliotropine, essence of hawthorn, etc. The electro-chemical industry has developed considerably within the last few years in France, and the amount of horsepower used is estimated at 100,000.

Wireless Telegraph Receiver.

Three patents recently issued to Dr. Lee de Forest disclose means for detecting aerial electric oscillations by the aid of a telephone. The wireless telegraph signals are received by causing the electric oscillations developed in a wireless telegraph receiving system to vary the conductivity of a gas maintained in a condition of intense molecular and ionic activity, and having associated and conducting ions.

One of the arrangements used by the inventor is illustrated herewith. The gas flame serves to maintain the medium sepa-



DE FOREST OSCILLATION DETECTOR.

rating the electrodes in the proper ionic activity. The electrode which is placed in the flame, is kept at a high temperature relative to the lip of the burner. Thus there is formed a local receiving circuit possessing a certain asymmetric electrical conductivity, whereby the current from the battery from the relatively cool burner to the more highly heated electrode. The influence of the electric oscillations reaching the antenna produces current variations in the local battery circuit and results in a signal in the telephone.

Reorganized Extension Courses in Mechanical Engineering at Brooklyn Polytechnic.

The Polytechnic Institute of Brooklyn starting this year with the reorganized department of Mechanical Engineering in charge of Prof. William D. Ennis, is offering enlarged courses of extension work through its evening classes. These classes began with purely lecture courses about three years ago, and have developed into valuable adjuncts to the regular college work. They offer to the student employed during the day opportunities for study or review of elementary and advanced mathematics, besides practical courses on engineering subjects.

During the past summer the mechanical laboratories of the institute have been greatly enlarged and large expenditures made for new equipment, which now includes two steam engines with high pressure boiler, one gas engine, one gasoline engine, one 100,000-lb. testing machine, one small testing machine, pumps, meters, etc., besides the usual small equipment for field and laboratory testing. Laboratory courses are offered to evening students, involving the use of portions of this apparatus, and the training of the student in the precise measurements of engineering. A thorough course in machine design is also to be given under the direction of Prof. F. De R. Furman; this will be open to men who have completed the equivalent of one year's work in mechanical drawing, and is intended to fit such men for positions as detail draughtsmen. This course, in common with others offered, will be practical in its nature rather than mathematical. It is given on Fridays at 7.30 p. m.

The courses in heating and ventilating, by Prof. Taggart, given on the same day and hour, are planned to train men in the practical design of the commercial forms of direct and indirect heating systems.

On Wednesdays at 7.30 p. m. there is to be given a thorough course in mill engineering by Prof. Ennis. This will cover the problems met with in the arrangement of buildings, tracks and yards for large industrial works and especial discussion of the various elements entering into their engineering equipment. Attention is to be given particularly to the practical design of such features as crane installations, automatic sprinkler equipment, apparatus for generating and utilizing compressed air and hydraulic operative machines. The general principles covering the economical design of mill buildings will be discussed and exemplified, and the broad relations of engineering equipment to factory organization will be analyzed.

The major course of the series will be that on power plant design, given by Prof. Ennis, on Thursday evenings. This will start with a consideration of the power house as a manufacturing plant, its location with regard to the raw material and the market, the choice of site and standard types of buildings. The various items of equipment will then be discussed, their performance analyzed and their relations to the general problems of design investigated. The object of the course is to fit engineers for actual practice in the design and construction of steam or gas power generating plants. The mathematical knowledge required for admission is elementary only, the subject being one that permits of thorough treatment without an extended use of higher algebra or calculus.

The evening work at the Polytechnic Institute is largely pursued by men who are candidates for a degree. A certain amount of credit is allowed, based upon the courses taken during the evening, and the student has the encouragement of working toward the same definite end as the usual day student.

Self-Excited Alternator.

Three patents, issued Oct. 22, to Mr. M. Latour, of France, are interesting at this time, particularly on account of the date of application, July 9, 1901. The patents reveal an induction motor with a commutator on the rotary secondary used as a [illegible] The scheme employed

seems to differ from that with which the name of Heyland is frequently connected in that no resistance is connected between the commutator segments. One of the patents deals with a self-exciting alternating-current generator, consisting of an armature having a distributed winding and a many-part commutator, and a distributed field winding supplied with polyphase current. The other two patents are limited to the use of this machine as a shunt-wound generator and as a compound-wound generator, respectively.

George Westinghouse.

The New York *Times*, in speaking of the recent financial storm, and its results, says: For Mr. Westinghouse himself, the utmost sympathy will everywhere be felt. The regret will be general and sincere that he should suffer even temporary embarrassment. He has done so much for the splendid industrial evolution of the country, his enterprises have been so varied and so important, he has carried the name and the fame of American invention and development in the application of novel scientific principles over such wide areas and everywhere has won for his nation such admiration, confidence and respect, that he presents himself, in a way, as an American institution in whom we have patriotic pride. The wish will be universal and the belief general that he will come through the difficulties he has encountered safely with his material and intellectual resources undiminished, and ready for new triumphs.

The *Boston Herald* says: This undaunted man will surely emerge triumphant from the predicament in which the financial disturbances culminating this week have placed him and several of the great industrial companies of which he is the illustrious and honored head. George Westinghouse is a man who knows no fear and always conquers. * * * * * * Any serious reverse to a man of this character and force would partake of the nature of a public calamity. But he will not permit the present difficulty to seriously retard him. He will go on. It may truly be said of him that he has long been a creator of wealth, a discoverer of opportunity, a powerful influence in the advance of the age. In all lands men will rejoice, for his sake as well as for their own, that his industrial organizations are solvent, and everywhere there is hope that he will be spared for many more years of superb achievement by which armies of labor benefit and the whole body of civilization is aided in its onward march.

Development of the Central Station Industry.

Below is given an interesting classification of the central stations of the country, made on the basis of McGraw's "Central Station Directory," issued by the ELECTRICAL WORLD. The compilation has been made by the Co-operative Electrical Development Association. As will be seen no fewer than 5577 places are dealt with, but of these 1020 are supplied from other points, leaving 4557 as the apparent number of communities; but this would include duplications where more than one central station exists in any given place. Thus it will be observed that one central station is returned in a city of 1,000,000 population and over as not giving night service. This would be both improbable and impossible, but for the fact that the city in question happens to be Chicago, which, of course, whatever minor plants it may have, enjoys the splendid service of the Commonwealth Edison system.

With regard to the subsidiary table showing a total of 1020 towns, these are, as stated, included in the larger table, but are those listed in the Directory as being lighted by companies or plants in other towns. For instance, the Houghton County Electric Light Company lights some 15 or 20 towns around Houghton, Mich., and this "territorial" drift of central station work becomes more pronounced each year, with the consolidation of enterprises and the extension of high-voltage circuits. The issue of the Directory used is that of March, 1907. We are indebted Mr. J. Robert Crouse for the data.

CLASSIFICATION OF CENTRAL STATIONS BY STATES.

Population	[illegible]
1,000 & under	[illegible]
1,000 to 5,000	[illegible]
[illegible]	[illegible]
10,000 — 25,000	[illegible]
25,000 — 50,000	[illegible]
[illegible]	[illegible]
100,000 — 250,000	[illegible]
[illegible]	[illegible]
500,000 — 1,000,000	[illegible]
1,000,000 & over.	[illegible]
[illegible]	5577

CURRENT NEWS AND NOTES.

NATIONAL TELEPHONE CONVENTION.—The National Interstate Telephone Association will hold its convention at Chicago during the progress of the Chicago Electrical Show. The convention dates are Jan. 21, 22 and 23, 1908.

A. I. E. E. MEETING.—The American Institute of Electrical Engineers will hold its two hundred and twenty-second meeting in the auditorium of the Engineering Societies Building, on Friday, Nov. 8, at 8:15 p. m., when Mr. A. H. Armstrong, of the General Electric Company, will read a paper entitled "Comparative Performance of Steam and Electric Locomotives."

TELEPHONES AS COMMON CARRIERS.—As a result of the sale of the Marion County Telephone plant, Marion, Ohio, to the Bell interests, trouble has arisen that will probably result in the courts being asked to decide whether telephone companies are common carriers. It seems that the United States Telephone Company has refused to accept messages from the company, and it has charged that both the long-distance companies are common carriers and are, therefore, compelled under the law to accept the messages. The Bucyrus Telephone Company, of Bucyrus, has refused to make a trunk-line connection with the Marion County plant, and it is believed that most of the other independent companies will do likewise.

SUICIDE BY ELECTRICITY.—A special cable despatch from London, of Oct. 20, says: "The story of what is believed to be the first case of suicide by electricity was told at the inquest at Kingston into the death of William Brown, secretary of the local football club. Brown was engaged as a carpenter at the electric lighting works, and it was stated that a little while before his death he made inquiries as to dangerous parts of the switchboard. It was supposed at the time he was anxious to avoid risking his life and the fullest information was supplied him. Subsequently he was seen with his hands on two of the terminals, and instantly thereafter he fell dead. The evidence showed he had had no worry, but had suffered from a religious mania, the recurrence of which he feared. A letter was found indicating his intention to commit suicide."

MANUFACTURE OF DIAMONDS.—A special cable despatch of Oct. 26, from Paris, says: "Aristide Charette, a little-known chemist, attained sudden fame this week when a report was read before the Academy of Science telling how he had crystallized carbon by an entirely new process and had thus manufactured diamonds. A test tube with tiny diamonds attached to the sides was shown to the assembled savants and later submitted to analysis. Mr. Charette's method is as follows: A feeble electric current is made to pass during several days through sulphuret of carbon in the presence of iron. The operation is carried out in a vacuum, and thus electrochemically treated, the iron is transformed into sulphuret of iron, and the freed carbon being unable to combine with the oxygen in the air, is deposited in the form of crystals. Although very small, the light and brilliancy of these artificial diamonds equal that of the finest natural gems.

A. S. M. E. ANNUAL MEETING.—The fifty-fourth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York, Dec. 3 to 6, 1907. Symposiums on foundry practice, giving the experiences of prominent men in that work, have been arranged. The specific heat of superheated steam will be taken up, and a very important and exhaustive work by a professor of engineering at Cornell will be presented. The utilization of low-grade fuels in gas producers, combustion control in gas engines, tests of producer gas engines, etc., will be given a session. Other live topics, such as industrial education, power transmission by friction driving, cylinder port velocities, etc., will be discussed. All of these subjects will be treated by prominent engineers of Europe and America, professors of our universities, and men eminent in the particular work of which they write.

INCANDESCENT LAMP FILAMENTS.—Two patents were issued Oct. 22 to Eugene McOuat and Henry W. F. Lawrence, of Amsterdam, N. Y., on filaments for incandescent lamps. The patent earlier in date of application relates to a process which consists in dipping a carbonized core in a caramel solution containing finely divided metallic light-emitting particles in mechanical suspension, the coat thus deposited on the core then being carbonized. By this means, finely divided metals, including oxides or nitrides, are cemented together by particles of carbonaceous matter, and form a continuous and uninterrupted enveloping coat. The second patent relates to a process for making incandescent lamp filaments, which consists of incorporating a metal and silicon in the filament and forming a silicide by reaction between the metal and the silicon components. One method described consists in mixing with the usual filament cellulose material when in a plastic state, a quantity of a silicon and a metal, both in finely divided state, the amount being about 50 per cent of the plastic mass. The filament is then squirted and treated as usual, the heat when it is brought to incandescence serving to create the reaction which produces the silicide.

FOREIGN COMMERCE.—Advices from Washington state that with a view to rendering practical aid to the commercial and industrial interests of the United States and to the promotion of the foreign commerce of this country, Secretary Straus of the Department of Commerce and Labor has caused to be prepared a pamphlet by N. I. Stone, the tariff expert of the bureau of manufactures. The pamphlet contains a study of the commercial situation and conditions, together with a statement of the results already achieved by the Department of Commerce and Labor in promoting America's foreign commerce. It urges that "Congress be brought to a realization of the magnitude and the importance of this task," and give its support with funds commensurate with the work to be done. With a view to developing the most practical plan for rendering the department of greater service to the commercial interests of the country, and at the same time to enable the department to enlist the cooperation of such interests, Secretary Straus has invited the chambers of commerce and boards of trade from 20 of the leading cities of the country to appoint committees to meet in Washington on Dec. 5, to consider with him ways and means of accomplishing these objects.

FLAME ARC LAMP ELECTRODE.—Dr. C. P. Steinmetz has been granted a patent, dated Oct. 15, on an arc-lamp electrode of the type used in luminous arc or flame lamps. It is stated that during the operation of arc lamps of the type to which the patent relates, a fluid pool of molten metal exists at the top of the lower, and generally the negative electrode. The arc in its passage is carried by means of a bridge of vapor issuing from a point on the negative electrode and has apparently the characteristics of a high velocity blast, which causes a noticeable depression in the liquid pool. The arc, however, tends always to pass across the shortest distance between the electrodes, and, therefore, tends to climb up the sides of the depression, and in so doing, a new spot in the electric pool is depressed. The result of this action is a more or less rapid motion of the negative spot over the electric pool and a consequent tremble or rapid flicker of the arc flame. Instead of using a homogeneous mixture for the electrode from which the arc blast issues, the patent proposes a mixture consisting of a practically homogeneous body interspersed with refractory granules of 1/32 in. to 1/16 in. in diameter. When the liquid pool is formed, these grains project above the surface and serve to center the arc blast; except for relatively infrequent transitions of the arc from one granule to another, the arc flame thus remains absolutely steady. An electrode described is composed of powdered magnetite and tantalum intermixed with granules of chromite

ILLUMINATING ENGINEERING LECTURES.—A course of 11 public lectures on illuminating engineering, under the auspices of the Department of Education, New York City, is being delivered in the Y. M. C. A. hall, 5 West 125th Street, New York. The lectures are delivered Wednesday evenings, by Mr. Theodore I. Jones, and will conclude Dec. 11.

PROTECTION AGAINST ACCIDENTS.—The Baltimore, Md., Gas & Electric Company has made a good point in one of its recent circulars advocating the use of electric motors. The circular on its title page calls attention to the fact that "protection against accidents to machinery and operators comes with electric-motor power;" and the text shows how starting rheostats, overload releases, no voltage releases, etc., speed controllers, etc., serve as safeguards and as protective devices in time of emergency. The point is well made, and cannot be too strongly urged.

HARD RUBBER SUBSTITUTE.—A patent issued Oct. 8 to Cæsar Marter, of London, England, describes a composite substance which is claimed to have some or all of the properties of vulcanite or ebonite, and which can be produced at a much less cost than these materials. Spent tan bark or bark containing considerable portions of tannin is reduced to a powder, with which is mixed from 25 to 33 per cent of sulphur. After heating the mixture, with continuous stirring, the coarse black powder resulting is allowed to cool, then ground to fine powder and placed in a suitable mold under pressure; the mold is then heated, and the contents set into a hard, durable mass of the shape of the mold and possessing the properties of vulcanite or ebonite.

CENTRAL STATION STATISTICS.—The September number of the *Central Station List,* just issued by the McGraw Publishing Company, contains the data of 5232 central-station plants in the United States, Canada, West Indies, etc. Of these, 220 are new, not having been enumerated before. No fewer than 2767, or more than half, carry lines of electrical supplies. The greatest number, though not the greatest capitalization, is shown in Illinois, with 385. New York, with the largest capital, has 318. Out of the total, 386 are credited to Canada and 44 to Mexico. Pennsylvania has 325; Ohio, 275; Michigan, 252, and Texas, no fewer than 208; while Indiana has 205, Indian Territory has already 33, Oklahoma Territory, 27, and Alaska, 6.

A BLEACHED COW.—George W. Eberhardt, superintendent of the municipal electric light plant at Lawrenceburg, Ind., reports a strange transformation of his cow. The cow was formerly a coal black animal. A wire from the pole of the electric street railway broke and struck the cow on the back. The animal dropped as though shot, but was soon on her feet again. She continued to tremble for three days. White spots were discovered in various places on the cow after a few days, which continued to grow until now the cow's hair is white. The theory is that fright and not the shock occasioned the complete transformation. Mr. Eberhardt has brought suit against the company for $100, because the cow has given no milk since the shock, although apparently in the best of health.

A. I. E. E. AT LAFAYETTE, IND.—The Purdue University branch of the American Institute of Electrical Engineers held a meeting on Oct. 18, in honor of Professor Benjamin, the new dean of the engineering school. After a brief address by Professor Benjamin, in which he expressed a deep interest in the institute, the discussion centered on the protection of electrical construction from damage by lightning. It was brought out by Professor Plumb that no arresters are in use at Purdue, and because of this omission the 3-kw transformer in the science building was disabled dusing a recent storm. Instances of trolley lines having been put out of service were discussed. A variety of lightning arresters were described by Professor Esterline, who said it was a bold move upon the part of any one to expound a theory of lightning arresters.

MISSOURI LIGHT ASSOCIATION.—The Missouri Electric Light Association was formed recently at St. Louis by representatives of electric and gas lighting and street car companies from different parts of the state. The meeting was held at the Marquette Hotel. The first officers of the association chosen, are at follows: President, Dr. J. D. Porterfield, of Cape Girardeau; first vice-president, W. B. Hays, of Poplar Bluff; second vice-president, W. H. Ledford, of Bowling Green; third vice-president, R. Irvine, of Marshall; secretary, C. Z. Pierson, of St. Charles. The executive committee consists of C. L. Clary, of Sikeston; Thomas Fox, of Cape Girardeau, and Harry Markham, of Brookfield. When the meeting was called the visitors were welcomed on behalf of the city by A. J. O'Reily, president of the Board of Public Improvements. Hugo Wurback welcomed them on behalf of the local electric supply men and Dr. Porterfield responded for the new association.

PRODUCTION OF GRAPHITE.—The U. S. Geological Survey has given out some data as to the production of graphite. Although this country consumes about 35 per cent of the world's total output of graphite it furnishes but 20 per cent of it. The amount imported into the United States in 1906, chiefly from Ceylon, was valued at $1,554,212, and the value of the domestic production was only $340,239. The purest graphite is carbon with 0.05 to 0.20 per cent of hydrogen, but the commercial grades of crystalline graphite contain clayey impurities, even the best, such as some of that from Ceylon, comprising as high as 15 per cent of ash. The production of artificial graphite has steadily increased since 1897, the year of its introduction, and the quantity manufactured in 1906—5,074,757 pounds, valued at $337,204—is the largest yet reported. The use of this product is being rapidly extended, and it probably comes into competition with the natural graphite in many lines of manufacture.

LEGISLATION IN CHICAGO.—A draft of a statute to compel the electrical equipment of all railroads in the city was completed by the council committee on state legislation, recently, and will be sent by Mayor Busse to Springfield with a recommendation for its enactment into law. Another proposed bill to enable the city to regulate public utilities so far as rates are concerned was laid over for further discussion. The law for the electrical equipment of railroads provides that in all cities of more than 200,000 population locomotives must be operated by electricity, compressed air or some other motive power which does not require steam or combustion on the locomotives. The railroads must make the change within three years after the law becomes effective. The railroad companies are made liable to a fine of $500 per day for each locomotive operated by steam after that date. Plans for the change must be submitted to the respective city authorities within six months after the passage of the law.

CORNELL UNIVERSITY.—The report of President Schurman to the Board of Trustees of Cornell University, which has just been issued, shows that for the year ending September, 1907, the total number of regularly enrolled students was 3523. Of this number 82 were studying architecture, 466 civil engineering and 1081 mechanical and electrical engineering. The report proposes a momentous change at Cornell University. Hitherto students upon graduation at the high schools have been admitted to the Cornell courses in law, medicine, civil, mechanical and electrical engineering, and architecture, and on completion of their professional courses have received the professional degrees. President Schurman's recommendation is that in the near future matriculants at Cornell University shall spend one or more years in the study of language, literature, history, economics, political science, etc., before admission to any professional courses of the University. It is noteworthy that of the total income of the University for the year 1906-7, [illegible] was received from the students in the form of tuition, laboratory and other fees.

Remodeled Station of the Watertown Light & Power Company.

IN the early days of electric lighting, it was customary for the parent companies, as they were called, to install an exhibition electric-light plant in a town and light the business district. Local capital was then interested and the parent company would sell out to the stockholders. Thus was electricity introduced in Watertown, N. Y., in 1884, by the Excelsior Electric Company, of Brooklyn; most of the merchants subscribing for stock. Shortly afterwards several armatures were burned out by lightning during a severe thunder storm and many of the stockholders parted with their holdings to Messrs. D. C. Middleton and F. L. Baker. The latter died in 1895 and Mr. Middleton directed affairs until July, 1906, when the old company, the Watertown Electric Light Company, was bought by the present Watertown Light & Power Company.

The Black River, from which the Watertown Light & Power Company derives its power, has its source in the Adirondack Mountains and flows in a westerly direction into Lake Ontario, below Dexter, N. Y. The river is a rather rapid stream, so that from its source to its mouth, there is a chain of dams and falls; there being no less than 20 such dams with a total fall of 500 ft. in the last 30 miles of its length. Within the city limits of Watertown alone, there is a total drop of 112 ft. It can readily be seen, therefore, that with an average flow for nine months of the year of 10,000 cu. ft. of water per second, and with an average flow of 1771 cu. ft. per second at its lowest stage, the river is of vast importance to the villages and towns which line its banks. Most of the power is utilized by paper mills.

The power house of the Watertown Light & Power Company is well situated on the Black River as to center of distribution, being but a thousand feet from the public square, the center of business activity. At the power house site there is a natural fall in the river which is further increased by a low

FIG. 1.—INTERIOR OF REMODELED STATION OF THE WATERTOWN LIGHT & POWER COMPANY.

dam across the ledge of rock at the crest, making an available head of 32 ft. As previously stated, the first equipment consisted of Excelsior arc-light machines until 1889, when a 25-kw, 1100-volt, 125-cycle alternator was installed. With the growth of the city other alternators were added, until, in 1906, the rating of the alternating-current machinery aggregated 550 kilowatts. During this period there were also added two 62-kw, Thomson-Houston 500-volt generators and one 100-kw General Electric generator delivering current, also at a potential of 500 volts. Stationary motors only were used on the 500-volt circuits. Previous to the installation of the 500-volt generators, however, a fair-sized motor load was operated from the arc-light system. The motors used were of the Excelsior Company's make and gave good satisfaction. In fact, one of the motors rated at 10 horse-power, was in operation in the station until

FIG. 2.—BLACK RIVER FALLS AT WATERTOWN.

last spring. Previous to the installation of the first alternator, series and multiple-series incandescent lamps were fed from the arc-light dynamos, and it is interesting to note that from 1884 until late in 1906 the streets were illuminated by the same lamps, supplied from the same generators; or in other words the original equipment was operating until last year.

When the present company assumed control, it was decided to scrap all the old belted machinery and to replace it with new and up-to-date, direct-connected machinery. To do this it was necessary to remodel the buildings to a great extent. At the same time it was decided to make them practically fire-proof, so that reinforced-concrete construction was used throughout. The old wooden flume was also replaced by one of reinforced concrete. The old wooden dam, however, is still used. This

is about 200 ft. long and is 10 ft. high. About 3600 horse-power is available at the falls, but of this the Watertown Light & Power Company has a right to only 1500 horse-power at normal flow.

With the rebuilding of the station, three Holyoke twin water-wheels were installed, each of which has direct-connected to it a 240-kw, three-phase generator. At the other end of the plant are two vertical wheels geared to a horizontal jack shaft. This shaft formerly drove small belted generators, but now has a 240-kw generator direct-connected to it by a flexible coupling. This water power was acquired after the original development, which accounts for its separation from the other water-wheel units.

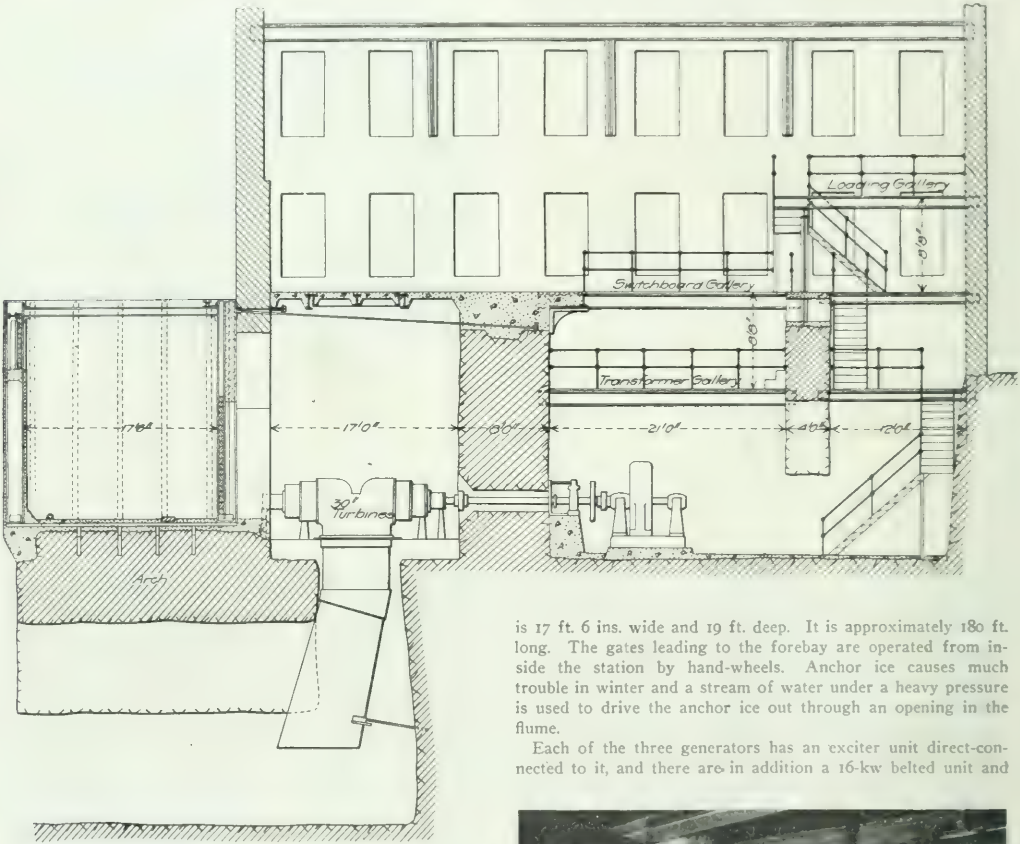


FIG. 3.—CROSS SECTIONAL VIEW OF HYDRO-ELECTRIC STATION

Between the buildings housing the water-wheel generators, is the steam-driven apparatus. The old equipment consisted of a 400-hp Watertown Corliss engine and this has been replaced by a 1000-hp Quincy Corliss engine which is direct-connected to a General Electric, 600-kw generator delivering three-phase current at a potential of 2300 volts. Steam is obtained from two 500-hp Stirling water-tube boilers situated in a boiler room adjoining. The boilers are fitted with stationary herring-bone grates for burning bituminous slack and are hand fired. The furnaces operate under an induced draft supplied by a Sturtevant engine driven, induced draft outfit. The feed-water will eventually be taken from the flume; but is at present purchased from the city. The ashes from the pits will be washed out into the river when the alterations are completed. A 10-in. pipe will run from a hopper across the flume to the river. The ashes will be thrown into the hopper and from there washed into the river by a stream of water under pressure. The engine is supplied with steam from a 14-in. header through a 10-in. pipe and separator, and will operate non-condensing. Because of the rock on which the station is built the engine is set five feet above the old floor on a concrete foundation. This was much cheaper than excavating and blasting and brings the floor even with that of the water-power plant.

Fig. 3 shows a cross-sectional view of the rebuilt water-power building, a general view of which is given in Fig. 1. The flume is 17 ft. 6 ins. wide and 19 ft. deep. It is approximately 180 ft. long. The gates leading to the forebay are operated from inside the station by hand-wheels. Anchor ice causes much trouble in winter and a stream of water under a heavy pressure is used to drive the anchor ice out through an opening in the flume.

Each of the three generators has an exciter unit direct-connected to it, and there are in addition a 16-kw belted unit and a 25-kw steam turbine-driven unit available for excitation purposes.

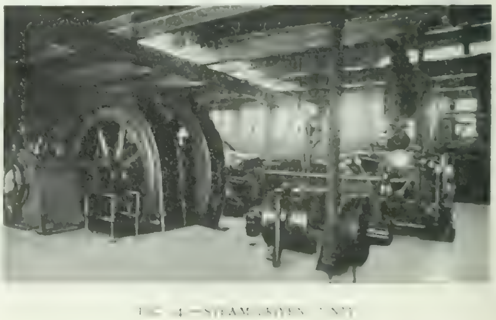


FIG. 4.—STEAM-DRIVEN UNIT

The switchboard, shown in Fig. 1, is of the General Electric Company's standard type. The panels are arranged in the following order: One regulator panel, five exciter panels, six generator panels, three double feeder panels, one rotary converter

panel, three panels for 500-volt circuits, one panel for arc busses, and six mercury-rectifier panels for the street lighting system. The transformer equipment consists of six 50-light tub transformers, three transformers for the rotary converter and the necessary reactance coils for the mercury arcs. The feeders are carried in iron conduit from the switchboard to a

FIG. 5.—MAIN WATER WHEEL DRIVEN GENERATORS.

wire tower on one corner of the roof. This portion of the roof is concreted to make it fireproof, and the tower is constructed of iron with wooden cross arms.

The main part of the building is equipped with a traveling crane. A gallery extends across the north end of the building at the street grade, allowing a wagon to back to the doorway, where the load can be lifted by the crane.

The streets of Watertown are lighted by means of 250 magnetite arc lamps fed through 50 light mercury rectifiers. Multiple arc lamps are also used for commercial lighting. Motors are fed from a 500-volt circuit supplied by a 150-kw rotary converter. No more motors are being connected to the 500-volt circuits, however, and in time this service will be discarded altogether, alternating-current motors being used instead. The three feeder panels control six 2300-volt, three-phase circuits to which both motors and lamps are attached. Large motors are fed direct from the lines and small motors are fed from the secondaries of step-down transformers. The lines of the com-

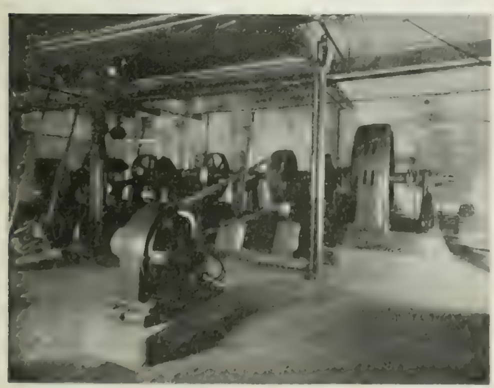


FIG. 6.—ALTERNATOR DRIVEN BY VERTICAL TURBINES.

pany aggregate 60 miles, entirely within the city limits, and are all overhead. The day load at present averages 550 kilowatts, and the night load averages 800 kilowatts. The connected load is approximately 1500 horse power in motors and 20,000 16-cp equivalents.

The rates for energy for lighting circuits is 10 cents per kw-hour, subject to a 2-cent penalty for non-payment within 15 days. The rates for energy for motor circuits range from 10 cents to 2 cents per kw-hour. Arc lamps for street lighting bring $73 per lamp per year. On the 60-cycle alternating-current motor circuits the rates are as follows: A minimum charge of $1 per month per horse-power or fraction thereof is made on all motors up to 10 horse-power in size; on all motors from 10 horse-power to 50 horse-power, the charge is 50 cents per horse-power per month, and on all motors over 50 horse-power in size the charge is 25 cents per month. Energy is sold as follows:

For the first 50 kw-hours	10 cents per kw-hour
For the next 50 kw-hours	6 cents per kw-hour
For the next 100 kw-hours	5 cents per kw-hour
For the next 200 kw-hours	4 cents per kw-hour
For the next 200 kw-hours	3 cents per kw-hour
All over 600 kw-hours	2 cents per kw-hour

A discount of 5 per cent is allowed on bills paid before the 10th of the month. On the 500-volt circuits the minimum charge per month is the same as with alternating-current motors; but the rates for energy are 10, 7, 6, 5, 4 and 3 cents respectively.

The company has just recently started a new business department, never having been in a position before to take on much load. At present three canvassers and one manager are em-

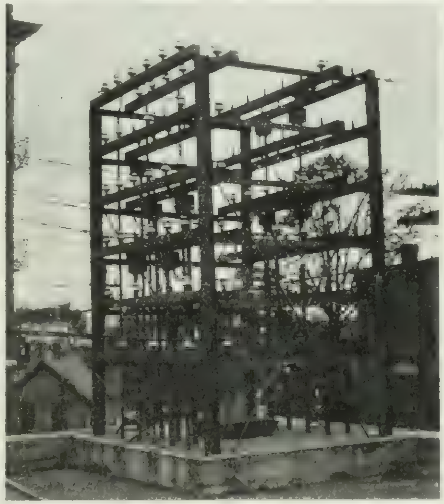


FIG. 7.—WIRE TOWER ON ROOF OF STATION.

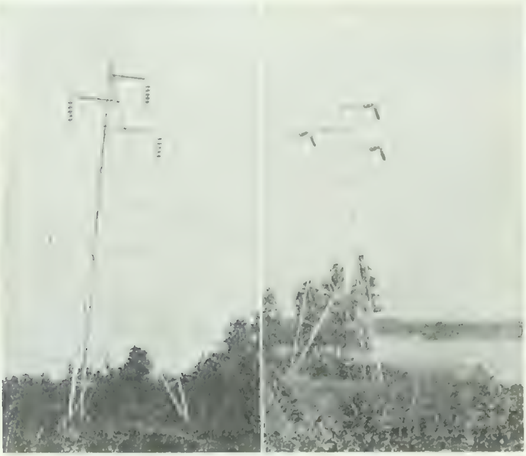
ployed. This department has not been in existence long enough to give any facts regarding its working.

The Watertown Light & Power Company has also purchased from the H. Remington & Son Pulp & Paper Company its water-power rights in the village of Black River, six miles above Watertown. The building and flume will be rebuilt, new water-wheels installed and a tail race excavated, etc. The head at this fall, as at present developed, is 20 feet and as the company owns all the water rights at this point, about 3500 horse-power is available. Pulp machinery was installed on all but one of the water-wheel units. To this one a 600-kw, 11,000-volt, three-phase generator will be direct-connected. The generator is now being erected, as is also the transmission line to Watertown. It is the intention to replace the pulp grinders with generators as business increases. The station at Watertown is now using all the water power available under its rights, and steam-driven units are required at times. All increase in demand will therefore have to be supplied from the station now building at Black River through the Watertown station.

The officers of the company are as follows: President, Mr. James T. Lynn; vice-president, Mr. George H. Babcock; treasurer, Mr. J. B. Taylor; secretary, Mr. F. A. Rogers; manager, Mr. J. I. Mange; and superintendent, Mr. J. C. Fagan.

The 100,000-Volt, Steel Tower Line of the Grand Rapids-Muskegon Power Company.

Descriptions have previously appeared in these columns of the wooden-pole line system of the Grand Rapids-Muskegon Power Company, which has been used for some time to transmit electrical energy at voltages over 70,000. In order to provide a duplicate line over the most important link in this company's extensive transmission system, 35 miles of steel tower line is now being built between the Croton power plant, on the Muskegon River, to a sub-station in Grand Rapids. This line is designed for operation at 100,000 volts. It is being built over a right of way some distance from that of the wooden-pole line, in order that local thunder-storms may not affect both lines at the same time.



FIGS. 1 AND 2.—VIEWS OF TOWER LINE.

FIG. 3.—SUSPENSION INSULATOR ASSEMBLED.

The triangular steel towers used on this line are from 40 ft. to 60 ft. high, and were built by the Aermotor Company, of Chicago. They are spaced about 500 ft. apart. Each leg is anchored to a 3-in. steel angle, 7 ft. 10 ins. long, buried in the ground. The steel angles are enclosed in concrete to prevent corrosion, except for about 10 ins. at the bottom, which is left bare to provide an effective ground for the steel towers. Stranded copper cables with hemp centers, and having a conductivity equal to No. 2 solid wire, are used for conductors. Figs. 1 and 2 show views of this line, and also the suspension insulators used. The conductors are hung from cantilever arms, two arms being placed on one side of the pole and one on the other.

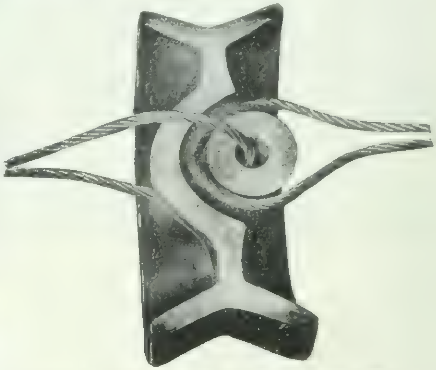


FIG. 4.—CROSS SECTION OF STRAIN INSULATOR.

The suspended insulators are of the type described by Mr. E. M. Hewlett in his paper presented at the last convention of the American Institute of Electrical Engineers, at Niagara Falls, June 26. Figs. 3 and 4 show the construction of the members of this insulator. Five of these insulators are suspended in series to insulate the line. The diameter of each porcelain link is 10 ins., and the rated voltage that each link will withstand is 25,000, although the links arc over when wet at approximately 65,000 volts each. Fig. 4, while showing the interior construction, also shows the form of petticoat on the insulator used in a horizontal position as a strain insulator at curves and at intervals to anchor the line.

The steel angles to which the links of the tower are anchored were set in concrete at a mixing plant at one end of the line and were afterward transported to points needed. Each complete anchor weighs about 275 lbs. The concrete envelope is elliptical in section, the axes of the ellipse being 4½ ins. and 6 ins., respectively. One 3-in., 4-lb. steel channel and several short reinforcing rods were fastened horizontally near the bottom of each main angle as anchors. These channels and rods also were enclosed in concrete discs; sheet-iron molds being used for that purpose.

Electrical Equipment of the Grosse Pointe Water Works.

Mr. H. P. Gunnison, at the convention of the Michigan Electric Association, on Aug. 22, gave some interesting facts regarding the motor-driven centrifugal pumps and equipment of the water works at Grosse Pointe, near Detroit. The villages of Grosse Pointe and Grosse Pointe Farms were formerly supplied with water by a small plant which also supplied electricity for commercial incandescent lighting in the village of Grosse Pointe Farms. The street lighting in the village of Grosse Pointe Farms was done by gasoline vapor lamps, which had been in use about six years, and sometimes a number of lamps in a row would be out of order at the same time. The water works were located 12 miles up the lake in an aristocratic residence district and had no railway facilities, so that coal had to

works were located 12 miles up the lake in an aristocratic residence district and had no railway facilities, so that coal had to be hauled from the city. The rates were very high, and electric lamps were used only by the wealthy citizens, who perhaps lived in the city during the winter. The electric light and water company barely managed to exist, and its patrons were complaining both of the service and of its cost, while neighboring villages were well supplied from Detroit at much cheaper rates. The water rates were $1.80 per 1000 gals.; the electric light rates 40 cents per kw-hour from Oct. 1 to May 1, and 20 cents from May 1 to Oct. 1.

The Peninsular Electric Light Company, which retails energy for the Detroit Edison Company in outlying districts around Detroit, in looking for new business, found this district a very desirable one to increase its summer load, but it was not desirous of going into the water works business. However, in order to get a contract for furnishing electricity for lighting, it was also necessary to pump the water. An appraisal was made for the Peninsular Company by Mr. C. W. Hubbell, civil engineer, who also made the selection of pumps and designed the water works plant hereinafter described. The Peninsular Electric Light Company purchased the water works plant under a contract whereby the village at the end of a 10-year contract may purchase the equipment at an appraised valuation. The company extended a three-phase, 4600-volt transmission line from an adjoining village to the water works. A three-phase automatic regulator is used for maintaining the voltage on the commercial lighting circuits. The village distributing e. m. f. was changed from 1000 to 2200 volts, and small transformers were replaced by larger ones, capable of carrying the load of several customers.

The electrical energy for operating the Grosse Pointe water works is generated at the steam turbine station at Delray and is transmitted underground to the easterly limits of Detroit by three-phase, 4600-volt cables and then overhead on three No. 2 bare wires to a transformer house in the rear of the water works, where the e. m. f. is stepped-down to 2200 volts, which value is used directly on the pumping station motors. The transmission line is designed for 22,000 volts, both on the underground and overhead portions, and soon will be operated at this e. m. f. The switchboard at the water works has eight panels, one for the commercial lighting circuit, one for the series alternating arc circuit, two for series incandescent lamp circuits, one for each of the three pump motors, and a totalling panel.

After receiving prices and guarantees from four makers of centrifugal pumps as to power consumption, duties and characteristics, three De Laval pumps were ordered. Two of these were two-stage pumps of 400 gals. per minute capacity, with 4-in. suction and discharge pipes, and driven by 35-hp, 2200-volt, three-phase, 60-cycle induction motors. The third unit, for fire service, was a three-stage pump of 1600 gals. per minute capacity, driven by a 75-hp induction motor. This pump has 8-in. suction and discharge. The guaranteed mechanical efficiency was 60 per cent for the small pumps and 64 per cent for the large one. This guarantee was fulfilled and, in fact, slightly exceeded by accurate tests made at the factory before the pumps were [illegible].

The steel reservoir tank for holding the water has its bottom 55 ft. and its top 88 ft. above its foundations, and the foundations are 20 ft. above the pumps. Its capacity is 100,000 gals. These pumps take up very small floor space, considering their capacity. The small pumps are 3 ft. wide by 6 ft. 8 ins. long, and the large one 4 ft. x 10 ft. The pumps are not self-priming. The suction pipe must be absolutely air-tight and the system designed so that the suction pipe can be filled before attempting to start the pumps. These requirements have been met, and the installation has given no trouble whatever since its installation.

The meter at the plant, according to which the output of water is measured and paid for by the village, is a 10-in. Premier meter of the Venturi type, made by the National Meter Company. It has a 4-in. throat opening and registers correctly within very wide limits; 200 gals. per minute being thought to be about the average, the maximum being about 1600 gals. in case of fire, and the minimum 50. A Crosby gauge reading to 100 points and also a Bristol recording commercial gauge are connected to the water system at the plant. The gauge is connected with the suction, which indicates either pressure or vacuum. No telltale float is used on the tank, as the pressure on the gauge indicates the height of water in the tank more satisfactorily than a telltale. The pressure of the water is maintained between 45.5 lbs. and 37 lbs. per sq. in. The town water supply system is maintained by running one pump for from three to six hours per day, depending on the particular season of the year.

TESTS.

The amount of water, in gallons, pumped from Feb. 1 to Aug. 1 was as follows:

February	[illegible]
March	[illegible]
April	[illegible]
May	2,801,700
June	[illegible]
July	[illegible]
Total	[illegible]

For July 933 gals. of water were pumped per kw-hour. If the village had paid for energy at 4 cents per kw-hour, the energy would have cost 20 per cent less than the coal burned for the month of July, 1906. Some experimenting was done, however, which made the reported energy consumption for this month somewhat larger. Tests on the water meter were not as extensive as they would have liked, nevertheless they justified the conclusion that the meters were registering very close to the makers' guarantee, which was 5½ per cent slow at 100 gals. per minute; correct at 208 gals. per minute; 2 per cent fast at 348 gals. per minute.

In the discussion following the reading of the paper, Mr. E. F. Phillipps, of Detroit, brought out the point that the Peninsular Electric Light Company pumps water for the village of Grosse Pointe Farms at $40 per million gals. for the first 50,000,000 gals. pumped, with a minimum of $2,000 per annum; for the second 50,000,000 gals. $20 per million, and for any excess over 100,000,000 gals., $15 per million, the payment being based entirely on the gallons of water pumped rather than on the kw-hours of energy.

Mr. Gunnison being asked as to the possibility of operating such a system automatically without an attendant, said it would not be safe on account of the suction, which is from 16 ft. to 20 ft. in height, varying with the rise and fall of the lake. Sometimes a little air creeps in and the pumps accumulate enough air in the upper chamber to lose their suction. There are remote control motors on the market, and if one can put in a centrifugal pump below the water level so that it would be primed at all times and ready to pump, this system could be used. An ideal equipment would be a vertical deep-well centrifugal pump to raise water at a reservoir and another pump to supply water to the tank and system. Mr. Gunnison further stated that this equipment could be worked automatically, as there would be no danger of the deep-well centrifugal pump losing its suction.

President Chandler said that the pumping question is one of the most important that is at the present time before electric lighting companies. There are few places in the state where the question is not worth investigation. The lighting company should be able to pump the water for the city and save the city a large proportion of the amount it is paying for the present steam pumping and make money for the electric light company.

Mr. Marshall asked whether the water meter is considered accurate enough for an electric light company to make a certain charge per thousand gallons instead of per kw-hour. City officials and water commissioners are usually more favorable to basing a contract on water pumped rather than kw-hours. Mr. Phillipps replied that the Peninsular Electric Light Company has confidence enough in the water meter to do so at the prices previously mentioned.

Direct-Current Motors, Their Action and Control—I.

By F. B. Crocker and M. Arendt.

Many types of electric motors are manufactured and each has its characteristics of design and operation. In general electric motors may be divided into those of the direct- and alternating-current groups, and these may be subdivided into particular types. The types of direct-current motor are as follows:

DIRECT-CURRENT MOTORS.

Type.	*Operative Characteristics.*
Shunt-wound motors	Starting torque usually 50 to 100 per cent greater than rated running torque, and fairly constant speed over wide load ranges.
Series-wound motors	Powerful starting torque, speed varying greatly (inversely) with load changes.
Compound-wound motors	Compromise between shunt and series types.
Differently-wound motors	Starting torque very small, speed can be made almost absolutely constant for load changes within rated capacity.

The conditions under which machinery operates, in regard to varying speed and power required of the driving motor, may be divided into four classes, and certain types of motors are usually best suited to these divisions, which are as follows:

(a) Work which requires the motor to operate automatically at a practically constant speed, regardless of load changes or other conditions.

(b) Work requiring frequent starting and stopping and wide variations in speed, including sometimes rapid acceleration.

(c) An approximately steady load or work that varies as some function of the speed should it change.

(d) Work in which the power varies regardless of the speed, or where speed variations with constant torque may be desired.

The first case (a) applies to line shaft equipments with many machines operated by the same motor and where slight speed variations may be allowed; the direct-current shunt or slightly compounded motor or the alternating-current induction motor would answer, depending naturally upon the character of electric current available. A refinement of this problem is encountered in the driving of textile machinery, especially silk looms with which even a slight speed variation might affect the appearance of the finished product. In such instances the alternating-current motors, polyphase induction or polyphase synchronous, are generally employed because the speed of direct-current motors varies considerably with voltage changes and the variation in temperature which occurs after several hours of operation, whereas, the speed of the alternating-current motors, unless the voltage varies greatly, is primarily dependent upon the frequency of the supplied current.

The second class (b) is divided into two parts, the first being electric traction and crane service, in which the motor is frequently started and stopped and rapidly accelerated at starting; or where the speed is to be adjusted automatically to the load, slowing down when heavily loaded or climbing a steep grade. These conditions are well satisfied by the series motor of either the direct or alternating-current types, depending upon the current supplied. Elevator service is of this character as regards frequent starting and stopping, but after rapid acceleration it calls for a speed independent of the load. Hence, to fulfill both requirements, elevator motors when of the direct-current type are heavily over-compounded to give the series characteristic at starting; then, when the motor is up to speed, the series field winding is short-circuited and it operates as a shunt machine. Recently, however, two-speed shunt motors have been employed for this service, the field being of maximum strength for starting and sparking prevented by use of interpoles. If only alternating current is available the polyphase induction motor should be employed, but for powerful starting torque either slip-ring or compensator control would be necessary. For the second subdivision of this class the motor must be started and stopped frequently and not rapidly accelerated, but on the contrary, simply "inched" forward at the start, as in the operation of printing presses, gun turrets, etc. These conditions of service are satisfied by a direct-current compound motor provided with double armature and series-parallel control of the machine, as, for example, that manufactured by the C. & C. Electric Company. This character of work is also well performed by having a double or variable potential source of current supply for the working motor, low voltage being used for starting and "inching" and higher voltages for running. These features are supplied by the Bullock "teazer" system, by the Holmes-Chatworthy two-motor method, or by the Ward-Leonard motor-dynamo equipment; the latter, however, being somewhat expensive its use is almost entirely restricted to the operation of gun turrets and such special service, in which cost is a secondary consideration.

The third class (c) of work is the operation of pumps, fans or blower equipments and its requirements are satisfied by the series motor, whose speed adjusts itself to the work, and also because it exerts the maximum torque required at starting. It must be, however, either geared or directly connected to the apparatus, because the breaking of the belt or the sudden removal of the load would cause a series motor to race and become injured. The operation of pumps by electric motors is usually effected by gearing, since ordinary plunger pumps do not operate efficiently if driven in excess of fifty strokes per minute, and to accomplish this by direct connection would demand a very low speed and costly motor. Centrifugal pumps operating at high speed may be direct driven.

The fourth class (d) is found in individual machine-tool service, for which the maximum allowable cutting or turning speed requires the number of revolutions of the work or tool to vary inversely as the diameter of the cut. This condition is satisfied best by the direct-current shunt or slightly compounded motors, as they are readily controlled in speed by variation of the applied voltage, shunt field weakening, etc., as described later.

It is to be noted that *a* and *c* regulate automatically to maintain a constant speed, while *b* and *d* are controlled by hand to give variable speeds. Furthermore, *b* is usually under control of the hand all the time, whereas *d* is set to operate at a desired speed for some time and regulates automatically when so adjusted.

The Speed Classification of Motors recommended in the Standardization Rules of the American Institute of Electrical Engineers is as follows:

1. *Constant-speed motors,* in which the speed is either constant or does not materially vary, such as synchronous motors, induction motors with small slip and ordinary direct-current shunt motors.

2. *Multispeed motors* (two-speed, three-speed, etc.), which can be operated at any one of several distinct speeds, these speeds being practically independent of the load, such as motors with two armature windings.

3. *Adjustable-speed motors,* in which the speed can be varied gradually over a considerable range; but when once adjusted remains practically unaffected by the load, such as shunt motors designed for a considerable range of field variation.

4. *Varying-speed motors,* or motors in which the speed varies with the load, decreasing when the load increases, such as series motors.

[illegible]

Let us consider first the action of shunt-wound motors under various conditions of load, temperature, speed, etc. To make the results as significant as possible, standard shunt-wound machines have been selected as examples. Three sizes are taken, *i. e.*, 1, 10 and 110 horse-power. It is to be remembered that the

average size of motors is less than that of generators, several of the former being usually fed by one of the latter. Hence these sizes represent small, medium and fairly large machines. It is also a fact that the 110-hp size is sufficiently large so that still larger motors will correspond closely. For example the efficiencies of the three sizes are about 81, 86 and 93 per cent, respectively, above that the efficiency would increase only 1 or 2 per cent. Therefore, the characteristic differences are found below 110 horse-power, and these machines may be taken to represent commercial practice, using shunt motors.

A few simple tests determine the fundamental facts from which the action of these machines under almost any reasonable conditions may be readily calculated. Most of the tests are well known, but they are included here as a desirable part of the definition of the fundamental quantities to avoid any uncertainty in regard to them.

1. *The Voltage V,* for which the motor is designed and at which it normally operates, is assumed to remain constant, being applied to the terminals of the armature and field circuits, which are in parallel (Fig. 1). If V is not constant it should

FIG. 1.—SHUNT MOTOR CONNECTIONS.

be maintained so (for experimental investigation) by inserting a rheostat which can be adjusted to correct any variations. This voltage should be that marked on the manufacturer's name plate and is generally known as the rated voltage. It may be found later that some other voltage is preferable in order to obtain a different speed or other result, in which case a new series of tests should be made at the modified voltage.

2. *The Total Current I* taken by the motor at rated load is also marked on the name plate. This may be found later to differ from the current at which the rated horse-power is developed, or it may cause heating in excess of the limit specified in (4). In either case another series of observations should be taken with the corrected current. For the present, however, it will be assumed that the rated voltage V and the rated current I are both correctly given on the maker's name plate.

3. *The Room Temperature t* is taken at 25 degs. C. in standardizing electrical apparatus. If it differs from 25 degs. C. allowance should be made.

4. *The Temperature Rise Θ* permissible in the armature or field is 50 degs. C. as measured by increase in resistance of these respective windings. This gives a working temperature of $t + \Theta = 75$ degs. C. $= T$, at which the machine is said to be "hot" in contradistinction to "cold" at the room temperature t. To determine whether the temperature rise Θ is within the limit of 50 degs. C., the motor is supplied with the rated voltage V and operates with sufficient load to draw the rated current* I_a until a constant temperature T is reached, requiring from 6 to 18 hours, depending upon the size, speed and ventilation of the machine. The resistance of the field and armature circuits is measured before, during and after the run, as explained in (5) and (6). This resistance at 25 degs. C. is $R_0 + (.0042\,R_0 \times 25) = 1.105 R_0$ and at 75 degs. C. it is $R_0 + (.0042\,R_0 \times 75) = 1.315\,R_0$, where R_0 is the value at 0 deg. C.

Hence the resistance at working temperature or "hot resistance" is as $1.315 \div 1.105 = 1.19$, i. e. 19 per cent greater than the "cold resistance." If the increase in resistance is found to be less than 19 per cent so much the better, not only for safety, but also for constancy of speed as shown later.

5. *The Field Current I_{sh}* in the shunt motor is determined by connecting the field terminals directly to the supply circuit, the voltage of which is V. This should be measured when the machine is "hot," that is, after the run specified in (4) to obtain working conditions. The field current should also be determined with the machine "cold," before the run, because speed variations are caused by the temperature changes, as explained later. Furthermore, with both values known, the increase in resistance and temperature rise may be easily calculated. The shunt field resistance "hot" $R_{sh} = V \div I_{sh}$ and the corresponding values cold are $R'_{sh} = V \div I'_{sh}$, from which $R_{sh} \div R'_{sh} = I'_{sh} \div I_{sh}$. With temperatures of 75 deg. and 25 deg. C., respectively, it was shown in (4) that $R_{t+\theta} \div R'_t = 1.19$, hence $I'_{sh} = 1.19 I_{sh}$. In any case, however, the temperature rise in degrees C. is $\Theta = (238.1 + t_1)\left(\frac{R_1}{R''} - 1\right)$ where t_1 and R_1 are the initial temperature and resistance, while R'' is the final temperature.

6. *The Armature Resistance, Ra* including resistance of brushes and brush leads, but not brush contacts, is also measured "hot." Potential difference or voltage "drop" due to the brush contacts which depends upon the current density should be measured at the rated current value and deducted from the total drop in the armature circuit, to get the true resistance of that circuit, or that quantity which multiplied by the current gives the IR drop. The armature before it has time to cool off after the run, is supplied with its rated current I_a, but is not allowed to rotate, under which condition suitable resistance must be inserted in series to compensate for the absence of counter e. m. f. The total drop V' in volts across the armature terminals is then measured, also the drop D_b due to the brush contacts, and we have $R_a = (V' - D_b) \div I_a$. The armature circuit resistance "cold," if entirely of copper, is then $R'_a = R_a \div 1.19 = .84 R_a$, assuming "cold" and "hot" temperatures of 25 degs. and 75 degs. C., respectively. As a rule, however, since the armature circuit resistance includes that of the carbon brushes, which latter have a negative temperature coefficient, the total increase between 25 degs. and 75 degs. C. is about 15 per cent, or $R'_a = R_a \div 1.15 = .87 R_a$. This variation in armature resistance is not very important, however, as it will be shown later that it has little effect upon the efficiency, regulation, etc., of the machine.

Before proceeding with the various problems to be considered in connection with electric motors, it is desirable first to study their counter electromotive force as it plays an exceedingly important part in the action of such machines.

The counter e. m. f. of a motor armature is the e. m. f. that it would develop as a generator when operated at the same speed and field strength.

Let Φ = flux entering or leaving the armature per pole
n = total number of inductors on the armature
N = revolutions per minute
p = number of pairs of poles
b = number of circuits in parallel in the armature winding

then c = c. e. m. f. of motor armature $= \dfrac{\Phi n N p}{60 \times 10^8 \times b}$ (V)

By inspection of the equation (V) it can readily be seen that with Φ, n, p and b maintained constant, the c. e. m. f. varies directly with N the number of r. p. m., and conversely we may state that the speed of a motor varies directly as the c. e. m. f., other factors being constant. This is a very important fact, especially in shunt motors, because these quantities do remain practically constant unless purposely varied. The c. e. m. f. can be calculated if the various quantities listed above are known.

Experimental Method of Determining the C. E. M. F.—The armature shaft may be fitted with a heavy flywheel, so that the stored energy in the revolving parts is great. The motor is then operated without load, but at rated speed by slightly re-

*Standardization Rules, Amer. Inst. Elec. Eng., 1907.

ducing the voltage applied to the armature by introducing resistance, while the field is excited with the proper line voltage V. When the rated speed is attained, the armature circuit is suddenly opened, while the flywheel effect will cause the armature to maintain almost constant speed for a short time, during which the c. e. m. f. can be measured by a voltmeter since it then becomes the e. m. f. of the machine acting as a generator.

2. *Determination of C. E. M. F. from True Torque of Generator or Motor.*—Connect the field windings to the supply lines, and allow rated field current I_{sh} to pass through them; then connect the armature to the mains, through such resistance that the rated load current I_a flows through its winding, but develops only a static torque (*i. e.*, armature not revolving). Attach a brake arm or lever of known length to the machine pulley and measure in pounds the pull plus friction of bearings and brushes, also the pull minus friction, add these together and divide by two, the result muliplied by the length of brake arm in feet will be the true torque (T_t) provided the weight of arm or lever is eliminated. Then at any speed N in r. p. m., the total power developed would be $2\pi T_t N$ foot-pounds per minute, which divided by 33,000 is the total mechanical horse-power evolved in the armature and corresponds to the indicated horse-power of a steam engine. This must equal the electrical horse-power supplied to the armature, hence

$$\frac{2\pi T_t N}{33{,}000} = \frac{EI_a}{746}, \text{ or } E = \frac{2\pi T_t N\, 746}{33{,}000\, I_a} = \frac{T_t N}{7.03\, I_a} \quad \text{(VI)}$$

Where E is the motor *c. e. m. f.* or generated voltage at any speed N. The true torque or turning effort of a motor depends upon the armature current, the number of armature inductors and the flux through the armature. It is independent of the speed and the equation for the determination of its value is $T_t = KI_a\Phi$, where K is constant, depending upon the number of poles, effective conductors, etc. This true torque includes not only the effective torque developed by a motor at its pulley when running, but also the torque required to overcome friction, windage and core losses. In the case of a generator, the total torque is that necessary to revolve the armature and overcome friction, etc. Hence effective motor torque + (friction + windage + core loss torque) = true torque = generator torque — (friction + windage + core loss torque).

In the case of belt-driven machinery, the effective torque is equal to the difference in tension on the two sides of the belt multiplied by the radius of the pulley in feet.

Calculation of C. E. M. F.—In the armature circuit of a direct-current shunt motor the applied voltage, V, overcomes three factors, namely, resistance drop, brush contact drop and the c. e. m. f.; hence, $V = I_aR_a + D_b + c.\ e.\ m.\ f.$, or rearranging $c.\ e.\ m.\ f. = V - (I_aR_a + D_b)$ (VII)

Electric Light and Power at Danbury, Conn.

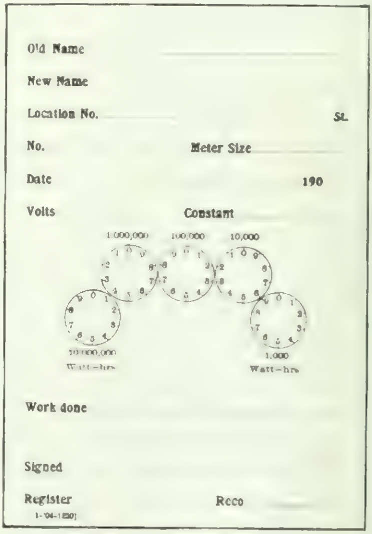
By William H. [illegible]

Danbury, Connecticut, is a city of some 22,000 inhabitants, the county seat of Fairfield County, and the center of a truck-farming district. Danbury is noted for its hats, their manufacture being its principal industry. Scattered through the city are more than two score hat factories, and also a number of factories for the production of hat-making machinery.

The first electric light plant was started in Danbury along about 1888, and was known as the Schuyler Electric Light Company. The Schuyler Electric Light Company existed for a period of one year, when a consolidation was made with the Danbury Gas Light Company, and the new concern assumed the title of the Danbury & Bethel Gas & Electric Light Company.

The station is a two-story brick building, containing the engine and dynamo room, boiler room, office, store room and meter room. The equipment consists of four Heine boilers, two of 300 hp and two of 150 hp. There are two Buckeye engines of 150 hp direct-connected to two 150-kw, 2300-volt generators. The voltage is 220 volts for motor service and 110 volts for lighting. A 500-kw Curtis steam turbine is now being installed to be run from the present batteries of boilers. The engine room is large and well-lighted, with a concrete floor. The switchboard is on the floor level, and made up of 15 panels. Behind the engine room is the office of the superintendent, the storeroom and the meter room. There is also a large locker room fitted up for the station employees. Coal is received on a spur from the railroad and hoisted to a large bin, and is delivered to the boiler room by an industrial railway. The boilers are fired by hand, although within a very short time mechanical stokers will be installed. The ashes are taken away in carts and dumped in a swamp near the station as filling.

Distribution is by means of pole lines, Danbury as yet having had no agitation, political or otherwise, toward requiring the placing of its mains underground. Transformers are all placed on the poles and used individually, save at two congested points, where they are grouped. The arc circuits are tested out every day before the current is turned on for grounds, crosses and open circuits. The arc system is operated on six circuits with from 19 to 24 lamps on each. The contract with the city requires that 130 1200-cp enclosed arcs be burned until 1 a. m on the moonlight schedule. The company is now negotiating with the town of Bethel to illuminate the streets with about 40 arcs of the enclosed type. The commercial lighting shows a connected load of about 4500 incandescent lamps, 16-cp equivalent.


Old Name
New Name
Location No. St.
No. Meter Size
Date 190
Volts Constant

Work done
Signed
Register Reco
1-'04-1M0]

[illegible]

The power load is about 900 hp in motors, 10 per cent of which are for 110 volts and the remaining for 220 volts. The station load during the summer months reaches its peak at from 9 a. m. to 11 a. m., when the motor load is heaviest. In the winter months the peak occurs at 5 p. m. when the motor and the lighting loads lap. During the month of August, 1907, the total output was 105,000 kw-hours, and in December will probably reach 130,000 kw-hours. The Danbury Company had to discontinue taking on new business in the spring on account of the station having reached its maximum capacity; this condition will of course be changed when the 500-kw turbine unit is started up.

The force maintained to operate the station consists of a superintendent and an assistant, three engineers, three firemen, five linemen, one meterman and a laborer.

When a meter is received from the factory, it is tested in the meter department, given a number, and placed in stock. When sent out the form reproduced in Fig. 1 is filled out in full and then filed away. A card record of the meters is also kept which includes the information on this form. All changes, tests and repairs are noted on the cards under respective dates. When a consumer complains of high bills and requests that the meter

be tested, it is replaced by another and the questionable one brought to the station for testing. If found to be in good condition and to register correctly, it is placed in stock again and the consumer informed as to the result of the test. If the meter was at fault and fast, a proper credit is made on the consumer's bill.

The meters are read at the end of each month. The readings are taken by men who have no connection whatever with the meter department at the station. Instead of an index book or card, blank bill forms with the name and address of the consumer are used. The meter reader draws in pencil the index hands in their exact position over the dials of the meters. When returned to the office, the bill clerk gets the previous month's reading from the ledger and computes the amount of the bill. The bills are delivered, but the carrier does no collecting, collectors calling later in the month. A reproduction of a bill is given in Fig. 2. The coupon shown is detached when the bill is paid. The same form is used both for the lighting and power service. Fig. 3 shows the reverse side of the bill, which gives the rates for both lighting and power service, and also the "Rules and Regulations" the consumer agrees to abide by when signing an application for electricity. On the stub will be noted a little reminder for large consumers, the only advertising matter appearing on the bill.

The offices of the company are located in the center of the city in the Public Library Building on Main Street, and have two large windows facing the street in which from time to time are placed various electrical displays. In going to the office

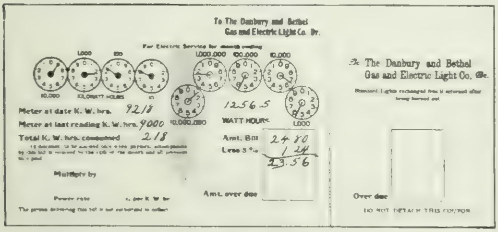


FIG. 2.—ELECTRICITY BILL.

to pay a bill, make a complaint or to transact any business, the visitor passes through the show room, which contains various electrical heating and cooking appliances, arranged so that a quick, practical demonstration can be afforded an interested person.

Fig. 4 shows a copy of the application for electrical service a consumer is asked to sign. Mr. Hodgson, the electrical superintendent, in commenting on its brevity, said that he believed it was just as binding and more satisfactory than an application containing a great many clauses which, when boiled down, amounted in the end to about the same thing. After experimenting, he found that a simple, short form caused less hesitation about signing on the prospective consumer's part, than did the form of contract including a number of legal clauses.

The rate for energy for lamps ranges from 15 cents to 10 cents per kw-hour, according to the quantity used, as will be seen by reference to Fig. 3. A consumer's bill for a consump- [illegible]

[illegible]

special one to encourage this form of lighting.

[illegible] at 4½ cents per kw-hour, while a 60-hp consumer would get a 3½-cent rate. There is a minimum charge on all installations of $1 per month. A discount of five per cent is allowed on all bills paid on or before the 15th of the month following the one for which it was rendered.

Mr. C. R. Hodgson, in speaking of the amount and character

DANBURY AND BETHEL

Gas and Electric Light Co.

ELECTRIC BILL FOR

The Month of__________19__

$__ ___ __

Lighting Rate.	Power Rate.
1st 20 K. W., 15c per K. W. Hr.	Under 3 H. P. 10c for 1st 50 then 5c per K. W.
2nd 20 " 14c " " "	3 to 5 H. P. 5c per K. W. Hr.
3rd 20 " 13c " " "	5 to 10 " 4½c " " "
4th 20 " 12c " " "	10 to 25 " 4c " " "
5th 20 " 11c " " "	25 to 50 " 3¾c " " "
All over 100 K. W., 10c per K. W. Hr.	50 to 75 " 3½c " " "
	75 to 100 " 3¼c " " "
	Over 100 " 3c " " "

The minimum monthly bill for Electric Service, shall be $1.00.

A further discount of 5% will be allowed if the account is settled in full at the office of the Company on or before the 15th of the following month.

Rules and Regulations.

1st. In default of payment for Electric Lighting within the first 15 days of the month, the consumer will forfeit the discount, and service may be stopped until the bill is paid.

2d. The Company reserve to themselves the right at any time to require a deposit of money, and to shut off the current from any consumer, if they shall deem it necessary.

3d. The tenant of any premises using current shall give at least one day's notice in writing whenever about to remove, that the current may be stopped, or he will be liable for any that may pass the meter until such notice is received.

4th. The Company shall at all times, by their Inspector or other authorized agent, have the right of free access into the premises for the purpose of examining the whole Electrical Apparatus or for the removal of such as belongs to the Company.

5th. Consumers should allow no changes in any apparatus on their premises without due notice to the Company. Neglect of this precaution may LEAD TO SERIOUS DAMAGE.

6th. The location of Transformers, Main Switches and Meters must be accepted by the Company before wiring is commenced. Wires and fittings must conform to the rules of the New England Insurance Exchange. After the wiring is completed, and before it is covered, notice should be given the Company that the work may be inspected. No electricity will be supplied where the wiring has not been inspected and accepted.

This applies to both alterations and new work.

SPECIAL RATES

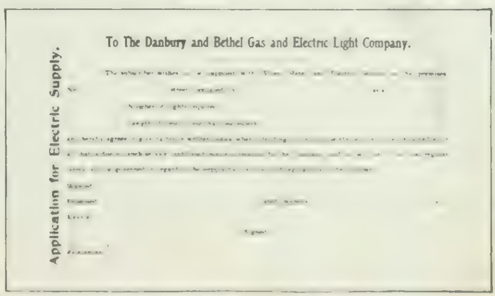
FOR LARGE CONSUMERS

OF POWER.

INQUIRE ABOUT IT.

FIG. 3.—REVERSE SIDE OF ELECTRICITY BILL.

of the new business in Danbury, said that the motor business is the greatest revenue producer. "Some years ago we began to interest the hat factories of our city in the use of individual motors: it was some time before we made any headway along this line, but after one installation was in operation and the



[illegible]

results showed that electric motors reduced production costs, it was not long before the other factories were making inquiries. To-day nearly every factory in Danbury uses our energy to some [illegible]

being 30 hp, which drives a coal hoist for the New Haven Railroad. This business reached such proportions that the station became overloaded and we had to stop taking on new business while awaiting the enlargement of the plant. A good deal of persistent and continuous work was required to obtain this business even after we had got started, and good, straight-from-the-shoulder talks with the consumer did more toward landing him than newspaper advertising or circular letters.

"In our lighting business we have had to contend against the condition that our city population is composed mostly of factory hands, but we have nevertheless done quite a little residence lighting. Along the main shopping street the stores have all been wired up and present a well-lighted appearance during the two evenings a week when they are open. The outside and window lighting is done on the outline plan and we have considerable of it in Danbury. The sign proposition has not been pushed in Danbury and what signs there are have been erected by the consumers; we have, however, encouraged this class of business with a 5-cent rate. The heating load is small at present. There are about 100 flat irons, a few curling irons and some heating pads in use."

In regard to advertising Mr. Hodgson said that while he believed in it, not much had been done along that line in the past owing to the limited capacity of the station. He has done some newspaper advertising and gotten up a booklet which describes the electric service and its varied uses.

There has been considerable active soliciting done for new business by Mr. Hodgson, while the employees have always been on the outlook and any prospects reported by them have been followed up by the superintendent. Incandescent lamps are renewed free of charge by the company. The bookkeeping is all done by one set of bookkeepers for both gas and electric service. The ledgers used are the loose-leaf style.

The present capitalization of the company is $200,000 and bonds have been issued for $150,000. The officials and heads of departments are: President, Mr. C. H. Merritt; secretary and general superintendent, Mr. G. E. Cowperthwaite; treasurer, Mr. A. N. Wildman; electrical superintendent, Mr. C. R. Hodgson; assistant superintendent, Mr. G. E. Stubbs; chief engineer, Mr. A. N. Fillow.

The Brooklyn Edison Company's Model Apartment and Its Attributable Results.

The model apartment exhibit of the Edison Electric Illuminating Company of Brooklyn at the recent electrical show in Madison Square Garden, New York, attracted widespread attention and comment, so that a brief statement as to the method of arranging for and conducting this example of spectacular and effective publicity will doubtless be of interest to central-station men throughout the country.

When the model apartment was decided upon as an exhibit, it was determined to furnish the rooms in as complete and artistic a manner as possible and to equip the apartment with every electrical appliance practicable for household use. At the same time the item of expense was to be kept down to the lowest possible figure consistent to the adequate carrying out of the conception; due regard being given to the fact often lost sight of, that under certain conditions economy is the wildest extravagance.

FIG. 1.—GENERAL VIEW OF MODEL APARTMENT SHOWING ALSO A PORTION OF THE [illegible] SIGN.

The furnishing and decorating of the apartment was planned between the advertising department of the Edison Company and the art and furniture departments of one of Brooklyn's largest department stores, which latter company was glad to supply, without charge, the furniture, rugs and general fittings of the apartment for the sake of the advertising obtained thereby. This scheme of cooperation worked out nicely in more ways than one. It was thus possible to secure an outfit of the most expensive and up-to-date character that otherwise would be out of consideration for a temporary exhibit of this nature. Rugs valued at $500 each for instance, were placed on the floors, and pictures many times this value were hung on the walls. Moreover the Edison Company secured the benefit of the department store's advertising of the model apartment, which advertising was done on a large scale. The Edison Company paid for the wall hangings, window draperies and all material and utensils that could not be returned in the same condition as received. The general result was harmonious and striking.

The majority of the electrical apparatus was also secured on a cooperative basis. The refrigerating machinery, clothes

washing and ringing machine, electric water heater, dish-washing machine, vacuum cleaner, electric piano, sewing machine, etc., were supplied by the manufacturers of the apparatus and the ordinary heating and cooking appliances were taken from stock.

The illumination of the apartment was planned by Mr. Lansingh, whose company also supplied the glassware and original sketches of suitable fixtures. All the concerns supplying feat-

FIG. 2.—BEDROOM

ures of the exhibit were given credit for the same, not only on placards conspicuously posted, but also in printed matter distributed to the crowd attending the exhibition.

The publicity work in connection with the show was begun about 10 days before the opening day. The Brooklyn newspapers were requested to send representatives to the office of the Edison Company and these were told of the wonders of the coming electrical show. There is in connection with such an event, a very real and powerful news interest, which if properly presented to newspaper men results in a great deal of free and valuable publicity. Advertising was not issued until the day before the show opened and then quarter-page

FIG. 3.—REFRIGERATING ROOM

advertisements were inserted. Prior to this, however, columns of news had been printed in the newspapers without charge.

On the opening evening Mr. Seelman of the Edison Company entertained the Brooklyn newspaper men at dinner and accompanied them from the hotel to the show. This resulted in more columns of news publicity the next day. During the show the newspapers were supplied each day with matter from the Edison Company's office detailing interesting features connected with the model apartment. This information was supplemented with photographs, many of which are shown herewith. The amount expended by the Edison Company for newspaper advertising was about $1,500, while $25,000 would be a conservative estimate of the value of the publicity secured.

In addition to newspaper publicity, the company mailed to each of its customers and to many thousand prospective

FIG. 4.—DINING ROOM

customers, a well-worded letter describing briefly the show and the company's exhibit and offering to those requesting them two tickets of admission. To this letter about 75 per cent of the recipients replied. The tickets mailed to customers and others who responded were enclosed with another letter requesting the persons favored with tickets to register at the Brooklyn Edison booth. This letter also enumerated different prizes which were to be distributed among about 50 persons registering; each person so doing receiving a number.

Only two tickets were allowed in each case. As a consequence the box-office receipts at the Garden were much higher than expected; in fact the publicity methods brought such

FIG. 5.—DRAWING ROOM.

immense crowds to the show that it was necessary on several occasions to close the doors for from one-half hour to an hour and a half to prevent possible accidents from overcrowding.

Ten well-instructed women demonstrators were constantly in attendance at the model apartment. Each of these was supplied by the company with two tastefully designed pink

dresses so as to obtain a uniform effect. The solicitors and other members of the contract department were also in constant attendance as per schedules framed in advance. While no effort was made to sell appliances, more than 150 were actually sold during the show. The exhibit certainly fulfilled its puropse in educating thousands of people to the household possibilities of an electric service, besides giving the Edison Company a great deal of valuable advertising it could not have otherwise secured.

The entire cost to the Edison Electric Illuminating Company of Brooklyn for its exhibit was in the neighborhood of $10,000. The number of persons registered at the company's booth was 14,190. More could have registered, but the crowd at some times was so dense that it was necessary to desist registering in order to avoid congestion.

Many plans have been formed by the company and some are already in operation, to secure the largest amount of business from those represented in the registration, and so to reap the utmost benefit from its expenditure in connection with the show. All those registered who are off the lines of the company are for the present eliminated from consideration. The rest are divided into two classes—customers and non-customers. To the former by advertising and personal solicitation an active

FIG. 6.—GENERAL OFFICE.

campaign for the installation of electrical appliances other than for illumination will be carried on. To a limited list of such customers who can afford such apparatus, the question of electrical refrigeration, sweeping, dish washing, silver polishing, etc., will be brought home; while to a much larger list will be addressed a campaign for the introduction of washing, ironing, cooking and heating appliances.

Special solicitors have been engaged to do night work in connection with the non-customers along the lines. Letters making appointments for these solicitors to call will be sent out in advance and each registrar will be canvassed while the impression made by the exhibit at the electrical show is fresh in mind. In this way it is hoped to secure the wiring of a great many residences. The Edison Company will agree to pay for the wiring contracted for by any responsible householder, receiving payments therefor in monthly installments covering a period of one year. Before this canvass was started a number of requests by mail and by telephone to supply estimates for wiring of residences whose owners were impressed with the value of an electric service by the model apartment at the show, was received. It is hoped in the ways outlined above, and by other methods now being planned, to secure an amount of business from this advertising expenditure that will repay the company over and over again, and present indications are that this hope will be amply realized.

A detailed description of the model apartment, and also of the immense electric sign over it, was published in the first issue of October.

The Free Wiring of 1200 Residences at Pueblo.

At the Colorado Electric Light, Power & Railway Association Convention at Denver in September, Mr. J. F. Vail, general manager of the Pueblo & Suburban Traction & Lighting Company, mentioned the fact that his company had wired free 1200 residences in Pueblo for the sake of getting these customers on the company's lines. As this appeared to be a rather radical move, we have secured from Mr. Vail further information on the reasons for doing this free wiring, its cost and the returns obtained from it.

The condition with which the company was confronted was that in a town with about 5000 dwellings only 2000 were electrically lighted. Efforts to get additional residence business gave very discouraging results. Many of the houses were rented, and while the occupants said they would be glad to use electricity if they could get it, they would not pay the cost of wiring, and the landlords would not pay for wiring because they argued that the house would not rent for any more than before. Accordingly, it was decided that it would be better to wire a lot of these houses free and get them on the lines as paying customers immediately than to spend an equal amount of money distributed over several years to get a portion of them by solicitation. Of the 1200 houses wired, all were on the company's secondary circuits. The majority were rented houses, and most of them were not piped for gas. The two regular solicitors whom the company keeps in the residence districts were given the work of taking orders for free wiring. The free wiring offer was not advertised and was announced by solicitors as open only for a limited time. The company wired the houses and installed drop-cords free. The customer paid for the lamps and for any fixtures he might want. An extra charge was also made for wiring a porch lamp with a switch. The company employed 25 wiremen, most of whom were boys learning the business, working under competent supervision and drawing about $40 per month. The wiring was begun in April, 1906, and continued to February, 1907. The cost of wiring during the first part of this period was less than during the latter part, because of city ordinances which went into effect in June, which made the requirements more rigid and increased the cost.

The cost of wiring the first 348 houses was $7.64 per house. In these houses there were 2387 drop lamps, making the cost $1.11 per lamp, and the average number of drop lamps per house about seven. The second set of 116 houses wired under the more rigid requirements costs $11.06 per house with 786 drop lamps at $1.60, the number of lamps per house being about seven. The cost for 532 houses was $57.66, being about $10.85 per house. In this figure is included the time spent by the solicitors on this class of business, which amounted to about 10 per cent of the total cost, and a further 10 per cent was added to the cost shown on the books to provide for the use of teams, storeroom expense, etc. The actual cost of wiring came below the company's preliminary estimates, and the revenue which these customers have brought in amounts to more than that estimated.

It was thought before the work was begun that it would pay to do it if a revenue of $1.50 per month per customer could be secured. There is a minimum bill of $1. Mr. Vail states that as a matter of fact these 1200 customers have increased the company's revenue an average of $3,000 per month, or $36,000 per year. This seemed to be a rather high figure for such a class of houses. However, Pueblo is a railroad and manufacturing town, and the class of people who live in small, rented houses of the kind wired are inclined to be extrava-[illegible]

While the proposition appears as a rather startling and radical one at first glance, when the facts are investigated it is seen that with the cheap class of wiring done, the gross revenue from this class of business will, in any event, more than pay for the wiring the first year; and under conditions as favorable as those in Pueblo, within much less time than that.

Fighting the Isolated Plant in Haverhill, Mass.

One of the most compact folders recently issued in central-station service in the campaign against isolated plants is a 3⅛ in. x 6 in. leaflet prepared by the Haverhill (Mass.) Electric Company for distribution among its customers and the general public. One page of the folder is reproduced herewith and needs no explanation, though emphasis might be laid upon the blank spaces to the right of the list of 21 expense items which make up the total cost of operating an isolated plant. It is safe to say that many a "prospect" has never realized the

Items chargeable monthly to the cost of operating
ISOLATED PLANTS.

OPERATING EXPENSES.				
1. Superintendence.				
2. Wages—Engineers and Engine Attendance.				
3. Wages.—Firemen and Coal Passers.				
4. Fuel.				
5. Cost of Removing Ashes.				
6. Water for Boiler.				
7. Repairs to Engines.				
8. Repairs to Boilers.				
9. Repairs to Dynamos.				
10. Repairs to Belts.				
11. Repairs to Steam Elevators.				
12. Repairs to Hydraulic Elevators.				
13. Repairs to Pumps and Miscellaneous Machinery.				
14. Miscellaneous Expense, Oil, Waste, Packing, Etc.				
15. Insurance—Fire and Boiler.				
TOTAL OPERATING EXPENSES				
FIXED CHARGES.				
16. Interest on Plant Investment, 5%.				
17. Depreciation on Plant Investment, 7%.				
18. Rental Value of Space Occupied by Plant.				
19. Decreased Rental Value of Space made less desirable by Heat of Plant in Summer.				
20. Taxes on Plant.				
21. Risk of Damage to Employees and Public through Accident.				
Cost for Maintaining Plant, per Month.				

Horse Power of Plant.

Cost Per Horse Power Per Month, $

THIS IS FOR DAY SERVICE ONLY.

BLANK FORM FOR EXPENSE ITEMS.

number of items which enter the case, the usual plan being to figure the fuel and supply cost, with a possible repair and wages allowance in case it is clear that the attendants are not needed for other than plant duties a large part of the time. The blank spaces invite every business man to put down the cost of the various items in the operation of his isolated plant for two definite periods; to compare them with what he thought it was costing him, and then to send the estimate to the Haverhill Company to see if a lower charge cannot be made.

An Interesting Lighting Contract Experience.

An [illegible] was given in the ELECTRICAL WORLD of Nov. 18, 1905, of the [illegible] Maryville, Mo., of a special daily newspaper, by the Maryville Electric Light & Power Company, in its struggle for a franchise and lighting contract. This newspaper was used as a medium of appealing to the public, and was issued outright by the company with a frank avowal of its purpose. Mr. J. C. Donnell, the energetic secretary and manager, now furnishes us the sequel as follows:

I [illegible] election Sept. 2, 1907. This election gave us a new franchise for 20 years and authorized the city council to enter into a very satisfactory contract for lighting the streets for a period of five years. Our contest, for two years, has been very vigorously waged and at no time has the public interest in our city or the efforts of our company relaxed, from the first battle until the final issue, which was passed upon by the people at the last election.

During this time we were compelled to issue seven more issues of our paper, of which we changed the name on Nov. 9, 1905, from the "Gas News" to "The Searchlight" and issued one number on that date; then from March 30, to April 2, we issued three numbers; from Oct. 6 to Oct. 18, 1906, we issued three numbers with a supplement. During this time we met and defeated another gas franchise, and a municipal ownership proposition, and lacked only 17 votes of carrying a renewal of our franchise and a 10-year contract by a necessary two-thirds vote. We have had two city elections at which the light question was the paramount issue, not by our choice but by the choice of the people.

The city council was lighting our streets with gasoline lamps when they were not in darkness, under a contract unauthorized by law, and then the whole city council including the mayor resigned. The citizens elected a new city government last April, which was favorable to resubmitting our proposition to the people. This was done on Sept. 2, and resulted as follows: For granting us a 20-year franchise, 101 votes more than two-thirds of all votes cast, a majority only being necessary; for authorizing the city council to enter into the contract 90 votes more than two-thirds of all votes cast, a two-thirds vote being necessary; the total vote being 702.

It is unnecessary to state that I feel greatly relieved and complimented in the results, considering the efforts we made in defending a public service corporation, in the face of an antagonistic press, the popular craze that is going over the country, of condemning all private corporations for everything they have done in the past and the extreme effort being made to regulate such corporations by legislators and city governments. All this makes our victory, which received such an overwhelming indorsement from our people, the more gratifying.

Convenient Tests for Central Station Operators.

BY W. M. HOLLIS

Without laying claim to originality or novelty of treatment, the writer is of the opinion that the following enumeration and descriptions of convenient tests for central station operators will be of interest to those directly concerned in such work. There are times when tests are necessary, and if these can be made with ordinary instruments and apparatus by the station man, this is to his credit.

Several methods will first be shown for obtaining alternating current of various voltages from the regular station lines. Fig. 1 shows a bundle of iron wires serving the same purpose as the core of a transformer; and wound upon this bundle of iron wires are two coils A and B, each containing the same number of wires, similar ends being connected to the same line wire. The station wires have a potential difference of 1000 volts between them. On the same core is wound another coil of wire, C, containing a lesser number of turns of wire than the coils A and B, and serving the purpose of the secondary winding of a transformer. When the similar ends of the coils A and B are connected to the alternating-current mains, a flux is set up in the iron core and the counter e. m. f. induced in the primary winding is directly proportional to the number of turns. The flux set up by the magnetizing current in the primary cuts the turns of wire in the secondary coil, C, and the voltage generated in the closed secondary circuit will be approximately proportional to the number of turns of wire in the coil. As connected, the effect of the coils is additive. If now the connections of one of the primary coils be reversed, the direction of the lines of force will be reversed and both coils having the same number of turns, a neutral effect results and no secondary e. m. f. will be generated in the coil C.

In order to show the practical application of the above, con

sider the case of a transformer with two primary and two secondary coils, the ends of which are brought out to a suitable connecting board on the casing of the transformer. The connections should be arranged so that various multiple and series combinations can be easily made.

In Fig. 2 a single transformer is shown with the primary coils connected in multiple and the secondary coils connected in series; the ratio of transformation being 5 to 2. In Fig.

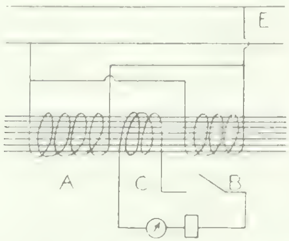


FIG. 1.—DIAGRAM OF TRANSFORMER CONNECTIONS.

3, the primary coils are shown connected in series and the secondary coils connected in multiple; the ratio of transformation being 10 to 1. If the pairs of coils are connected both in series and both in multiple the ratio would be 5 to 1; so that with an e. m. f. of 1000 volts on the primary wires a secondary voltage of 100, 200 or 400 may be obtained. In practice, however, most transformers are adapted for only two changes, as, for instance, for 100 and 200 volts.

In Figs. 4 and 5 connections are shown whereby various intermediate voltages may be obtained for use in various tests. It should, of course, be borne in mind that in the arrangements immediately following the voltages are those of the primary side and the secondary current due to the secondary e. m. f. generated depends on the resistance in the secondary circuit and on the primary input.

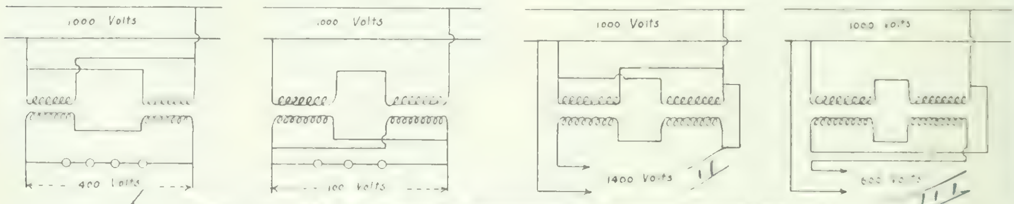
When a voltage higher than the line voltage is desired, the transformer is arranged for "boosting," and when a lower

readings are essential. It is the purpose here to consider some of the uses to which a voltmeter may be adapted. For the purpose of illustration consider a direct-current voltmeter with a 150-750 volt scale. For convenience, assume that the series resistance for the 750-volt scale is about 75,000 ohms, and that for the 150-volt scale about 15,000 ohms. As a matter of fact, the deflection of the needle is directly dependent upon the current flowing in the movable coil. With a full-scale deflection, the current flowing is equal to 750 ÷ 75,000, or 0.01 ampere.

With a calibrating coil having a resistance of about 75 ohms and with a current of 0.01 ampere flowing, the applied e. m. f. would be 0.75 volt. By using an additional resistance of suitable value in series with the other, the instrument may be used as a millivoltmeter. For a full-scale deflection of 1.5 volts with a current of 0.01 ampere, this resistance should be 150 ohms. The instrument may, therefore, be used for measuring voltages as high as 750, and may be used with a full-scale deflection of 150 volts or 1.5 volts. If in addition it is desired to measure currents by means of a metal shunt in series with the line the voltmeter may be used for that purpose. In every case where current flows through a resistance there is a definite drop of potential equal to the product of the resistance and current.

Suppose it is desired to measure currents up to 150 amperes. With a current of 0.01 ampere flowing through the instrument a full scale deflection of 150 is obtained in the voltmeter. Therefore, the shunt should have such resistance that with 150 amperes passing through it and the connections to the instrument, the drop across the terminals should give a full scale reading. Using the 1.5 volt scale, the resistance of the shunt should be such that there will be a drop of 1.5 volts when the shunt passes 150 amperes. Therefore, the resistance of the shunt and connections should be 1.5 ÷ 150, or 0.01 ohm. Skill will, of course, be required to make such an instrument.

A convenient method of ascertaining resistances rapidly where accuracy is not desired is by comparison with some known resistance. For this purpose the millivoltmeter readily adapts itself. The known resistance is placed in series with the voltmeter and the resistor whose resistance is to be ascertained. By means of a resistor of adjustable resistance, such as a water rheostat, a convenient current may be obtained to



FIGS. 2, 3, 4 AND 5.—TRANSFORMER CONNECTIONS FOR OBTAINING VARIOUS [illegible]

voltage is desired the connections are arranged for "bucking." In this latter case the secondary coils contain a less number of turns than the primary coils and are connected so that the voltages added to or subtracted from the line are only a part of the same and are not completely neutralized. If the secondary lead to be connected to the line wire for boosting, for instance, is not known, after connecting the secondary coils in series, connect either outside lead at random and then measure the voltage of the line and then that between the unconnected secondary lead and the other wire by means of a regular instrument transformer with a voltmeter in the secondary circuit.

If the voltage is less than that of the line, the primary circuit should be opened and the outer secondary leads reversed. Fig. 5 shows connections for obtaining a reduced voltage, the arrangement being opposite to that shown in Fig. 4. With the transformer shown in Figs. 2 and 3, voltages may be obtained from 800 to 1200, or, in some instances, from 600 to 1400.

In order to make a single test or a series of widely different tests upon lines, insulation, apparatus, etc., a number of instruments are ordinarily needed, especially where simultaneous

give a fair scale deflection. By maintaining the current constant, the voltage is measured across the known resistance and then across the unknown resistance. The resistances are directly proportional to the deflections, so that the value of the unknown resistance is readily ascertained by proportion.

If the only instrument at hand has a considerably less range than desirable, lamp banks may be employed for obtaining

FIGS. 6 AND 7.—CONNECTIONS FOR [illegible]

rough values by measuring between points within the range of the instruments and adding the results. If a large number of such readings is likely to be taken from time to time, a multiplier may be used. See Fig. 7. The resistances in this case are equal between binding posts, and, as used here, the multiplier allows a voltage five times as large as the instrument can measure directly to be ascertained.

Wiring with Iron Conduit.

By Louis J. Auerbacher.

The installation of electric wires in conduit is recognized as exemplifying the best practice known in the art. There are two kinds of conduit on the market—the lined and the unlined. The latter is used almost exclusively and is either galvanized or enameled with some insulating varnish. For out-door use

TABLE I.—CONDUIT FOR VARIOUS WIRE SIZES.

No. B. S.	Circ. Mils.	Ampere.		Sizes of Pipe.		
		Rubber	W. Pr'f	1 Wire.	2 Wire.	3 Wire.
18	[illegible]	3	5	½"	½"	½"
16	[illegible]	[illegible]	8	½	½	½
14	4,107	12	16	½	½	¾
12	[illegible]	17	23	½	¾	¾
10	10,380	24	[illegible]	½	¾	1
8	16,510	33	[illegible]	½	1	1
6	26,250	[illegible]	[illegible]	¾	1	1¼
5	33,100	54	77	¾	1¼	1¼
4	41,740	65	92	¾	1¼	1¼
3	52,630	76	110	¾	1¼	1¼
2	[illegible]	90	131	¾	1½	2
1	[illegible]	107	156	1	1½	2
0	105,500	127	185	1	2	2
2-0	133,100	150	220	1	2	2
3-0	167,800	177	262	1¼	2	2½
4-0	211,600	210	312	1¼	2	2½
	200,000	200	[illegible]	1¼	2	2½
	[illegible]	235	[illegible]	1¼	2½	2½
	[illegible]	270	[illegible]	1½	2½	3
	[illegible]	300	[illegible]	1½	2½	3
	[illegible]	330	[illegible]	1½	3	3
	[illegible]	[illegible]	[illegible]	[illegible]	3	3½
	500,000	390	[illegible]	2	3	3½
	550,000	420	635	2	3½	4
	600,000	450	[illegible]	2	3½	4
	650,000	475	[illegible]	2	3½	4
	700,000	500	[illegible]	2	3½	4
	750,000	525	800	2	3½	4
	800,000	[illegible]	[illegible]	[illegible]	3½	4
	[illegible]	575	880	[illegible]	[illegible]	4
	900,000	600	920	[illegible]	4	4½
	950,000	625	[illegible]	[illegible]	4	4½
	[illegible]	650	1000	[illegible]	4	4½
	1,100,000	690	1080	[illegible]	4	[illegible]
	[illegible]	730	[illegible]	2½	4	[illegible]
	1,300,000	770	[illegible]	2½	4½	[illegible]
	[illegible]	810	1290	[illegible]	4½	[illegible]
	[illegible]	850	[illegible]	[illegible]	[illegible]	[illegible]
	1,600,000	890	[illegible]	3	[illegible]	[illegible]
	1,700,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	1,800,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	1,900,000	[illegible]	1610	[illegible]	[illegible]	[illegible]
	2,000,000	1050	1670	[illegible]	[illegible]	[illegible]

or [illegible] in damp places, and [illegible] work embedded in [illegible] the galvanized conduit should be used. The code requirements permit the use of single-braided wire in lined conduit, but call for double-braided rubber-covered wire in the unlined conduit. Inasmuch as the lined conduit is fast becoming obsolete, the author in this article will treat only of the regular unlined type.

The use of iron conduit has resulted in standardizing various accessories and fittings, enabling the contractor to install a neat, safe and superior electrical installation without much trouble.

When laying out a conduit installation, the size of wire necessary for the various circuits should first be determined. Afterwards the necessary size of conduits to enclose the mains and feeders may be ascertained. The branch circuits are usually run in ½-in. conduit, since this is the smallest size permissible under the code rules, and since the branch circuits are usually of a size easily accommodated by a conduit of this dimension. It is usual to draw both wires of the circuit in the conduit regardless of whether the supply be alternating current or direct current. In the former case, the running of both wires of the circuit in the same conduit is mandatory, while in the latter case it is strongly recommended. Table I shows the sizes of conduit required for various sizes of wire. Allowance has been made in this table for easy pulling of the wires around three elbows, so that in straight short-line runs, conduit a size smaller than specified may be used. Table II gives the actual inside and outside diameters and also the weight of standard conduit. The outside diameters are given so that the necessary size of drill and bit may be readily ascertained for drilling holes in panels, pull-boxes, etc.

In laying out long runs, or runs requiring more than three elbows, a pull-box may be substituted for bends to advantage. The pull-box may be of iron or may be made of wood iron lined; the sheet-iron of the iron-lined pull-box should not be smaller than No. 12 gauge. Pull-boxes properly drilled should be made up and sent to the job, as workmen are liable to waste much time if required to make them on the spot. When running a number of large conduits together, an angle pull-box is preferable to elbows. Elbows, especially if they are large, are quite expensive, and one pull-box may easily displace two or more elbows. Fig. 1 shows a pull-box substituted for three elbows. Another advantage of the pull-box over the elbow is that a size smaller conduit can often be used, owing to the absence of the elbow.

Conduits should always be of such size that wires may be easily pulled in. One of the objects of the conduit system is to provide a substantial raceway for the conductors. The practice of pulling wires through a conduit by means of a block and fall is objectionable, and the underwriters should compile a table showing the smallest size of the conduit allowed for various sizes and groups of wires. It is evident that if wires are pulled in forcibly, the insulation becomes damaged and it is also next to impossible to pull them out again. This is especially true in very warm places, where if the conduit is too small and the lining softens because of the heat, the removal of the wires becomes very difficult indeed. In fireproof buildings, the conduit is run on the firebrick floors, the ends being bent so as to reach the outlet box, as shown in Fig. 2. There

TABLE II.—SIZES AND WEIGHTS OF [illegible]

Size Pipe.	Weight — [illegible]	Diameter — .64.	
		Inside	Outside.
[illegible]	[illegible]	39	54
[illegible]	112	52	1.4
1"	167	1 2	1.21
[illegible]	224	1 24	1.43
[illegible]	268	1 38	1 58
[illegible]	[illegible]	2 4	2 25
[illegible]	594	2 30	2 57
[illegible]	754	3 2	[illegible]
[illegible]	900	[illegible]	[illegible]
[illegible]	[illegible]	4 4	4 32
		[illegible]	64ths

should be no burrs in the conduit and all joints should be well screwed together. It is generally necessary to rerun the threads of the conduit in order that the joints may be well and rapidly screwed together. In a large installation, this work should preferably be done on a threading machine.

There are many devices on the market for bending conduit,

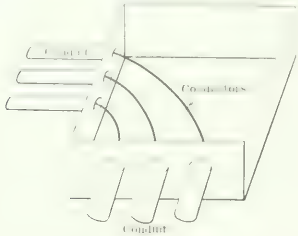


FIG. 1.—PULL BOX

but one of the chief disadvantages of these devices is that the conduit must be brought to them to be bent. For this reason, a very simple, efficient, and home-made device known as the "hickey" is extensively used. The hickey illustrated in the upper part of Fig. 3 is made of an ordinary T pipe fitting, and a piece of pipe. The lower hickey is a commercial form. By means of either of these, the conduit may be bent while being laid. For bending large conduit, a heavy, substantial support, as shown in Fig. 4, is often used. This consists of two pieces of wood, bolted to a column or other support in the manner shown.

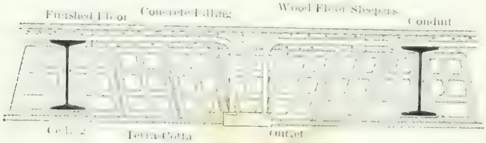


FIG. 2.—CONDUIT IN FIRE-PROOF FLOOR.

For fastening conduit to firebrick, ceilings or other plastered walls, toggle bolts are extensively used. In fastening conduit to a brick wall, expansion bolts and screws should be used. When running conduit on iron beams, girder hooks, fastened to wooden or iron supports may be used, or special girder clamps, of which there are a number on the market. Fig. 5 shows some forms of girder clamps for this work. In fastening

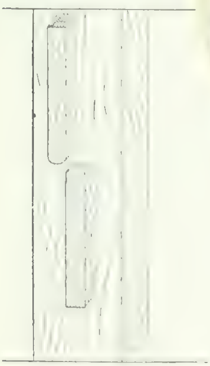


FIG. 4.—CONDUIT BENDER.

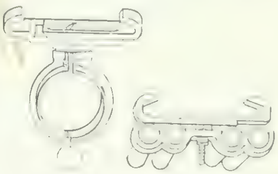


FIG. 5.—PIPE HANGERS.

conduit to wooden beams, the ordinary pipe-hook, staple or strap may be used, and in long, vertical runs, straps which securely grip the pipe are preferable.

A new class of buildings, made entirely of reinforced concrete, presents a new problem to the electrical contractor. This problem may best be solved by laying out the preliminary work when the building is being erected so as to avoid drilling of holes in the concrete as much as possible. If the wiring is to be concealed the location of the outlets should be marked by a sheet-iron tube large enough to accommodate the conduit lines. This tube, properly plugged, may be set in the false work before the concrete is poured, as shown in Fig. 6. For risers a threaded piece of conduit of proper size should be put in the false work before the concrete is poured. This pipe

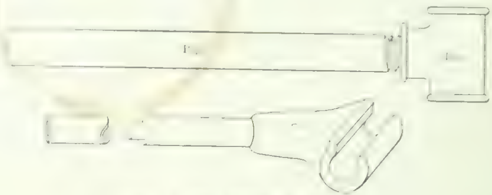


FIG. 3.—TWO FORMS OF HICKEY.

should have a running thread so that the conduit can be readily joined to it. See Fig. 7.

For open wiring on concrete ceilings, a series of cast-iron supports should be set in the mould. These supports, one of which is shown in Fig. 8, should be drilled and tapped, and when liberally used, form good supports for other piping as well. The supports should be inserted in the ceiling moulds at regular intervals in order to obtain the greatest flexibility

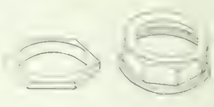
FIGS. 6, 7 AND 8.—DEVICES FOR REINFORCED CONCRETE BUILDINGS.

in installing the pipe lines. For use in connection with open-conduit wiring, outlet and switch boxes similar to those used in concealed work should be used. Figs. 9, 10 and 11 illustrate a number of these.

It is very important that the insulating quality of the wire used in conduit work should be the best. Very often condensation takes place in a conduit and the insulating material deteriorates. In such cases the importance of having conduits of ample size is apparent. In running circuits requiring No. 12 and No. 14 wire, duplex wires are usually used. No wires should be drawn in the conduit system until the finishing coat of plaster is in place. This is done in order to test all the conduit after all the other work in the building has been completed. If no obstructions are encountered when pulling through the wires, it indicates that the conduit system has suffered no damage.

Where conduit is used outdoors or in damp places, a lead-

FIGS. 9, 10 AND 11.—OUTLET AND SWITCH BOXES.



FIGS. 12 AND 13.—LOCK NUT AND BUSHING.

encased wire should preferably be used. Great care should be exercised in drawing in the lead cables so as not to puncture the casing.

In all conduit systems the fittings such as outlet and switch boxes should be iron or iron-lined. The selection of fittings and the method of installing them are very important from the

standpoint of cost. The fittings should be adapted for the purpose so that it will not be necessary for the wiremen to tinker with them. The iron outlet box should, for use in fireproof buildings, preferably be of stamped steel of the "knock-out" type. These boxes are made with a number of easily removable discs known as "knock-outs," any of which the wireman may knock out with a hammer, thereby giving him holes in any part of the box as may be required. Figs. 15, 16, 17 and 18 illustrate a number of outlet boxes of this type. Boxes used in concealed work in fireproof buildings are fastened to the conduit by means of a lock-nut and bushing, and wherever a conduit terminates, the bushing must be used. Figs. 12 and 13 illustrate the standard lock-nut and bushing for this purpose. All boxes should be set so that the edges are flush with the finishing coat of plaster.

Switch boxes for the use of switches and receptacles should

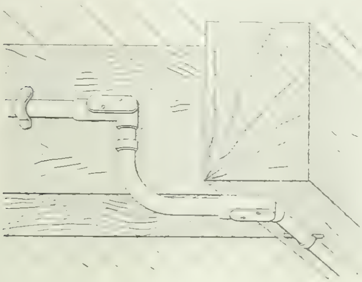
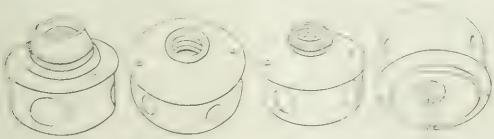


FIG. 14.—ELBOW FITTING.

also be of the knock-out type, and securely fastened to the wall by means of toggle-bolts or expansion bolts.

To supply the demand for a neater-fitting, as well as a more substantial one, a new and distinctive line of outlet boxes, etc., covering the wide range of adaptability has recently made its appearance in the market. These fittings are made in a large variety, and while they would tend to complicate the already overburdened stock room, they are nevertheless a boon to the contractor. Fig. 19 illustrates an outlet fitting of this type which can be used to advantage for outlets between beams. As



FIGS. 15, 16, 17 AND 18.—[illegible]

the fitting screws rigidly to the conduit, no support is necessary. In buildings of mill construction this is a decided advantage. The cover of the fitting is interchangeable and either a drop-lamp fixture or a stem may be used. Fig. 21 illustrates an end fitting where an outlet also terminates the circuit. The end fitting used, as shown, requires no support, and besides saving time and money, presents a neat appearance.

FIGS. 19 AND 20.—[illegible]

Fig. [illegible] also a [illegible] from [illegible] conductors to be brought over from the conduit, as for instance in wiring [illegible] [illegible] from the [illegible]

and safe job is secured. Fig. 14 shows a good elbow fitting, serving also as a pull-box, which is especially useful for wiring on wooden columns or making complicated turns, since it does away with awkward elbow work. For wiring outlets in groups on outdoor awnings, a receptacle like that shown in Fig. 22 answers very well. It is advisable to make up these outdoor circuits in the shop so that all that remains for the wiremen to do is to screw the lines in place. A good feature of this line

FIG. 21.—END FITTING.

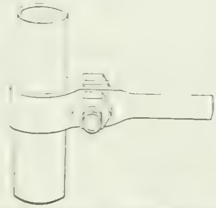


FIG. 22.—RECEPTACLE FOR OUTDOOR WORK. FIG. 23.—GROUND CLAMP

of fittings is that they make good electrical contact with the conduit. Such is not the case with the ordinary outlet boxes, and since all conduit systems are required to be grounded, this is important. Fig. 23 shows a type of ground clamp applicable for conduit work. The conduit should be scraped clean before the clamp is applied. Another clamp of this description should be fastened to a water main and the two joined together with a copper wire sweated in the lugs.

For terminating a conduit line outside a building, a fitting designed to prevent the ingress of moisture should be used. Fig. 25 illustrates a good device for this purpose, one ad-

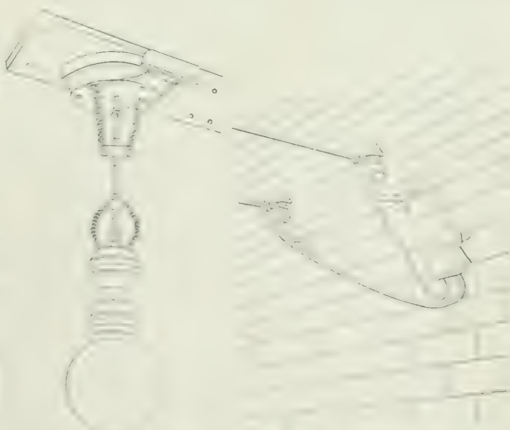


FIG. 24.—[illegible] FIG. 25.—[illegible] ENTRANCE

vantage of which is that the porcelain cover spreads the wires [illegible]

Where conduit terminates in a switch or panel box, the lining [illegible] make a good [illegible] must be [illegible]

The Right to a Patent as Between Employer and Employee.

By John Edson Brady.

To determine which of two or more parties is rightfully entitled to a patent is a task frequently placed upon the courts of the United States. No fixed rule can be laid down which will cover all, or even a majority of the cases, each case being necessarily decided upon the facts presented. The respective rights of the parties are in many cases difficult of determination, but in no case is the question presented more complicated than when the parties bear to each other the ordinary relationship of employer and employee. The rule that the "first and original inventor" is entitled to a patent always holds true. However, it is obvious that a prospective inventor may dispose beforehand of his rights to a patent upon any device or process which he may invent, and in such case, not the original inventor, but his assignee is entitled to the patent. Thus, an employee may agree to devote his inventive faculties to the service of his employer, and thus confer upon him all the fruits of his inventive skill during the period covered by his contract. This, in effect, is an assignment in advance by the employee of any inventions which he may make during the term of his employment. An agreement of this kind, however, must be unequivocal, and cannot be implied from a general bargain for his time, skill and labor, nor is it proved conclusively by the fact that the experiments resulting in the invention were made at the request and expense of the employers.

But it is in cases where the parties have made no contract other than the ordinary contract of employment that the rights of the parties must often become most intricately involved. There is no doubt that the mere fact that a person is in the employ of another does not preclude him from making improvements in the machines with which he is connected, and obtaining patents therefor, as his individual property, and that in such case the employer would have no more right to seize upon and appropriate such property than if the relation of employer and employee had never existed between the parties. On the other hand, it is equally clear that, if the patentee be employed to invent or devise certain improvements, the patents which he obtains on such improvements belong to the employer, since in making the improvements he is merely doing what he was hired to do. Gill vs. United States, 160 U. S. 426.

In the case of Deane vs. Hodge, 35 Minn. 146, it appeared that the director of a corporation engaged in the business of manufacturing harvesting machines invented an improvement, which was immediately taken up by the company and placed on every harvester turned out. It was advertised in the circulars sent out and materially increased the profits of the business, while the additional expense of adding it to each machine was trifling. There was no express agreement between the company and the inventor, and it was held that the inventor owned the right to the patent and might recover a reasonable compensation from the company for the use it had made of his invention. Where a party has availed himself of the services or used valuable property of another, such as an invention, the law, in the interest of justice, will imply an agrement to pay a reasonable compensation, unless the circumstances attending such use are of such a character as to justify the conclusion that it was the understanding of the parties that the use was to be gratuitous. It is true that a man has a right to render a voluntary service, or give a right to use his property to another, without remuneration, and if he does, he cannot afterwards recover for such services or use of his property; but it does not follow that his mere neglect to demand a specific agreement for compensation, or to forbid the use of his property, necessarily deprives him of his right to a reasonable remuneration. The circumstances may be such as to show that the understanding of the parties was that the services rendered, or the use of the property, was to be without compensation; and in such case, the party cannot recover. Where the evidence fails to disclose an express agreement or understanding, the law may imply a contract from the circumstances or the acts of the parties; and where there is nothing from which a contrary intention or understanding is to be inferred, it is a just and reasonable presumption that he who has received the benefit of the services or property of another impliedly undertakes to pay for it.

In another case the plaintiff, while in the employ of the defendant railroad, invented a spark arrester, an automatic air brake and other improvements intended for use on railway rolling stock. The general manager of the road, upon being apprised of the inventions of the master mechanic, ordered a portion of the rolling stock to be equipped with them. After the inventor left the employ of the railroad he brought suit to recover damages from the company to compensate him for the use by the company of his patented improvements. It was held that inasmuch as none of the company's labor or material had entered into the discovery or perfection of the inventions, the company was not entitled to use the inventions merely because the inventor was in its employ, and the latter was allowed to recover the reasonable value of his patents to the company. The use of the patents by the railroad was compared to the taking of coal or any other commodity by the railroad. If the railroad, for instance, had run out of coal, and, knowing that its master mechanic was plentifully supplied therewith, had ordered him to bring down a thousand bushels for the use of the company, it was said by the court, "no one would claim that the master mechanic should not be paid for it, because he was an employee, and the coal was necessary to the proper carrying on of his department, even though nothing was said about pay." Fort Wayne, Cincinnati & Louisville Railroad Company vs. Haberkorn, 15 Ind. 479.

In 1876 an employee of a manufacturing corporation was instructed to devise and build an iron sulky plough which would retain the valuable features of the wooden plough, which had previously been made by the company, and would also have certain new features suggested by the president and other officers of the company. The employee accordingly went to work and constructed a sulky plough of wrought and malleable iron which met with the approval of the company's president. During all the time he was engaged in getting the new plough ready, the employee drew a salary from the corporation of $3,000 a year, and the men who did the manual part of the work were in the employ of and paid by the corporation. While the employee remained with the company he never made any claim of property in the new plough, and never claimed that he was entitled to a patent. But after his connection with the corporation ceased, and after the corporation had been engaged for many months, with his consent, in the manufacture of the ploughs the employee applied for and was granted patents covering certain parts of the plough. The corporation having in the meantime dissolved, its trustee brought action against the employee to compel him to convey to them the letters patent which he had obtained upon the plough. There was nothing in the contract of employment which gave the corporation any right to the patents on the plough, and it was held that the most that could be claimed for the company was a mere license to manufacture the ploughs, which right, being a mere personal one, was extinguished by the dissolution of the corporation. The right to a patent belonged to the employee. Hapgood vs. Hewitt, 119 U. S. 226.

There are many other cases in which, while the employee has been regarded as being the proper person to take out the patent, it has been held that the employer is entitled to use the subject of the patent. A draftsman, employed by the United States at the Frankford Arsenal in Pennsylvania, as master armorer, invented during the term of his service, a cartridge loading machine and several other devices, upon all of which he took out patents. These patents he assigned to various persons, but reserved in each instance the right of the government to use them. His engagement required him to perform manual labor and exercise mechanical skill in the service of the government, but did not require the exercise of inventive genius. After he left the service he brought an action against the government to recover the reasonable value of the use of his in-

ventions by the government. The case raised the question whether an employee paid by salary or wages, who devises an improved method of doing his work, using the property or labor of his employer to put his invention into practical form, and assenting to the use of such improvements by his employer, may, by taking out a patent upon such invention, recover a royalty or other compensation for such use. In a series of cases it has been held that this cannot be done. The inventor may not have intended to give the benefit of his discovery to the public and may have supposed that, by giving permission to a particular individual to construct for others the thing patented, he could not be presumed to have done so. But it is not a question of intention which is involved, but is rather one of legal inference, resulting from the conduct of the inventor. It was here held that the draftsman could not recover. "Clearly," said the court, "a patentee has no right, either in law or morals, to persuade or encourage officers of the government to adopt his inventions, and look on while they are being made use of year after year without objection or claim for compensation, and then to set up a large demand upon the ground that the government had impliedly promised to pay for their use. A patentee is bound to deal fairly with the government, and if he has a claim against it, to make such claim known openly and frankly and not endeavor silently to raise up a demand in his favor by entrapping its officers into making use of his inventions." Gill vs. United States, 160 U. S. 426. So, also, when one is in the employ of another in a certain line of work and devises an improved method of work or instrument for doing that work, and uses the property of his employer and the services of other employees to develop and put in practical form his invention, and explicitly assents to the use by his employer of such invention, a jury or court trying the facts is warranted in finding that he has so far recognized the obligations of service flowing from his employment and the benefits resulting from his use of the property and the assistance of the co-employees of his employer as to have given to such employer an irrevocable license to use the invention. Solomon vs. United States, 137 U. S. 342.

A person in the employ of a smelting company invented a new method of tapping and withdrawing molten metal from a smelting furnace. He took out a patent for it and permitted the company by which he was employed to use it without charge so long as he remained in its employ, which was about ten years. After that his employer continued to use it, and when the patent was about to expire the patentee filed a bill against the company, praying for injunctions, preliminary and perpetual, and for an accounting. On the trial, it appeared that the invention had been used for more than 17 years with the knowledge and assent of the patentee, and without any complaint on his part, except that the company had not paid royalties after he quitted its employment. It was held that the employee was not entitled to an injunction. Keyes vs. Eureka Consolidated Mining Company, 158 U. S. 150. In McClurg vs. Kingsland, 17 How. 202, the inventor, whose name was Harley, was employed by the defendants at their foundry in Pittsburg. In 1834, while he was so employed, Harley invented an improved roller as a result of which his wages were increased. Harley continued in his employment and some time after making the invention he suggested that his employers take out a patent and purchase his right, which they declined to do. He made no demand on them, however, for any compensation for using his improvement, nor did he give them any notice not to use it until a misunderstanding in regard to another subject arose and he left the foundry. It was held that the facts amounted to a "consent and allowance of such use" and gave the defendants a right to continue the use of the invention.

Many contracts of employment, in which it is contemplated that the employee will exercise his inventive skill for the benefit of his employer, are so framed that under them any inventions which are made by the employee belong in toto to the employer. For instance, where one employs another to make a device, pointing out the distinct and dominating feature of his improvement, although he does not make anything resembling a perfect drawing for the guidance of the other, or describe the proposed construction in detail, the maker of the device is not entitled to claim the invention, although by reason of his mechanical skill, he may have made a neater and more perfect device than was in the mind of his employer. A member of a firm which was engaged in the jobbing sale of various novelties wishing to get out an improvement upon a device which his firm handled, employed a person engaged in the manufacture of electrical and brass goods to prepare a model for him. The novelty consisted of an arrangement intended to be fastened to bath tubs, there to perform the functions of a soap holder. The employer was something of a mechanic, having spent the years of his youth as apprentice and journeyman in the shops of manufacturing jewelers. He claimed that the improvement was suggested to him by objections raised to a soap holder which was on sale by his firm. In giving directions for the making of the novelty, the employer did not make anything resembling a drawing for the guidance of the party who was to do the work, nor did he describe the improvement in detail. But he pointed out the distinctive and dominating feature of his improvement, and he reasonably accounted for the lack of particularity of detail by saying that he was talking to a mechanic familiar with similar devices then in use and one who had been employed in their manufacture. When the device was finished each party filed an application for a patent, but the employee got his application in four days ahead of his employer. In an appeal from the decision of the Commissioner of Patents it was held that the employer was nevertheless entitled to the patent. It was undoubtedly true that the employee, by means of his mechanical skill and knowledge of the art, had made a neater and more perfect device than had been in the mind of the person by whom he was employed, but he was not entitled to claim the invention on that ground alone. An inventor, who employs a mechanic to embody his conception in practical form retains his exclusive right to the perfected improvement notwithstanding the perfection is partly due to the exercise of the mechanical skill of the employee. In order to be entitled to anything in the premises the latter must "invent" something, not merely improve, by the exercise of his mechanical skill, upon the conception which he has been employed to work out. Huebel vs. Bernard, 15 App. Cas. (D. C.) 510.

In Annin vs. Wren, 44 Hun. 253, the plaintiff was engaged in the manufacture of iron trucks and wheelbarrows of sheet iron. In February, 1883, he employed the defendant, George Wren, at a weekly salary of $18, to apply himself personally to the development of the business and to develop the truck and wheelbarrow made by the plaintiff. Wren, being a skilful draughtsman, made detailed drawings of the proposed improvements and patterns were made in accordance with the drawings. The design was to get patents for the improvements and engage outside capital in the enterprise, and the patents were expressly to be in the name of the plaintiff. In 1884, the employee made application for a patent for truck improvements and assigned the same to the defendant, William Wren, who obtained a patent therefor in his own name. This action was brought to compel William Wren to assign the letters patent, which had been issued to him, to the plaintiff, and it was held the patent equitably belonged to the plaintiff. The special service of inventing was the entire scope of the employment. There was no room left within the employment for inventing by the employee on his own hook. The employee had no right to think or invent for himself on the particular subject matter in hand. He could not carry off both his salary and the only valuable product of his work under such employment, leaving his master with his useless models, the result of his uselessly spent money on tools, machinery, time, labor of self and employees, with only a license or shop right which is not assignable or useful in any way save to himself. Such a result would necessarily have defeated the whole purpose of the contract and the contracting parties.

In Sparkman vs. Higgins, 1 Blatch. 205, the plaintiffs brought a bill to enjoin the making of oilcloths of a certain patented

[illegible] plaintiffs were not the original inventors, but that one in their employ actually made the invention. This, if true, would be a sufficient ground upon which to deny the plaintiff any rights in the matter. In regard to the making of the invention, it appeared that the plaintiffs would inform the employee in question that they wished him to get up a pattern and would instruct as to what they wanted in a general way. If the pattern, when finished, did not meet their approval, they would criticize and suggest and perhaps alter and improve upon it. It was held that the plaintiffs and not their employee were the inventors. To constitute an inventor it is not necessary that he should have the manual skill and dexterity to make the patterns. If the ideas are furnished by him, for producing the result aimed at, he is entitled to avail himself of the manual skill of others to carry out practically his contrivance.

Where an employer conceives the result embraced in the invention, or the general idea of a machine upon the particular principle, and, in order to carry his conception into effect, it is necessary to employ manual dexterity, or even inventive skill in the mechanical details and arrangements requisite for carrying out the conception, the employer is, nevertheless, the inventor and the employee the mere instrument through which he realizes his idea. If any of the essential parts and principles of the machine are invented by the employee and introduced into the machine on his suggestion, a patent taken out by the employer is void. But if it appears that the employee merely suggests alterations in the form or proportions of the machine, then the employer is entitled to the patent. If a contrary doctrine were to be maintained, very few patents could be upheld. Except in those cases where the inventor is also the mechanic who constructs the machine, patents would, in general, be necessarily held invalid. One's genius may be equal to the task of conceiving all the principles as well as the general structure and form of a machine. But he may be unacquainted with the use of tools, and be quite unable to anticipate in what manner the contemplated form of any particular part of the machine may affect its operation until the work is in progress and the materiality of form can then be readily discerned. That some alterations of the contemplated form or proportions should be found necessary would be, in most instances, to be expected. And who is more likely to perceive the necessity of it, and to suggest it, than the workman who is engaged in constructing the machine? If such suggestions were sufficient to invalidate the patent, few patents would be found equal to the test. Wellman vs. Blood, 29 Fed. Cas. 17,385.

An employee, performing work assigned to him, may exercise his inventive faculties in any direction he chooses, with the assurance that whatever invention he may thus conceive and perfect is his individual property. But this general rule is subject to certain limitations. If one is employed to devise or perfect an instrument, or a means for accomplishing a prescribed result, he cannot, after successfully accomplishing the work for which he was employed, plead title thereto as against his employer. Whatever rights as an individual he may have had in and to his inventive powers, and that which they are able to accomplish, he has sold in advance to his employer. One Clark, employed by the United States government as chief of the Bureau of Printing and Engraving, was assigned the duty, by the Committee on Ways and Means, of getting up the best self-cancelling revenue stamp which he could devise. Clark made use of the machinery and other property of the government and perfected a stamp which was accepted by the committee and the commissioner of internal revenue. No agreement was entered into between the government and Clark concerning the right of the former to use the stamp or the remuneration, if any, which should be paid for it. But it was understood that Clark was to make no charge to the government on account of the invention, as he was employed for the purpose of devising it. However, Clark assigned all his rights in the matter to a man named Solomons, in payment of a long-standing obligation, and the latter secured a patent and notified the government that he would like to arrange for a proper compensation to be paid him for allowing the government to use the patented stamp upon whiskey barrels. No attention being paid to his communication, he brought suit in the Court of Claims. It was held that Solomons' patent was invalid for the reason that Clark had never secured the right to a patent. Solomons vs. United States, 137 U. S. 342.

To sum up, the employer is the inventor and entitled to the patent where he conceives the idea of the invention, and employs others to carry out the conception, even though the latter use inventive skill in the details. But the mere fact that the actual inventor is at the time in the employ of another does not entitle the latter to a patent for an invention made by his employee. Inventions made and introduced without the employer's knowledge cannot be appropriated and patented by the employer. Even in cases where the inventor was expressly employed to exercise his inventive skill, the employer is not entitled to the patent unless there is an express or an implied agreement for an assignment, but the right to the patent belongs to the actual inventor. The employer, however, in such a case has an implied license to use the invention thus made at his expense. American and English Encyc. of Law, vol. 22, p. 349.

Boiler Blow-Off Connections.

By R. T. Strohm.

The various impurities that are carried into the steam boiler in the feed-water and that are left there by the subsequent evaporation of the water give rise to the necessity of periodical cleaning. But, thorough cleaning of all the interior surfaces and water passages involves the shutting down of the boiler and the cooling of its setting, a matter which is of no

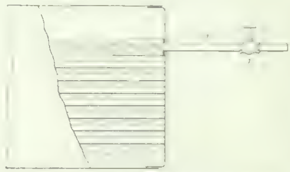


FIG. 1.—SIMPLE FORM [illegible]

small importance in a plant where cutting out a boiler is followed by a decrease in output and a pecuniary loss.

To obviate the necessity of opening up the boiler so frequently and thus wasting valuable time, methods have been devised whereby foreign matter may be drawn off from time to time without interfering with the regularity of working of the plant.

The impurities in feed-water, having once entered the boiler, will manifest themselves in one or both of two ways. Those that are light and flocculent will float on the upper surface of

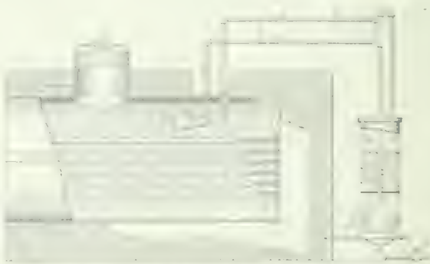


FIG. 2.—[illegible]

the water, and the heavier ones will sink to the bottom. As a consequence, it will be found that there are two distinct [illegible] these is the surface blow-off, and the other the bottom blow-[illegible]

moment the accumulated foreign matter may be blown out by the pressure in the boiler.

The simplest form of surface blow-off would consist of some such arrangement as that shown in Fig. 1, in which a small pipe, *a*, fitted with a valve, *b*, is screwed into the rear head of the boiler at the water level, a pan, *c*, being fixed inside to collect as much of the floating matter as possible and hold it near the outlet. By opening the valve *b* at intervals and for short periods, the impurities could be easily discharged. Such an arrangement is objectionable, however, in several respects. The pipe *a* is not a large one, and if the water level falls to any great extent, the outlet will be wholly uncovered, so that upon opening the valve, *b*, only steam would escape. Again, this device would be intermittent in its action, depending upon the care or thoughtfulness of the attendant.

As an improvement on such a crude system, the continuous automatic surface blow-off or skimmer was devised. Fig. 2 shows an apparatus of this kind. It consists of three skimming funnels, *a*, that open, at their small ends, into the discharge pipe, *b*, leading into the lower chamber, *c*, of the blow-off tank, *d*. The foreign matter is caught at the surface of the water in the boiler by the funnels and is carried to the chamber, *c*. From this point the water rises through the filtering material, *e*, leaving the sludge behind in the bottom of the tank, *d*, from which it may be blown by opening the valve *f*. The filtered water passes upward into the chamber, *g*, and thence to the boiler through the pipe *h*. A continuous circulation takes place

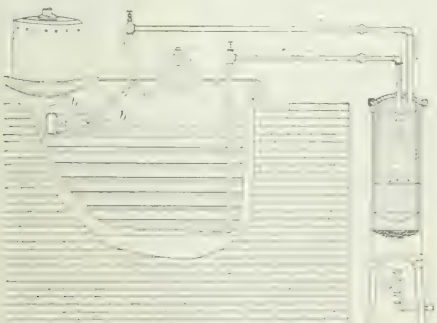


FIG. 3.—FLOATING SKIMMER FOR SURFACE BLOW-OFF.

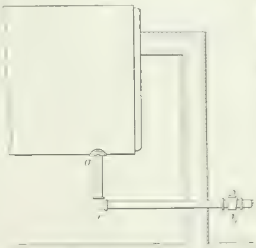
throughout this system when the boiler is in service, and hence the skimming action is uninterrupted and independent of outside attention. Moreover, the hot water carrying the sludge to the settling tank is returned to the boiler, purified, and there is no heat loss beyond that due to radiation.

The device in Fig. 2 would become inoperative if the water level should rise above or fall below the mouths of the funnels, and they are made wide to allow of some fluctuation. The arrangement in Fig. 3, however, provides for any change of height of the water level, since the single funnel, *a*, is fitted with a pair of floats, *b*, *b*. The discharge pipe has a swinging joint at *c*, by virtue of which the floats are enabled to keep the funnel always at the level of the water. The remainder of the system differs only in details from the one already described [illegible]

[illegible] on the type of boiler. Obviously, the blow-off pipe must be [illegible] Another reason for locating it at the lowest point is that the [illegible]

The ordinary return-tubular boiler gives greater difficulty in the location and protection of the blow-off pipe than any other type of boiler. As ordinarily set, the rear end of the [illegible] boiler is such as to cause much of the scale to settle near the blow-off pipe, from where it may be blown out by opening the cock *b*.

However, it must be remembered that, with the blow-off pipe connected at *a*, it is directly in the path of the hot gases as they pass from the furnace to the tubes. Further than this, the blow-off is used intermittently and there is no circulation of



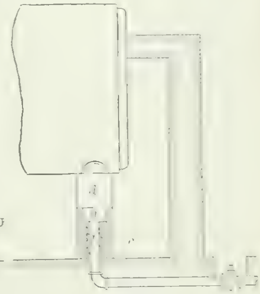
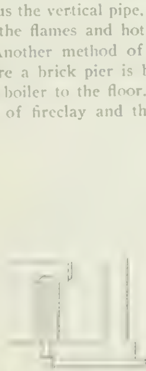


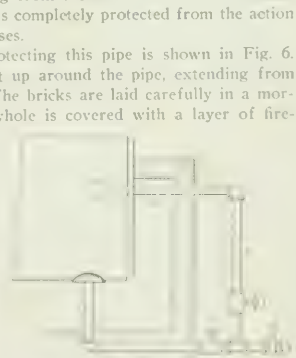
FIG. 4.—BLOW-OFF CONNECTION ON RETURN TUBULAR BOILER. FIG. 5.—PROTECTED BLOW-OFF FOR RETURN TUBULAR BOILER.

water in the pipe. As a consequence, trouble is certain to arise unless reasonable precautions are taken to prevent it. With the arrangement shown in Fig. 4 it would be only a matter of time before sediment would collect in the elbow, *c*, where it would be baked hard by the intense heat and lack of circulation. The elbow and the vertical pipe would then rapidly clog with scale, and this scale would further prevent the heat from being transmitted to the water in the pipe. As a result, the pipe would be burned out, and would have to be replaced. That such trouble as this is very real and not uncommon may be inferred from the fact that some engineers have had to renew the bottom blow-off pipe as frequently as once in six weeks. Hence the need of proper protection of this important fitting.

First of all, the elbow should not be in the path of the hot gases. The arrangement shown in Fig. 5 will accomplish this, since the bend is beneath the floor of the setting, where it is protected by the brick and soot covering it. The blow-off pipe, *b*, is enclosed in a larger pipe, *a*, the space, *c*, between them being filled with mineral wool or asbestos. Outside of all, a third pipe, *d*, is placed, reaching from the shell to the floor beneath. Thus the vertical pipe, *b*, is completely protected from the action of the flames and hot gases.

Another method of protecting this pipe is shown in Fig. 6. Here a brick pier is built up around the pipe, extending from the boiler to the floor. The bricks are laid carefully in a mortar of fireclay and the whole is covered with a layer of fireclay after being built. This is a simple and effective way and [illegible] rounding the pipe, a V-shaped guard is built, with the point toward the front of the boiler. This is open at the rear, however, and is not so good as the enclosing brickwork. Still another way of preventing the pipe from burning out is to wrap it tightly and thickly with asbestos rope.





[illegible]

The manner of connecting the vertical pipe to the boiler should be carefully observed. It is not satisfactory to screw the pipe directly into the plate, for the plate may be too thin to enable a good connection to be made. Instead, a steel flange should be riveted to the boiler, and the blow-off pipe attached to this. Also, the pipe should be free to have a reasonable amount of expansion, which demands that it shall not be fixed too tightly in the rear wall or in the floor of the setting.

An additional means of prolonging the life of the blow-off pipe is to maintain a circulation through the pipe, as, for example, by the arrangement shown in Fig. 7. This shows a combination of surface and bottom blow-off, the discharge pipes, *a* and *b*, being connected by the riser, *c*. When the boiler is in

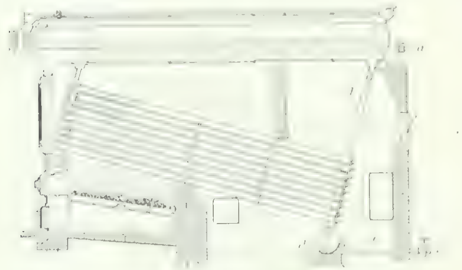


FIG. 8.—BLOW-OFF CONNECTION OF BABCOCK & WILCOX BOILER.

operation, the blow-off cock, *d*, is closed and the valves, *e* and *f*, are open, and there is a continuous circulation through the pipes, *a*, *b* and *c*, that prevents the collection of sediment in, and overheating of, the bottom blow-off pipe. When it is desired to use the surface blow-off, the valve *e* is closed and the cock *d* is opened. When the bottom blow-off is to be used, the valve *f* is closed and the cock *d* opened.

In all cases where the blow-off pipe is exposed to the hot gases it should be made of extra-heavy pipe in order to reduce the chances of failure. In fact, many specifications name extra-heavy pipe whether there is any protecting device to be used or not.

Where there are several boilers in service, it is not unusual to find them connected to a common blow-off main leading to the sewer. This is a questionable practice, inasmuch as it may become dangerous. Suppose that, while one boiler of the battery is open for inspection, the blow-off cock on one of the others should be opened. The consequences to an inspector inside the idle boiler would be terrible. This is no hypothetical case. Accidents of precisely this character are on record. Evi-

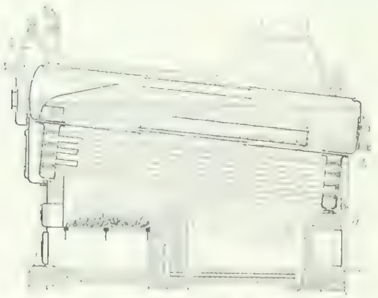


FIG. 9.—BLOW-OFF CONNECTION OF HEINE BOILER.

dently the safe plan is to have each boiler discharge through its own pipe.

In the Babcock & Wilcox water-tube boiler as illustrated in Fig. 8, the water is forced into the upper drum through the feed-pipe, *a*. The circulation then is downward through the risers, *b*, upward toward the front header through the tubes, *c*, and thence back to the rear in the drum above. The rear header is connected to a mud drum, *d*, that forms the lowest part of the water space. To this drum the blow-off pipe, *e*, is attached.

The Heine boiler, also of the water-tube type, has a double blow-off system. The usual bottom blow-off is provided at *a*, the lowest part of the rear water leg. An auxiliary blow-off, however, is installed at *b*. Suspended inside the steam drum, beneath the water, is a long drum, *c*, closed at the rear end but

FIG. 10.—BLOW-OFF CONNECTION OF STIRLING BOILER.

open at the front. Into this drum the feed-pipe, *d*, discharges, and thus the incoming feed-water is heated to nearly the temperature of the surrounding water before it begins to circulate through the tubes. The result is that a large part of the soluble impurities are precipitated in the drum *c*, from which they are removed at intervals by the opening of the valve at *b*.

The Stirling water-tube boiler, differing in design from either of the foregoing, is shown in Fig. 10. The feed-water enters the rear upper drum at *a*, passes downward through the tubes

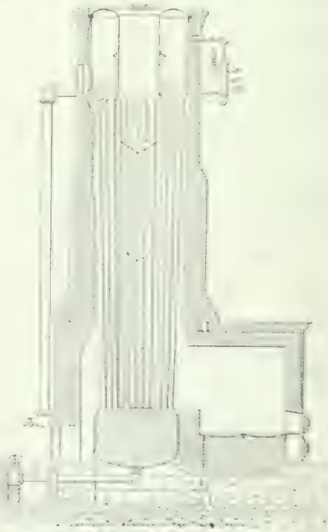


FIG. 11.—BLOW-OFF CONNECTION OF CAHALL BOILER.

b into the mud drum, *c*, and thence upward through the other tubes. At the bottom of the drum the blow-off pipe, *d*, is attached.

In the case of the Cahall vertical boiler, consisting of upper and lower drums connected by tubes almost vertical, as in Fig. 11, the lowest part of the water space is at the bottom of the drum, *a*, and this is the logical point of attachment of the blow-off pipe, *b*. Had the boiler been a fire-tube instead of a water-tube, the blow-off pipe would have been connected to the water leg at its lowest point.

LETTERS ON PRACTICAL SUBJECTS.

THE CARE OF ELECTRIC DRILLS.

Few pieces of electrical apparatus receive harder usage than motor-driven drills, and in many cases lack of proper care, coupled with severe service, have given rise to the impression that electric drills are not reliable tools. The proper maintenance of an electric drill is not a serious difficulty. Operation with reasonable care contributes its part to the reliable service which may be expected of a good drill, and a little intelligence exercised in the field will save many an interruption. The practice of using the wrong size of fuses in drill sockets opens the door to trouble, as does the habit often seen of dragging the drill around by its cable. When a drill refuses to start, ignorant operators will sometimes take it to pieces before finding whether the fuse is blown, or whether current is on the line.

In some styles of drills the use of oil on the armature bearings leads to insulation troubles. Even on spindle bearings, oil should be used sparingly. Small, rather than large quantities of grease in the gear boxes are desirable, and in most cases an application once a week or two, depending on the service, should be sufficient. Attempting to drill with dull drills, using larger drills than the outfit is rated for, and feeding too fast when the point of the drill is breaking through the stock, often lead to damage in the motor windings.

In case a drill refuses to operate, the first course should be to look at the commutator and brushes, throwing the drill switch several times. If no spark can be seen at the brushes when the switch is thrown in, the drill should be disconnected from the line, and a test made by lamp or otherwise, to find out if the power is on. If the fuse is intact and the commutator all right, a careful inspection of the commutator and brushes should be made to see whether one of the brushes is not being held off the commutator by dirt or grease. The remedy here is, of course, to wipe off both commutator and brushes, turning the armature completely over in so doing. If the trouble is not here, it may be in the switch. This applies to a search for an open circuit or a condition in which the drill does not get current.

If an electric drill refuses to work properly or overheats with an excessive spark visible at the brushes, the commutator should be examined for burning in any particular spot. If it is not burned, but simply dirty, a few drops of kerosene applied to it on a cloth will be sufficient to stop sparking. The brushes should bear on the commutator with a moderate pressure.

It occasionally happens that a field wire is broken, which causes excessive sparking and may cause the drill to run at far above normal speed. This can be found by removing the armature, then switching on the current, and trying the pole pieces for magnetism with a piece of iron or steel. If no magnetism is present, the field circuit is open, and an examination must be made to determine the exact point. Unless a break can be very easily repaired, it is better to send it back to the makers. If the commutator shows a decided burn between any two bars, or the armature coils are burned, as indicated by the insulation being scorched, the armature should be returned to the factory where it was made for repairs, or a new armature substituted. It is generally inadvisable to have local electricians mend such armatures. The only electrical trouble likely to occur is a ground, causing the workman to receive a shock when handling the drill. This can be located by testing the armature, fields and switch separately, using a test lamp and trying the circuit between the winding and the armature shaft or the housing of the drill. In cases where drills are operated from trolley circuits with a pole for the connection staff, a fuse block should be placed near the top of the pole so as to make it necessary for the operator to remove the pole from the line in order to replace the fuse.

BOSTON, MASS. K. S. HOWARD.

TINNING BLOCK FOR ELECTRIC SOLDERING TOOL.

During several years' use of the electric soldering tool, the writer has tried many ways of keeping the tool coated with solder, or "tinned," but thus far, a substitute for the homely but efficient "tinning brick" has not been found. Some sort of support must be used for the electric tool when it is being heated, and when not in actual use. All kinds of stands have been tried for this purpose, but a common clay brick answers just as well.

Fig. 1 shows the method used by the writer, in which two "soft" bricks comprise the entire outfit needed for supporting and for tinning the tool. As shown, one brick is used merely as a support for the soldering tool, while the other brick is used to contain the tinning material and to furnish a material which will keep the copper bit bright enough to receive its coating of "tin."

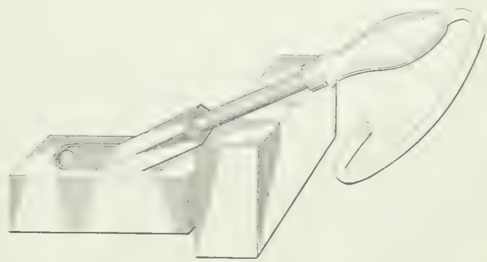


FIG. 1.—ELECTRIC SOLDERING TOOL.

Fig. 2 represents a section of the tinning brick, which is scooped out on top as shown by the lower line. The brick need not be hollowed out as much as shown. If a hollow place ½ in. deep is dug in the middle of the brick with a cold chisel, it will be enough to start with, and subsequent use of the tool in the act of tinning, will hollow out the brick as shown. In time, of course, it will dig a hole through the bottom of the brick, when a new brick will be necessary.

Into one end of the hollow in the brick, some sal-ammoniac is placed to help tin the copper bit. Sal-ammoniac is a natural flux for copper and aids greatly in keeping the tool well tinned. Next, as shown by Fig. 2, some melted solder is run into the hollow in the brick, and lastly enough resin to fill the cavity nearly to the top.

When the tool is not in use, the electricity is switched off and the tool permitted to lie in the resin. If it is desired to repair the tin coating a little when the tool is in use, the latter is rubbed on the brick below the layer of solder and the layer of resin. If the tool is in very bad condition, it may be pushed into the sal-ammoniac once or twice and then rubbed in the solder again. It requires but little heat to keep the brick and its contents ready for instant use. In fact, the brick is a fair non-conductor of heat and prevents the escape of heat from one side of the tool.

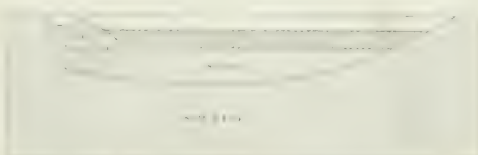


FIG. 2.—CROSS SECTION OF TINNING BLOCK.

When momentarily not in use, the tool remains in the solder which becomes melted underneath the layer of resin. When the copper bit becomes too hot, it will begin to volatilize the resin, thus calling the attention of the workman to this fact, whereupon, the electricity will be turned off from the tool, or

[illegible] The the apparatus is not only a stand for the tool, a continuous tinning arrangement, but it is an alarm as well, giving a smoke notice whenever the tool is getting hot enough to burn the tinning off of the copper.

Only a very soft brick should be used for this purpose. A vitrified paving brick is of no use. A soft yellow brick is preferable, although a fire brick can be made to answer fairly well. A sandlime brick does not work very well. It seems to "kill" the solder as well as the resin and the sal-ammoniac.

DETROIT, MICH. JOHN JACKSON.

[illegible]

A recent boiler and pump experience may be of interest to readers. When the boiler in question was opened and nearly three-sixteenths inch of very hard scale was found coated fast to the inside of the water tubes, it was high time that something was done to lessen the coal bills. The scale was so hard, and adhered so firmly to the inner sides of the tubes, that it seemed almost impossible to start the scale without destroying the tubes. For two days all the men that could get at the tubes, hammered away with cold chisels without seeming to make an impression upon the scale.

Next, a turbine scale remover was tried with 60 lbs. pressure in the water mains, and that tube cleaner made about as much impression upon the scale as a cheese bullet would upon a war ship. Next, a 6 in. x 4 in. x 6 in. duplex Worthington pump was placed convenient to the front of the boiler and connected direct to the turbine by means of very strong wire-wound rubber hose. The suction of the pump was connected direct to the water main and its 60 lbs. pressure, which forced a considerable stream of water through the pump when air was cut off from that appliance.

Compressed air was used in the business which operated the power plant and air at 90 lbs. pressure was turned into the steam end of that duplex pump. It can be easily understood that the pressure in the air chamber of that pump was something worth having. A pressure gauge applied to the water vent of the pump showed a fluctuating pressure between 180 and 240 lbs. to the square inch, and the manner in which the hose which was attached to the turbine cut up around the front end of the boiler was lively, to say the least, and it required the united efforts of two men to keep the turbine to its work and to control the very lively hose connection.

But, alas, though the turbine ran mightily, and tons of city water was wasted through the pump and the tube cleaner, the scale seemed to have decidedly the best of it, and two days' work only saw 15 tubes cleaned—and of those 15, out of 70, how many of them would be tight after the scaling operation is complete? That is a mighty question, and it is pretty safe to say that many, if not all of those tubes will leak so badly that it will be impossible to run the boiler without further repairs. Once a water tube is so badly coated with scale on the inside, that so heavy a pressure is necessary to remove the scale, it is almost a foregone conclusion that the tubes will be so nearly destroyed in forcibly removing the scale, that they will prove worthless and must be replaced before the boiler can be operated to advantage after the cleaning.

Instead of letting a boiler go until such a heavy scale formation results in enormously increasing the coal consumption, how much better it is to use continuously the necessary amount of the proper solvent, that the scale may be chemically removed from the tubes. Then, use the necessary chemical in the feed water to prevent the formation of scale, or use such purifiers as may be found necessary. But, the question is asked: "How is all this to be determined—the 'proper solvent' and the 'necessary chemical'?" Well, that is easy. Just send a sample of the water to a reputable chemist and have the liquid examined for substances detrimental to steam boilers.

The chemist will very soon tell just what salts are contained in the water, and he will also tell what chemicals should be used be used to prevent scale formation. If the impurities held in solution in the water are of such nature that they may best be removed by means of a feed-water purifier, then the chemist will determine that fact also, and by following his advice, the steam boiler will never have its tubes knocked to pieces by 240 lbs. hydrostatic pressure in a turbine tube cleaner.

The detection of leakage in the water-end of a duplex pump was most graphically illustrated during the use of the steam pump as described above. It was thought that there was considerable leakage past one of the water pistons, and to determine which one, a pressure gauge reading up to 300 lbs. was attached to the pump by removing the pet-cock from the top of the water-end of the pump. The water-delivery pipe was throttled by means of a valve until the pump was working up to about 240 lbs. as indicated by the gauge. Of course, this pressure would not be maintained all the time, but would fluctuate during each stroke, but it was noted that the pressure was maintained very steadily while one of the water cylinders was working, and that the pressure fell off very fast while the other cylinder was at work.

This occurrence demonstrated that one of the cylinders leaked badly and it furthermore showed that there was more leakage at one end of the water cylinder than there was at the other end. By completely closing the valve in the discharge pipe, and then running the pump, the amount of leakage which existed was plainly shown. When it was demonstrated that this pump would make nine complete strokes a minute with the discharge valve tightly closed, then the owner commenced to figure what the existing leakage in the water cylinder was costing him for coal. This leakage is, of course, in addition to the leakage of steam which might be taking place past the steam piston. This leakage is easily detected by removing the exhaust pipe and running the pump very slowly with the exhaust passing freely from the pump into the room.

Sometimes it is found that steam literally blows right through the pump, and that the waste of coal from this cause alone, is something enormous. In more than one instance, steam enough thus leaks past the pistons to run another pump of the same size as the one under consideration. The steam leakage, added to the steam used by nine strokes a minute extra for water slippage, sent the steam consumption of this pump up to 325 lbs. of water to each horse-power-hour! Rather an expensive pump to operate? And this pump, with all its expense, can be found running in duplicate in many an engine room.

The two easily made tests above described should be frequently applied to every steam pump and the results, if carefully noted and acted upon, will save a considerable amount of coal to the engine owner.

[illegible], OHIO. [illegible]

[illegible]

When looking over a thirty-year-old book recently, I came across the following description of a sheet-iron belt, which may be of interest to your readers:

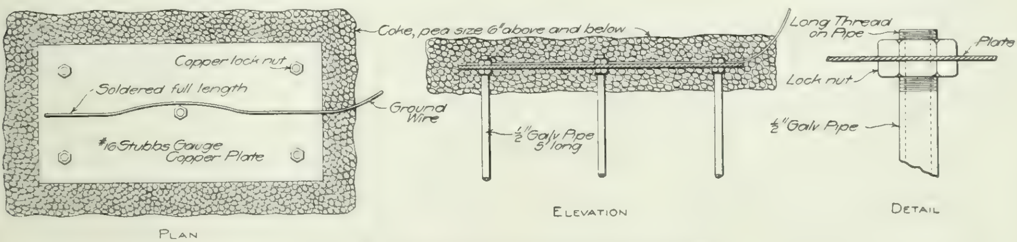
"Mr. John Spiers, of Worcester, Mass., gives us an account of a sheet-iron belt. A lathe used for turning rolling-mill rolls, compound geared, has a 48-in. pulley on it; this is driven by an 18-in. pulley on the countershaft which makes 120 r. p. m. and is 8 ft. from the 48-in. pulley measured from center to center. Both pulleys are of iron, smoothly turned on faces. A 7-in. double-leather belt was used on these pulleys, but would slip when the turning tool became dull. This belt was replaced by one made of Russia sheet iron, such as is used for stove pipes and parlor stoves, and was riveted together in the ordi- [illegible] belt. This extra length made up for the want of elasticity in the iron. During one year's steady run this iron belt could not be slipped, even when a heavy cut on a 25-in. roll was taken, which broke a 'Sanderson' steel tool having a section of 2 ins. x $2\frac{1}{2}$ ins., a cutting surface of $2\frac{1}{2}$ ins., a feed of $\frac{1}{8}$ in. per revolution, and an overhang of 4 ins." This is certainly a novelty in belt drive and appeared to have worked very satisfactorily, although one would hardly have expected sheet iron [illegible]

[illegible]

GROUND PLATES FOR CENTRAL STATION WORK.

I give herewith a method of making a ground which appeals to me as being very serviceable. The writer has been impressed of late with the vagueness of the data available with regard to the proper size and method of installing ground plates for central station work. The method of grounding described has been adopted in our new plant and, while original with us, may be of service to others who have similar work to do. We procured a plate of No. 16 gauge copper 3 ft. x 6 ft. as advised in the National Electric Code, and dug down until we struck earth which seemed to be permanently damp. The plate was pierced by five ¾-in. holes, spaced equally and laid in the bottom of the hole to be used as a template. Five lengths of ½-in. galvanized pipe were threaded about 1½ ins. at one end and shaped into a rough point on the other end. These pipes were driven into the earth by means of a driving cap, through the holes in the copper plate, care being taken not to injure the threads. About 6 ins. of the pipe were left projecting above the plate. The latter was then removed and powdered coke filled around the projecting pipe ends to a depth of about 6 ins. A copper lock-nut, made from a piece of bus-bar drilled and tapped, was screwed on the end of each pipe and the copper plate replaced. Another copper lock-nut was then screwed on each pipe, thus fastening the copper plate securely in position over the powdered coke. Powdered coke to a depth of 6 ins. was then spread over the copper plate and the hole filled with earth. The usual form of connection to the plate was varied a trifle to make it a little more secure. A No. 2 bare wire was doubled on itself and the loop soldered the length of the copper plate, giving two ends to which the lightning arresters and other apparatus were connected. The accompanying illustrations show very clearly the manner in which the ground connection was made. In addition to this plate, a wire was run from the arrester to the water piping of the building, thus making two separate grounds.

AMES, IOWA. FRANK K. SHULE.



DETAILS OF GROUND PLATE FOR CENTRAL STATION WORK.

BOILER BRIDGE WALLS.

Why is it that so many people use inferior things when it costs no more—perhaps much less—to have the best? It surely is a sort of inherent depravity to which mankind is heir. The writer is thus moved to express himself after looking at a bad case of boiler setting which seems rather more a monument of stupidity than a creation of a supposedly competent engineer.

Fig. 1 illustrates a common-sense bridge wall, one made for the purpose of preventing the fuel from being pushed off the back end of the grate before the fuel is consumed. In the engraving, the wall is shown at a as having been built up about 10 ins. above the grate, and as shown at b, b in the end elevation, the wall is straight from one side of the furnace to the other. Behind the bridge wall is a generous back-combustion chamber, the passage through which imparts a very slow velocity to the gases during the combustion period, giving time for combination of oxygen and carbon and the full development of most of the heat possible.

Fig. 2 represents a very common form of bridge wall and one which the writer never could find any excuse for. As shown by the illustration, the wall follows the curve of the boiler and is built from 10 to 15 ins. distant from it. The writer has seen some 72-in. boilers with less than 8 ins. between the curving bridge wall and the shell of the boiler. Why some people should imagine that more heat will be imparted to the boiler when the hot gases are all driven against the shell in one spot, is more than he can figure out. If this theory were true, it would be unnecessary to have any heating surface to the boiler except a small portion against which all the products could be driven, and as close to the grate as possible.

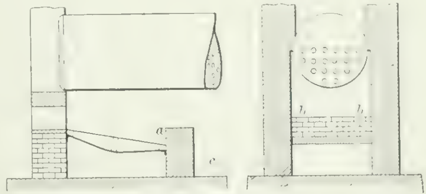


FIG. 1.—COMMON-SENSE BRIDGE WALL.

The men who set boilers in this way, or who design such settings, do not seem to consider that it requires a little time for heat to pass through any conducting material, be it boiler shell or water, and that when the velocity of the hot gases is made very high by passing all the products of combustion through a contracted area, the heat cannot have the time necessary to pass through the boiler shell; consequently, the gases pass into the chimney at a very high temperature and the best results are not obtained from the amount of fuel burned.

It is, therefore, necessary that the flame and smoke passages be so large that the products of combustion have plenty of time to give up their heat to the contents of the boiler and do not get a free ticket to the smoke-stack. In many instances, combustion does not begin to be completed by the time the gases get to the entrance to the tubes at the back end of the boiler. When this is the case, it will readily be seen that anything which hurries the gases through the passages under and inside, the boiler, is a source of loss instead of gain. Hence the value of plenty of room under the boiler, and the injury done by contracting any of the passages with walls or other structural work, so as to increase the gas velocity at any point.

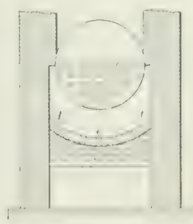


FIG. 2.—CIRCULAR BRIDGE WALL.

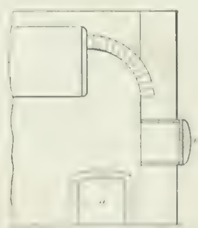


FIG. 3.—LOCATION OF CLEANING DOORS.

Another way in which the passages are cramped under the boiler, is shown by Fig. 4. In this case, the man who set the boiler evidently got it into his head that the flame should be kept as close to the boiler as possible, hence the trouble he went

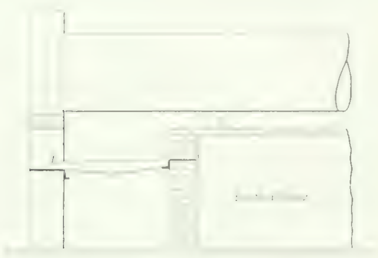


FIG. 4.—BACK COMBUSTION CHAMBER OMITTED.

to to put in a paved surface back of the bridge wall, and the keeping of the surface in question as high as possible, instead of allowing lots of room in back of the bridge wall for the completion of the combustion process.

Fig. 4 illustrates an example of this kind of boiler setting. A front was secured which had the fire doors too close to the boiler to begin with, and not even being satisfied with that, the boiler setter raised the grates from their bearing plate shown at *j*, and placed them on top of the dead plate, where they remained gloriously in the way, and in constant danger of falling off the back bearing plate into the ash pit. The manner of placing the grates is shown at *k*, and in addition to this, instead of the back end of the grate being lower so as to get the fuel in place with the least work possible, the grates were raised as shown at *l*, still further contracting the already too small combustion chamber above the grates.

To make bad matters worse, the bridge wall was carried up very high as shown at *h*, and the space back of the wall, which should have been a large combustion chamber, was filled full of earth and paved with bricks as shown at *h, i*. This answered so perfectly to cut down the combustion space, that it was impossible to burn any kind of fuel without causing smoke in abundance. The gases did not have time to burn, so quickly were they forced through the boiler by the most direct way possible.

Just one more "knock" against the manner in which some boilers are set, and the writer will stop off his "unconsumed gas." Fig. 3 shows the manner in which this abomination is sometimes placed. The only opening through which the combustion chamber may be reached for cleaning, is, as shown, very small, and the cast-iron frame is set nearly 3 ft. from the ground or floor line. The only way to get the dirt and fine ashes out of the combustion chamber is for a man to crawl through the small opening *m* (which is closed by means of a small loose door or cover) and shovel out the ashes with a small shovel which can work through the opening *m*. Whenever a door is placed in the back combustion chamber, let it be placed on the floor line as shown at *n*. Then the ashes can be easily shoveled out into a barrow, with some degree of comfort.

NEW YORK CITY. JAMES FRANCIS.

POSSIBLE SOURCES OF ECONOMY IN STATIONS.

There appear from time to time elaborate theoretical dissertations on possible sources of economy in steam plant operation, and while these are interesting in that they show in which direction to look for best results, they seldom are within the grasp of the ordinary operating engineer in many plants or in many cases to the owner, either. The latter is confronted with coal bills, engine bills, etc., to which no theory is attached, and which he is able to comprehend at a glance. Few firemen, I take it, ever concern themselves with the question of evaporation; notwithstanding that the rate at which water is evaporated is a factor in fuel economy, and that there is a most economical rate of combustion per square foot of grate surface for a certain make of boiler using a certain quality of fuel. Opinions differ as to what the best rate of steaming is, so that it would be best to determine this in each individual case. To ascertain positively the best rate of steaming for a given battery of boilers, a number of tests should be made at various rates of evaporation, and with the quality of coal that is ordinarily used. The fuel consumption per unit rate of evaporation should be compared in each case. Where it is possible to obtain more than one kind of fuel, a complete set of tests at different rates of steaming should be made with each kind of fuel and the results compared. Instances have been cited where it was found economical to increase the load on boilers already heavily overloaded by cutting out of a battery. Other boiler-room economies have been pointed out in this and other publications from time to time, so that it will not be necessary to touch on them here. One question, however, has not been given the attention it merits, and that is the question of superheated steam. Economy is the central idea involved in the use of superheated steam, and this gain arises through an improvement in the limiting conditions to engine economy. The condenser pressure furnishes the limit to the temperature of the exhaust, but by elevating the admission temperature economy is possible. Leakage is reduced in the engine cylinder also, as well as condensation in the steam-engine cylinder and steam pipes. The number of types of superheaters is large. Some are independent of the boiler; others are in the boilers themselves, but both can be installed without much disturbance to the existing plant. The use of superheated steam leads to the question of best engine installation. Can the combination of an efficient reciprocating engine and good condenser be bettered? Under ordinary working conditions a condensing engine represents a closed cycle, so that another cylinder may be added to get all the work possible out of the steam and still have all the advantage by condensing it. Lately instead of adding another cylinder, a steam turbine has been introduced between the engine and the condenser, and in this way, it is said, very great economies are obtained. So well has this proposition been received that there is now building a large steamship in which two sets of quadruple expansion reciprocating engines will be used in connection with a low-pressure turbine, each having its shaft and propeller. Low-pressure turbines are used in connection with reciprocating in Philadelphia, and also in Scranton, Pa. Reciprocating engines lend themselves admirably to the utilization of high-pressure steam; but not so to low-pressure steam. Any attempt to attain complete expansion would result in friction losses, exceeding large and cumbersome cylinders, etc. The turbine, on the contrary, is able to use steam at low pressure and to derive the benefit of the vacuum given by a condenser. It is for this reason that improved condenser efficiency has been given an impetus, since the reciprocating engine cannot make so advantageous a use of a high vacuum as the steam turbine. The facts regarding the Philadelphia and Scranton low-pressure turbins have already appeared in type, and it would be interesting if readers having definite information as to very low back pressures in reciprocating engines and also information as to their economy would send in the facts for publication. The use of low-pressure turbines does not seem to be increasing rapidly, so that possibly the marked economy claimed for them is not realized.

NEW YORK CITY. CHARLES J. THOMAS.

NON-PATENTED ARTICLES.

In reading the article by Mr. J. E. Brady in the first issue of October, in which the use of the caveat in protecting inventions is described, a plan having an end quite different from that of a caveat was brought to mind, and which first occurred to me some years ago. This is an arrangement whereby an inventor may register his invention at the Patent Office as non-patentable, thus placing on file a record which in cases may prevent a patent being issued on the same idea to a later inventor, which patent might, through litigation, cause expense to

the prior inventor if he is manufacturing the article on which, for one reason or other, he did not care to take out a patent. Any expense to the Patent Office could be covered by a small fee.

PITTSBURG, PA. I. T. HEINZ.

CONSTRUCTION OF HIGH-TENSION CONDENSERS.

The best known form of condenser for high-tension work is the Leyden jar. In cases where a fairly large capacity is desired, this form of condenser becomes entirely inadequate, due to its bulky size, and provisions must be made for piling-up a large number of tinfoils and dielectrics into a smaller space than that occupied by the Leyden jars.

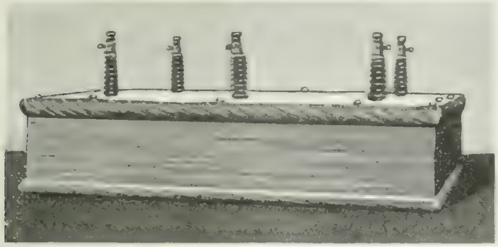


FIG. 1.—HIGH-TENSION CONDENSER.

One of the best dielectrics for high-tension condensers is glass. All of the glass used must be of a nearly uniform thickness and free from blow-holes. Common window glass, if properly selected, answers the purpose admirably.

A good insulating material in which to dip the condenser plates consists of the following: Rosin, four parts; ozokenite, one part; vaseline, one part, by weight.

All of these materials must be pure and free from acids. The compound has the desirable property of adhering to the glass at all temperatures. It is [illegible] flexible and if the plates are properly dipped, it will [illegible] a marked freedom from [illegible]

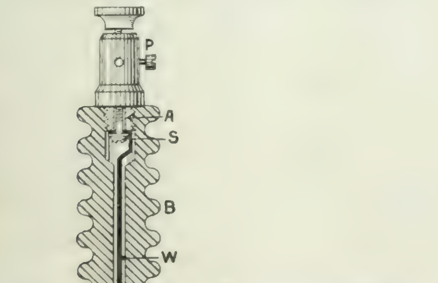


FIG. 2.—[illegible]

In Fig. 1 is shown one of eight condensers constructed with these materials by Mr. George M. Albrecht and the writer at the electric laboratory of the University of Minnesota. Four of these were arranged with five terminals leading to one, two, four and eight surfaces (total, 15), and the other four had 16 active surfaces of tinfoil each. Some of the principal details in their mechanical construction will be briefly given.

The tinfoils were cut 1 in. wider than necessary on one edge and an incision was made therein extending to within an inch of the edge of the foil. This construction provided a flap of tinfoil which by suitable folding was formed into an ear and used as a terminal for the foil.

The tinfoils were fastened to the glass with turpentine, all air-bubbles being removed from between the two surfaces by means of a roller. They were then heated for some time at a temperature of from 100 degrees C. to 115 degrees C. in order to dry the turpentine.

After this treatment the slates were dipped into a pan containing the aforementioned molten mixture, precautions being taken to have the bow of the glass all in the same direction.

After the mass had cooled it was removed from the pan, and the excess of insulating mixture was removed from the edges.

To form the connections with the binding posts the following scheme was used: A flexible wire was soldered to the ears of the foils, and led through the base of the binding posts. These binding posts were mounted upon a hard rubber base (*B*, Fig. 2), the surface being corrugated to prevent leakage.

The method of making connections is shown in Fig. 2, where *C* is the condenser, *W* the wire leading through the base *B*, which is attached by the screw *S* passing through the threaded brass plug *A* to the binding post *P*. The whole is then screwed into the base *B* and a suitable connection is thereby formed.

The condenser is then inverted and filled with the molten mixture, and the bottom of the box is screwed down.

The following data are from eight condensers having 124 active surfaces of 8.5 in. x 10.5 in. and glass plates 12 in. x 14 in., varying in thickness from .085 to .102 in.

Total capacity on instantaneous charge, .168 m. f.

Total capacity on slow charge, .215 m. f.

Thus the absorption was about 25 per cent.

These condensers safely withstood 20,000 volts alternating and they showed no tendency toward breaking down.

A test condenser made up of three plates of glass .075 in. thick and two sheets of foil dipped into the above mixture withstood 33,600 volts. It is noteworthy that when the condenser broke down the glass cracked near the corner of a foil; that is, where the charge was the most intense.

MINNEAPOLIS, MINN. E. L. WEBER.

WORTHLESS SPECIFICATIONS FOR ELECTRIC WORK.

Accompanying this is a copy of the complete specifications issued from the office of an architect and supposed to cover the wiring of a building. The copy is given verbatim. The architect states that the specification is intended to cover a "knob and tube" job. We have had hundreds of specimens in the past few years which were worthy of attention, but the present one we believe is the most interesting curiosity we have ever run across. Very likely it may be of some interest to your readers. Any man engaged in contracting business at least will appreciate the real humor of a specification of this kind.

ELECTRICAL WORK.

The [illegible] of the work, and upon its completion secure a satisfactory certificate of its acceptance, at his own expense, the very best service and secure likewise, at his own expense, for a period of two years, the efficiency of the system, and shall submit both to the architect.

The building shall be thoroughly equipped from the service of supply to each outlet with best insulated condition, put up in such manner as to provide continuous insulating channels for all wires, and the tubes to be so well connected as to exclude water and gas. All wiring shall be done in a thorough and workmanlike manner, and to be well insulated and wrapped at each and every joint. Place wires as shown on plans and leave enough wire so as to be able to connect with fixtures when necessary. The owners will provide all lights and the electrician set same in place. Place all necessary shut-offs and cut-offs on each fixture and place a switch at head of stairway to cut off hall lights on first floor. Also place a switch at bottom of stairway to shut off or turn off lights [illegible]

WILKES-BARRE, PA. G. E. SHEPHERD.

QUESTIONS AND ANSWERS.

[illegible] time in an unused factory be dried out? B. W.

If the generator is a compound-wound machine, short circuit the armature through the series winding and increase the speed from rest until full-load current is obtained.

Where can copies of the results of the fuel tests at the Louisiana Purchase Exposition be obtained? We understand that these tests have been published. L. C. I. L. & W. Co.

The results of the tests were published by the U. S. Geological Survey in three volumes. For copies apply to the Department of Interior, Washington, D. C.

Kindly advise me what impurities to look for in storage-battery acid and how to test for them. I. H. O.

The ordinary commercial acid is liable to contain traces of metals and also traces of other acids. Other impurities present may be due to the use of ordinary water from the water mains rather than distilled water. Tests for these may be found in any book on analytical chemistry.

In a recent issue mention was made of a dynamo giving approximately a constant output with varying speeds. A machine of this character should be suitable for use with a wind mill, and as we have inquiries for such installations, we would be obliged for further information on this dynamo. L. H. & Co.

The machine referred to is known as the Rosenberg dynamo. This generator was described in the columns of the ELECTRICAL WORLD AND ENGINEER of July 15, 1905.

Will a Westinghouse synchroscope designed for 60 cycles operate satisfactorily on a 25-cycle circuit, or vice versa? If not, what changes are necessary? I. T. B.

If the synchroscope is designed for 60 cycles and it is desired to operate it on a 25-cycle circuit, the following changes will be necessary: The field coils should be connected in series instead of in parallel and the impedance coil should be readjusted for one ampere at 100 volts.

What is the resistance of a person's body from hand to hand and from hands to feet? How much current does it take to kill a person? Will two contacts on an arm or leg have as great an effect as when the current passes through the body? H. C. T.

The resistance of a person's body and the amount of electricity it takes to produce fatal results depend entirely upon the person. It is generally recognized that the most dangerous path through the body is from hand to hand across the region of the heart.

What is the function of the reactance coils used in conjunction with rotary converters? S. B. C.

Reactance coils are used in conjunction with rotaries for traction purposes to obtain the necessary compounding effect. These reactance coils would be replaced by induction regulators which enable the impressed e. m. f. on the rotary slip rings and consequently the direct-current voltage to be varied at will, if the rotaries were used for delivering direct current for lighting circuits.

How may the direction of rotation of a rotary converter be changed? [illegible]

If the supply is two-phase, reverse the two leads of either one of the phases, and if the supply is three-phase, reverse any two leads. Should the machine refuse to [illegible] its voltage, it will be necessary to reverse the terminals of the field circuit so that the field current may be in a direction to assist the field [illegible].

[illegible]

[illegible] and bottom of slot ten? [illegible] more convenient to wind. C. H. H.

The armature will revolve at the same speed and give the same output if the coils are placed as suggested. The motor, however, would possess a greater tendency to spark with this arrangement, than with the old arrangement.

How can gas be excluded from conduit lines?

The best that can be done in conduit work is to minimize the entrance of gas into the conduit system. Paint the joining ends of the conduit with a hot compound of pitch tar, refined asphalt and wax tailings, and after saturating cheesecloth in the same compound apply the wrapping to the painted joint. A joint made in this manner is somewhat expensive, but the results obtained by this method appear to justfy its use. Burlap and liquid asphaltum is also used at the joints. After the application of the wrapping, the whole system should be enveloped in concrete.

Will a gasoline engine be serviceable for direct connection to a 75-kw direct-current dynamo, the output from which is used by incandescent lamp and elevator motors? H. R.

There is no reason why a gasoline engine cannot be used for this purpose. Some of the electric manufacturing companies are building at present portable gasoline engine and generator outfits with ratings as high as 25 kilowatts. We understand that the building of larger sizes is in contemplation. However, gasoline engines suitable for direct-connection to standard generators may be obtained. Any tendency to irregularity of speed may be overcome by equipping the engine shaft with a heavy flywheel.

There is a difference of opinion between the several state engineers as to the value of a steel and a wrought-iron boiler tube, and I am taking the liberty of asking for your opinion as to which is the better of the two? L. C. R.

For ordinary use there is little to choose between the lap-welded wrought-iron tube or the lap-welded steel tube, some conditions being favorable to the use of one and some conditions being favorable to the other. The insurance companies report that the tendency to pitting, other conditions being the same, is more prevalent in the steel tube than in the wrought-iron tube. The hot-finish steel tube is not as brittle as the cold-drawn steel tube and would appear to be the better of the two for boiler-tube purposes. There is a prevailing impression that the charcoal iron tube of 20 years ago was much better than the charcoal iron tube of to-day. The drawn steel tube is without doubt much better than the lap-welded steel or lap-welded charcoal iron tube and is now being used to a very great extent, especially in marine work. The U. S. Navy Department specifies the drawn steel tube exclusively.

What is a motor converter, and for what purpose is it used? O. B.

A motor converter is a modification of the ordinary induction motor-generator. It consists of a direct-current generator coupled to an induction motor, the two machines being electrically as well as mechanically interconnected. The high-tension current circulates in the stator windings of the induction motor without the intervention of a step-down transformer. Owing to the counter e. m. f. of the direct-current machine the synchronous speed of the rotor does not correspond to the speed of the revolving field of the induction motor, but it depends on the pole ratio of the machines. Assuming that the two machines have equal numbers of poles, the synchronous speed would correspond to half that of the revolving field. Currents are therefore generated in the rotor windings at one-half of the supply frequency and these currents pass into the direct-current armature by suitable cross-connections and are there commutated. Theoretically, in the case assumed, one-half of the power of the combination is transmitted through the shaft and the remaining portion through the electrical cross-connection. In the case of the rotary the direct-current machine acts as a generator; in the latter case the motor acts as a transformer and the direct-current machine as a generator. To a certain extent, therefore, the machine combines the advantages possessed by both a motor-generator and a rotary converter.

CENTRAL STATION SALE OF CURRENT.

Electric Power Business in New England.

The New England town as a field for new business differs somewhat from towns in other sections of the country. Each city or town has one or more large industries or a number of smaller ones, which furnish the greater proportion of the revenue earned by the citizens. Examples of such cities are Danbury, Conn., with its 40-odd hat factories, and Fall River, Mass., with its great cotton mills, each industry employing the greater part of the population of its respective city. With a population thus consisting so largely of mill or factory hands, the field for lighting is much narrower than that for motor applications.

The sale of electric energy to large mills in New England is, however, beset with difficulties, and especially so when water power has to be contended with. Throughout New England the numerous streams were quickly seized upon as a means to furnish power so that today almost every watercourse of any size has a dam across it wherever there is an available fall for the development of power. In some places, like Holyoke, Mass., on the Connecticut River, and Shelton and Derby, Conn., on the Housatonic River, large water powers have been developed by companies who sell the power at very moderate rates. Fortunately for the electrical companies there are two seasons of the year when water power is apt to prove inadequate; namely, during the winter, when the ice holds back the water, and in the summer when the river is low. Consequently other power sources have to be maintained for these emergencies, and the question of continuous operation resolves itself, on the one hand, into whether a manufacturer will pay a lighting company a high rate for energy to tide him over the period of insufficient water power or invest in a power plant, or, on the other hand, whether the electric company can and will furnish him energy all the year at a satisfactory rate to both parties. Naturally the importance of this class of business has incited effort on the part of central stations to secure it. When the same company controls or owns both gas and electric interests, which is the case in nearly every city, no attempt is made to introduce the gas engine as a source of power.

As an example of what has been done in the way of power business in New England, the case of the city of Fitchburg, Mass., will be taken. Mr. A. H. Kimball, the superintendent of the Fitchburg Gas & Electric Company, who has made a special study of power for the last 15 years, presents the Fitchburg situation as follows:

"Our business of supplying energy for motors began with the installation of a 15-hp, 500-volt direct-current motor in June, 1892, and from that time until July, 1903, the date of starting our present new three-phase station, the growth of this business was very slow. This was due to several causes. The business was new, and people were skeptical regarding our ability to give them good service. Rates were high and the electric motor was not the simple, reliable machine it is to-day. The modern methods of business getting of to-day were unknown and the principal argument we made to our prospective customer was that 'the electric motor was a good thing.' This also seemed to be the general opinion of the customer, too, but looking from the company's standpoint only. We had two actual cases where we could not give the energy away, and business in this department was slow. Gradually, however, matters began to improve, small customers were added here and there, and spoke well of electric motors to their neighbors, and by the spring of 1900 our connected load had increased to 110 horse-power in motors. In [illegible] beginning of 1902 that orders were given for apparatus and material that now comprise our new station, which we started July 1, 1903.

"At that time our motor load consisted of 234 horse-power in 500-volt direct-current motors. These we replaced as rapidly as possible by 550-volt, three-phase motors and started to acquire a larger motor load. It was at once apparent that to attract the attention of the manufacturers and business men to the advantages of electric motors, arguments regarding their economy, reliability, etc., must be backed by some actual facts and figures. The old argument that the electric motor was a good thing still held good, but the customer wanted to have the good things shown up in a detailed and comprehensive manner. In order to do this, I tabulated data, which are now made up every six months, ending January and July 1. Opposite the names of all our motor users are printed the horse-power the customer has installed, the kw-hours used for six months as shown by his watt-hour meter, the rate which he is paying per year per horse-power installed based on his six months' consumption, and the average horse-power used, which is based on a day of ten hours, or 1500 hours for the six months. From these figures can be obtained at once the amount the customer has paid for six months, and the ratio of the horse-power used to the horse-power installed. These figures have been of great assistance to us in obtaining new business, as we were able to demonstrate to a prospective customer that the electric motor is economical and efficient by showing him in detail the actual conditions as they exist in different classes of manufacturing in his own city.

"One of the first questions we ask a customer who is considering the installation of motors is the size of the motor he desires. He may say 5 horse-power, and follow this statement with the question, 'How much is 5 horse-power going to cost me?' According to our rates, a 5-hp motor on a meter basis running fully loaded ten hours a day would cost the customer $50 a month, which statement in 99 cases out of 100 would terminate our business transaction then and there. However, we find, for example, that this customer wishes a 5-hp motor for a wood yard for both sawing and splitting; we, therefore, turn at once to the same class of customers similarly equipped and find that Mr. Smith with a 5-hp motor has used 286 kw-hours in the last six months, and that the average horse-power use for that period was .254 horse-power. We also find another customer of the same class who has used 511 kw-hours at a cost for energy of $46.82, and with an average horse-power use of .445, while still another customer had used 602 kw-hours at a cost for energy of $52.78, or an average horse-power use of .535. These figures are at once conclusive and show our prospective customer that he can afford to use electric motors. These figures give an actual condition taken from a period of six months.

"This is simply one illustration of the method which we have used with very satisfactory results, and we find the figures not only valuable for business getting, but extremely interesting in showing the load conditions in different classes of business. It also gives an excellent opportunity for comparing the efficiencies of the electric drive in use by different customers, and I think an excellent example is to compare the results obtained by two firms in this city engaged in the same class of manufacturing, as follows:

"One has 30 horse-power in motors installed, consisting of one 15-hp, one 10-hp and one 5-hp motor, all belted to lines of shafting from which all machines are driven. For a period of six months, the average horse power used by this customer was 11.23 The other customer has 25 horse-power installed, consisting of three 5-hp, three 2-hp, one 3-hp and one 1-hp motor. In this case no shafting whatever is used, each machine being driven directly by an individual motor with the switch within easy reach of the operator. The average horse-power used for the same period of six months in this case was only 3.22.

This shows to a marked degree the saving made by the elimination of friction and intelligent installation of motors, and should be very forcibly brought to the customer's attention when bidding for his business.

"It is seldom that a steam engine can be replaced by a single motor belted to the same driving shaft, and highly economical results obtained. We make a point in every new installation of 10 horse-power or over, and often in smaller installations, to test the total and individual loads of the motors, showing both friction and working loads. These tests are given to the customer with full details which show him the exact condition of his power plant, and it is then optional with him whether he shall make any changes to better this condition, which in many cases would warrant a considerable outlay and be the means of reducing his cost of energy.

"Over two years ago we were called upon to meet a demand for large power, something over 300 horse-power from one company manufacturing cotton goods. This power was divided between two mills, one 6000 ft. and the other 10,000 ft. from out station, and both adjacent to our main pole line. In order to obtain this business we realized that our rates must be reduced for quantity, and I prepared some careful estimates of the present and probable cost of production. Our minimum rate at that time was 2.7 cents per kw-hour for 5000 kw-hours and over. This rate was reduced by steps to 1.95 cents per kw-hour for 37,500 kw-hours and over, based on monthly readings; these terms were acceptable to the new company and a contract for three years was obtained. In September we were called upon to furnish energy to a third mill of this same company. In this mill the entire steam plant was shut down and 125 horse-power in motors installed. Since then, several other additions have been made in the three mills, and to-day the motor installation aggregates 715 horse-power. In order to obtain the addition of 125 horse-power mentioned, we made a further slight reduction in rates, bringing the minimum kw-hour rate down to 1.85 cents, or $40 a year per horse-power of 3000 hours, and obtained a new three years' contract on all three mills. A great deal of persistent and continuous work was required to obtain this business, but it was finally secured and is giving excellent service and satisfaction."

The Fitchburg Company has for distribution a handsomely printed and illustrated pamphlet of 36 pages entitled "Facts Regarding Electric Power Used in Fitchburg." The left-hand pages of the pamphlet contain illustrations of motors and their application to various classes of work. On the right-hand pages and opposite marginal classifications, such as "Operating Elevators," "Making Combs," are lists of the users in Fitchburg of electric energy for motors. The pamphlet is gotten up so attractively that it invites attention, and everyone contemplating the use of electric motors cannot avoid being impressed by the showing the pages make. The following list, compiled from the pamphlet, of the applications of electric motors in Fitchburg, indicates the effectiveness of Mr. Kimball's work:

Operating traveling cranes, operating trip hammer, operating lathes, operating ruling machine, making paper stoppers, making novelties; piano playing, medical apparatus, blowing forges, making ginghams, printing presses, operating dental engines, cancelling stamps, charging storage batteries, telephone ringing, sawing and splitting wood, operating blast furnace, ventilating, making candy, mixing dough, mixing clay, crushing stone, operating carbonator, operating portable drill, operating elevators, making ice cream, cleaning and grinding castings, grinding grain, grinding and roasting coffee, crushing coke, grinding meats, cutting leather, operating wood working machines, running circular saws, making combs, making curtains, blowing organs, washing bottles, making brooms, operating cash system, hoisting coil, making cotton yarn, compressing waste, horse clipping, saw manufacturing, running sewing machines, pumping, making shoes, operating machine shops, cream separator, buffing, polishing and grinding, linotype machines, massaging.

Mr. G. L. Sadler, manager and superintendent of the Nashua, N. H., Light, Heat & Power Company, speaking of the rapid growth of the power business and the methods he used in Nashua, said: "I believe that the business was there waiting for us, and after introducing the required generating capacity at our station, we started after this business. We knew every manufacturer and his needs in Nashua. We went from one to the other presenting arguments containing facts that were easily demonstrated or proved. I found that personal heart-to-heart talks, driving home conclusive facts, were of much greater value than advertising campaigns. A contract was obtained first here and there, business began to amount to something and to-day we are furnishing energy in amounts beyond our dreams of years ago. Our largest consumer is one of the largest glazed paper concerns in the world, to whom we furnish energy 24 hours a day, every day in the year. At present we operate only their finishing department, with an average consumption of 35,000 kw-hours per month, with such satisfactory results to them that we expect to furnish energy for the entire concern. Our business is still growing and is bound to grow for some time. We are making a thorough campaign on small motors, our energy man going through the territory like a fine comb."

The New Bedford Gas & Edison Light Company, operating in New Bedford, Mass., has just started a small-motor soliciting campaign. Mr. Charles R. Price, treasurer of the company, in speaking of the motor business said: "We have for a long time been aware of its value, of the many advantages it held over other power, and that if a satisfactory rate was offered we would have little difficulty in obtaining business. The effect of our power campaign thus far has justified our opinion. Our increase has been steady and we hope soon to have the small manufacturers of the city generally using our energy. Everything possible is done for the consumer in order to hold his business, and results have shown us that the helping-hand policy is an excellent one."

Colorado Discussion on the Sale of Energy for Motors, Signs and Heating Devices.

Mr. Charles Robbins, of the Westinghouse Electric & Manufacturing Company, presented a paper at the September convention of the Colorado Electric Light, Power & Railway Association, on "Central-Station Power Problems." The first part of his paper took up an analysis of the cost of supplying a load which is on only a few hours per day. He showed that the cost per kw-hour for purely peak load business is excessive. In order to sell energy more hours per day, he suggested that central stations divide the 24 hours of the day into three periods; one period including the evening peak lighting load, the second period including the day load up to the peak, and a third period including the balance of the day. They should then strive mainly to get business for the second and third periods. He stated that the daylight motor load should ordinarily be from 50 to 60 per cent of the peak load. Most of the effort should be devoted to increasing the load during the second and third periods. He suggested that separate solicitors should be assigned to the different periods. He also suggested that the solicitor looking after the peak load business should seek to sell light rather than kilowatt-hours, and should look after the securing of the best results with minimum demand by the customer by the exercise of good illuminating engineering. In this way the investment needed to serve the most unprofitable class of load would be kept down. All-day load and the load after the peak should be canvassed to the limit. This is the business upon which there is profit. The electric light company, like the merchant, sells some goods at little or no profit, but must make up this lack on the general run of the business.

In the discussion following this paper, Mr. Cowling, of Denver, said that the Denver company had a contract with the North Denver Water Company for pumping of water in which it was provided that pumps would be shut off between 7 and 9 p. m. in the winter. On account of this, a lower rate

was given. The company has two wells at the present time, but expects to put in 30. This is therefore an important prospect for load of the character classified under the second and third periods by Mr. Robbins.

Mr. C. K. Durbin, of Denver, said that among the central-station companies which he represented, he had in mind two contracts where the right was reserved of cutting off the service during the peak. President Tripp said that pumping for irrigation purposes was also non-peak load and should get a low rate.

Mr. Robbins showed how the central-station illuminating engineer could help the company by keeping down the investment necessary to serve the peak-load customer by skilfully planning the illumination so as to cause the least maximum demand. As an extreme case of this, he mentioned church lighting, where the revenue is very small and where a difference in planning the illumination may make considerable difference in the investment necessary to serve the church. He said that one station in eastern Pennsylvania is trying this policy.

Mr. C. N. Stannard, of Denver, asked for an enumeration of the different classes of business which Mr. Robbins would seek under his second and third classifications. Mr. Robbins replied that under the second class would come all kinds of day motor service. For load after the peak, or the third class, he suggested water pumping, operation of compressors and breweries.

Mr. J. C. Lawler, of the Colorado Springs Electric Company, inquired as to what success central-station companies were having in getting architects to consult with them on illuminating problems and on the wiring of buildings to include all modern electrical appliances.

Mr. C. N. Stannard, of Denver, said that his company found it was easy to interest architects in all progressive measures which would enable the architects to keep up to date. They have men detailed to call on the architects and make suggestions. In the case of new store buildings these men would ask for separate feeders to be provided for sign, show-window and display lighting, which would be taken on a flat rate. This field had been cultivated until now the architects will call up the company and ask for its man to give advice on various subjects. He believed this money well spent. It secures lighting and motor business that could not be obtained if provision were not made for it at the time the building was erected.

Mr. Robbins called attention to the extensive field for the operation of beer pumps by electric motors. This was the cheapest known method, and could be operated cheaper than a water motor or a pressure tank of carbon dioxide frequently used.

HEATING AND COOKING

The question was then asked as to the extent to which electric heating appliances had been pushed in small towns. Mr. Stannard said that he recently talked with the engineer of a small central station, in the East, who said that enough irons had been placed on his company's circuits to make the Tuesday-morning peak load higher than the evening peak had been previously. Another question was asked as to the effect of electric heating and cooking appliances on the evening peak load. Mr. R. P. Bache, of Colorado Springs, thought it wrong to push electric cooking appliances for the reason that the load overlapped the peak. President Tripp also agreed in the main with Mr. Bache on account of the difficulty of competing with gas in cheapness, and because of the load overlapping the evening peak, but he admitted later in the discussion that in some towns where gas competition was not present it would be worth while, and that there might be a number of small appliances that could be profitably pushed.

Mr. J. F. Vail said that his company loaned out 1200 flat-irons to get them introduced. Many people preferred to own the iron, however, and they had been gradually changing over, so that now, at the end of two years, about 800 of these customers owned their irons, and only 400 were loaned. During the summer season he figures the increase in revenue from a customer due to the use of the iron at $1 per month per iron, or 70 cents average for the year around. His company now sells irons at cost and does not loan them. They are put out on two weeks' trial, under the supervision of a lady solicitor and demonstrator, who is given the services of a wagon to carry the irons. They had also done something with heating and cooking appliances. He personally has a coffee percolator, water boiler and other devices on the dining-room table, and practically gets breakfast on the table. These devices are not used for the evening meal, and therefore do not come on the evening peak. He believed there would be considerable profit for central-station companies in the future from this class of business. One of his customers was installing a modern electric kitchen for the consumption of which he would be allowed a rate of 3 cents per kw-hour. This would be the equivalent of gas at $1 per thousand. The regular lighting rates in Pueblo were 10 cents for the first two kw-hours per lamp connected per month, and 6 cents for energy consumed in excess of that. As heating devices were not counted as connected load, this practically gave the customer a 6-cent rate on small heating appliances and irons. He believed that small stations in Colorado where there was no gas competition and where coal was very high, could obtain considerable electric cooking load, and that for small appliances there was a field everywhere.

Mr. C. K. Durbin, speaking of irons, said that he understood the Denver company had introduced 3000 irons the past summer. A small Oklahoma central station which his company controlled, and which had just started day service, had introduced 60 electric irons in the last three months. In Sheridan, Wyo., (population 6000) 75 irons had been placed. Mr. Sewall said that in one case with 123 consumers, 117 irons had been placed on trial and 92 had been sold.

Mr. Putnam, of Denver, said that the advantage of placing the iron on trial was that it let the solicitor into the house, so that he could perhaps secure the introduction of other useful appliances. Mr. I. A. Hoy, of Leadville, said that since May 1, 1907, his company had placed 101 irons, of which 60 were paid for and 41 were loaned on a deposit. Mr. J. F. Vail said that in Pueblo the revenue amounted to about $6 per year per iron.

Mr. C. N. Stannard, of Denver, said that the average of those upon which they had kept records was 67 cents a month.

Mr. Monroe cited the case of one customer who formerly used gas irons and put in seven electric irons in July. The net increase in gas and electric bills combined for the month of August was $23.35. The net increase for September was $33.10. He paid 9 cents per kw-hour for energy used in the irons. The gas and electric company's revenue was therefore increased by the substitution of electric for gas irons and the customer was better satisfied.

ELECTRIC SIGNS.

The question was opened of getting electric sign business in small towns. Mr. C. K. Durbin said that it was hard work getting such signs in the smallest towns where his company controlled the central stations. In towns of 10,000 and over, such as Albuquerque, N. M., and Tucson, Ariz., it was easier. He used a flat rate, the signs being turned on a certain number of hours each night. The rate is calculated to give the company six cents per kw-hour. A question was asked as to the advisability of furnishing signs free to customers. Mr. R. P. Bache, manager of the Colorado Springs Electric Company, said that he was opposed to free signs because of his experience with this practice in eastern companies before he came to Colorado. He liked the plan which he found in effect at Colorado Springs much better. There the customer either pays cash for his sign or buys it on the installment plan.

Mr. C. N. Stannard thought that if a company went into the business of selling signs it ought to sell them. The customer who is likely to want the free sign or whose payment is scattered over a long period, is likely to be a man with poor credit, who may go under and leave the sign on the company's hands. He did, however, believe in doing wiring for show-window and outline lighting free, provided the contract was made for two years and the cost of construction was not above

the gross revenue which would be received under the contract the first three months. This concession undoubtedly brought in business which could not have been secured otherwise.

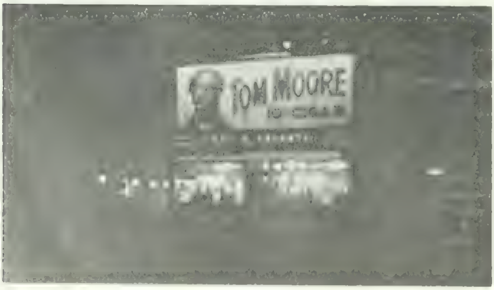
Billboard Lighting in Various Cities.

The electric lighting of billboards to make them valuable at night as well as during the daytime is now getting a good foothold and becoming recognized as a desirable thing by both billboard companies and by advertisers. Last year we published some account of the work begun at St. Louis in the lighting of billboards, both for advertising the central station

FIG. 1.—BILLBOARDS NEAR NORTHWESTERN ELEVATED RAILROAD TERMINUS.

company's own business and that paid for by the regular billboard advertisers.

In Chicago, Kansas City and Indianapolis the Thomas Cusack Company, a billboard concern operating in those three cities, has begun to sell day and night billboard service, purchasing energy from the electric lighting companies and billing the advertising customer for the total cost of his billboard service plus the electric lighting feature. Some Gunning system billboards are also lighted in Chicago, the Gunning system buying its energy from the Commonwealth Edison Company. The Commonwealth Edison Company in Chicago gives service for billboards at the same rates as its sign lighting service and turns the electricity on and off at stipulated hours, maintaining a patrolman service for this purpose. As the number of hours' use per month is thus entirely under the control of the company, a flat rate is made, this flat rate being the equivalent of the company's regular lighting rates for the same



[illegible] AT INTERSECTION OF TWO CHICAGO STREETS

number of hours' service per month. As this lighting rate is 15 cents per kw-hour for the first thirty hours' use of the maximum demand and 9 cents for all over that, the cost of a 16-cp lamp on a billboard lighted six hours per night or 180 hours per month would be about 88 cents per month.

[illegible]

the central station company has sold electric lighting service direct to the billboard advertiser, independently of the billboard company, as such companies have as a rule been indifferent and in some cases even antagonistic to the electric lighting feature. The sentiment of billboard companies, however, has been rapidly changing about this, and they are now looking upon it more favorably, as it undoubtedly adds much to the total value of advertising to have billboards lighted at times when people are most likely to read them.

Fig. 1 shows a couple of lighted billboards across the street from the Wilson Avenue terminus of the Northwestern Elevated Railroad in Chicago. One of these signs is turned on and off by a flasher at intervals of about four seconds. The flasher feature undoubtedly attracts attention to a billboard, even more than to a sign, because of the large surface lighted up. Both of the billboards in Fig. 1 have dark letters on a

FIG. 3.—BILLBOARD IN DENVER.

white background. They are lighted with 16-cp incandescent lamps placed about 12 ins. apart in a metal trough painted white inside. The trough has a flat bottom which holds the lamp sockets. The sides are straight. Fig. 2 shows another Chicago billboard at Thirty-Fifth Street and Cottage Grove Avenue. This is over a store at the intersection of two streets where it can be seen for a considerable distance. This sign is also flashed. It is equipped with deep, conical reflectors.

Fig. 3 shows a billboard on Sixteenth Street in Denver. In this city the Denver Gas & Electric Company contracts direct with the billboard advertiser for the lighting of the billboard. The company furnishes the lamps, wiring and trough in which the lamps are concealed. This is done under a two years' contract, where the cost of construction to the company will not exceed the revenue the billboard lighting brings in the first three months of its operation. The rate charged is a flat rate which is equivalent to the company's regular readiness-to-serve

FIG. 4.—[illegible]

rate, figured for the number of hours the billboard is lighted per month. The company turns the lamps on and off, just as [illegible] largely taken at a flat rate. This readiness-to-serve rate is $1 service charge per month plus 15 cents per 16-cp lamp connected plus [illegible]

discount of 10 per cent if paid within ten days from date of bill. This makes the cost approximately 60 cents per 16-cp lamp per month if the board is lighted six hours per night, or 180 hours per month.

In Chicago, on an important junction station on the Metropolitan Railroad at Marshfield Avenue, a number of billboards are placed on the roofs of adjoining houses. One of these as

FIG. 5.—DENVER BILLBOARD BY DAY.

it appears by daylight is shown in Fig. 4. This illustrates the appearance of the trough in the daytime, showing how unobtrusive it is.

Fig. 5 is a view of a Denver billboard by day, showing the appearance of the troughs. On the billboards recently erected in Denver, however, the supports are not placed on the surface of the board, as in Fig. 5. The general form of the trough is semi-circular. Lamps in the trough are supported horizontally on weather-proof porcelain sockets. This arrangement appears to be not very satisfactory, however, as the socket supports frequently get bent so that the lamps project below the trough. Fig. 6. shows a billboard placed on top of a Denver garage which it advertises.

Besides billboards lighted with incandescent lamps in Chicago, experiments are being made with flaming arc lamps for this purpose, the most notable example being at Jackson Boulevard and Dearborn Street, in the heart of the business district. One 450-watt flaming arc is more than ample for 25 ft. of billboard. The arc lamps are fitted with metal guards or reflectors on the side toward the street, to prevent the light from blinding those looking toward the board. The flaming arc

FIG. 6.—BILLBOARD ON DENVER GARAGE.

lamp [illegible] a cheaper method of lighting a billboard than incandescents where as much as 50 ft. of board is to be lighted, so that two lamps can be placed in series on 110 volts.

The chief trouble to be avoided in using flaming arc lamps for billboard lighting is so to place them high enough above the board so that the glare of regular reflection from the paint will not interfere with the reading of what is on the board. Wherever the angle of the lamp to the board equals that from the observer's eye to the board, this trouble is sure to be serious, as the flaming arc lamp is such a powerful source of light. At present there seems to be no way of avoiding this trouble, save to hang the flaming arc lamp some distance above the top edge of the board.

In the incandescent system the chief defect at present is that too much light is thrown on the top of the board and not enough on the bottom, as is apparent in the illustrations. This contrast is great enough to interfere with the reading of billboards some distance away. Near by, it is not of so much importance. If the illumination could be distributed evenly over the board and light escaping in useless directions directed on the board, doubtless considerable saving could be made. It must not be understood from this that the electric lighting of billboards is not at the present time in a satisfactory condition from the advertiser's standpoint. It simply means that future developments may make it possible to reduce the cost of lighting a given amount of billboard, and so from the central station standpoint increase the amount of such business.

In Pittsburg the lighting of billboards has been gone into very extensively. Mr. G. G. O'Brien, who gives billboard service in that city, has made extensive use of electricity for illuminating his boards. In one case a board 300 ft. long has been lighted and flashed in a number of sections. Another board 200 ft. long is flashed in sections.

Grand Rapids, Mich., Electrical Situation.

By L. W. Bailey.

The ultimate success of the Grand Rapids-Muskegon Power Company in securing a new franchise in the city of Grand Rapids, Mich., marks the beginning of a new era in that city. The publicity campaign of the company was described in the Oct. 5 issue of the Electrical World, and it won out by a pleasing majority at the polls. The franchise obtained, while a good one for the company, is one of the most favorable in the country for a city the size of Grand Rapids. It puts the rates for both lamps and motors far below the terms of the old franchise.

Following its campaign for a new franchise the company has continued its publicity policy in a campaign for new business. The advantages of electricity, particularly for lighting purposes, are emphasized in the newspaper advertisements, and the city is circularized carefully with both circulars and booklets. A page advertisement in the daily papers, run several times, sets forth a proposition for wiring a six-room house for $12, and then tells what can be done with a kilowatt-hour of electricity.

The city is preparing either to enlarge the capacity of its street lighting plant or to buy energy from the power company. However, the gas company is endeavoring to secure a contract for street lighting, and permission has been given to both concerns to place lamps on both a business and a residence street for demonstration purposes. The system of street lighting by the use of the tungsten lamps, as employed in Hartford, Conn., has been reported on favorably by an investigating committee and the power company will experiment with these lamps. A plan is also on foot to equip the lighting plant with machinery for operating the city pumping station.

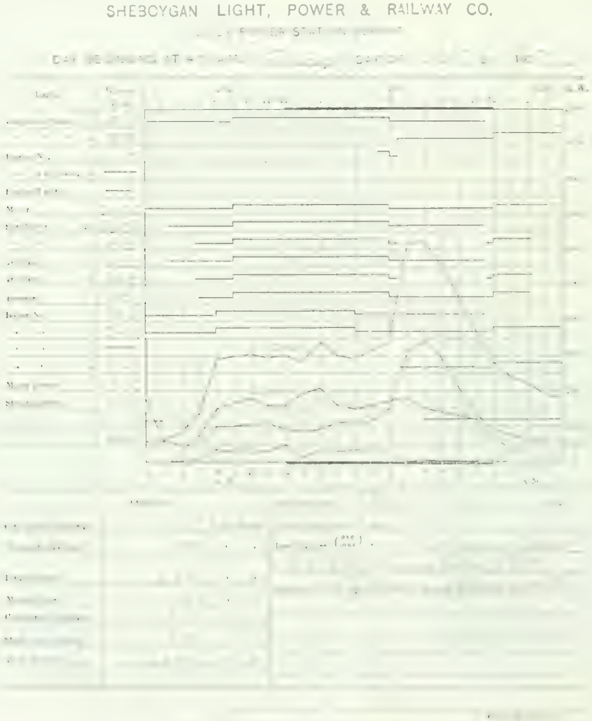
The Canal Street Business Men's Association is figuring with the power company on a proposition to light that street from end to end in a manner which will give it the appellation of the "great red way." At present the street is lighted with festoons of incandescents strung thickly from curb to curb the whole length of the thoroughfare. The fire marshal has objected to this system, and one of the new type arc lamps may replace the incandescents, but at intervals of 120 ft.

The Grand Rapids East Side Power Company, which now obtains its power from a canal, may change its system to electricity. The city's flood protection plans include the filling of

the power canal. A station may be installed at the head of the canal and water taken through a sluiceway to operate an electric power plant. The central power plant, if erected, will cost about $10,000. Robert W. Irwin and Alexander Dodds represent the company in the matter.

A New Power Station Report.

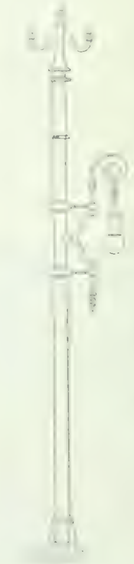
The accompanying form of power station report has been in use for the past six months by the Sheboygan Light, Power & Railway Company, and has also been adopted by the Milwaukee Northern Railway Company, both companies being under the management of Mr. Ernest Gonzenbach. Mr. Gonzenbach has been getting out power-station reports for the past 15 years and has always wanted something clear and concise by means of which he could read the story of the day at the power station without wading through a mess of figures. About a year ago Mr. Gonzenbach began to experiment, with the result that last spring he put into service the form of report shown herewith, which has so far been entirely satisfactory, and which has been pronounced satisfactory by everybody who has used it. The record is very simple, is easily read and can be understood at a glance. Possibly the only explanation required is the little break in the straight lines, indicating the runs of the various units. This little break in the straight line is put in to show the time when the men changed shifts. The amount of apparatus in operation during the hours of peak load can be seen at a glance, and it is very readily observed if any machine has been run too long after the peak was off or if it was started too late. The time of switching on and off the street lamps is also shown by the last straight line at the bottom. The load curves are obtained by reading watt-hour meters in the power station every hour. This has been found very practical and no extra trouble for the power-station force. The method of making up these curves is interesting. All of the charts and curves are made by the engineer in charge of the shift at the power station and they involve no labor of any kind at the office. The pads are accurately registered and a carbon copy sheet is put under the first leaf. The power-station engineer or his assistant then plots a curve every hour by making pencil points with an ordinary lead pencil. At the end of his shift he connects all the pencil points with a line. The engineer on the next shift does the same thing. This necessarily makes the sheet somewhat grimy, but the top sheet is kept by the power-station force for its own record. In this way the manager has a complete history of the power station in the most complete form available at all times. The load factor given is the percentage which the average load is of the maximum. The station factor is the percentage which the average load is of the total capacity of the station. The railway demand factor is the percentage the maximum railway load is of the station capacity, and the lighting demand factor is the corresponding figure for the lamp load.



POWER STATION REPORT BLANK.

Special Street Lighting in Denver.

Special plans have been completed for the lighting of Fifteenth Street, Denver. Sixteenth Street, the most important thoroughfare of the city, has been lighted by arc lamps placed on special ornamental poles for some time past. Pictures of the pole used on Sixteenth Street, Denver, were published in the Electrical World of April 13, 1907. The poles used on Sixteenth Street are of very heavy cast iron and were designed to be used for supporting both trolley, span and feed wires and arc lamps. The new design for Fifteenth Street, made by Art Commissioner Henry Reed, contemplates the use of a special bracket on standard street railway steel tubular poles. This design is illustrated herewith. Along each block will be placed eight 6.6-ampere alternating-current arc lamps. Eleven blocks will be thus equipped.



COMBINATION RAILWAY AND LIGHTING POLE.

Service Supervisor Work in the Denver Gas & Electric Company.

The recent convention of the Colorado Electric Light, Power & Railway Association, at Denver, Sept. 18 to 20, brought out some interesting and valuable experiences of the Denver Gas & Electric Company in increasing the revenue from its customers. The subject was opened by a paper on "Business Building by Commercial Departments," by George E. Putnam, of the new business department of the Denver Gas & Electric Company, which was followed by a general discussion, in which Mr. C. N. Stannard, secretary of the company, gave additional information.

The company has in the past year been giving special attention to increasing the gas and electric consumption of its customers. For this purpose, in 1906, seven service supervisors were appointed from among the men in the new business department. It was the duty of these men to secure, if possible, increased revenue from consumers. The regular district solicitors kept away from customers upon whom the service supervisors were working. These service supervisors appeared first to the customer as men looking after the quality of the service rendered by the company, to see wherein improvements could be made which would give the customer better satisfaction for the money expended. In straightening out any little troubles the customer might have, these service supervisors would get an entrance to the customers' premises and become acquainted, so that the way would be open for the supervisor to introduce new appliances. Mr. Stannard stated that when these service supervisors were started in their work of getting more business from customers he almost felt sorry for the men, because he thought that they were undertaking a very difficult task, in which they might not be able to show the results expected by the higher officers of the company. The results, however, have been fine and exceed all expectations. The added business is lucrative because it involves no cost of construction, as the lines and meters are already in place.

The actual results obtained were shown by figures given for a period of ten months with seven service supervisors at work. Each one of the men was given a list of 300 residences to visit. After a period of about 3⅓ months, a second list of 300 houses per man was selected. At the end of the second 3⅓ months another set of 300 houses per man was assigned. At the end of ten months, therefore, the seven service supervisors had been assigned in the three installments, 6300 residences. The work was confined entirely to residences, because these seemed the most promising. The men worked both the electric and the gas fields. Results for the first ten months showed 39 per cent gain in the kilowatt-hour consumption of the residences using electricity worked upon over the corresponding period of the previous year. The gross revenue from this source was increased 28 per cent. The gas consumed by the customers worked upon was increased 44 per cent, and the revenue 27 per cent. The increase in revenue in the first instance amounted to $10,307, and in the latter instance, $10,892 for a period of ten months.

When it is considered that the business brought in by service supervisors involves no construction costs, it will be seen that it doubtless yields the highest returns to the company for the amount spent in soliciting it. The successful experience of the Denver Gas & Electric Company with its service supervisors has already resulted in a considerable change in the organization of its new-business force. Whereas, there were formerly 14 district solicitors, each having an assistant, and a few service supervisors and specialists in various branches of the work, there are now 14 district solicitors, no assistant district solicitors, 14 service supervisors, and specialists in motor work, show-window, sign and display lighting. In the combined gas and electric business, it is approximated that for each dollar spent in a year for solicitation, the increase in gross revenue for that year will be about $2. In the electric end of the business alone, some of the classes of business giving the best returns for solicitation will yield as high as $3 increased yearly revenue for each dollar spent within the year for solicitation.

How effectively a well-organized new-business department such as that of the Denver company can introduce a new device is shown by the rapidity with which electric flatirons have been put in service last summer. Until last spring the company had not taken up the work of pushing the electric iron to any extent. Since last spring over 3000 irons have been purchased and put in service by customers. The average increase in revenue due to the use of these irons so far has been about 67 cents per month per customer. Irons are sold at $5 each. The Pacific iron has been the one most extensively used, although a large number of American and Simplex irons have also been put out.

The service supervisors' work, although confined heretofore to the residence district, will probably be extended to downtown districts.

In connection with service supervisor work, a knowledge of illuminating engineering is of considerable importance to the service supervisor, in order that he may win the customers' confidence and pave the way for the introduction of new devices by showing the customer how he can get better results for the money he is spending for light. The Denver Gas & Electric Company was one of the first to recognize this fact and act upon it in a practical way. In the fall of 1905, a corps of six men was selected in the new-business department to become trained specialists in illuminating engineering. Mr. J. R. Cravath, western editor of the Electrical World, was retained as consulting illuminating engineer to guide the study and training of these men and advise with them by correspondence on practical problems in illumination coming up in the company's work. Since then the illuminating engineering corps has been a recognized part of the company's new-business department. On account of the removal of a number of the original men to other companies, there have been many changes in the corps, but it has always kept up its work and at the present time holds regular weekly meetings to discuss illuminating-engineering problems.

A Merchant's Opinion of Gas Lighting.

The leading clothing merchant in a prosperous Western city, when talking recently of the possibility of gas lighting in his new store, remarked, "I figure the fly specks begin to collect the minute a man adopts gas for store lighting." He spoke figuratively, of course, but very much to the point, as he expressed the effect on the public as to general inferior standing and unprogressiveness of the stores which cling to antiquated, ill-smelling, stock ruining and troublesome gas or gasoline lighting.

Electric Railway Advertising.

At the meeting last week of the American Street and Interurban Railway Association at Atlantic City, two papers were presented on the subject of electric railway publicity and advertising. One of these was by Mr. J. Harvey White, publicity manager of the Boston Elevated Railway Company, and dealt more particularly with relations, with the newspaper press in connection with the supply of information relating to the railway having an interest to the general public. The publicity department of the Boston Elevated was organized for the purpose of furnishing a central source of supply to which newspaper men could go for information relating to accidents, complaints against service, construction, finance, etc. To this end, the office keeps on file statistics, etc., and when the occasion arises calls upon any officer of the company for information.

The second paper was by Mr. A. W. Warnock, general passenger agent of the Twin City Rapid Transit Company of Minneapolis and St. Paul, Minn., who described the means adopted by his company for furthering the increase of passen-

[illegible] district and excursion amusement resort at Lake Minnetonka, 18 miles from Minneapolis, where it owns about a dozen steam vessels on the lake. The attractions at this place during the summer season are constantly kept before the public by various advertising means, and traffic to other lakes, parks, etc., reached by the lines of the company, is similarly promoted. The paper describes in detail the various methods used in obtaining publicity.

Commercial Progress in Seattle Central Station Work.

During the past summer the Seattle Electric Company has been putting out 250 to 300 electric flatirons per month on trial, and not more than 8 per cent have been returned. To introduce the use of electric heating pads each of the hospitals in the city was presented with a pad, and also some ten prominent physicians, calling attention to the advantage of such a pad over the ordinary hot-water bottle, and requesting that the pad be made useful. The company also informed the doctors that it would welcome their opinion of the merits of the pad when they had had opportunity to observe its work. In almost every instance gratifying replies were received.

In connection with the display of heating devices many have been shown in actual operation in the show windows of the company, such as the coffee percolator with boiling coffee, teapot steaming, cereal cooker in service, chafing dish at work, bucket boiling potatoes, griddle frying pancakes, broiler cooking steak, and so on. These actual working displays have materially helped in the sales, and the result has been an increased non-peak output. In the last two years the Seattle Electric Company has sold over 4000 flatirons, besides many small heating devices, and a considerable number of the larger cooking utensils.

The city of Seattle has just let the largest contract for regrading in its history, namely, the taking down of Denny Hill. This work will cost over $1,000,000, and will be largely done by the hydraulic process. A large electric motor installation will be used for pumping the necessary water from Puget Sound.

Financial Methods in Floating Electric Light Securities.

By E. H. Mather.

It certainly appears as though financial methods detrimental to the future welfare of electric light properties were becoming more common at this, the most dangerous period, for such practice, within the history of the electric light industry. The practice which deserves criticism is the over-capitalization of electric companies followed by the publication of misleading statements of earnings and expenses. The former, although under the ban at the present time, is unjust only when coupled with unreasonably large dividends, or other profits, taken from the business, but when followed by the latter immediately becomes a matter of much concern, and the practice will sooner or later injure the innocent stockholders as well as the guilty promoters.

The public is well aware that public service corporations have in many instances abused the privileges given them, and it is quick to suspect that any and all such corporations are securing from the public more than that to which they are justly entitled.

There is, as is well recognized, a general feeling that electric light companies, as well as other public utility corporations, have been and still are charging too high rates for the service rendered. As a result of this feeling, the public is looking for and adopting methods to prevent this practice.

The operating managers, quickly seeing the importance of checking this move, have set about to give the public better service, and in many cases, lower rates. They are clearly showing that better service and lower rates cannot, generally speaking, be secured by municipal ownership, the remedy commonly adopted by municipalities for the evils, real or imaginary as they may be, that may exist. Of late, more attention has been given to the individual requirements of customers, their wants have been anticipated, complaints have been received cheerfully and promptly attended to by young men of ability and diplomacy; they have been educated to a much wider field for the use of electricity, and able solicitors have been sent throughout the territory. Since these representatives are to the public the personnel of the companies, the customers have come into much closer touch with many corporations supplying electricity; all of which has worked to the great advantage of both the producers and consumers.

While the operating managers have been striving to secure public confidence, the financial managers have in many cases adopted methods of financing which will more than counteract the benefits secured by the operating departments. It is not uncommon for a local electric light company to be purchased by outside parties, and then bonded for a sum sufficient to pay practically, if not quite, the entire cost of the property to the new owners, and also make all necessary improvements and extensions for several years to come. In addition, an issue of stock is brought out which not infrequently equals the bond issue, and represents but very little, if any, cash investment. While this is beyond the bounds of conservative financing and while the public may wonder at such an increased capitalization, it can be shown that the value in the original stock has simply been transferred to the new issue of bonds, leaving under them practically no equity.

To assist in floating such issues of bonds, statements of earnings and expenses have been published. These have frequently shown a reasonable increase in gross earnings, but most extraordinary increases in net earnings. In some cases the net earnings as shown have been sufficient to pay the interest on all the outstanding bonds and from five to ten per cent on the total issue of stock, which is practically all water.

What is the result? An impression is made on the minds of the local public that there are enormous profits in the electric light business when properly conducted, and therefore the rates must be altogether too high, even though they in fact be comparatively low. The public becomes dissatisfied, and efforts are made to secure lower rates by one method or another.

Any electric light company which shows net earnings of 15 to 20 per cent on the entire cost of the property is, in my opinion, either charging too high rates or its statements are not entirely correct. Cost in such cases as these usually includes a good profit on the actual cost of the entire property to the original stockholders.

An analysis of the published statements of some of these companies will often clearly show that the accounts were kept with a view of making as good statements as possible. The operating expenses have been reduced to the lowest amount, and in some cases the construction accounts have carried a portion of the expense that properly belonged to the operating accounts, and depreciation has frequently been lost sight of entirely. Such statements have been prepared solely for the purpose of inducing the investing public to purchase the bonds of the companies.

To one familiar with the electric light business, it is apparent that the financial managers or promoters of companies making such statements have been rather over ambitious, and in preparing such statements as are often seen in circulars describing issues of bonds, have told the truth and nothing but the truth, but not quite the whole truth.

On such statements of earnings and expenses, bankers are induced to purchase the bonds which are retailed to their clients as first-class securities, and so long as the interest is paid and such statements are published, the bonds will be so considered. If, however, the net earnings are decreased by forced reduction in rates caused by legislative action or by competition with competing companies or municipal plants or by dull times or by heavy replacement expenses caused by depreciation which was not provided for, this now desirable class of securities will not stand in good favor with the investing public.

Any practice that educates the general public to believe that the profits in the electric light business are greater than they actually are, should be strongly condemned by all conservative electric light managers, for it is suicidal to the business.

The over-capitalization of electric light properties, followed by the publication of incomplete and misleading statements of net earnings, is an injustice to the bondholders, who are led to believe they have purchased securities with a large equity under them, and to the stockholders in companies conservatively financed, and if continued will lead to one or more of the following conditions:

1. Municipal ownership, which with few exceptions is of no benefit to the general public.

2. Unprofitable low rates caused by competition or legislative action.

3. Over-stringent state laws which will prevent even reasonable capitalization.

4. Loss of confidence by investors in electric light securities.

Better Lighting for Chicago Business Streets.

Arrangements have been made for the improvement of a street in the heart of Chicago's down-town district, which will very likely result in improved lighting for all of the streets in that district. The Dearborn Street Improvement Association has been formed by property owners to pay for the improved paving and lighting of Dearborn Street for a distance of about nine blocks from Van Buren Street north to the river. At a meeting of Dearborn Street property owners held Oct. 22, owners of over half of the frontage involved pledged their support to the lighting scheme which is to be carried out immediately. Although no details have been worked out, it is generally understood that ornamental boulevard posts at frequent intervals, with incandescent lamps, will be used. Mr. J. R. Cravath is consulting illuminating engineer for the association. The western offices of the Electrical World are on Dearborn Street. Other streets are now organizing associations with a similar purpose.

Letter to the Editors.

Calculating Show-Window Illumination.

To the Editors of Electrical World:

Sirs:—We find that a very curious and inexcusable error slipped into the article on the "Engineering of Show-Window Illumination" by the writers which appeared in the Electrical World of Sept. 7, 1907. In regard to the illumination curve necessary evenly to illuminate any show window, the writers in effect stated that this curve should be plotted by taking the square roots of the distances from the lamps to the points in the window to be illuminated; whereas, as must be apparent to all engineers, the correct method is to take the square of these distances. This error of employing square roots instead of squares, of course, will make considerable change in the forms of the ideal distribution curves given in that article. As to the selection of reflectors, however, the reflectors commercially available are so far from giving the ideal distribution that in the majority of cases the selection of reflectors given in the article would not be changed.

The writers will not attempt to explain the psychological reasons why two apparently sane engineers, who have frequently used this method and used it correctly in times past, should allow such a mathematical twist to get into a published article. They can only apologize to any who may have been led astray by the error.

Chicago, Ill. J. R. Cravath.
New York, N. Y. V. R. Lansingh.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Turbo-Dynamos.—The conclusion of the illustrated article on turbo-alternators and turbo-dynamos of Brown-Boveri & Company. The field-core system adopted for the direct-current

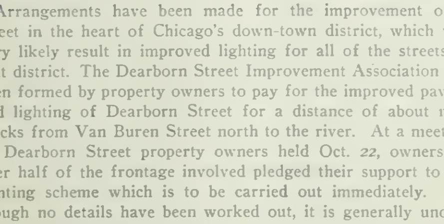


Fig. 1.—Winding Diagram.

machines is shown in Fig. 1. The field structure, which is practically smooth all around, is very similar to that of the stator of an induction motor, it being built up of stampings provided with slots spaced around the inner periphery. There are two sizes of slot, into which the main windings and compensating windings are respectively placed. The main windings consist of former-wound coils, and they are placed in the larger slots, into which they are secured by means of metal wedges; the compensating windings consist of copper strip, placed edgewise in the smaller slots, and also secured therein by wedges. The field distribution thus obtained is such that perfectly satisfactory commutation is obtained at all loads with a fixed position of the brushes. This special type of machine is built in all sizes from 100 to 1800-kw individual output.—Lond. *Electrician*, Sept. 27.

Single-Phase Commutator Motors.—J. [illegible].—A mathematical [illegible] the period of starting single-phase commutator motors.—*L'Eclairage Electrique*, Aug. 31.

Lamps and Lighting.

Determination of Mean Horizontal Cp.—E. P. Hyde and F. E. Cady.—With reference to the paper of Uppenborn, which is liable to discredit the determination of mean horizontal cp by the convenient method of rotating the lamp about its axis of figure, the authors have again carefully tested this method, which is the one in almost universal use in this country. Uppenborn attributed the errors of this method found by him to the distortion of the filament by the rotation. The present authors found that the maximum error observed, due to a bending of the filament, was not in any case greater than 1.5 per cent, provided the filament did not touch the bulb, even though the filament was bent so as almost to touch the bulb. The speed of rotation necessary to force the filament against the bulb was not less than 600 r. p. m., except for special 32-cp, 220-volt lamps without anchors, and for these it was about 425 r. p. m. For most common types of lamps the speed would be much higher than 600 r. p. m. and it is probable that for some types a rupture of the filament would occur before the filament would touch the bulb. When the filament touches the bulb, changes in candlepower of as much as 6 or 7 per cent may take place, but as these large changes are always accompanied by relatively large changes in resistance, it is probable that they are due to a cooling of the filament owing to the contact with the glass. As to the effect of flicker, the authors state that for many of the common types of lamps used in the United States the error due to flicker at a speed of 300 or 400 r. p. m. is probably not very great with most experienced observers, and since the error due to bending is quite small at these speeds the ro-

uting lamp method is convenient and reliable in commercial testing. For the photometry of lamps having an annoying flicker, or for the more accurate photometric test of lamps with a moderate flicker, the simple experiment of employing an auxiliary mirror as described in detail in their former paper will be found very satisfactory.—*Bulletin, Bureau of Standards*, Vol. III, No. 3, August.

Power.

Electric Power in Metallurgical Works.—A fully illustrated description of the electric installation of the Burbacherhütte in Germany, where power is used for driving the rolling mills, and a great many other purposes. There are in the whole about 300 motors with an aggregate rating of 3000 hp, while 4000 incandescent lamps and 300 arc lamps serve for lighting the plant. The old power plant contains three gas engines driven by blast-furnace gases. Each is coupled to a 240-volt, 420-kw, direct-current dynamo, so that this work has a total rating of 1260 kw; it feeds energy to a 240-volt, two-wire system. With the increasing use of electric power for different purposes it became necessary to erect a second power plant. This contains a gas engine operated by coke-oven gas and driving a 980-kw, 2x240-volt, double-commutator dynamo. This new plant also contains a 1250-hp steam turbine driving two turbo generators, each of 420 kw, which also supply energy to the 2x240-volt, three-wire network to greater distances from the plant. The electric installation of the rolling mill is described and illustrated.—*Elek. Kraftbet. u. Bahnen*, July 24.

Electric Power for Tunnel Construction.—In the construction of the Tauern tunnel which will make connection between Salzburg and Kärnten, and after the completion of which the new large railroads in the Alps can begin full operation, electric energy is used to a very large extent. Near the southern end of the tunnel a water power of 1100 hp has been developed, the electrical energy being transmitted to the entrance of the tunnel where three motors of a total rating of 540 hp serve for driving 3 blowers for ventilating the tunnel. At the other end of the tunnel another station has been erected. Both hydraulic and electric drills are used. The hauling is done electrically; the lighting is carried out exclusively by electric lamps. In the whole there are installed on both sides of the tunnel machines and transformers of 7500 hp, of which 1900 hp are simultaneously used. Direct-current machines of 550 volts and three-phase machines of 110, 220, 350, 2000 and 5000 volts are installed. After completion of the tunnel the stations will be used for lighting and industrial purposes.—*Elek. Zeit.*, Sept. 26.

Inclined Electric Lift.—An illustrated description of a peculiar form of inclined electric lift recently installed in a hotel in St. Moritz in Switzerland, in which the car always hangs vertically although the inclination of the track upon which the trolleys run is variable. Push-button control is employed.—Lond. *Elec. Eng'ing*, Sept. 26.

Electric Percussion Rock Drills.—L. BRINKMANN.—Illustrated descriptions of various types of that drill. The drills dealt with include examples of solenoid drills, motor-driven, spring drills, pneumatically cushioned and electro-pneumatic drills. Figures are given showing the superiority of electric over air drills in the matter of efficiency, and a table compares the weights and efficiencies of the types described. The class of work and conditions for which each form is most suited are discussed.—*Elek. Kraftbet. u. Bahnen*, Aug. 14 and 24; Lond. *Elec. Eng'ing*, Oct. 3.

Lifting Electromagnets.—C. R. BENJAMIN.—An illustrated article on the construction of electromagnets for lifting and handling materials of iron, etc.—*Cassier's Magazine*, October.

Wear and Tear of Turbines.—J. DALEMONT.—The conclusion of his serial on the wear and tear of hydraulic turbines. The author deals with Pelton wheels and then summarizes the causes of abnormal wear and tear.—*L'Eclairage Electrique*, V[illegible]

Traction.

Steam and Electric Traction for High-Speed Railroads.—R. RINKEL.—An article in which the author first shows that the capacity of steam locomotives cannot be further increased for higher speeds without necessitating reconstruction of the roadbed under present German conditions. To increase the speed on the present roadbed electric traction offers the only solution. A comparison is made of the operating cost for steam and electric traction, and the final conclusion is that in addition to the increased speed the electric operation which does not necessitate strengthening the roadbed and track will be cheaper than the present steam operation of express trains even if the electrical energy must be generated from coal. It is assumed, however, that large power plants not below 10,000 kw are built and that not more is charged for the coal than is charged at present for the coal used on locomotives on Prussian state railways. "If we consider all circumstances it does not seem to be too optimistic to say that electric high-speed traction with trains of 9 or 10 cars with a speed of 72 miles per hour will be about 40 per cent cheaper than steam traction with two steam locomotives. With one steam locomotive such trains cannot be operated on the present strongest roadbed of Germany." It is strongly recommended to give electric traction a trial in the Westphalia industrial district on the road from Hamm to Düsseldorf of a length of 66 miles.—*Elek. Kraftbet. u. Bahnen*, Aug. 3 and 14.

Tramway Brake.—A note on a new tramway brake which is being experimented with on the Leeds Tramways. It is a track brake of the magnetic type, in which the drag of the magnetic shoe is employed to apply other track-brake shoes, instead of wheel brakes. In the experimental car the wheel brakes are entirely dispensed with.—Lond. *Elec. Eng'ing*, Oct. 3.

Installations, Systems and Appliances.

Berlin Electricity Works.—K. WILKENS.—A very full summary of the equipment of the Berlin electricity works in the beginning of 1907. Negotiations between the company and the municipality of Berlin have led to an understanding according to which the output of the works is no longer restricted and the works will be obliged to satisfy any demand for electric energy within the city limits. The company has the right to use the public streets and squares for placing its cables until the city makes use of the privilege of taking over the works. Nothing has been changed in the former arrangement as to taxes, but the electricity works will have to increase the rate of amortization if they should be allowed to operate the works after the year 1915. Further, if the company wants to change the charge for motor service it must first get permission from the city. There are 14 stations, and during the year 1906 there were generated 182,808,881 kw-hours by means of generators of 81,566 kw rating. At the end of 1906 the connections for lamps were 52,885 kw and those for motors 68,494 kw without taking the electric railways into consideration. The total energy sold during 1906 was 138,140,613 kw-hours, including that for traction. A maximum load of 75,982 kw was reached in December, 1906. At this time a capital of $27,000,000 had been invested, of which already $6,700,000 had been written off. It is estimated that the central stations will have to double their equipment during the next 10 years to satisfy the requirements, and that a capital of about $10,000,000 will be required for this. Originally each part of the city had a direct-current generating station, but this soon became unfeasible on account of the expense for the ground and difficulty of water supply and coal transport, etc. For this reason the scheme is now to transmit energy from a few very large stations by means of high-tension, three-phase currents to substations distributed over the whole city. In the substations the three-phase currents are changed to direct current which is distributed at 2x220 volts for lighting and at 550 for traction. The old direct-current central stations have a 2x110-volt net-work. While the inner city is supplied with direct current, the suburbs get three-phase currents at 3x220 volts, and consumers with large motor connections get in some cases a secondary voltage of 3x500. The different suburbs have a closed secondary net-work which is mostly placed underground. All the primary feeders are underground. The high-tension, three-phase currents are changed to low-tension, three-phase currents by means of transformers

placed in columns which also serve for advertisements, signs, etc. There are now three high-tension stations supplying three-phase currents at 3x6000 volts; one of them also supplies currents at 3 x 10,500 volts. The author then discusses the arrangements provided for coal transport and the boiler plants. The steam engines have increased in size with the size of the work, but more recently steam turbines are exclusively used. The saving of space which is thereby rendered possible became evident at the station in Moabit where at the place occupied before by a reciprocating engine of 1830 kw it became possible to place 3 steam turbines with a total rating of 13,000 kw. The 3000-kw steam turbines of the Allgem. Elek. Ges. consume 6.0 kg of steam per kw-hour at a steam temperature of 300 degrees C. For a steam temperature of 350 degrees C. this is reduced to 5.5 kg per kw-hour; the 3000-hp reciprocating steam engine consumes at 300 degrees C. 6.7 kg of steam per kw-hour. The article is to be continued.—*Elek. Zeit.*, Oct. 3.

Short-Circuit Brake.—M. KALLMANN.—The author has formerly made manifold applications of the "ballast" resistance used in the Nernst lamp, consisting of a resistor with high positive temperature coefficient, for instance, iron. As recently described in the Digest, he applied such resistors to the automatic starting of motors. He now uses them for automatic short-circuit braking. The advantage of his automatic method is that one gets independent of the speed of braking. Fig. 2

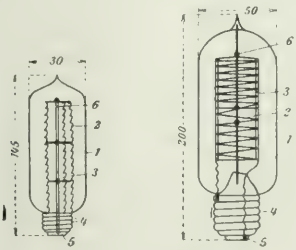


FIG. 2.—RESISTORS.

shows a small and a large resistor of this type which is called by him a variation resistor. The dimensions in the diagram represent millimeters. The diagram at the left hand shows a small variation resistor consisting of various pairs of iron spirals, two of which are 1/10 mm thick and are heated to red heat by a current of 1 ampere. A resistor of this type consumes about 70 volts at 2 amperes, that is, 140 watts. When the current increases by 20 per cent the e. m. f. varies from 10 to 70 volts. A larger resistor is shown in the hight-hand diagram in which a bunch of thin iron wires is wound around and fastened to the frame 3. With a current of 10 amperes it consumes from 100 to 200 volts, or from 1 to 2 kw. The resistance when cold is 1 ohm, at red heat 10 ohms. The "inertia" is quite different for the two sizes; the smaller resistor becomes red hot in about 1/10 second after having been connected to full voltage while the large resistor becomes red hot in 1 second. According to the purpose for which the resistor is to be used the size must be chosen. The resistance is very low when cold so that in the first moment after closing the circuit there is a strong rush of current. If necessary, this rush of current is diminished by connecting an ordinary constant resistor of nickeline wire in series with the iron resistor in order to get the original value of both resistances sufficiently high. This rush of current, however, lasts only for a short time, and when red hot the resistance increases to about 5 or 10 times the value in a cold state. The resistors then rapidly cool off with the rapidly decreasing armature voltage of the motor which is being braked, the resistance decreasing to almost zero when the motor comes to rest. An arrangement for hand-braking is shown in Fig. 3, where 7 is a shunt-wound motor with the field coils 8. After disconnecting the starting resistor 11 by means of the lever 12, and after disconnecting from the net-work, the armature of the motor is connected in series with the variation resistor 9 and 10, and part of the starting resistor 11 when the lever bridges the contacts 13 and 14. Fig. 4 shows an automatic braking arrangement. When the lever 17 bridges the contacts 26 and 16, the motor 7 is connected to the net-work in series with the nickeline resistor 19 and the variation resistors 20 and 21. The winding of the starting relay 25 is in this position in shunt with the armature of the motor. When the motor is connected to the circuit the relay armature 22 is attracted and makes contact at 23 and 24, whereby the starting

FIGS. 3 AND 4.—DIAGRAMS OF HAND AND AUTOMATIC BRAKING ARRANGEMENTS.

resistor is disconnected and the motor is started. For braking, the lever 17 interrupts the connection with the line and makes contact with 18, whereby the motor is connected in series with the braking resistors 9 and 10, and the resistors 19, 20 and 21, because the contacts 23 and 24 of the relay armature are simultaneously opened. Several other arrangements are shown, and the application to series motors and to three-phase motors is also discussed.—*Elek. Zeit.*, Sept. 26.

Liquid Starter.—An illustrated description of a liquid starter of English make which has been designed to overcome the difficulties sometimes experienced in wire starters in connection with the no-volt release arrangement, possibility of starting-up too quickly, heating through starting too slowly, and also separately exciting the motor field, irrespective of the resistance in the armature circuit. The starter is totally enclosed in a wooden case, with the starting handle projecting at one side. On turning the starting arm, the plunger is lowered through the liquid resistor, and a weighted magnet-shoe fixed in a slide, is lifted, the raising of the latter immediately allowing the shunt switch to drop by its own weight before the plunger reaches the liquid, thus completing the shunt circuit before the armature circuit is formed. The plunger is fixed to a wooden float of a slightly smaller diameter than the jar containing the liquid, compelling it to displace the latter before sinking, and therefore making it impossible for the armature circuit to be completed too rapidly. The plunger reaches the contact at the bottom of the jar before the magnet-shoe reaches the top of the slide, which then at once cuts out the liquid resistor. This weighted magnet-shoe is held up by means of a magnet coil (in series with the shunt circuit), so that the moment the main switch is opened the coil is demagnetized, allowing the magnet-shoe to fall by gravity, the weight of the magnet-shoe at the same time allowing it to draw up the plunger to the off position. A resistor is inserted in the shunt circuit (which comes into play automatically as soon as the main switch is opened) to deal with the "extra" e. m. f. The overload release is operated by a solenoid device. "The liquid used is fireproof, and, unlike acids or soda, has very little effect on metals." These starters are thought to be specially useful for motor hiring schemes as only four sizes are required for dealing with motors up to 30 hp. The resistor solution is specially graded for any given hp and can be altered or renewed in a few minutes at the cost of a few cents.—Lond *Electrical Review*, Oct. 4.

Wires, Wiring and Conduits.

Alternating-Current Cables.—C. BREITFELD.—Roessler has shown that for a clear insight into the phenomena in alternating-current cables and for the practical calculation of all cable problems two quantities are of decisive importance. namely, the apparent resistances of the short-circuited and the open cable. The present author shows how to get simple formulas for such calculations. If the no-load and the short-circuit resistance of an alternating-current cable for any short length is determined by measurement, these resistances may be easily calculated for other lengths.—*Elek. u. Masch.*, Sept. 15.

[illegible] tributing system there is always a certain cross-section of cable for which the sum of interest and amortization of first installation, cost of maintenance and cost of energy lost in the cable is a minimum. The author gives simple formulas for finding this commercially most favorable cross-section.—*Elek. Kraft-* [illegible] Aug. [illegible]

Electrophysics and Magnetism.

Ratio of the Electromagnetic to the Electrostatic Unit of Electricity.—E. B. ROSA AND N. E. DORSEY.—The first part of [illegible] of the ratio of the electro-magnetic to the electrostatic unit of electricity. The authors believe the condenser method to be the best one known at present, the ratio of the units being derived from the ratio of the electrostatic to the electromagnetic capacity of a condenser. By this method the ratio is determined in terms of a resistance, but inasmuch as the ratio of the units is equal to the square root of the ratio of the capacities, the uncertainty due to an error in a value of the ohm is divided by 2 so that if an uncertainty of 2 parts in 5000 in the value of the International ohm is admitted, an uncertainty of only 1 part in 5000 is involved in the ratio of the electrostatic to the electromagnetic units. The present installment of 110 pages deals with [illegible] *Bulletin Bureau of Standards,* Vol. III, No. 3, August.

Electric Sparks.—H. BARKHAUSEN.—A spark discharge is simply a special case of an alternating-current arc, and on this basis the author gives a simple theory of spark discharges. —*Phys. Zeit.*, Oct. 1.

Units, Measurements and Instruments.

Universal Shunt Box.—[illegible] SALOMONSON.—A description of an improved universal shunt box which not only allows a definite fraction of the current which is to be measured to be sent through the galvanometer but also enables one to adjust the total resistance of the shunt-box so that it is neither too large nor too small compared with a galvanometer resistance. It may therefore be used with any galvanometer. The arrangement is indicated in Fig. 5, which shows the ordinary

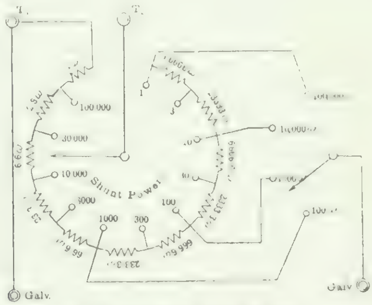


FIG. 5.—DIAGRAM OF SHUNT BOX.

universal shunt-box with a dial switch to alter the shunting power and with a second dial switch, permitting part of the resistance to be cut off from the galvanometer circuit, so as to reduce its total resistance. In the shunt box the total resistance amounts to 100,000 ohms. The eleven shunt powers are 1, 3, 10, 30, 100, 300, 1000, 3000, 10,000, 30,000 and 100,000. By means of the right-hand dial switch the total resistance can be reduced from 100,000 ohms to 10,000, 1000 or 100 ohms. If the box is used with one of the lower resistances, the shunt powers are reduced in the same proportion. The number of the useful shunt powers is, of course, also modified when the right-hand pointer does not point to the largest resistance. With 10,000 ohms nine-shunt powers are available, with 1000 ohms seven, with 100 ohms there are five shunt powers left. This modified universal shunt is particularly useful with moving-coil instruments, as it allows the absolute sensitiveness as well as the damping to be modified. Every galvanometer of this kind provided with it can be used with a periodic or an aperiodic movement of the coil. A critical damping can always be obtained, but necessitates the introduction of a suitable additional resistance, the amount of which depends on the external resistance.—Lond. *Electrician,* Sept. 27.

[illegible] The authors first give a brief calculation of the torque which is exerted by two alternating-currents differing in phase, on a disc as in the well-known Ferraris experiment. They then discuss the possibility of devising a relay on this principle. They deal with different methods of obtaining electrically a torque which is, up to the beginning of motion, proportional to the square of the current or to the voltage or to the product of current and voltage. They then discuss the possibility of devising relays for various purposes by combining such electric torques with mechanical torques.—*Elek. Zeit.*, Sept. 26.

[illegible] direct-current arc lamp with two homogeneous electrodes is shunted by a capacity and a smaller self induction, pure alternating currents of high frequency are generated automatically and continuously in the latter circuit. The author shows that for this reason the arc represents a valuable and convenient means for testing purposes in alternating-current engineering. It is specially suitable for measuring coefficients of self-induction and capacities. A number of arrangements for this purpose are described and explained by numerical examples.—*Elek. Zeit.*, Sept. 19.

Compensation Instrument.—C. PAULUS.—An illustrated description of the technical compensation instrument of the European Weston Instrument Company.—*Elek. u. Masch.*, Sept. 29.

Single-Phase Meters.—A note on a British patent of the Compagnie de Construction Electrique. In meters of the induction type for single-phase circuits, the phase displacement between the series and the shunt field flux is obtained by the use of two shunt coils connected in series but wound in opposite directions on the limbs of an electro-magnet provided with four pole-pieces. The series winding is disposed, partly on two of these pole-pieces and partly on a separate electromagnet facing them. The resulting fluxes are practically 90 time degrees apart, and react upon an ordinary metal disc and cause it to rotate.—Lond *Elec. Eng'ing,* Oct. 3.

Resistance Coils.—[illegible] paper on resistance coils and comparisons. The author gives some forms of standards of low resistances less than 0.1 ohm and then gives a full account of numerous resistance alloys and their electrical and mechanical properties, like nickeline, constantan, manganine, [illegible]—Lond. *Electrician,* Oct. 4.

[illegible] J. SAHULKA.—An illustrated translation in abstract of his German paper on the measurement of insulation resistance and capacity of individual conductors of an alternating-current net-work without interruption of service.—Lond. *Electrician,* Oct. 4.

Telegraphy, Telephony and Signals.

Thermophone and Continuous Electric Oscillations.—F. WEINBERG.—The author first refers to the old thermophone of Preece, and then shows how hot rheostats, electric furnaces, etc., may be used as thermophones. For instance, a rheostat

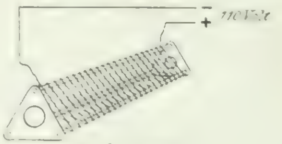


FIG. 6.—RHEOSTAT.

(Fig. 6) which is sufficiently long and so constructed as to enable good air circulation, when connected to a lighting circuit at 110 volts, reproduces clearly the sound of the running machines (commutator interruptions) in the central station. The author found that this phenomenon took place when the wire had been heated to 37 degrees C., and the temperature of the air was 19 degrees C. When the air was cooled and the speed

of ventilation was increased the sound became stronger. An arc lamp inserted in the same circuit as shown in Fig. 7 reproduces sounds and speech spoken into the microphone *Mi*, the microphone currents being transmitted to the arc circuit by means of the transformer *T*. If several rheostats are connected in series the intensity of the sound is considerably increased. The surprisingly strong effect obtained with this arrangement is thought by the author to be due to the following circumstances. The current oscillations of the microphone are transmitted by means of the transformer to the arc, the resistance of which is varied according to the oscillations, where-

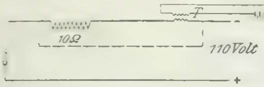


FIG. 7.—THERMOPHONE CIRCUITS.

by the main current of the lighting circuit and the rheostat in the same are acted upon. When the lighting circuit was suddenly disconnected and at the same time the hot rheostat and transformer were short circuited, as indicated by the dotted lines in the illustration, the rheostat reproduced the words of the microphone with greatly reduced intensity and only until it had cooled down to about 35 degrees C. The author thinks that any little wire piece of a telephone circuit when artificially heated would reproduce the telephone message to a sufficiently sensitive ear. Fig. 8 shows an experiment in which a rheostat was brought to incandescence by means of a 110-volt storage

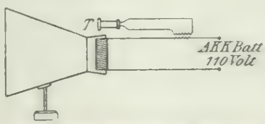


FIG. 8.—THERMOPHONE [illegible]

battery. The telephone *T* which was in inductive connection with the storage-battery circuit by means of a transformer, reproduced the sounds spoken into the megaphone. Another experiment is shown in Fig. 9 in which the Duddell arrangement using a capacity and a self-induction in shunt with the heated element was used. As heated element, rods of thorium, cerium (well known from the Nernst lamp) are suitable. *A K K* represents a storage battery, *M* the microphone. If the thorium rod is used in a hydrogen atmosphere hydrogen gas being passed through the box in the direction of the arrows shown in the figure, the arrangement represents a stable gen-

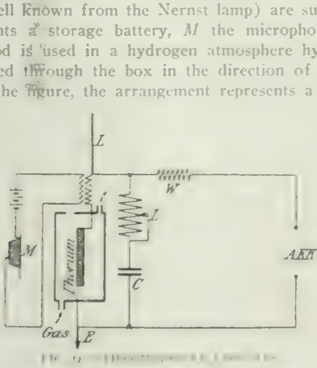


FIG. 9.—[illegible]

erator of undamped electric oscillations and may be used as a substitute for the unstable arc in the Poulson method.—*Elek Zeit.*, Sept. 26.

[illegible] central-battery working was recently carried out. Fifteen min- [illegible] many months had been occupied in the requisite preparation and organization, and the actual change over was accomplished well [illegible] ing adjoining the old exchange, and the lines had been diverted [illegible] equipments were connected in parallel. The necessary alterations had also been made in the subscribers' instruments, and the junction circuits incoming from Gerrard in other exchanges. Previous to the transfer, the cut-off relays on the subscribers' circuits in the new exchange were disconnected by the insertion of wooden pegs, so that the heat coils could be fitted on the new main frame. The heat coils on the old test-board were looped together in small groups by means of tape. At the given time, these heat coils were pulled out, and then men waiting at the relay racks were given the signal to pull out the pegs from the cut-off relays.—Lond. *Elec. Eng'ing*, Oct. 3.

Wireless Telephony.—R. A. FESSENDEN.—An illustrated paper in which the author gives an account of the wireless telephone system of the National Electric Signalling Company in operation between Brant Rock and New York, a distance of nearly 200 miles. The apparatus, which includes a high-frequency alternator, worked at 81,700 periods, and telephonic relays, is described, and the commercial possibilities of wireless telephony are discussed.—Lond. *Electrician*, Oct. 4.

Miscellaneous.

Lubricating.—K. LENZ.—A long discussion on the best methods of lubricating high-speed machinery.—*Zeit. d. Ver. Deutscher Ing.*, June 1, abstracted in *Elek. u. Masch.*, Sept. 15.

London Exhibition.—Illustrated descriptions of the various exhibits at the engineering exhibition at the Olympia in London. Machine tools seem to represent the predominant feature as illustrated in London *Electrical Review*, Oct. 4, while several apparatus for the scientific control of combustion in raising steam and its subsequent utilization in power plants are described in Lond. *Electrician*, Oct. 4.

BOOK REVIEWS.

MOTEURS À COLLECTEUR À COURANTS ALTERNATIFS. By Dr. F. Niethammer. Paris: *L'Eclairage Electrique*. 131 pages; 138 illustrations. Price, 5 francs.

The book presents the electrotechnical theory of alternating current commutator motors from the engineer's standpoint. It also briefly discusses the history of the development of this type of motor. The work is divided into three chapters. Chapter I contains a general discussion of the subject, including its outline history. Chapter II deals with the theory of such motors with relation to vector diagrams, and covers their torque, power-factor, speed-regulation, braking and commutation. Chapter III relates to structural details, and refers to various installations and applications of these motors. In view of the importance of the modern alternating-current series motor, the book deals with a prominent technical subject of the present day. It is clearly written. The work will be appreciated by students and designers of alternating-current motors.

[illegible] "Standard Handbook for Electrical Engineers," is announced [illegible] about Nov. 15. A partial list of the authors and subjects is as follows: A. S. McAllister, Ph. D., "Transformers and Motors"; H. M. Hobart, "Generators"; George Shaad, "Central Stations"; Louis Bell, Ph. D., "Illumination"; A. H. Armstrong, "Electric Traction"; E. F. Roeber, Ph. D., "Electrochemistry"; Kempster B. Miller, "Telephony." The book is divided into 20 sections as follows: Units, circuits, instruments and measurements, materials, magnets, transformers, generators, motors, batteries, central stations, transmission and distribution, illumination, electric traction, electrochemistry, telephony, telegraphy, miscellaneous applications of electricity, wiring, standardization rules, tables and statistics. The book will be printed on "bible" paper, bound in flexible morocco, and will contain over 1300 pages and more than 1500 illustrations, all of which were [illegible]

Time-Limit Relays.

By M. C. Rypinski.

Continuity of service is an essential consideration in all installations, and interruption of the service cannot be tolerated unless the protection of the apparatus demands it. There are, however, certain abnormal conditions of current which may exist for a short time on a circuit without causing serious damage, such as swinging "grounds," intermittent short-circuits, synchronizing cross-currents, etc. The simple instantaneous relay would in such cases act instantly and interrupt the service unnecessarily. There has, therefore arisen the necessity for a relay having a retarded or time-element action. For certain service it is sufficient that this retarded action have a definite predetermined value independent of the load condition. Such a relay is termed a "definite time" limit relay. For other service, it is necessary that this time element vary inversely with the load; that is, with greater load, the time element should be less and vice versa. Such a relay is termed an "inverse time" limit relay.

Instantaneous relays are used where it is desired to give protection only at the limiting current carrying ability of the apparatus.

Definite-time-limit relays are used where it is necessary to maintain service on a given circuit at all hazards for a predetermined time. This relay allows temporary "grounds" and short-circuits to "clear" by burning themselves out, and it prevents synchronizing cross-currents from opening the breakers. Most desirable of all, however, it enables instantaneous and inverse-time-limit relays on contiguous circuits of less importance to operate and "cut off" under disturbances without opening the important circuit, even though the latter is temporarily heavily overloaded during the disturbance.

Inverse-time-limit relays possess two valuable characteristics, as follows: (1) Their delay in operation is inversely proportional to the strain on the system; the greater the strain the quicker the relay will operate. (2) By virtue of (1) they act "selectively" those nearer a point of disturbance in a system, and which, therefore, receive the greatest load, operating first—disconnecting the affected portion and "clearing" the system while confining the disturbance to a minimum area. As an example—consider a system of three feeders, 1, 2 and 3 of Fig. 1—connecting a set of power station bus-bars A with a set of sub-station bus-bars B and protected with automatic circuit-breakers controlled by overload inverse-time-limit relays at D, E, F, and reverse power inverse-time-limit relays at P, Q and R. Each overload relay will be adjusted for operation at the same current as the others; likewise each reverse power relay will be adjusted for operation at the same current as the others.

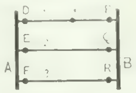


FIG. 1.—DIAGRAM SHOWING FAULT ON FEEDER.

Assume now that a short-circuit develops in 1 at point X. All three feeders will at once supply energy to the short circuit from A. If B is a synchronous converter sub-station, the converters by virtue of their enormous stored rotative energy, may tend to supply energy also, but as this has no particular bearing on the facts to be brought out, it will not be further considered. D being nearest the fault X, and, therefore, in the circuit of the least line drop, will receive more current than E and F. By virtue of the inverse time law it, therefore, operates first or "selectively" disconnecting the feeder 1 from A before E and F have time to act. Simultaneously P has been receiving energy in the reverse direction through bus-bars B from feeders 2 and 3, and has disconnected feeder 1 from B. Q and R will not operate, as they receive energy only in the normal direction and E and F will not operate as the fault has been isolated and they have been relieved of their overload before they have had time to act. In actual practice on alternating circuits, relays P, Q and R will operate on both overload and reversal of power, and they are so designed that the operation on reversal of power is at a much lower value of current than on overload (about one-third to one-eighth in representative types). If overload and reverse power relays were used at P, Q and R, the relay at P would operate sooner than Q and R, for the reverse fault current through P is the sum of the normal fault currents through Q and R.

Where only two feeders exist, such as 1 and 2, both P and Q would receive the same amount of fault current and the selective action is not so great, but is still amply sufficient to allow P to operate before Q, on account of the difference between their reverse and overload tripping values.

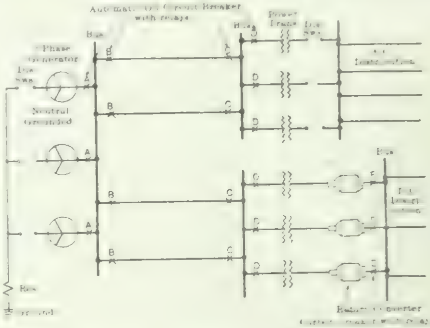


FIG. 2.—RELAYS IN A FOUR-WIRE THREE-PHASE SYSTEM.

Similarly to the definite-time-limit relay, the inverse-time-limit relay will allow temporary "grounds" or short-circuits to "clear" themselves, and it will prevent synchronizing cross-currents from opening the breakers. The action is somewhat more limited in the latter on account of the inverse feature, but it is amply sufficient for all ordinary conditions.

Time-limit relays in their simplest form consist of three elements: (1) the actuating mechanism energized by the line source to be protected; (2) a set of contacts operated thereby; (3) the time-limit feature.

The actuating mechanism may assume any form which will give operation under the desired conditions. It usually involves a motive device consisting of a solenoid and a core, a rotating motor, or some form of instrument movement.

Tripping mechanism usually consists of a set of moving platinum, silver or carbon-tipped contacts engaging a corresponding set of stationary contacts. Some relays have single contacts for closing a single tripping circuit; others are provided with multiple contacts for closing two or more tripping circuits, as in the operation of double-throw systems, where a relay in the main circuit has to operate circuit breakers in each of the duplicate feeder bus-bars.

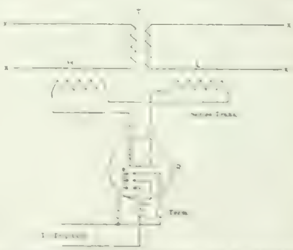


FIG. 3.—RELAY FOR TRANSFORMER PROTECTION.

The usual arrangement of relay contacts provides for their closure upon the operation of the relay, in which case the relay is spoken of as being provided with "shunt-trip contacts." The contacts are connected in series with the tripping circuit of the breaker and an independent source of electrical energy and

upon closing energize the tripping circuit and open the breaker. The tripping coils are wound for shunt operation from the independent source, which is usually a direct-current exciter circuit or a storage battery, and the circuit-breaker is spoken of as being equipped with shunt-trip coils. The operation of shunt tripping coils from the circuit being protected is inadvisible, owing to the liability of the trip coil failing to operate on the low voltage existing under short-circuit and overload conditions.

On an alternating-current system, where an independent source of energy is not available, the circuit-breakers are provided with series tripping coils wound for operation from series transformers in the main circuit. Overload relays are also provided with series-trip contacts, which differ from the shunt-trip contacts in being normally closed instead of open and opening upon operation of the relay. They are connected in shunt with the series trip coils, thereby short-circuiting them. Upon operation of the relay they open, sending the transformer secondary current through the trip coils and trip the breaker.

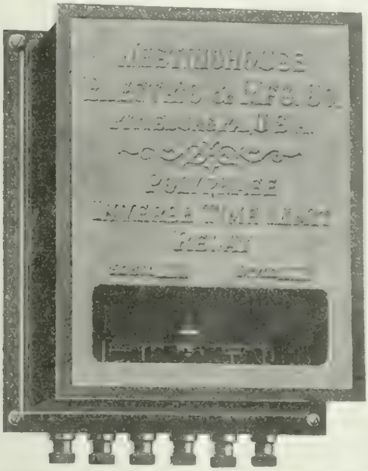


FIG. 4.—POLYPHASE OVERLOAD RELAY WITH INVERSE TIME ELEMENT.

FIG. 5.—DIRECT-CURRENT REVERSE-POWER RELAY WITH INVERSE-TIME ELEMENT.

As there is always sufficient current under overload and short-circuit conditions to operate the trip coils, this arrangement is as satisfactory as shunt tripping.

The application of relays to any certain system depends almost entirely upon the local conditions of operation, varying somewhat with each installation. Representative practice recommends the placing on generator circuits of either a reverse-power relay with a time-limit feature or else the entire elimination of automatic protection.

Feeder Circuit Protection: For feeders at the power station end overload-inverse-time-limit relays are desirable. For feeders at the sub-station end overload and reverse-power inverse-time-limit relays are desirable.

With synchronous converters, an overload inverse-time-limit relay in the high-tension side of the main transformers will give protection for the alternating-current side. For the direct-current side a reverse-power inverse-time-limit relay operating the direct-current breakers will be required.

An example of the relaying required in a typical four-wire, three-phase system is illustrated in Fig. 2. Three generators, operating with their neutral points grounded through a resistance, feed a common bus system, four sets of feeders, main transformers, converters, etc., for alternating-current and direct-current distribution of energy. Automatic circuit breakers are inserted operated by relays as follows: at *A*, alternating-current overload and reverse-power inverse-time-limit relays; at *B*, alternating-current overload inverse time-limit relays: at *C*, alternating-current overload and reverse-power inverse-time-limit relays; at *D*, alternating-current overload inverse-time-limit relays; at *E*, direct-current reverse-power inverse-time-element relays.

The relays at *A* are intended for reverse protection only and so have their overload adjustment set at the maximum value.

In sub-stations, where many transformers are operated in parallel, a damaged transformer may be disconnected by means of the arrangement illustrated in Fig. 3. Here *T* represents any one of a bank of transformers connected in parallel, in the high and low-tension sides of which are connected relay transformers *H* and *L*, arranged so that their secondaries are in series and e. m. f.'s oppose each other. These relay transformers are so selected as to tend to give the same secondary current under all normal conditions, under which therefore the overload relay *R* will not be affected. In the event, however, of a short-circuit developing within the transformer the two sides will be unbalanced and the resultant current will be sufficient to operate the relay and disconnect both the high and low-tension sides of the transformer. Figs. 4 and 5 represent types of inverse-time-limit relays.

Meeting of General Electric Managers.

The managers of the General Electric Company have just held their annual meeting at the main office of the company in Schenectady. Owing to the national interest taken in the business affairs of the industrial world to-day the principal topic during the afternoon was a discussion of the general situation in the electrical field. Due to the fact that Vice-President J. R. Lovejoy has not entirely recovered from his recent illness, Vice-President B. E. Sunny, of Chicago, presided.

The satisfactory condition of the company's business was indicated by a statement that orders received during the current year to date exceeded those of the corresponding period of last year by fully 15 per cent. The volume of orders and the prospective demand for supplies and for the various lines of smaller electrical devices which the company manufactures, are very satisfactory.

Dr. Thomas Addison, manager of the Pacific Coast territory, reported a recent order for a Curtis steam turbine generator of unusual size. This machine, which will be one of the largest energy producers ever built for electrical purposes, will have a normal capacity of 20,000 horse-power.

Generally encouraging sentiment regarding the business outlook prevailed among the company's managers. The company's foreign business continues to show gratifying increases.

Among those in attendance were the following: C. A. Coffin, president; E. W. Rice, Jr., vice-president; Hinsdill Parsons, vice-president; B. E. Sunny, vice-president, Chicago; Anson W. Burchard, assistant to president; M. F. Westover, secretary; H. W. Darling, treasurer; Edward Clark, general auditor; J. R. McKee, manager power and mining department; W. J.

[illegible] lighting department; J. G. Barry, manager railway department; D. R. Bullen, manager supply department; G. E. Emmons. manager, Schenectady works; W. C. Fish, manager Lynn works; George F. Morrison, manager Harrison works; Thomas Addison, Pacific Coast manager; E. D. Mullen, manager Philadelphia office; C. B. Davis, manager Boston office; Gen. Irving Hale, manager Denver office; T. Beran, manager New York office; A. F. Giles, manager Atlanta office; J. B. Pevear, manager Cincinnati office; E. E. Gilbert, turbine sales manager; P. D. Wagoner, transformer sales manager; A. D. Page, manager incandescent lamp sales; W. L. R. Emmett, engineer lighting department; D. B. Rushmore, engineer power and mining department; M. P. Rice, publication bureau; F. H. Gale, [illegible]

Annual Show of Automobile Club of America.

The eighth annual exhibition of the Automobile Club of America was held in the Grand Central Palace, New York City, Oct. 24-31. Affiliated with the Automobile Club of America was the American Motor Car Manufacturers' Association, whose members contributed a majority of the machines on exhibition. One of the interesting sidelights of the show was the presence of the aeronauts and of the balloons which competed in the recent international balloon race at St. Louis. The Motor & Accessory Manufacturers' exhibits were more numerous than ever.

Of the numerous pleasure and other vehicle manufacturers represented but two were makers of electric vehicles. The Anderson Carriage Company of Detroit, Mich., exhibited two pleasure vehicles and the Lansden Company of Newark, N. J., showed one pleasure and a number of commercial vehicles. Offsetting these were about 65 manufacturers of gasoline vehicles, eight of whom showed commercial trucks also. Taken as a whole the show offered nothing radical in automobiles, the tendency being, if anything, towards a standard practice so that new yearly models are becoming things of the past.

Six-cylinder cars have greatly increased in number; but one, two and four-cylinder engines still hold their own. Jump spark ignition leads and is double in a great many vehicles; while make and break are occasionally seen. The use of the magneto both for jump and make and break spark has largely increased; more than half of the cars shown being thus equipped. Many of the other cars were equipped with two sets of batteries. Storage cells apparently predominated although the present dry cell has been so thoroughly adapted to automobile use by its makers that excellent results are obtained from it.

Below are given brief descriptions of some of the exhibits made by the Motor & Accessory Manufacturers:

The Oliver Manufacturing Company displayed its line of jacks for automobile use.

The Electric Storage Battery Company showed a line of its well-known chloride accumulators for automobile work.

The Ampere Manufacturing Company displayed a line of "Best" dry cells for automobile, gas-engine and telephone work.

The Joseph Dixon Crucible Company had on exhibition various forms of its graphite products, as applied to automobile lubrication.

The Western Electric Company showed battery-charging dynamos and motor-generators made by the company for the automobile trade.

The Whitney Manufacturing Company displayed various [illegible]es of chains and a patent system of keying largely used in [illegible]e construction of automobiles.

The B. F. Goodrich Company exhibited its regular clincher type of smooth, Bailey and flat threads. An opportunity was also given of testing the company's quick-detachable tires and rims.

The William Cramp & Sons Ship & Engine Building Company displayed manganese bronze castings of every conceivable shape for automobile use. This great shipbuilding house has specialized in work of this kind.

The Eastern Carbon Works showed their gas engine dry cells, particularly designed for the rigorous service required in automobile work. Battery connectors guaranteed not to shake loose under the most severe conditions of vibration and jolting were also a feature.

American Electric Novelty & Manufacturing Company, the originators of "Ever Ready" specialties, had on exhibition a line of dry cells especially made for automobile ignition service. These batteries are made in many sizes and are put up for automobile and motor-boat use.

Morgan & Wright had as the most prominent feature of their exhibit the improved Midgley universal rim for use with their clincher or Dunlop tires. This rim will accommodate every type of mechanically fastened tire but one. A full line of Morgan & Wright's tires was also on view.

The National Carbon Company displayed its well-known line of Columbia dry cells, prominent among which was the "Red-Top Columbia Igniter" cell manufactured especially for automobile use. The company also distributed a pamphlet entitled "Helps and Hints of the Motor Car."

The Heinz Electric Company which has long been identified with the manufacture of induction coils for use with X-ray apparatus displayed its coils for ignition purposes. These are made in interchangeable unit types, from 2 to 6 cylinder styles, and are mounted in waterproof cases with switch.

The Whitlock Coil Pipe Company's automobile department exhibited a number of different types of coolers, hoods, and motor manifold connections of special construction, and in a variety of designs. These consist of inlet manifolds of copper and brass, steel exhaust manifolds, and other specimens of bent-pipe work.

The Hess-Bright Manufacturing Company had on exhibition a full line of its annular ball-bearings. A feature of the company's exhibit consisted of two railway axles taken from a standard passenger coach that had traveled 65,000 miles. No appreciable wear or other depreciation was visible, demonstrating in a striking manner the capabilities of the company's ball bearings under severe service conditions.

The Veeder Manufacturing Company had on exhibition its tachodometer. The indicator shows the speed of the car from 0 to 64 miles; or when required to have close readings at slower speeds the scale reads from 0 to 32 miles an hour. It is only necessary to move a small lever to the right and the instrument is adjusted for high-speed work. No springs or delicate moving parts are incorporated in the system.

The Connecticut Telephone & Electric Company displayed spark coils in both automobile and marine types; lever switches, plug switches, indicators, etc. The company's standard unit type dash coils were shown with all numbers of units from 2 to 6. These were enclosed in a mahogany case with protected terminals. The switch is made waterproof so that the efficiency of the ignition apparatus will not be lessened through leakage.

The National Battery Company featured the complete components of its cell, mounted on an ornamental panel, so that the features of construction were easily studied. Sparker, vehicle and truck batteries were shown, a new method of assembling and sealing the sparker batteries having been made in the 1908 model of these accumulators. The company's method of sealing, which dispenses with the use of the usual sealing compounds, was also shown.

C. F. Splitdorf's synchronized distributing coil was one of the chief objects of attraction amongst the numerous ignition specialties exhibited. By means of this coil the firing of a multi-cylinder engine is accomplished in each cylinder at the proper time without any of the detrimental effects usually experienced with a single coil, as a different unit supplies the secondary current for each cylinder. These new coils are made up in any number of units and are suitably mounted in a standard type of mahogany case.

The Dayton Electrical Manufacturing Company's exhibit consisted of a dynamo and storage-battery charging system in

complete working order. The outfit comprises the well-known Apple dynamo, a switchboard and a portable lead bottle-type of accumulator. The dynamo is friction-driven from the flywheel of the engine and charges the battery. The timers, coils and plugs of the system were all in plain sight of the spectator at the show, so that the working of the system could be seen at a glance. The nature of the spark produced was also shown.

THE ATWATER-KENT MANUFACTURING WORKS made one of the most interesting exhibits shown in the line of ignition apparatus. A spark-generating outfit with six small dry cells was sealed in a glass case and driven from outside by means of a small motor, a speedometer and odometer being attached to indicate the equivalent rate of speed traveled and the distance covered during the time of the test. The exhibit was intended to demonstrate the reliability and low consumption of the Atwater-Kent apparatus. The regular line of spark generators, meters and switches was also displayed.

Illumination of Baltimore in Home Week.

By LAURANCE JONES.

Baltimore signalized Maryland's Home Coming Week, Oct. 13 to 20, by an illumination of the principal thoroughfares and public buildings upon a scale far surpassing any previous displays of this character. The installation was approximately the equivalent of 45,000 4-cp lamps. Baltimore street for a distance of one mile, Eutaw Street for half that distance, Lexington and Charles Streets for a number of blocks were spanned at frequent intervals by streamers of incandescent lamps. The City Hall, Post Office and Court House, occupying three adjacent city blocks, were elaborately outlined and decorated. Numerous minor public buildings in various parts of the city were similarly treated. Arches, brightly illuminated, welcomed the home comer at the principal railway stations. An electric fountain was erected at the intersection of Baltimore Street and the principal wholesale thoroughfare. A Court of Honor, composed of staff columns spirally wreathed in incandescent lamps and streamers of lamps, all surmounted by a crown of orange-colored lamps, marked the geographical center of the city.

The street loops, supported by spans of No. 12 iron wire attached to buildings upon opposite sides of the street, and suspended therefrom at two points, one over each curbline, consisted of No. 10 weatherproof wire; receptacles were of the "pigtail" type, spaced 15 ins. apart. Feeders, consisting of three strands of No. 8 weatherproof wire, equally balanced on opposite sides of an Edison three-wire, 120-240-volt system, were supported by cleats fastened to a wooden backing banded to the trolley poles. Connections between loops and feeders were made through fuse blocks adequately protected from the weather. Energy was supplied through 11 overhead emergency connections, each controlled by a fused knife switch. Eighty-five loops were erected, averaging 60 4-cp lamps to the loop, aggregating about 5000 4-cp lamps.

The City Hall dome, rising to a height of 200 ft., was outlined in every detail with 8-cp lamps spaced 15 ins. apart. The cornices of this building were also outlined, lamps of 4 candlepower being placed at intervals of 15 ins. The Elblight system was used throughout. The load was equally balanced on opposite sides of an Edison three-wire, 120-240-volt system, and was controlled by a fused knife switch. Approximately 5000 8-cp and 3500 4-cp lamps were used.

The towers, windows and cornices of the Post Office were outlined with 4-cp lamps spaced 15 ins. apart, in Fielding cleat receptacles. Circuits of No. 12 wire connected through fuse blocks to sub-feeders of No. 10 weatherproof wire; these were in turn connected through fuse blocks to feeders of 300,000 cir. mil cable controlled by fused knife switch. The load was balanced on an Edison three-wire, 120-240-volt system. About 6000 4-cp lamps were used.

The cornices, windows and doorways of the Court House were outlined in 4-cp lamps spaced 15 ins. apart; surmounting the cornices were 16 flower pots consisting of vari-colored lamps. The Elblight system was used throughout. The load was balanced on an Edison three-wire, 120-240-volt system. Approximately 15,000 4-cp lamps were installed.

The minor public buildings were outlined and festooned in 4-cp lamps, the Elblight system and the Fielding cleat receptacle being used. The respective installations were as follows: Entrance to Fifth Regiment Armory, 1200 4-cp lamps; "Number Six" Engine House, 800 4-cp lamps; Shot Tower, 800 4-cp lamps. The Wells and McComas Monument was lighted by 200 4-cp lamps.

Each street arch was equipped for 600 4-cp lamps placed in Fielding cleat receptacles. The electric fountain was lighted by seven 15-ampere and two 5-ampere arc lamps, together with 105 8-cp lamps. The color changes were accomplished by means of revolving screens rotated by a small motor. The Court of Honor contained about 1500 4-cp lamps.

The wiring and construction was performed under specifications which required compliance with the very rigid inspection laws in force in this city, and was satisfactory in every respect, both from the mechanical and electrical standpoints. In the decoration of the public buildings, contractors were forbidden to use nails or screws, and were compelled to rely upon bands and clamps to support all the equipment.

From the detailed description of the equipment, it will be seen that a total of approximately the equivalent of 45,000 4-cp lamps was used. This equipment was lighted at 7 o'clock each night and extinguished at midnight. In all, 42 hours' use was made of the entire installation, requiring about 38,000 kw-hours of electrical energy.

All the energy was contributed generously free of cost by the Consolidated Gas, Electric Light & Power Company, of Baltimore.

In commenting upon the success of the Home Coming Week celebration, the mayor of Baltimore stated that "Most of that success was due to the glorious illumination which marked our nights."

Synchronism and Constant-Speed Apparatus.

The development of automatic and machine telegraphy has necessitated the production of synchronously operating rotary mechanisms; that is, a motor at one terminal of a telegraphic line must be so controlled that it will run at precisely the same speed as a generator at the other end of the line. This synchronism can only be considered perfect when the two machines run as if they were both attached to opposite ends of a rigid shaft extending from one station to the other. To accomplish such synchronism, many complicated devices have been resorted to. The problem involved in the case of synchronism for telegraphic purposes is to cause a rotary device to run with a speed of rotation strictly proportional to the speed of vibration of some vibrating reed or relay tongue. If the vibrating member gradually varies in its speed of vibration, the rotating machine will vary in its speed of rotation. If the vibrating

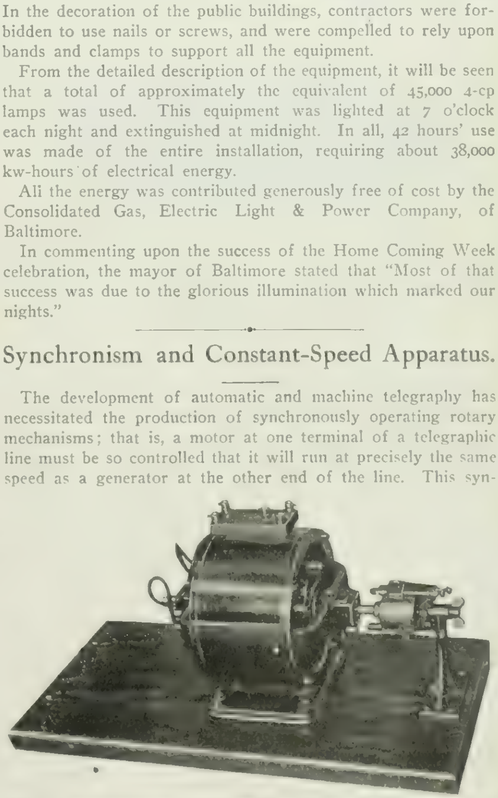


FIG. 1.—SYNCHRONOUS CONVERTER WITH ATTACHED COMMUTATOR.

member has a constant periodicity, the rotation of the rotating machine will also be constant. If the rotating machine is an alternator and the controlling vibrating member is a tuning fork, having constant frequency of vibration, the alternating current furnished by the generator will have constant frequency, provided the generator runs in perfect synchronism with the vibrating tuning fork. Such an alternating current of known and constant frequency, from which, by well known methods, the harmonics may be removed, is extremely useful in measuring many electrical quantities. There are many methods for determining inductances and capacities, in which the frequency enters into the formulæ expressing the values to be measured. If the frequency, therefore, is accurately known, the quantities can be measured in very simple ways.

The Leeds & Northrup Company has developed an extremely simple, novel method of running an alternator in perfect synchronism with any rapidly-vibrating contact maker. It is now placing upon the market a 200-watt synchronous converter, with a commutator attached for purposes to be described, and a large electrically driven tuning fork, which controls the speed of the synchronous converter in a very perfect manner. A transformer is also furnished as a part of the outfit. Fig. 1 shows the rotary converter with its attached commutator; Fig. 2, the electrically-driven tuning fork. The diagram of connections,

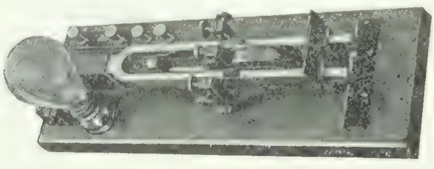


FIG. 2.—ELECTRICALLY-DRIVEN TUNING FORK.

Fig. 3, together with a few words of explanation, will make it plain how the tuning fork is able to control the speed of the rotary converter. The direct-current side of the converter is joined through a resistor of variable resistance to a 110-volt circuit. Leads from the alternating-current terminals go direct to the load circuit of the machine, and other leads go from the same terminals to the primary of a small transformer. The secondary of this transformer is joined by a pair of leads to the speed-controlling tuning-fork mechanism. A study of the diagram will show that as the tuning fork vibrates, two contacts, *a* and *b*, are opened and closed, throwing the load taken by a 32-cp lamp off and on the secondary of the transformer. Two small condensers, shown in the diagram, serve for eliminating the sparking which otherwise would occur at the contacts, *a* and *b*, as well as at the contact *d*. This last contact is

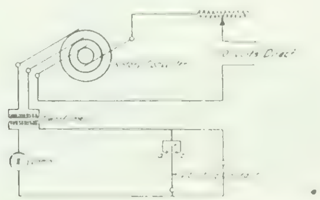


FIG. 3.—SIMPLIFIED DIAGRAM OF CONNECTIONS.

used to maintain the vibration of the fork, the fork itself being operated by an electromagnet on the direct-current circuit. A telephone receiver, shunted over a small resistance, enables one readily to ascertain when the rotary converter has come into synchronism with the tuning fork.

Fig. 4 is a diagram showing all of the connections, including the operating circuit for the fork. There are supplied with the tuning fork adjustable weights, which being set at different positions on its prongs, enable the speed of the tuning fork to be greatly varied in coarse steps. A small U-shaped spring is placed betwen the prongs of the fork, the ends of this spring pressing against the prongs. This spring can be moved by a screw parallel to the prongs while the tuning fork is vibrating, and so vary the speed of vibration by infinitesimal steps over a small range. Thus, with the weights, and the spring, the fork can be driven at any desired speed, and the rotary converter will produce any desired frequency. The speed of rotation of the generator will, of course, be as constant as the vibration of the tuning fork. Experiments have shown that a good fork will give the same number of vibrations in one hour as in the succeeding hour, within one-fiftieth of 1 per cent.

The commutator, which is mounted upon the shaft of the rotary converter, has no connection whatever with the running of the apparatus in synchronism, but serves the purpose of converting the alternating current into direct current. By passing alternating current through four arms of a Wheatstone bridge arrangement and rectifying it with the aid of this commutator, an ordinary D'Arsonval galvanometer may be used to indicate when the bridge is balanced for alternating currents; thus the arrangement becomes suitable for the accurate comparison of inductances and capacities.

The commutator on this machine may be somewhat modified so as to make and break contact in circuit with a secondary of a transformer, the primary of which is connected to the terminals of an alternator of large rating. It thus becomes prac-

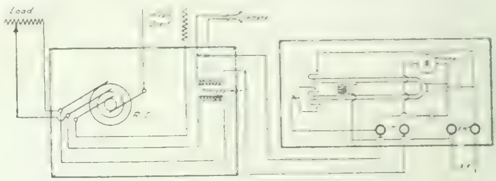


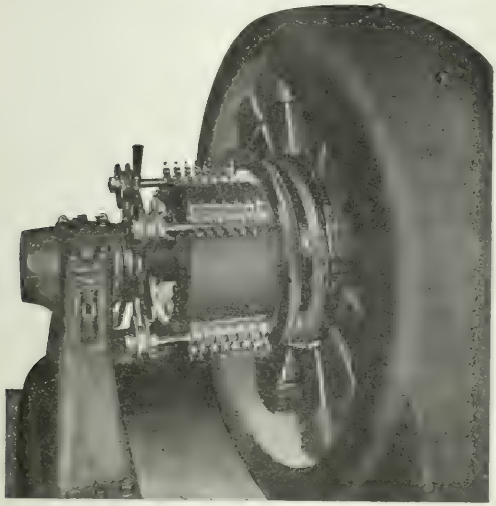
FIG. 4.—COMPLETE DIAGRAM OF CONNECTIONS

ticable to control with the tuning fork, through the intermediation of a small machine, the speed of a very large alternator. The difficulties encountered with many previous methods of obtaining synchronism have come largely from a tendency which large machines have to "hunt." By the methods of synchronism here described, such tendency is entirely damped out electrically, and no mechanical devices are required to damp out the "hunting," such as are used on the synchronized machines which are used in connection with "machine telegraphy." The constant speed of rotation obtained enables chronographs to be driven with very great precision, and other uses of constant rotation are readily suggested to those working on physical problems.

Variable Transformation Ratio Synchronous Converter.

The accompanying illustration shows a special form of synchronous converter designed for use in connection with storage batteries. The machine is provided with "split-poles," the field winding being so arranged that the flux distribution over the pole face may be changed during operation. Thus, since the direct voltage bears to the alternating voltage the ratio of the maximum of the alternating e. m. f. wave to its effecive value as measured between phase lines, the ratio of the delivered direct e. m. f. to the supplied alternating e. m. f. changes with the change in flux distribution. In consequence of the "split-pole" construction and special field windings there is a large range of voltage at the commutator with a constant value of e. m. f. at the collector rings, and hence series reactance need not be used in the supply leads, and a booster is not required in the leads between the converter and the storage battery. The variation of the voltage at the brushes to which the battery is directly connected, and which is effected by the special field winding controlled by a carbon-regulator, compels the battery to charge and discharge in response to fluctuations of load on the alternating-current

circuits, energy being transmitted in either direction between the battery and the alternating-current circuits. Thus the load on the supply generators may be kept approximately constant



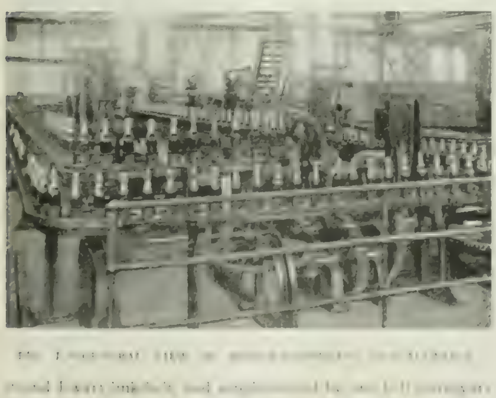
VARIABLE TRANSFORMATION RATIO SYNCHRONOUS CONVERTER

at the average demand although the instantaneous demand may fluctuate throughout a very wide range.

The above described regulating equipments are built by the Electric Storage Battery Company, Allegheny Avenue and Nineteenth Street, Philadelphia, Pa.

Motor Bottle-Conveying System.

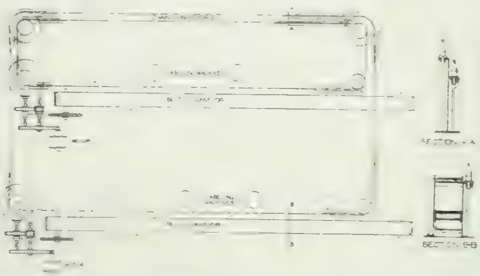
A new bottle-conveying system having a capacity exceeding 20,000,000 bottles a year, was recently installed in the brewery of S. Liebmann's Sons, Brooklyn, New York, by the Philadelphia works of the Link-Belt Company. The general view of this installation, Fig. 1, which was devised from plans by Mr. Adolph Liebmann, shows the bottles en route from the filling and capping machines to the labeling machines. The equipment comprises two horizontal chain conveyors made up of single-



[illegible]

[illegible] The chain conveyors run on angle-iron tracks supported at intervals by the cast-iron frames shown in detail cross-section [illegible] combination chain and belt conveyor support, and the other [illegible] The bottle holders, of cast-iron and rigidly attached to the chain, are designed to permit quick, easy loading and, by a sufficiently snug fit, to assure safety in transportation.

The operation of the system is set forth in the diagram



FIGS. 2 AND 3.—DIAGRAMS OF BOTTLE-CONVEYING INSTALLATION.

illustrated, Fig. 2. The chain conveyors traverse rectangular paths of different size, that followed by the larger or "outer" conveyor approximating 45 ft. in length by 11 ft. in width, the dimensions for the smaller ("inner") conveyor being about 42 ft. x 6 ft. The belt conveyors, before mentioned, parallel the labeling-run of each chain conveyor.

As the bottles are filled and capped, they are transferred manually to the chain conveyors for delivery to the labeling machines, four of which are served by the "outer" conveyor and two by the "inner" one. As they pass in front of the labeling operators attending the outer conveyor, the first man picks up every fourth bottle, the operators at the succeeding machines each removing one of the remaining three; bottles are taken alternately from the inner conveyor. The labeled bottles are placed upon the contiguous belt conveyor and delivered to the casing department. The conveyors are driven by General Electric motors.

Turbines for the Utilization of Exhaust Steam.

Willans & Robinson, of Rugby, England, the builders of high-speed turbines and steam engines, have been recently engaged on the construction of turbines for the utilization of exhaust steam, and have at present under construction at their works two machines of the normal output of 1350 kilowatts with an overload capacity of 2000 kilowatts. These are the largest exhaust turbines constructed in Europe. These machines are for the Samuelson shops at Middlesborough, and have been arranged to take steam from a number of non-condensing blowing engines, used for supplying air to blast furnaces.

The turbines are coupled to three-phase generators working at 40 cycles, 3000 volts, and running at a speed of 2400 revolutions per minute. This is a very high speed for the output developed. The machines will work in parallel with a number of other turbines in the same district, and will supply electrical energy to iron works and also power in bulk to the local power-distribution company.

Each steam turbine exhausts into a surface condenser of Willans & Robinson type, each condenser being designed to [illegible] of 60 deg. F.; the quantity of steam to be dealt with at normal load being 45,000 lbs., and about 70,000 lbs. at overload.

One special feature of the plant is the arrangement of relief valves, all the low pressure steam that is not required for doing work in the turbine being by-passed direct into the condenser, so that all the steam output of the blowing engine is returned to the boilers as condensed water.

The condensing plant is fitted with Edwards three-throw air pumps, driven by means of three-phase induction motors through machine-cut gearing. The circulating pumps of the centrifugal [illegible]

water for circulating is pumped from the river and forced through 27-in. cast-iron mains to the turbine house, a distance of some 250 yards, the amount of circulating water being about 4500 gallons per minute.

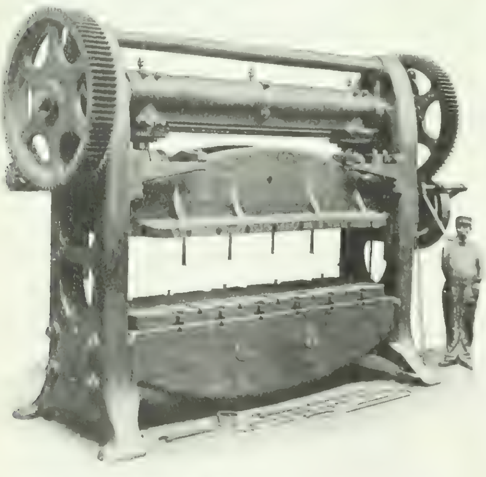
Messrs. Willans & Robinson have also on hand 200-kw exhaust turbines for the South Wales District, the machines being arranged to work in conjunction with heat accumulators, the exhaust steam in this case being furnished by colliery winding engines. Among other sets on hand at Rugby is a 500-kw exhaust turbo-alternator for an iron works and colliery in the Staffordshire district, working in conjunction with a vertical non-condensing blowing machine.

Heavy Power Press for Electrical Work.

The forming of sheet metal requires considerable pressure and when the surface is large or the design deep and intricate or the sheet metal is of an unusually thick gauge the pressure necessary may run into thousands of tons. For the heaviest pressures, hydraulic machinery is indispensable. An objection to hydraulic machinery, however, is that its speed is usually too slow and that the press ram does not come down so definitely to the same point every time as with motor-operated presses.

The press shown in the accompanying illustration is motor-driven and was designed especially for electrical work. A large electrical manufacturing company had been corrugating heavy sheet-iron transformer cases in a hydraulic press which did the work satisfactorily but was very slow. It had recently built for it, by the Ferracute Machine Company, of Bridgeton, N. J., a heavy press to take the place of the hydraulic machine, the new press making 15 strokes per minute, thereby trebling the output.

The construction of the press is comparatively simple, the more apparent features being the heavily trussed bed and ram which reduce the "spring" to a minimum, and the twin gears on the end of the main shaft, which relieve the torsional stress, affording, it is said, an even pressure at both ends, besides dividing the load between the gears. The rods which project down from the ram and up through the bolster are positive



HEAVY MOTOR-DRIVEN PRESS FOR ELECTRICAL WORK.

knockouts, the former being attached to the frame and the latter to the ram.

The adjustment of the ram is obtained by means of a bevel-gear and pinion at each end; the pinions being on the same shaft, a construction which insures accurate adjustment. The gears are protected by guards and the eccentric sleeve is fitted with oil-cups. The press is equipped with a "multi-disc" friction clutch and is driven by a 20-hp variable-speed electric motor. The clutch is of the automatic-stop type but can be quickly adjusted for stopping the ram by hand at any point of its decent or ascent, or if desired, can be set for continuous running. The dimensions of the machine are as follows: Distance between columns, 10 ft. 4 ins.; height from bed to ram when up, 28½ ins.; stroke of ram, 9 ins., but any stroke up to 17 ins. can be made if ordered; adjustment of ram, 6 ins.; flywheel, 35 ins. diameter and 6 ins. face; pressure exerted, 200 tons; height of press, 10 ft. 6 ins.; floor space occupied, 5 ft. front to back and 16 ft. right to left. The total weight is 52,000 lbs.

Automatic Oil Switches.

The Hartman Circuit Breaker Company, of Mansfield, Ohio, has recently brought out a light, compact, automatic oil switch for potentials of 3300 volts or less. The switch is of very simple construction, consisting essentially of a double-break knife switch immersed in oil. The parts have been reduced to the least possible number and extreme compactness has been secured by the use of a double-break contact. The overload coils are connected in series with the main circuit, thus dispensing with the use of series transformers. Overload coils to be operated from the secondaries of series transformers can be supplied, however, when desired. The insulation of the series coils has been worked out with great care, and this method can be safely used where the potential does not exceed 2500 volts. One coil is furnished with the double-pole switch and two coils with the three and four-pole switches. The operating lever is made in two parts, which are held together

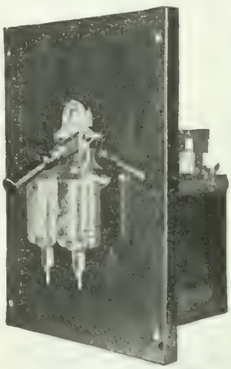


FIG. 1.—SINGLE-THROW AUTOMATIC SWITCH.

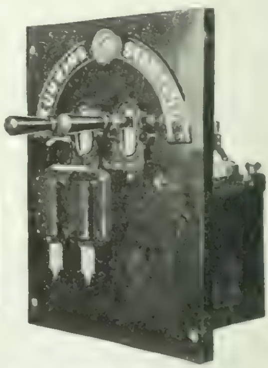


FIG. 2.—DOUBLE-THROW SWITCH AUTOMATIC ON ONE SIDE.

normally by a trigger-shaped catch. This feature prevents the closing of the switch as long as the overload continues, as the inner lever will be instantly disconnected from the outer or handle lever should the attendant undertake to close the switch while overload conditions exist. The switch can be opened by hand by pressing a trigger under the operating lever. The single-throw switch is shown in Fig. 1.

The double-throw switch is made automatic on both sides, which is the standard form, or automatic on one side and non-automatic on the other. The latter form is shown in Fig. 2. This style of switch is frequently furnished for controlling induction motors, the non-automatic or starting side of the switch being connected to the low-voltage taps of an auto-transformer. All double-throw switches are made to interlock, so that it is impossible to close both sides at the same time.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The financial upheaval in New York and other cities affected trade and industry unfavorably, tending to cause wise conservatism in preparations for the future. Current retail trade, however, was generally active and the leading industries kept their machinery busy. An encouraging sign was the absence of cancellations. Transporters were unable to handle promptly all of the freight offered. Recent declines in prices of cereals and cotton have encouraged foreign demand for the country's products. The lumber market was quiet and prices were shaded to stimulate business. Iron and steel were dull. Pig iron continued quiet and prices were weaker. New orders for structural material were of moderate proportions, and steel rails were quiet, the railways being out of the market altogether. Copper found new low levels of prices, lake being quoted as low as 12 cents, and electrolytic for future delivery 11⅝ to 11⅞ cents. Domestic business was light, but shipments to Europe were heavy. Gross and net railway earnings point to the continuance of favorable conditions. The gross earnings for August show a gain of 12.4 per cent, while net gained only 1.4 per cent. The earnings for October thus far show a gain of 6.8 per cent over those of the same period last year. *Bradstreet's* reports 220 business failures during the week ended Oct. 24, as against 194 in the previous week and 184 in the corresponding week last year.

BLOCK SIGNAL EQUIPMENT.—It is stated that the Harriman railroads have undertaken probably the most extensive installation of block signals on record. Some $12,000,000 has already been spent by the present management of the Union Pacific and Southern Pacific for safety appliances, and, with the completion of additional installations already authorized, the two systems will have a total of 5786 miles of automatic signals. According to information compiled in the office of the chief engineer of the company, the Union Pacific now has in operation, all equipped with electric automatic signals, 469 miles of single track and 244 miles of double track. An additional 176 miles of double track and 107 miles of single track installation is under construction, and will soon be put into service. More than 300 distant switch signals, protecting the movement of trains toward 158 stations and spurs on the main line of the Kansas and Colorado divisions, have also been put in place. When all the work now authorized and under construction is completed the entire main line of the Union Pacific from Council Bluffs, Ia., to Green River, Wyo., will be protected by automatic signals. The main line of the Kansas Division from Kansas City to Topeka is already equipped with automatic block signals. The remainder of the line into Denver is protected at stations with distant switch signals, as are also the lines between Denver and Cheyenne, and Denver and Julesburg, Col.

THE QUEBEC BRIDGE.—At the huge cantilever bridge over the St. Lawrence at Quebec, which fell down recently while unfinished, electricity was used exclusively for all the hoists, etc. The electrical energy for operating all the motors is generated by the hydro-electric plant of the Canadian Electric Light Company at La Chaudiere Falls, three miles from the bridge, and among the units installed there is a [illegible]-kw Allis-Chalmers water-wheel type alternator. This current is transmitted as a 2400-volt alternating current to motor-generator sets installed on the approach span to the bridge, where it is transformed to a 550-volt direct current and distributed to all parts of the work. Air for operating the pneumatic hammers, drills, reams, etc., is furnished by two motor-driven, air compressors also placed on the approach span and connected to a [illegible] main running through the center of the bridge, from which branch lines were tapped. The cost of the completed structure was estimated at $10,000,000, of which $5,000,000 had already been spent. [illegible]

WESTINGHOUSE EXPORT.—The export department of the Westinghouse Electric & Manufacturing Company has been unusually flourishing of late, and among the contracts taken by the company, two from the republic of Colombia, South America, are of more than ordinary interest. This work calls for the complete equipment of two city electric lighting plants. One is for the city of Tunja and the other for Bucaramanja. Tunja is located 9000 feet above the level of the sea in the Colombia mountains, while Bucaramanja is located 2000 feet lower down the slope. The electric plant for the former will be steam driven, but at Bucaramanja is a splendid water-power, and the plant will be operated in that manner. A peculiar feature of this mountainous country is that the mule is the only method of transportation, and all the apparatus, boilers, steam engines, electric generators, switchboard appliances, etc., will have to be hauled from the seaport up into the mountains on muleback.

ALLIS-CHALMERS STEAM TURBINES.—Among the noteworthy features of the textile industry this fall has been the ordering of steam turbines of the improved type built by the Allis-Chalmers Company for installation in some of the largest mills of New England and the Central and Southern States. Power machinery of that company's build has long been prominent throughout the country in manufacturing plants of every description, and in the electrification of textile mills, Allis-Chalmers steam turbines and generators, as well as its "induction" motors for alternating current, are now playing a leading part. Contracts recently awarded by textile manufacturers include three turbines for the new 10,000-hp plant of the Pacific Mills, Lawrence, Mass., one of 2200 hp for the American Thread Company's Watuppa Mills, one of 3000 hp for the Tremont & Suffolk Mills and machines of 800 hp each for the Jamestown Worsted Mills and Cherry Cotton Mills.

NEW HAVEN SINGLE-PHASE.—The New York, New Haven & Hartford Railroad is now running its 35 Westinghouse electric locomotives with local trains between the Grand Central Station, New York, and Stamford. The success of the operations involved has exceeded, it is said, the expectations of the officials of the railway company and of the manufacturers, and it is understood that a considerable addition to the locomotive equipment is under negotiation. The New Haven company, it is authoritatively stated, has paid the manufacturers practically in full for the entire work done to date, and continues to pay as the work makes progress. Each locomotive was intended to haul only five-car local trains, but it happens frequently that trains of as many as eight cars are handled with ease by a single unit, and on a recent occasion one of these locomotives pulled a broken-down steam locomotive with its train into Stamford so that a new engine could be attached.

NEW YORK TURBO-GENERATORS.—The rapidity with which the steam turbine has come into popular favor is one of the phenomena of modern steam engineering. It is less than a decade ago since the first turbine was sold in the American market, but there are to-day about 700 in use throughout the country, aggregating a total capacity of approximately 1,000,000 kw, or about 1,500,000 hp. An interesting test conducted recently by the engineers of the New York Edison Company at the Waterside Station, near Thirtieth Street, is said to have developed results hitherto unattained by any steam prime mover in this country. The unit under test was a Westinghouse turbine of 10,000 hp capacity. It had been sold under a steam consumption guarantee of 15.9 lbs. of steam per kw-hour, but the test recorded the phenomenally low steam consumption of a shade less than 14.9 lbs. per kw-hour. The steam consumption figures less than [illegible] lbs. of coal per kw-hour.

J. G. WHITE & COMPANY have contracted with the Alliance Gas & Power Company, of Alliance, Ohio, to act as consulting engineers and supervise the purchase and installation of new machinery, consisting of a large turbine generator and a battery of 350-hp boilers, with complete auxiliaries for both electrical and steam ends. The new equipment will be installed in the old plant of the Alliance Gas & Power Company through the winter, and will be transferred later to a new plant, the construction of which will be begun by the engineers early in the spring.

THE TUNGSTEN LAMP IN ENGLAND.—Julius Auerbach, president of the Electrical Accessaries Company, New York City, informs us that he has received advices of the formation in London of the "Tungsten Metal Filament Electric Lamp Company, Ltd." The founders of this company are the International Tungsten Lamp Company, of Budapest, owners of the Just-Hanaman patents; the Auer Company, of Berlin, and the General Electric Company, of London. The new English company has acquired all patents of Dr. Just and Hanaman and of the Ostram Company, and will manufacture lamps in England according to both methods. The capital of the company is $500,000, all fully paid in in cash. The Tungsten Metal Filament Electric Lamp Company, of London, has already started to build a factory, which will have an initial capacity of 10,000 lamps daily. Mr. Auerbach, who represents the European syndicate, the owners of the Just-Hanaman patents in this country, left for Europe on Tuesday to arrange further details with reference to the transfer of the patents to an American company.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, Ohio, has recently moved into a new factory, located on the corner of Marquette Road and Lakeside Avenue. The new building affords a large increase of floor space over the old factory, and a correspondingly larger output will be possible. The new factory consists of one large three-story brick building, in addition to which there is a one-story frame building. The total floor space, including the frame building, is 400 x 200 ft. The power for the factory is generated by three Crocker-Wheeler generators, operated by two Bruce-Meriam-Abbott gas engines, and one steam engine. The ground floor is devoted to rolling, cutting, forming, lead-burning, assembling, etc. On the second floor are located the assembling department and offices. On the third floor, the carpentering and painting departments. The Willard Storage Battery Company will continue in the manufacture of batteries for all purposes.

WESTINGHOUSE, CHURCH, KERR.—Mr. Walter C. Kerr, president of Westinghouse, Church, Kerr & Company, one of the largest construction engineering companies in this country, speaking this week of the work his company is doing at present, stated that they have on hand about 40 contracts, representing some very important construction work. In this work are engaged upward of 100 engineers and about 7000 operatives. One of the largest contracts this company is engaged in is the work of the Pennsylvania Railroad terminal in New York City. Other contracts are for the Erie, the New York, New Haven & Hartford and the Wabash railroads. The amount of money involved in the completion of this work approximates from $25,000,000 to $50,000,000. Mr. Kerr says his company has never been busier than at present and that the outlook for the future is exceedingly bright.

HEAVY ORDER FOR ELECTRIC RAILWAY.—J. G. White & Company, operating managers and purchasing agents for the Eastern Pennsylvania Railways Company, have just ordered $200,000 worth of electric railway material for the Tamaqua and Middleport connecting link between Mauch Chunk and Pottsville. The order includes all the material required for the permanent way and overhead electrical work of a standard interurban railway. Considerable grading has already been done. When the line is finished Pottsville and neighboring towns will be nearer New York in actual time by trolley to Mauch Chunk and the Lehigh Valley Railroad than by the usual railroad detour through Philadelphia.

APPARATUS FOR RUSSIA.—The Central Electricity Station, Vilna, Russia, requests tenders for the supply of one dynamo, one water-tube boiler, 240 m, and one steam turbine, 500 horse-power.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was nervous with frequent fluctuations of an irregular character due to the announcements of failures of minor banks and trust companies. Prices were very irregular, but with good gains from the lowest figures of the week. A feature was the very heavy buying of stocks for investment, particularly in small lots. On Friday the market was very irregular from beginning to end. New low level prices were made by all the electric and traction stocks and some heavy declines are recorded, the heaviest being in Westinghouse, which lost 63¼ points. The quotations of this stock ranged between 106, the highest, and 34½, the lowest, the closing price being 45¾. General Electric fell below par, to 89½, but recovered and closed at 105, which is a net decline of 5 points. American Telephone & Telegraph also dropped below par, closing at the lowest quotation of the week, 96, which is a net loss of 6 points. Following are the closing quotations of Oct. 29:

NEW YORK.

	Oct. 22	Oct. 29		Oct. 22	Oct. 29
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	[illegible]	[illegible]
Allis-Chalmers Co. pfd.	[illegible]	[illegible]	Hudson River Tel.	—	—
Am. Dist. Tel.		[illegible]	Interborough Met.	[illegible]	[illegible]
American Locomotive		[illegible]	Interborough Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	[illegible]	[illegible]	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable		[illegible]*	Mackays Cos. pfd.	52	[illegible]
American Tel. & Tel.		—	Marconi Tel.	—	—
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	—	[illegible]
Electric Boat	—	—	N. Y. & N. J. Tel.	—	[illegible]
Electric Boat pfd.	—	—	Western Union Tel.	[illegible]	[illegible]
Electric Vehicle	—	—	Westinghouse	[illegible]	[illegible]
Electric Vehicle pfd.		—	Westinghouse pfd.	—	—

BOSTON.

	Oct. 22	Oct. 29		Oct. 22	Oct. 29
American Tel. & Tel.	[illegible]	[illegible]	Mass. Elec. Rs. pfd.	[illegible]	[illegible]
Cumberland Telephone	—	—	Mexican Telephone	[illegible]	—
Edison Elec. Illum.	[illegible]	197½	New England Tel.		[illegible]
General Electric	[illegible]	[illegible]	Western Tel. & Tel.	—	—
Mass. Elec. Rs.	[illegible]	[illegible]	West. Tel. & Tel. pfd.	—	—

PHILADELPHIA.

	Oct. 22	Oct. 29		Oct. 22	Oct. 29
American Railways	[illegible]	[illegible]	Phila. Electric	6½	[illegible]
Elec. Co. of America	8¼	[illegible]	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery	35	[illegible]	Phila. Traction	86	85
Elec. Stor. Battery pfd.	—	—			

CHICAGO

	Oct. 22	Oct. 29		Oct. 22	Oct. 29
Chicago City Ry.	140	140	National Carbon	—	55
Commonwealth Edison		79	National Carbon pfd.	—	—
Chicago Subway	15	12	Union Traction	[illegible]	[illegible]
Chicago Tel. Co.	—	[illegible]	Union Traction pfd.	—	—
Metropolitan Elec. com.	20	[illegible]*			

*Asked

THE NATIONAL ENGINEERING CORPORATION, of Baltimore, of which James B. Hoge, of Cleveland, was the head, has been consolidated with the North Electric Company, of Cleveland, and Mr. Hoge has been made vice-president of that company. The capital stock was recently increased from $250,000 to $2,000,000. The National Engineering Company was formed to develop and manufacture what is known as the Clement-Automanual telephone switchboard and has been in existence several years. The system has now been perfected, and it was found that more extended facilities would be needed to manufacture and put it on the market. This system does away with many of the elements of the manual board. One of the principal advantages is that when subscribers' stations are once connected central and all third parties are cut out until either one or the other hangs up his receiver. When parties are through talking and the receivers are replaced on the hooks, the board disconnects the wires automatically and they are ready for other service. When calling the exchange girl presses a button before her, at the same time calling the number back to the subscriber. With this her work ends, as the connection is made with the other line. The board also shows "busy" when a call is made for a line that is in use, and the exchange girl will be excused from calling this back. One of the features about the board is that calls will pass sections where the operators are busy and select one who is not or, at least, this is the claim made for it. A contract has been made for the installation of one of the new boards at Ashtabula, Ohio.

INTERBOROUGH EARNINGS.—The Interborough Rapid Transit Company, of New York, made public last week its statement of earnings for the fiscal year ended June 30, 1907, in comparison with the earnings of the preceding year. The statement showed a gain of $1,475,700.77 in net earnings and of $547,553 in net income, while the surplus earned in the year after the payment of charges and the dividend on the $35,000,000 Interborough stock increased $286,653 over the surplus for the year ended June 30, 1906. The dividends declared on the Interborough stock went to pay the interest on the $70,000,000 Interborough-Metropolitan bonds when received by the holding company as owner of substantially all the stock of the Interborough. That was the only income derived by the Interborough-Metropolitan as holding company, the surplus earnings of the Interborough remaining in its own treasury.

BELL TELEPHONE EARNINGS.—The American Telephone & Telegraph Company reports to the New York Stock Exchange the following income account from Jan. 1 to June 30 as follows: Revenue—Dividends, $5,685,089; rental of instruments, $2,478,497; telephone traffic, $4,228,560; real estate, $37,541; interest, $1,535,531; total, $13,965,218. Disbursements—Expenses of administration, $912,570; interest and taxes, $3,619,792; telephone traffic, $2,336,445; dividends paid, $5,262,056; revenue

balance, $1,834,355; total, $13,965,218. An estimate of the disposition of the proceeds of the company's new issue of stock, just added to the list, is given by the company as follows: For the New England States and Canada, $2,500,000; for the Middle States, $6,000,000; for the Middle Western States, $6,000,000; for the Western States, $3,000,000; for the Southern and Gulf States, $1,500,000; for the purchase of instruments and construction of long-distance lines, $3,000,000.

WESTINGHOUSE RECEIVERS.—The acute financial panic involving stringency in the money market last week was followed by the appointment of receivers for the Westinghouse Electric & Manufacturing Company, the Westinghouse Machine Company, the Securities Investment Company and the Nernst Lamp Company. All the other numerous Westinghouse interests were not disturbed. Judge N. Ewing, Pittsburgh, in the United States Circuit Court, appointed receivers as follows: T. Hart Given, president of the Farmers' Deposit Bank; H. S. A. Stewart, real estate man and financier, and E. M. Herr, vice-president of the company, were named to assume charge of the Westinghouse Electric & Manufacturing Company. William McConway, president of the McConway & Torley Company; W. H. Donner, president of the Union Improvement Company, and E. E. Keller, vice-president of the Machine Company, were appointed receivers for the Westinghouse Machine Company. The Fidelity Title & Trust Company, of Pittsburgh, was named receiver for the Securities Investment Company. Later T. W. Siemon, E. W. Childs and C. H. Hill were appointed receivers for the Westinghouse Lamp Company. For the Nernst Lamp Company W. P. Updegraff has since been appointed receiver. In regard to the situation Mr. Westinghouse has made the following statement: "The necessity for the receiverships is due solely to the acute financial stringency and consequent inability to renew our maturing paper. Both the electric and the machine company are solvent and are doing the largest and most satisfactory business in their history, and each company is earning liberal dividends on its stock and has quick assets substantially equal to its liabilities. I confidently believe that every creditor of each company will be paid in full, and that, with wise management, under the direction of the receivers appointed by the court, the properties will soon be restored to the stockholders. The loans to the Securities Investment Company and myself are secured by the stocks of the Westinghouse manufacturing companies, chiefly stock of the electric and machine companies, the sudden decline in the market value of which on Monday and Tuesday of this week has made it impossible for us to margin our loans. I strongly advise all holders of such loans to hold their collateral, the value of which, I am confident, will in time be sufficient to pay the loans. The sacrifice of the collateral in the present condition of the market can benefit no one. A policy of patience and forbearance is what the situation requires." The Securities Investment Company, whose embarrassment has crippled temporarily the other concerns, is a corporation organized five or six years ago, with a capital of $6,000,000, all of which is owned by Mr. Westinghouse. The company has been accustomed to take securities of corporations to which the manufacturing companies have sold apparatus, paying the manufacturing companies in cash, and itself negotiating the sale of such securities. In addition the Securities Investment Company had been a depositary for a considerable portion of Mr. Westinghouse's personal holdings of stocks, of his own and other companies, and has been the medium through which Mr. Westinghouse has negotiated many of his loans with these securities as collateral. In this trying emergency nothing but warm sympathy and praise are expressed for Mr. Westinghouse, whose leadership as a captain of industry was never more realized than at this moment. The strain put upon his personal finances and those of his corporations is readily understood when it is stated that the business of the Electric Company alone rose from $18,800,000 in 1905 to $38,300,000 this year, and the other companies have enjoyed a similar growth. At the same time it proved impossible to secure from the stockholders all the new capital necessary. It is announced that a plan has been formed to finance the personal obligations of Mr. Westinghouse, the three trustees having been appointed for the securities which he will turn over to secure the payment of loans aggregating $[illegible]. Of this amount $2,500,000 is due Pittsburgh banks, $[illegible] to New York banks and $[illegible] to banks in the New England States. Members of the syndicate met with Mr. Westinghouse and signed the agreement by which an extension of three years will be given him. Announcement was also made this week that notwithstanding the receiverships, foreign contracts aggregating $7,000,000 were obtained since the troubles of last week. The British Westinghouse Electric & Manufacturing Company has obtained a $2,000,000 contract to install apparatus at several sub-stations of the Manchester Electric Lighting Corporation and for equipping a lighting station in the East End, London. The Mexican National Railroad has awarded the Westinghouse Electric & Manufacturing Company a contract to equip its big shops at Durango and Monclova. The Rio de Janeiro Tramway, Light & Power Company has also given this company a $4,000,000 contract for the entire outfit of a lighting plant for the big Brazilian capital. Mr. Westinghouse says: "Our shipments for this month are among the largest in the history of the several companies, and additional orders are being received daily. We have about 17,000 men employed at the various plants, and this big force will not be reduced unless conditions materially change. It will be a very short time until all the companies will be released from the receivers."

BOSTON EDISON REPORT.—The twenty-second annual report of the Edison Electric Illuminating Company, of Boston, submitted to stockholders at the annual meeting, for the year ended June 30, 1907, compares with previous years as follows:

	1907.	1906.	1905.	1904.
Gross	$[illegible]	$[illegible]	$3,346,027	$[illegible]
Expenses	2,569,657	2,410,485	2,143,106	2,009,691
Net	$[illegible]	$[illegible]	$[illegible]	$[illegible]
Misc. profit	[illegible]	[illegible]	33,285	[illegible]
Total net	$[illegible]	$[illegible]	$[illegible]	$[illegible]
Int. and divs.	1,406,700	1,227,776	1,164,790	1,075,813
Surplus	$[illegible]	$[illegible]	$[illegible]	$[illegible]

Included in expenses this year are taxes amounting to $453,479, compared with $445,508 the previous year and $366,450 two years ago.

Lamps and motors connected as of date June 30 compare as follows:

	1907.	1906.	1905.	1904.
Incan. lamps	863,313	788,560	708,384	627,441
Arc lamps	10,339	10,534	10,102	9,358
Motors, hp	[illegible]	[illegible]	[illegible]	[illegible]

As no new properties were absorbed during the past year, the above table shows only the increase which the company obtained through its regular growth. It is by far the largest in the history of the company. The balance sheet as of date June 30 compares as follows:

ASSETS.

	1907.	1906.	1905.	1904.
Installation	$19,440,047	$18,161,329	$17,545,113	$16,251,146
Cash on hand	[illegible]	[illegible]	[illegible]	135,339
Stock on hand	[illegible]	[illegible]	[illegible]	[illegible]
Notes and Accts. Rec.	1,847,689	1,780,421	1,856,075	1,757,471
Open accounts	78,859	9,208	49,633	78,130
Sinking funds	[illegible]	[illegible]	[illegible]	....
Total	$23,442,388	$20,511,823	$20,132,536	$18,631,429

LIABILITIES.

	1907.	1906.	1905.	1904.
Capital stock	$[illegible]	$[illegible]	$[illegible]	$[illegible]
Mortgage bonds	1,485,000	1,486,000	1,486,000	1,342,000
Notes and Accts. Pay.	1,753,100	1,483,029	1,012,096	1,314,805
Dividend payable	442,526	287,202	287,202	261,112
Res. for Maintenance.	238,438	95,114	341,201	806,930
Premium on new stock	[illegible]	[illegible]	[illegible]	[illegible]
Accrued Int. & taxes.	64,132	89,355	68,253	84,511
Replacing account	[illegible]	[illegible]	[illegible]	4,614
Coupon notes	[illegible]	[illegible]	[illegible]	59,500
Profit and loss	241,108	213,409	67,509	52,174
Total	$23,442,388	$20,511,823	$20,132,536	$18,631,429

DIVIDENDS.—The American Light & Traction Company has declared the regular quarterly dividend of 1¼ per cent on the preferred stock and 1½ per cent on the common stock, payable Nov. 1. Directors of the Electrical Securities Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable Nov. 1. Directors of the Multiphone Operating Company have declared the regular monthly dividend of 1 per cent, payable Nov. 1 to stockholders of record Oct. 25. The J. G. Brill Company has declared a dividend of 1¾ per cent on its preferred stock and 1 per cent on its common stock. The preferred is payable Nov. 1. The common is payable Dec. 14. The directors of the New England Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent, payable Nov. 15. Directors of the American Gas & Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Nov. 1.

GENERAL NEWS

Construction News.

ENSLEY, ALA.—[illegible] Company, which [illegible] Ensley, will construct and operate an electric light plant. J. J. Waller [illegible]

HUNTSVILLE, ALA.—Messrs. Denham and Dupont, of the Huntsville Railway, Light & Power Company, have been in the city recently making investigations of the condition of the power plant and the local electric street car stystem. It is stated that they will recommend the construction of a new power house and that the street railway system be extended. The improvements contemplated will involve an expenditure of about $50,000. Francis N. Lawton is general manager.

CALAMINE, ARK.—The Arbuckle Mining & Milling Company, which is building a dam across Strawberry River, 5 miles from Calamine Mine, will develop 525 horse-power. The equipment of the plant will consist of generators and transformers for 6600 volts. Electricity will be transmitted to operate a 200-ton concentrating plant for zinc and lead ores being developed by the company near Calamine, 5 miles west of the dam. Machinery and transmission lines have not yet been purchased. D. A. Estill is president and W. H. Vaughn, general manager; E. S. Merkle, of Imboden, is engineer and has charge of the work and purchasing of the machinery. The company next year will build a dam at Imboden, on Spring River, and construct a hydro-electric plant and develop 800 horse-power.

CALISTOGA, CAL.—The City Trustees have granted a franchise to Henry Brown to construct and operate an electric light, heat and power system.

FRESNO, CAL.—The City Trustees will receive bids until Nov. 18 for a light and power franchise as applied for by the Fresno Home Light & Power Company.

LOS ANGELES, CAL.—The City Council has awarded the contract for an electric generator and transformers for the Cottonwood Creek hydro-electric plant to the Westinghouse Electric & Manufacturing Company for $18,039.

NAPA, CAL.—Machinery to be used in the new cars and power houses of the Vallejo, San Francisco & Napa Valley Electric Railroad has arrived. The poles and wires for the transmission lines are now being erected.

NEEDLES, CAL.—Carl F. Schrader has petitioned the Board of Supervisors at San Bernardino for a franchise to operate a gas and electric system at Needles. He will secure electricity from the Victor & Virgin Mining Company and will install a gas plant.

OAKLAND, CAL.—The Southern Pacific Company has notified the City Council of the withdrawal of its application for permission to change the Webster Street line into Oakland from steam to electricity.

REDLANDS, CAL.—The Pacific Telephone & Telegraph Company has decided to make many changes and improvements to the local telephone system. The entire exchange will be supplanted by a new one of later design, and new equipment will be installed where needed. O. Cole, of San Francisco, is superintendent.

SAN DIEGO, CAL.—It has been announced that the San Diego, Cuyamaca & Eastern Railway Company has secured an option on the electric car line which circles the water front. It is proposed to electrify the Cuyamaca road at some future time. E. S. Babcock is president of the company.

SAN FRANCISCO, CAL.—The Central California Power Company has filed a mortgage deed on its water and land rights, also its plant, in trust to the California Safe Deposit & Trust Company to secure an issue of $5,000,000 in bonds.

SAN FRANCISCO, CAL.—It has been announced at Washington, D. C., that the Forestry Bureau has granted to the Southern Pacific Company a permit to build a power house and conduits in the Cascade National Forest Reserve in Oregon. This recalls announcements regarding the purpose of Mr. Harriman to electrically equip the Pacific roads in the mountain regions and is probably in line with those plans, although in the face of his recent retrenchment orders it is not probable that active work will be done just now.

SAN JUAN, CAL.—The Stanislaus Power Company is making surveys for its transmission line to run from the Joaquin to the cement plant in this town.

COLEBROOK, CONN.—The Colebrook Manufacturing Company, [illegible] Winsted [illegible]

HARTFORD, CONN.—The stockholders of the Hartford Electric [illegible]

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Nov. 12, to furnish at the navy yards and naval stations the following supplies: Brooklyn, N. Y., schedule 449—steam disinfecting plant. Pensacola, Fla., schedule 438—8000 lbs. ingot copper, etc. New Orleans, La., schedule 435—electrical supplies. Bids will also be received until Nov. 19 as [illegible] Pensacola, Fla. [illegible] centrifugal pump; four transformers and four motor-generator sets; erecting complete one hot water heating system. California City Point, Cal., schedule 450—50-kw generating set. Norfolk, Va., schedule 445—twelve 2-ton trolley hoists; one motor-driven drilling, boring and milling machine. Portsmouth, N. H., schedule 446—one motor-driven pipe-threading machine, one engine lathe. Applications for proposals should designate the schedule desired by number. E. B. Rogers, paymaster-general, U. S. N.

PALMETTO, FLA.—John A. Graham has been granted a franchise to furnish electricity for lighting in this town.

ASHBURN, GA.—The citizens on Oct. 20 voted in favor of issuing $50,000 in bonds, $45,000 of which is to be used for the erection of an electric light plant and water works system. Work will commence on construction of the plant as soon as the bonds are sold.

ATLANTA, GA.—A petition has been filed in the United States Court to place the Southern States Electric Company in the hands of a receiver.

MACON, GA.—The State Railroad Commission on Oct. 17 approved the proposed issue of $150,000 in capital stock which the Bibb Power Company, of this city, proposes to issue. This company has just been organized, and plans to develop certain water powers in Bibb County to supply electricity for lamps and motors in Macon. It is also expected that the company will supply electricity to the new interurban electric railway soon to be built.

MACON, GA.—The [illegible] City Council for a franchise to furnish electricity for lamps and motors in the city of Macon. The company proposes to furnish electricity to the citizens of Macon for lighting purposes at 10 cents per kw-hour and 8 cents per kw-hour for manufacturing purposes and will allow 10 per cent discount for all bills paid before the 10th of the month. W. A. Burney, of Savannah, is at the head of the company. The capital stock of the company is placed at $100,000.

MADISON, GA.—Moses Cohen, city clerk, writes in regard to the construction of an electric light plant, water works and sewerage system for which the citizens were recently reported to have voted to issue $85,000 in bonds, that contracts have been awarded and the work has been under way for about three months.

WAYCROSS, GA.—The Waycross Electric Light & Power Company is planning to install additional machinery to increase the capacity of the ice plant. J. E. Wadley is president and manager.

CHICAGO, ILL.—It is reported that all bids received on Oct. 15 by City Electrician Carroll for 2500 lamps and their equipment have been rejected and new bids will be received. Four bids were received, all bidders submitting the same price, a total of $84,395.

MOLINE, ILL.—The People's Power Company is installing a large turbine engine in its power plant at the foot of Fourth Street in this city.

ROCKFORD, ILL.—The Third National Bank, of this city, is preparing to install an electric light system [illegible] building now being erected to furnish light for the entire building.

DECATUR, IND.—We are informed that the Illinois Traction Company has purchased all the apparatus required for the present year, with the exception of an exhaust base turbine condenser for a 3000-kw turbine, three 1000-kw transformers and switchboard apparatus for a turbine of 3000-kw capacity. H. C. Hoagland is electrical engineer.

GARY, IND.—The Town Board has granted a fifty-year franchise to the Chicago Telephone Company to erect a telephone system in the town. The company proposes to erect a plant at a cost of $500,000.

HAGERSTOWN, IND.—The Town Board has passed an ordinance authorizing the issue of bonds, the proceeds to be used in the procuring of an electric light plant recently voted for by the citizens of the town. Plans and specifications for the new plant have been ordered.

HUNTINGTON, IND.—A [illegible] the City Council to grant the Fort Wayne & Wabash Valley Traction Company the franchise, recently applied for by the company, to furnish electricity in the city. The company proposes to transmit electricity from Fort Wayne to Huntington and to utilize its old power house in this [illegible] at a lower price than that now charged by the local company.

INDIANAPOLIS, IND.—The [illegible] is preparing to construct an electric railway from Indianapolis to Evansville [illegible] enter the city.

[illegible], IND.—[illegible] providing for an issue of $12,000 in bonds for the purchase of new [illegible]

LAFAYETTE, IND.—A franchise has been granted by the Commissioners of Tippecanoe County to the Chicago & Western Indiana Traction Company to construct and operate an interurban railway through Fairfield, Wea and Randolph townships in Tippecanoe County. The franchise is for 50 years and stipulates that the company must provide its own bridges and also prohibits operation by steam.

WASHINGTON, IND.—The City Council has passed a resolution asking that an ordinance be prepared looking to the disposal of the municipal electric light plant.

MUSKOGEE, I. T.—Contracts have been awarded by the Bartlesville Interurban Company for grading its line between Bartlesville and Dewey, a distance of four miles. Contracts for bridges and trestles have been awarded. Joseph J. Curl, president of the company, is now in the East contracting for the equipment of the road.

KANSAS CITY, KAN.—The Bradley-Alderson Implement Company has purchased a site in Rosedale and will erect a new building at a cost of $50,000. Two electric elevators will be installed. J. Oliver Hogg, New York Life Building, Kansas City, Mo., is the architect.

LIBERAL, KAN.—The Liberal Light, Ice & Power Company has placed contracts for the construction of an electric light and ice plant. The main power house will be 60 x 65 feet, and the boiler house 32 x 42 feet. The equipment of the plant will consist of two 100-kw, three-phase, 60-cycle, 2300-volt generators; a 14 x 36 in. Corliss engine, built by the Murray Iron Works, Burlington, Ia., and a 100-hp Lycoming high-speed engine; one 50-hp, three-phase motor for compressor, circulating pumps driven by a 10-hp motor, and boiler feed and other pumps, also motor driven. The company is planning to install a machine shop later on, for which new equipment of machine tools will be required. J. W. Tyner is superintendent.

LATONIA, KY.—The City Council has granted a franchise to the Kentucky Electric Company for a term of thirteen years in accordance with the proposition recently submitted to the Council. The company agrees to furnish any number of arc lamps for the first three years at $60 per lamp per year and during the remaining ten years for $58 per lamp per year; incandescent lamps of 32 cp at $24 each per year; electricity for commercial purposes, 10 cents per kw-hour, less 15 per cent discount for payment within ten days; for motors and heat, 10 cents per kw-hour, less 20 per cent discount for payment within ten days after date of monthly bill.

EUNICE, LA.—The City Council has granted a franchise to Charles Lauve, of Franklin, for an electric light plant. The plant will cost about $30,000 and will furnish electricity to light the streets, business and private houses and for fan service. Warren B. Reid, of New Orleans, will be associated with Mr. Lauve in the construction of the plant.

PIONEER (P. O. FLOYD), LA.—The Pioneer Cooperage Company is installing an electric light plant and water works.

MILLINOCKET, MAINE.—The large dam of the Great Northern Paper Company at the Dolby Rips, on the Penobscot River, has been completed and will soon be put into service. This dam will furnish power to operate the large electrical plant of the Great Northern Paper Company, which will furnish electricity to operate the grinders and other machinery in the new pulp mill at East Millinocket and the old mill in Millinocket, and also for lighting both towns. It will also furnish power for a ground wood pulp mill, which will be located at Dolby.

PRESQUE ISLE, MAINE.—The new water plant of the Maine & New Brunswick Electrical Power Company, located at the falls on the Aroostook River, was formally opened Oct. 17. The plant will furnish electricity to be used in New Brunswick and Maine towns along the border. The plant has a capacity of 15,000 horse-power, and will be ready to furnish electricity in Presque Isle about the middle of November. James D. Seely, of St. John, N. B., is secretary of the company.

BALTIMORE, MD.—The Board of Awards on Oct. [illegible] rejected all bids recently received for a dynamo to be installed in the Eastern High School, and will receive new bids.

AYER, MASS.—The Ayer Electric Lighting Company is now furnishing a 24-hour service. Several firms have installed motors to operate their machinery. In order to meet the increased demand for electricity the company has increased the capacity of its plant, adding 200 horse [illegible] to its equipment.

BOSTON, MASS.—The Boston & Worcester Street Railway Company has petitioned the State Railroad Commission for permission to issue $50,000 additional capital stock.

BOSTON, MASS.—L. Moody Boynton, inventor of the bicycle rail [illegible] of the proposed railway to be known as the Boston, Quincy & Fall River Railway, has applied to the Board of State Railroad Commissioners for authority to issue [illegible] in capital stock and [illegible] in bonds. If permission is granted [illegible] to construct ten miles of the road between Quincy and Brockton, starting with this as [illegible] and [illegible] to construct the whole line between Boston and Fall River.

FALL RIVER, MASS.—[illegible] the new contract with the Fall River Electric Light Company [illegible] a saving of about $14,000 annually.

FITCHBURG, MASS.—The directors of the Fitchburg Gas & Electric Light Company have announced a reduction in the rates for electricity for lighting [illegible] per cent. In addition to the [illegible] rate for outside sign and decorative lighting has been established. Under the new schedule the base rate is 16 cents per kw-hour, with 10 per cent discount on all bills paid before the 20th of each month. The old schedule was on a base of 20 cents per kw-hour, with a varying scale of discounts in proportion to the amount used. The new schedule is as follows: For the first 100 kw-hours used per month, 16 cents; for the next 200, 12 cents; for the next 300, 10 cents; for next 400, 8 cents, and all over 1000 kw-hours used, 7 cents. For arc lamps, the minimum monthly charge will be according to the length of the contract, as follows: One year or more, $2 per month per lamp; six months or more, $3 per lamp per month; three months or more, $5 per month per lamp. A minimum charge of $1 per month will be made for each meter set. Conditions under which a flat rate of 5 cents per kw-hour for all outside decorating and sign lighting is given are: All such lighting shall be connected by an independent meter to be located by the company, and all wiring shall be placed in an iron conduit. The customers shall agree to burn these lamps not less than nine hours a week for the months of June, July, August and September, 15 hours a week for the months of October, November, December and January, and 12 hours a week for the months of February, March, April and May. These hours of burning shall constitute a minimum monthly charge to be made the customer based on the amount of lighting contracted for.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company is erecting an addition to its power plant to meet the increasing demands for electricity for lamps and motors. A new 500-kw General Electric generator and a 750-hp cross-compound McIntosh & Seymour engine will be installed. The company is building a pole line to transmit electric energy from the plant of the Turners Falls Company. A new storage battery is to be installed at Cheapside to take the place of the one that has become obsolete. The company has practically reconstructed its line in the village, which has resulted in a great improvement to the service. J. W. Stevens is president of the company.

LEICESTER, MASS.—The control of the Rawson Electric Light & Power Company has passed into the hands of the Worcester Electric Light Company. The Worcester company will operate the system from its plant in Worcester and establish a 24-hour service. A. B. R. Sprague is president.

MERRIMAC, MASS.—The citizens are considering the proposition of installing an additional dynamo and engine in the municipal electric light plant to meet the increased demands made on the plant to furnish electricity for lighting purposes.

NORTHBORO, MASS.—The Selectmen have received a notice from the Blair Light Company, which has been lighting the streets of the town at a cost of $1,750 a year, that after Nov. 1, unless a contract be agreed upon, it will have to charge the town $10 a night for lighting the streets, which would cost $210 per month, making a total of $2,520 per year. The Selectmen in reply have notified the company that its services would not be needed after Nov. 1, as other arrangements have been made for lighting the town.

SPRINGFIELD, MASS.—The United Electric Light Company has petitioned the State Gas and Electric Light Commissioners for approval of an issue of capital stock to realize $750,000 to retire its floating debt and additions to floating debt.

ALLEGAN, MICH.—F. Littlejohn and associates have applied for a franchise to erect and operate an electric power plant in this city. Energy will be secured from the Commonwealth Power Company. It will be sold on a flat rate basis. There is already an electric company operating in the city.

BYRON, MICH.—The Village Council has granted a twenty-year franchise to the Shiawasse Light & Power Company to light the village with ten arc lamps.

CADILLAC, MICH.—Surveys are now being made by the Electric Land & Development Company for railway spurs to the site of the first dam. Chief Engineer Hubbell states that it will require fourteen months to build this dam, one of the five to be built by the company. The construction of the first dam is associated with the project for constructing an interurban road from Traverse City to Charlevoix. The proposed electric road is to be built by the Carter Construction Company, which has already placed an order for 60,000 steel rails. The cost of the road is estimated at $15,000 a mile.

CADILLAC, MICH.—The Manistee River Power Company has been organized with a capital stock of [illegible] for the purpose of developing power on the Manistee River. As soon as the organization is perfected contracts for construction will be given out, preliminary work will be commenced this fall and heavy construction work in the spring on the first dam. The first dam, developing 5000 hp, will be built in Greenwood township. The company will construct four dams on the Manistee River with a capacity of 20,000 hp. The transmission lines from the first dam will run to Cadillac, Elk Rapids and Traverse City.

FLINT, MICH.—Detroit capital, represented by Joseph W. Martin, has presented a petition to the Common Council for a franchise for a new telephone system. The ordinance provides that the company be allowed to erect and operate a system for a period of [illegible] years. It is understood that the proposed system will operate in connection with the new grange system.

ESCANABA, MICH.—The Escanaba [illegible] Power Company [illegible] dam at [illegible] from the city [illegible] expects to have [illegible] completed and ready to operate by [illegible]. The com-

[illegible] municipal electric light plant, and also for commercial lighting and power [illegible] F. J. [illegible] Watertown, Wis., is secretary and treasurer.

[illegible] plating the purchase of machinery for an electric light plant consisting of boiler, engine, dynamo and other equipment.

IRON MOUNTAIN, MICH.—Contracts have been placed by the Iron Mountain Electric Light & Power Company for extensive improvements to its plant. The new equipment will include a new 150-kw generator with switchboard, etc. The street lighting system will be improved by the installation of new lamps of 2000 cp, and of improved design. The company will establish a 24-hour service when the improvements are completed. The improvements contemplated will involve an expenditure of about $10,000.

NEGAUNEE, MICH.—Work has commenced on improvements to the plant of the Marquette County Gas & Electric Company in this place, for which the machinery has been ordered. A new 500-kw turbine and generator have been purchased and will be installed in the electric light plant. A direct-connected engine and generator has also been ordered to operate the street railway system. A large storage battery will be provided for the latter to carry the excess load of the railway. A new 300-hp Babcock & Wilcox water-tube boiler will be installed, but the four boilers now in use will be retained for the present. Later two of the boilers will be abandoned and another 300-hp boiler installed in their place. An addition 43 feet in length will be built to the boiler house. W. J. McCorkindale, of Ishpeming, is manager.

TRENTON, MICH.—The Village Council is considering the proposition to sell the electric light plant and water works to the Detroit Illuminating Company to be continued under a ten-year contract.

BURLINGTON JUNCTION, MO.—The Burlington Junction Electric Light & Power Company, recently incorporated, will erect a one-story brick power house at a cost of $1,000, and will install machinery, including a gas-producing plant, at a cost of about $8,000. An engineer has not yet been engaged. D. T. Garrett and others are interested in the company.

CAMPBELL, MO.—A. C. Morse, proprietor of the local electric light plant, is planning to organize a stock company, to be composed of business men of Campbell, St. Louis and Cairo, to increase the present capacity of the plant and to install an ice plant later on. It is proposed to install a new 150-kw alternator, a Corliss engine of 150 hp, a 150-hp tubular boiler and a 10-ton ice plant.

MAYSVILLE, MO.—The citizens are considering the question of holding an election to vote on the proposition of issuing $10,000 in bonds to construct an electric light plant.

HELENA, MONT.—The Montana Electric Company has filed a certificate showing an increase in its capital stock from $100,000 to $250,000.

KALISPELL, MONT.—The Flathead Valley Water Power Company [illegible] purchased the property of the Big Fork Electric Light & Power Company in January, 1907, and is building an entirely new plant. The water power plant is located in Big Fork, Mont., at the junction of the Big Fork River and Flathead Lake. The new plant will contain 500-kw, 60-cycle, three-phase, 2200-volt, 514 r. p. m. Westinghouse alternators and step-up transformers delta connected to step the voltage from 2200 to 33,000. The company now has under construction 19½ miles of transmission line and a new sub-station at Kalispell. The sub-station will be equipped with step-down transformers, from 33,000 volts to 2200 volts, all three-phase work. The old plant and transmission line will be abandoned when the new plant is completed and the old generators will be rewound to three-phase, 2200 volts and run in parallel with the new plant. The plant is owned by Howard, Simmons & Company, of Chicago, Ill., of which H. M. Byllesby & Company are engineers, managers and part owners. O. A. Farrar is manager.

GENEVA, NEB.—The Geneva Electric Company is making arrangements to enlarge and improve its plant and has placed orders for a 100-hp boiler and an engine of 175 hp to be installed in the plant.

STELLA, NEB.—It is reported that an electric light plant will be installed in this place.

UNIVERSITY, NEB.—The Council is considering the proposition of purchasing electricity for operating the municipal electric lighting plant instead of erecting a new power house.

PATERSON, N. J.—The directors of the Paterson Heat, Light & Power Company have voted to dissolve the corporation. The company was formed with the intention of erecting a plant to furnish gas and electricity in opposition to the Public Service Corporation. As the city a few months ago made a new contract with the Public Service Corporation at a cheaper rate, and the commissioners did not favor the wholesale tearing up of improved streets, the corporation deemed it best to close up [illegible]

NEW PALTZ, N. Y.—The Electric Light Company [illegible] is planning to change its system from 133 to 60 cycles and to connect its system with the Poughkeepsie Electric Light, Heat & Power Company or with the Honk Falls Power Company and will furnish a 24-hour service. The company will also install a 15-hp single-phase motor. S. L. Johnston is treasurer and manager.

NEW YORK, N. Y.—The contract for installing electric equipment in [illegible] Borough of Manhattan, was awarded by C. B. J. Snyder, superintendent of schools, on Oct. 21, to T. Fred. Jackson, Inc., 592 Columbus Avenue, for $7,250.

[illegible]

[illegible] the Public Service Commission for permission to issue $532,000 in capital [illegible] capital stock of the Oyster Bay Light & Power Company.

[illegible] York City, has leased the old Van Alen mills in this place and is making improvements to the plant. New buildings are to be erected and an electric plant will be installed.

[illegible] operation in this town. J. A. Williams is owner.

[illegible] that bids be invited for furnishing thirty or more 1200-cp electric lamps for lighting the streets of the city. The present contract expires Dec. 1. The company securing the contract for the street lighting will have the privilege of supplying electricity for domestic and commercial use. Michael Schenck is Mayor.

LINCOLNTON, N. C.—The Newcome-Maury Company, of Atlanta, Ga., has been awarded the contract for the equipment of the new electric light plant. The Southern Power Company will supply the power for the plant.

NEWTON, N. C.—The Southern Power Company has completed its transmission line to Newton, 90 miles west of the principal hydro-electric plants, and will erect a sub-station here at a cost of $10,000.

SALISBURY, N. C.—The Whitney Power Company has selected Salisbury as the distributing point for its 45,000-hp plant being erected on the Yadkin River, 30 miles distant. It is expected to have the plant in operation by July, 1908.

SMITHVILLE, N. C.—The committee, recently appointed by the Town Commissioners to secure estimates on the cost of constructing an electric light plant, water works and sewerage system, is inviting plans, specifications and estimates on the construction of an electric light plant. N. M. Lawrence, Jr., N. B. Grantham and F. H. Brooks are members of the committee.

THOMASVILLE, N. C.—The Thomasville Light & Power Company has been granted a franchise to furnish electricity to light the town. It is proposed to erect a plant at a cost of $20,000 and furnish a 24-hour service. B. F. W. Bryant, of Boston, Mass., is interested in the project.

WILMINGTON, N. C.—Final negotiations in connection with the transfer of the control of the Consolidated Railway, Light & Power Company to the Tidewater Power Company have been made. The Consolidated Company has been taken over by the Tidewater Power Company under a lease for ninety-nine years.

ALLIANCE, OHIO.—The Alliance Gas & Power Company has contracted with J. G. White & Company, of New York, N. Y., to act as consulting engineers and supervise the purchase and installation of new machinery, consisting of a large turbine generator and a battery of 350-hp boilers, with complete auxiliaries for both electrical and steam ends. The new equipment will be installed in the old plant of the Alliance Gas & Power Company through the winter, and will be transferred later to a new plant, the construction of which will be begun by the engineers early in the spring.

BRYAN, OHIO.—The City Council has passed an ordinance to issue bonds for enlarging and improving the municipal electric light plant and water works system. New machinery will be added to the plant and new street lamps will also be installed.

CINCINNATI, OHIO.—Contracts will soon be awarded for rewiring the old City Hospital Building. The cost of the work is estimated at about $7,000. Elzner & Anderson are the architects.

ELYRIA, OHIO.—The City Council has granted the Cleveland, Southwestern & Columbus Railway Company a 25-year franchise for a belt line around the town and the old franchise has been extended for the same length of time.

ELYRIA, OHIO.—The Elyria Milling & Power Company has secured the contract for lighting the city for ten years at $64 per lamp per year. The bid of the Citizens' Gas & Electric Company, which has the present contract for city lighting, was $67.50 per lamp per year. The new company is to use water power in generating electricity. G. N. Arnold is president.

NEWBURGH HEIGHTS, OHIO.—Bids will be received until Nov. 18 at the office of P. S. Ruggles, village clerk, for lighting the streets of the village.

PORTSMOUTH, OHIO.—The Knox-Dickey Telephone Company is [illegible] Streets with a view of branching out on an extensive scale.

YOUNGSTOWN, OHIO.—[illegible] has decided to report favorably on the proposition for a municipal electric [illegible]

[illegible] winter. The company has completed its transmission line to the "Uncle

Dan" mine east of the city, and is now furnishing power for operating the machinery in the mine and for lighting. J. L. Lambirth is manager.

PANAMA.—Bids will be received until Nov. 19 at the office of H. F. Hodges, general purchasing officer, Isthmian Canal Commission, Washington, D. C., for electrical fixtures, conductor, wire, wrought iron, steel tubing, etc., as per circular No. 399.

BUTLER, PA.—The People's Telephone Company has arranged to issue $40,000 in bonds, the proceeds to be used for extension purposes.

DUBOIS, PA.—The Borough Council has awarded the contract for street lighting to John E. Dubois for a term of five years.

HARRISBURG, PA.—The Central Pennsylvania Traction Company is planning to extend the double track of its Paxtang line from this city to Paxtang this fall. Negotiations are now under way with the company and the Pennsylvania Railroad Company for the use of the old canal towpath for the extension to Dauphin.

HARRISBURG, PA.—The State Water Supply Commission has approved the applications for charters of the Iroquois Power Company and the Watts Power & Water Company. Both companies have recently made large purchases and propose to build large power plants to develop the water power of the Juniata River and generate electricity for lighting and motor purposes.

MAUCH CHUNK, PA.—J. G. White & Company, operating managers and purchasing agents for the Eastern Pennsylvania Railways Company, has placed orders for $200,000 worth of railway material for the Tamaqua & Middleport extension, connecting link between Mauch Chunk and Pottsville. The order includes all material required for the permanent way and overhead electrical work of a standard interurban railway.

MILLERSBURG, PA.—The stockholders of the Hegins-Millersburg Electric Railway have decided to commence work on the construction of the line.

PARSONS, PA.—The Borough Council has passed an ordinance granting the Wilkes-Barre & Plains Street Railway Company permission to construct and operate a railway on Main and Mill Streets.

WOMELSDORF, PA.—W. W. Lengel, borough secretary, writes that the contract for the construction of a municipal electric light plant has been awarded to the Reading Electric Company, of Reading, for $11,275. F. W. Darlington, Philadelphia, Pa., is the engineer.

PROVIDENCE, R. I.—Plans are being considered for the construction of a large addition to the Manchester Street power house.

ARMOUR, S. D.—The City Council has entered into a contract with the Wagner, Lake Shore & Armour Traction Company, which is installing an electric light and power plant in this city, to install four 1200-cp arc lamps at $6 per month.

CHARLOTTE, TENN.—The citizens are considering the question of issuing $5,000 in bonds for the construction of an electric light plant. Address Mayor Taylor.

SOUTH PITTSBURG, TENN.—It is reported that the municipal electric lighting plant, which has been in operation about a year, has proved a failure and is now on the market for sale.

BRENHAM, TEX.—The Southwestern Telegraph & Telephone Company is contemplating moving into another building and will install entirely new equipment.

ELGIN, TEX.—Mr. Graham, of Smithville, is contemplating the construction of a light, water and ice plant in this place at a cost of about $60,000.

MIDLAND, TEX.—The Midland Light & Ice Company, which was recently incorporated, is planning to install an electric light plant. George D. Elliott is president of the company.

McKINNEY, TEX.—An election will be held in November to vote on the proposition to issue $8,000 in bonds to improve and enlarge the municipal electric light plant.

MARBLE FALLS, TEX.—C. H. Alexander, of Dallas, Tex., who recently purchased the water power property at Marble Falls, is contemplating the construction of a 10-ft. dam on top of the present natural dam to provide for generating additional power to be transmitted by electricity for operating manufacturing plants.

BIG STONE GAP, VA.—The electric plant of the Wise Electric Company has been purchased by the Powell Valley Light & Power Company, which was recently incorporated. The new company proposes to improve and enlarge the plant. The officers are: R. A. Morrison, president and general manager, and J. B. Ayers, secretary and treasurer.

WAYNESBORO, VA.—We are informed that the local electric light plant, which was recently damaged by fire, has been sold to Gardner & Quarly, of Basic City, who are arranging to put in a new plant.

CHEHALIS, WASH.—The City Council has granted the Centralia-Chehalis Electric Railway & Power Company a franchise to operate an electric railway in this city and between the city and Centralia. B. J. Weeks and associates are interested in the company.

SPOKANE, WASH.—The lighting contract between the city and the Washington Power Company has been signed by the officials of the city and the president and secretary of the company. By the terms the company is to supply the city with [illegible] lamps at an annual rate of [illegible] each for a period of five years.

STEVENSON, WASH.—H. C. [illegible], general freight agent at Portland for the New York Central lines, has filed water rights appropriating 10,000 cu. ft. of water per second at the Upper Cascades, on the Columbia River, to be used for power and manufacturing purposes. It is said that the project contemplates the construction of a power plant of 30,000 hp.

TACOMA, WASH.—The City Council has voted to award the contract for furnishing electric power to the city for the next five years to the Seattle-Tacoma Power Company at the rate of 1¼ cents per kw-hour. The contract is for 5000 hp.

EAU CLAIRE, WIS.—We have been informed by the Northwestern Lumber Company, of Eau Claire, that the company has no definite plans as yet for building its dam on the Eau Claire River. It has been buying flowage rights and will probably build a dam within a year or two.

EAU CLAIRE, WIS.—The new power plant of the Chippewa Valley Electric Railway & Power Company at Menominie has been completed and will soon be placed in operation. When the plant is put in operation electricity will be transmitted to the power station in this city. The new dam at Menominie has been completed and will be capable of developing 10,000 hp.

CRANDON, WIS.—Otto Eckhoff, of Wittenberg, is contemplating installing an electric light system for street, residence and commercial lighting and will soon submit a proposition to the Council, and if granted a franchise, will erect a modern lighting system in the town.

GREEN BAY, WIS.—The City Council, on Oct. 19, adopted a resolution to award the contract for lighting the city to the Green Bay Gas & Electric Company at $70 per lamp per year.

WATERLOO, WIS.—The city has taken over the local electric light plant and is preparing plans for the construction of a power house in which to place the plant and electric equipment already purchased. A bond issue of $10,000 was made recently to provide for this improvement.

EDMONTON, ALB.—R. R. Keely, general manager of the municipal electric railway system, writes that a 1000 producer gas engine is now being installed in the power plant.

EDMONTON, ALB.—The Commissioners are considering the purchase of the street railway franchise from the town of Strathcona. If negotiations are successful the two systems will be operated under one corporation. Address Mayor Mills, Edmonton, Alberta.

STRATHCONA, ALB.—A schedule of charges has been made for electricity by the manager of the municipal electric light and power plant. To consumers using less than 100 kw the charge will be 14 cents per kw-hour with a sliding scale up to 600 kw, when the charge will be 5 cents per kw-hour.

KELOWNA, B. C.—R. Morrison, city clerk, writes that the proposed $40,000 water and electric light bonds to be issued have not yet been sold.

PENTICTON, B. C.—The ratepayers are discussing the advisability of installing an electric lighting plant. Address the Mayor.

VANCOUVER, B. C.—City Electrician McCrossan has resigned. The City Council has decided to advertise for applicants for the position. Address Mayor Bethune.

VANCOUVER, B. C.—Hon. Maurice Gifford, one of the directors of the British Columbia Electric Street Railroad Company, announces that the company will spend $1,500,000 next season in extensions and improvements. Address R. H. Sperling, general superintendent, Vancouver.

VANCOUVER, B. C.—W. J. Sutherland, 11 Old Broad Street, London, England, has been in the city in connection with the Alaska Perseverance mine near Juneau, Alaska. This mine will be operated by electricity. The company will generate 40,000 hp, of which 12,000 will be used at the mine, the balance being transmitted to the mines at Silver Bow Basin.

BRANTFORD, ONT.—General Manager Verner, of the Grand Valley Radial Company, has announced changes which will be made on the transfer of interests to the new company of Pittsburg capitalists. The Brantford Street Railway will be thoroughly overhauled and loop lines extended to Eagle Place and Terrace Hills, and a line will also be built to Cainsville, three miles east. A new line will be constructed to the south to Port Dover, on Lake Erie, a distance of thirty miles. The road from Brantford and Galt will be reconstructed and new rails laid, and a spur will be built to St. George. From Brantford a new line will also be constructed west via Burford and Cathcart to Woodstock, where the Thames Valley Road, which has been acquired, will be used to Ingersoll.

FORT FRANCIS, ONT.—Work on the large power dam will be resumed very shortly and will be under the management of G. J. Huss, chief engineer of the Minnesota & International Railroad, which is building to International Falls on the American side of the river. He states that work will be rushed on the power development, especially on the Canadian side.

HAMILTON, ONT.—The Cataract Power Company has announced a reduction in its rates for domestic lighting, commencing Dec. 1. The rate is now 10 cents per kw-hour. After Dec. 1 the rate will be graded from 5.94 to 7.65 cents per kw-hour, according to the consumption. The company will renew all lamps free of charge, but will continue to charge a rental of 25 cents a month for meters, and will refuse to renew its flat-rate contracts. For commercial purposes the rate will be 4½ cents per kw-hour in addition to a fixed charge, depending on the kind and size of lamps used.

[illegible]

MARKHAM, ONT.—The citizens on Oct. 22 voted in favor of a bylaw providing for $3,000 for extensions to the municipal electric light plant.

PORT ARTHUR, ONT.—The town has awarded the contract for the development of electrical energy at Dog Falls to Kerry, Smith & Chance, Confederation Life Building, Toronto. About 30,000 hp will be developed at an approximate cost of $800,000. John McTeigue is city clerk.

NIAGARA FALLS, ONT.—Fitzgerald & Bennie, the Canadian representatives of the American Electrical Furnace Company, have arranged with the Canadian Niagara Power Company to supply electricity to a plant to be constructed at Niagara Falls, Ont., not only for the demonstration of the utility of the present methods, but also for investigation into improvements of melting metal by electricity. At first an 80-hp furnace of the Colby type will be set up. This furnace at the Flerton Saw Works in Philadelphia, furnished ingots of metal weighing 70 lbs. with an expenditure of 34 to 54 hp, according to the composition of the steel. From England will be brought a furnace of the Kjellin type which will require energy of 200 hp. This furnace, when installed at the plant, will be supplied from the Canadian Niagara Power Company's line. The furnace will yield 1000 lbs. of steel at a single heat and has a capacity of six heats in twenty-four hours. A crane of 5 tons capacity is being built for the plant by the Niagara Falls Machine & Foundry Company.

ST. CATHARINES, ONT.—The Dunnville Consolidated Telephone Company has purchased the poles, wires and all other outside equipment of the Bell Telephone Company in this territory except what is reserved for long-distance service, and after Nov. 1 the Bell company will cease to maintain a local exchange in this place or to do business in the territory covered by the Dunnville company, which includes the entire county of Haldimand and adjacent sections.

TORONTO, ONT.—A proposition for the development of water power at Milleroches, on the St. Lawrence River, at a cost of $20,000,000, was submitted Oct. 24 to the International Waterways Commission for its approval by the St. Lawrence River Company, of Canada, and the Long Sault Development Company. The Canadian company proposes to spend $5,000,000, having already expended $1,000,000, and the American company is to invest $15,000,000. It is proposed to develop power at the lower end of Barnard Island, where both companies would work together. The St. Lawrence company at present supplies Cornwall with electricity. Its present plant has a capacity of 1200 hp and the new plan provides for 50,000 hp. The St. Lawrence company was represented by George Foster, K. C., of Montreal, Que., president of the company, and L. G. McCarthy, M. P., and the American company by Arthur V. Davis, of Pittsburg, Pa.; W. F. Rickey, of Massena, N. Y., and E. B. Freeman, of Hartford, Conn.

TORONTO JUNCTION, ONT.—The Town Council has awarded the contract for street lighting to the Stark T. L. & P. System, Ltd., for a term of three years at the rate of 9 cents per lamp per night. The company holds the present contract for furnishing street lamps. The Electric Development Company, which submitted a proposition to furnish street lighting on the same terms as was accepted from the Stark system, asked for permission to furnish electricity to private corporations in the town for manufacturing purposes, which was referred to a special committee.

WOODSTOCK, ONT.—A company is being formed here for the purpose of building a telephone system. Already over $5,000 worth of stock has been subscribed. Address D. Holyoke, secretary, Woodstock, Ont.

BATTLEFORD, SASK.—The contract for the erection of the power house here in connection with the municipal plant has been awarded to W. J. Broley. The arrival of poles is delaying the work, but it is hoped to have the power in use by the latter part of December.

FORT SASKATCHEWAN, SASK.—The civic power plant was recently destroyed by fire.

Company Elections.

HARTSELLS, ALA.—At a meeting of the stockholders of the Hartsells Electric Light & Power Company, held recently, the following officers were elected: J. J. Curley, president; J. Leydon Day, secretary and treasurer. The board of directors consists of J. L. Day, M. D. Wiggins, J. C. Rogers, J. R. Sample and J. J. Gould. A purchasing committee was also elected and a plant will be purchased and installed at once.

BUCYRUS, OHIO.—At the annual meeting of the Marion Bucyrus Railway & Light Company, held Oct. 14, the following directors were elected: Francis L. Judd, William Duke, E. C. Braun, F. W. Long, Frank S. Pelton and A. C. Shoeman. The control of the company has been purchased by Messrs. Duke and Judd and their associates. The company will push the work of construction of the road to completion, when it will be taken over by the Marion-Galion Electric Railway Company.

New Industrial Companies.

THE ADVANCE ENGINE & MANUFACTURING COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $25,000 by H. O. Coughlin, A. C. Bear and John R. Turner. The company proposes to manufacture motors and automobiles.

THE [illegible] ELECTRIC & MANUFACTURING COMPANY, [illegible] N. Y., has been incorporated with a capital stock of $25,000. The directors are Louis Liebes, Hannah Liebes and F. Alexander, of New York, N. Y.

THE ATLANTIC ELECTRIC GOODS COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $40,000 for the purpose of manufacturing electrical appliances. The incorporators are: Russell Dart, William S. Brown and Franklin Nevius.

THE ELECTRIC EQUIPMENT COMPANY, of Memphis, Tenn., has been incorporated with a capital stock of $10,000 by Fred Clayton, W. S. Counsell, J. H. Short, W. B. Morgan and George H. Harsh.

THE ELECTRO-GALVANIZING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $2,400. The directors are: Louis J. Aul, L. Louis Salant and Samuel Fischer.

THE NATIONAL ELECTRIC COMPANY, of Indianapolis, Ind., has filed articles of incorporation with the Secretary of State. The object of the company is to erect, equip and operate a plant for the manufacture of electrical apparatus, equipment and supplies and to do a general business of installing light and power plants. Henry C. Schildmier, C. B. Campbell and R. O. Balsey are the directors.

THE ST. LOUIS ELECTRIC HEATING COMPANY, St. Louis, Mo., has filed articles of incorporation with a capital stock of $10,000. The object of the corporation is to manufacture and deal in machinery for generating and transmitting electric heat, etc. The incorporators are: Joseph H. Beckwith, Henry C. Beckwith and James A. Hawze.

THE THOMAS BATTERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 by Dr. Julian P. Thomas, Thomas S. Witherbee and Frederick T. McIntyre.

New Incorporations.

LOUISVILLE, ALA.—The Louisville Light & Water Company has been incorporated with a capital stock of $20,000 by W. L. Strong and others.

GOSPORT, IND.—The Gosport Electric Light & Power Company has filed articles of incorporation with the Secretary of State. The company proposes to build, equip and operate an electric light and power plant to generate and distribute electricity for light, heat and power purposes. W. A. Montgomery, J. S. Davis and J. C. Brown are the directors.

NEW YORK, N. Y.—The Southern Power Company has been incorporated with a capital stock of $1,000. The directors are: William O. Spring, Tompkinsville, S. I.; Frank S. Wright and St. Julien Grimke, of New York.

MILLERSBURG, OHIO.—The Millersburg & Eastern Railroad Company has been chartered with a capital stock of $1,000,000 by O. S. Olmstead, D. M. Miller and W. W. Adams, of Millersburg, and Samuel P. Dunn and J. A. Burke, of Cleveland. The company proposes to build a line between this city and Beach City, a distance of 26 miles. The capital stock is to be increased to $500,000 later on.

PUTNAM, OKLA.—The Citizens' Light & Power Company has been organized with $250,000 capital stock to build an electric light plant at Putnam and later to enter Oklahoma City. The officers are: C. G. Jones, president; W. H. Philips, vice-president; W. L. Peck, treasurer; W. E. Grisby, secretary, and F. H. Peck is general manager, who will have charge of the erection of the plant.

ERIE, PA.—A charter has been granted to the East Erie Connecting Railroad to construct a line 2½ miles long in the suburbs of Erie. The company is capitalized at $25,000. Matthew C. Griswald is president of the company.

SYKESVILLE, PA.—A charter has been granted to the United Traction Extension Company to build an electric railway 7 miles in length over private right of way from this town to Big Run. The company is capitalized at $1,000,000 and the directors are: Austin Blakeslee, president; J. B. Sykes, Frank Hahne, M. I. McCreight, W. H. Cannon, J. E. Merris and W. C. Newcome.

TARENTUM, PA.—The Butler, Saxonburg & Tarentum Electric Railway Company has been chartered with a capital stock of $50,000 to construct an electric railway from Tarentum to Saxonburg and Butler, 24 miles in length. The directors of the company are: Joseph Cirighano, president; Emil T. Rudert, Edward C. Rudert, John E. Winder and Otto W. Rudert, all of Saxonburg.

MOUNT VERNON, VA.—The Vernon Telephone Company has been incorporated with a capital stock of $5,000 to construct a telephone system in Carroll County. The officers of the company are: S. W. Worrell, president; A. W. Alderman, vice-president; G. H. Alderman, of Ethelfelts, secretary.

TOPPENISH, WASH.—Articles of incorporation have been filed for the Toppenish Electric Light & Power Company. The company is capitalized at $15,000, and the trustees are E. F. Bohannon and G. G. Lee. The company was recently granted a franchise and will begin work at once on a plant, which will be in operation within a year.

RICHMOND, WIS.—The Richmond Telephone Company has been incorporated with a capital stock of $2,500 by John D. Clark and others.

VANCOUVER, B. C.—[illegible] Company has been organized here with local capital to develop 250,000 hp at a canyon on the Chekamus River, 48 miles from this city. At the [illegible]

Obituary.

MR. LEROY B. FIRMAN, inventor of the telegraph fire-alarm system and the messenger call box, died recently at Anaconda, Mont. He was 74 years old. For years he was associated with Thomas A. Edison and Alexander Bell. He was the organizer of the American District Telegraph Company.

Personal.

DR. LOUIS BELL is the author of a paper in the September issue of the *Proceedings of the American Academy of Arts and Sciences* entitled "The Physiological Basis of Illumination."

PROF. A. F. NESBIT, of New Hampshire College, is the author of a text-book entitled "Theoretical and Applied Electricity and Magnetism for Junior Students," which will shortly be published.

MR. H. H. PORTER.—The announcement has been made by the Interborough-Metropolitan Company of the appointment of Mr. H. Holbert Porter, member of the firm of Sanderson & Porter, engineers, New York City, as consulting engineer.

MR. R. R. SMITH, general manager of the Evansville & Southern Indiana Traction Company, of Evansville, Ind., has resigned to accept the position of manager of the Louisville Traction Company, of Louisville, Ky.

MR. O. H. FALK, vice-president of the Falk Manufacturing Company, of Milwaukee, Wis., has been elected a member of the board of directors of the Wisconsin Telephone Company to fill the vacancy caused by the retirement some months ago of Mr. Ira B. Smith.

MR. JAMES C. HOWE, manager of the Missouri & Kansas Telephone Company, in St. Joseph, Mo., has resigned and will leave the company's service Nov. 1. He will go to Kansas City to take the position as manager of an Eastern brokerage firm. His successor has not yet been appointed.

PROF. C. L. DEMURALT, of the electrical engineering department at the University of Michigan, at Ann Arbor, Mich., has been appointed consulting engineer to the state railways of Austria in connection with the electrification of the Arlberg tunnel under the Tyrolean Alps. The tunnel is 7 miles long.

MR. CHAS. W. BURKETT, for four years chief engineer of the Wisconsin Telephone Company, has resigned in order to accept a similar position with the Pacific States Telephone & Telegraph Company. His new headquarters will be in San Francisco, and he will assume his new duties before Jan. 1.

MR. EDWARD CALDWELL has been appointed chairman of the Library Committee of the American Institute of Electrical Engineers and has assumed the duties of the position. The joint library in the Engineering Societies Building is daily assuming larger proportions, and there are growing demands upon its resources.

MISS C. BECKWITH.—The many friends of this well-known technical journalist, who broke down recently at her desk from overwork, will be glad to learn that a very rapid recovery has been made and that early restoration to full health is now expected by the medical attendants, who have ordered meantime complete rest and quiet.

MR. G. MARCONI having put his wireless system into commercial operation across the Atlantic is proceeding immediately to England. He hopes, however, to return soon to the United States and to have the opportunity of presenting a review of his work this winter before the American Institute of Electrical Engineers.

MR. NATHANIEL P. CRAIGHILL has been appointed professor of electrical and mechanical engineering at the University of Montana, Missoula, Mont. Prof. Craighill carries to the position a wide experience in the fields of electrical and mechanical engineering, extending over the designing, construction and manufacturing branches, and at one time was associate editor of the *American Electrician*.

MR. THEODORE I. JONES, manager of the sales department of the United Electric Light & Power Company of New York, is delivering for [illegible] Harlem branch of the Y. M. C. A. each week until about Christmas. Each lecture is illustrated by burning illuminants and by lantern slides.

MR. DAVID B. CARSE has resigned from the chairmanship of the advisory committee of the United States Steel Corporation, and will re- [illegible] company has been reorganized and headquarters transferred from Chicago [illegible]

MR. BYRON [illegible] succeeded by Mr. W. E. Boileau, a capable electrical engineer and man [illegible] and leaves a fine record behind him.

MR. W. J. HARVIE [illegible] of the Utica & Mohawk Valley Railway Company, Utica, N. Y., has been promoted to the position of chief engineer of the Utica & Mohawk Valley Railway Company, the Oneida Railway Company and the Syracuse Rapid Transit Railway. For the present Mr. Harvie will remain in Utica. Mr. H. S. Williams, who has been Mr. Harvie's assistant, succeeds him as electrical engineer of the Utica & Mohawk Valley Company.

MR. JOHN A. BRITTON, vice-president and general manager of the Pacific Gas & Electric Company, of San Francisco, delivered a lecture on Oct. 16 before the Associated Mechanical and Electrical Engineers of the University of California. His subject was "Engineering Possibilities in California," and he reviewed briefly the wonderful progress of electrical and gas engineering in that state in the last twenty years, [illegible] openings for men in various lines. He made special mention of the opportunity in gas engineering, in which but one college, the University of Michigan, now offers instruction. At the close of his address Mr. Britton described the Martin gas engine station of the California Gas and Electric Corporation, illustrating its different features by means of lantern slides. Mr. Britton is a member of the Board of Regents of the University of California.

MR. P. T. DODGE, president of the Mergenthaler Linotype Company, and active in the management of both the Electric Vehicle Company and the Electric Storage Battery Company, is the subject of the following "Pen Point" sketch in the *Wall Street News:* "Mr. Dodge, who has just been elected to the executive committee of the Graphophone Company, may be truthfully termed the printers' fairy Godfather, for it is he who has done so much to make possible and popular the Linotype, which enables type to be set while you wait and the news to come hot off the press. Graduated from Columbia University, a very excellent foundation for his very excellent business career. His new position makes him, with the ones he already holds, the monarch of sight, sound and space, all three things of which he has done much to control and popularize. Six directorships and eleven clubs occupy his time and attention."

MR. RICHARD T. LAFFIN, vice-president and general manager of the Manila Electric Railroad & Light Company, has resigned, having completed the task of establishing the operating organization of this property on a sound earning basis. The management is now assumed by Mr. C. B. Graves, who has been Mr. Laffin's right hand man since the property was placed in operation, three years ago, officiating as manager of the lighting and power department. Mr. Laffin is still interested financially in the Manila properties, and resigns to take the management of another group of public utility properties in which J. G. White & Company, Inc., are largely interested. It is considered by Mr. Laffin and J. G. White & Company, operating managers of the Manila Electric Railroad & Light Company, that Mr. Graves is well qualified to continue the successful administration and maintain the policies inaugurated by Mr. Laffin, which have made the Manila company so successful. Mr. Graves has extended experience in the management of electrical plants in the tropics. At one time, before becoming connected with the Manila Electric Railroad & Light Company, he was electrical engineer and assistant manager of the extensive system of the Sao Paulo Tramway Light & Power Company, Sao Paulo, Brazil.

PROF. W. F. M. GOSS.—The University of Illinois has secured as dean of its College of Engineering and its new School of Railway Engineering and Administration Prof. William Freeman Myrick Goss. He was born in Barnstable, Mass., in 1859, graduated from the Massachusetts Institute of Technology in 1879, and went immediately to Purdue University, Lafayette, Ind., to organize a practical department of mechanics, of which he has ever since been the head. Professor Goss has specialized along the line of the investigation of motive power. He was the pioneer in locomotive testing and designed the locomotive testing plant at Purdue, which has been copied by the Pennsylvania Railroad at Altoona. He is a member of the American Society of Mechanical Engineers, of the Association for the Promotion of Engineering Education, the Western Railway Club, American Master Mechanics' Association, American Master Car Builders' Association, International Association for Testing Materials, and Fellow of the American Association for the Advancement of Science. He served as a member of the advisory committee of the United States geological survey in testing fuels and structural materials, on the jury of awards, Columbian Exposition of 1893, advisory committee of the Pennsylvania Railroad Company in testing locomotives at St. Louis in 1904, and has recently been chosen to carry on special investigations relating to superheated steam for locomotives by the Carnegie Institute of Washington. He has written several valuable books relating to locomotive works and has contributed freely to the technical press. Professor Goss expects to take up his work at Urbana on Nov. [illegible]

MR. G. S. RICE.—After Dec. 1 Mr. George S. Rice will no longer be the chief engineer of the Public Utilities Commission. The resignation of Mr. Rice, to take effect on the date mentioned, and the appointment of Henry B. Seaman as his successor, was announced last week. Mr. Rice will continue in the service of the commission as assistant engineer in charge of construction work. The salary of Mr. Rice has been $15,000. As first assistant he will receive $10,000 a year. Mr. Seaman's salary will be $15,000. Mr. Seaman is a native of New York and graduated from Swarthmore College, Pennsylvania, in 1881. He [illegible] after which he entered the employ of the Edgemore Bridge Company. A [illegible] County Elevated Railroad Company, a subsidiary concern of the B. R. T. Following this he was connected with the bridge department of the [illegible]

the firm of Wilson Brothers, of Philadelphia. Later Mr. Seaman returned to the Erie and had much to do with the construction of new bridges along that line between New York and Buffalo. For a while following this he was a construction superintendent for the New York, New Haven & Hartford Railroad Company, and at the time the present subway was built he was employed as an engineer by the contractor for the Fourth Avenue section. He is now a consulting engineer in the Bridge Department of this city and will remain in that position until Dec. 1. He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Engineers' Club, the American Institute of Mining Engineers and the Brooklyn Engineers' Club.

Trade Publications.

BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., have issued a very neat little vestpocket book of data on locomotives. It is bound in leather, well printed, and has been in great demand, especially in connection with the exhibit at the Jamestown Exposition.

BROWNHOIST LOCOMOTIVE CRANES are the subject of an illustrated pamphlet just issued by the Brown Hoisting Machinery Company, Cleveland, Ohio. They are intended for use with Brown grab buckets for handling ore, coal, limestone, slag, etc.

TOBIN BRONZE is the title and subject of a neat little pamphlet issued by the Ansonia Brass & Copper Company, of 99 John Street, New York, the sole manufacturer of this specialty. Full details are given as to the applications and uses of this alloy in its various forms of rod, bar, bearings, plates, etc.

CONDUIT WIRING.—The Sprague Electric Company has issued a new and revised edition of its Conduit Bulletin No. 421, which describes the Greenfield flexible steel conduit, flexible steel-armored conductors and steel-armored flexible cord. The bulletin also includes notices of outlet boxes, fittings and tools.

WOOD PRESERVATION.—The C. A. Manufacturing Company, Austin, Texas, presents in pamphlet form numerous testimonials from electric light, railway and telephone companies commending the use of "carbolineum America" for the preservation of wood poles. This composition is manufactured in Mannheim, Germany, and distributed in this country by the above-mentioned firm from St. Louis, New Orleans, San Francisco, Salt Lake City and Galveston.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is sending out a flyer on "Portable Lamps" which shows some very attractive portable lamps as gifts for the holiday season. The company has for some years devoted considerable attention to the fixture department, and this year special attention has been paid to this branch of its business and to lamps for the holiday season. This flyer calls attention to the company's display rooms and if the lamps which are shown are anything to judge from, prospective buyers would be well paid by visiting these show rooms in person. The Central Electric Company will gladly mail a copy of this flyer on request.

TRUMBULL LITERATURE.—The November cover of "Trumbull Cheer" illustrates the general two-color design adopted by this "magazinette, published each month" (if it's lucky), by the Trumbull Electric Manufacturing Company, of Plainville, Conn. The primary object of this clever publication is, of course, to put forward the new lines of Trumbull material, which are continually offered the trade and to re-emphasize the merit of other material already published. This is done by the publishing of regular price lists with cuts and discounts, and also by articles of more or less technical nature setting forth various matters arising in the manufacturing field that are of direct interest to the contractor, jobber and purchasing public in general. In this November issue appears an article on the recent rulings of the Underwriters, covering switches for alternating-current work; also a detailed list of Trumbull's "A" line of switches, showing that prices for 27,840 different type "A" switches are given in its bulletin. Its panel boards and switchboards are also advertised. The whole tone of the little magazine, as the title indicates, is cheerful, numerous epigrammatical sayings being introduced with catchy verses and reflections on business and general conditions. It is printed throughout in two colors on heavy coated paper and illustrated with caricatures and half-tone cuts, which produce a decidedly pleasing effect. The trade is urged to follow this publication carefully, as prices are changing, new lines are being continually introduced and old lines extended. Copies will be gladly sent upon application to all those interested in electrical developments.

Business Notes.

THE TREMAINE ELECTRIC COMPANY, of Brockton, Mass., has moved into its new store located at School Street and City Hall Square, where it will carry a line of electrical and gas fixtures and auto supplies.

THE STEEL CITY ELECTRIC COMPANY, Pittsburg, Pa., has purchased the outlet box business of the Sarco Company, New York, including patent rights, tools, machinery and stock of goods. Orders for Sarco outlet boxes can be fulfilled promptly.

TRANSFORMERS FOR TRANSATLANTIC WIRELESS.—In last week's issue we published an account of the opening of the Marconi transatlantic wireless telegraph service between Glace Bay, N. S., and Clifden, Ireland. It is interesting to note in this connection that the transformers used at both of these stations are of American make, having been supplied by the American Transformer Company, of Newark, N. J.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., has established a district office at Pittsburg, Pa., in charge of Mr. C. A. Poe, formerly of C. A. Poe & Brother. The office is conveniently located at 618 Park Building. Northern customers and others desiring to consider Northern machines will find the Pittsburg office in position to act promptly on inquiries for information or assistance. Mr. Poe is not unknown to Northern customers in the Pittsburg district, having represented the company in conjunction with other lines for several years. His entire attention is now devoted to the Northern work.

RAILWAY INSULATORS.—Mr. Louis Sternberger, president and general manager of the Electrose Manufacturing Company, Brooklyn, N. Y., writes as follows: "Your issue of Oct. 5 contains an article under the heading, 'Electric Traction in Belmont Tunnel.' Referring to the overhead third-rail insulators the article states, 'The rail inverted is suspended from molded mica insulators, etc.' Permit us to inform you that that statement is erroneous. The overhead third-rail insulators installed in the Belmont tunnel are electrose insulators. It may interest you to learn that exhaustive and competitive service tests were instituted by the engineers of the Interborough Rapid Transit Company on third-rail insulators made by various manufacturers, and after a period of thirteen months of constant use in regular service, under the severest possible conditions, Electrose insulation won out against all competitors, and as a result we were awarded the contract for the overhead third-rail insulators for the Belmont tunnel. Electrose insulation, wherever adaptable, fulfills all requirements in a highly satisfactory manner."

CHICAGO ELECTRICAL SHOW.—Space for the third annual Electrical Show to be held in Chicago, Jan. 13-25, 1908, is being eagerly sought by all lines of electrical manufacturers. The management announces that more than two-thirds of the available space has already been taken, and by reason of the unusually enthusiastic interest that has already been shown in this annual affair, the largest and most striking show ever held is assured. A feature of this year's show that will make it attractive is the scheme of booth construction, decoration and decorative lighting that has been arranged for. D. H. Burnham & Company, the well-known achitects, have been engaged to design the entire installation, and have planned it on a scale in keeping with the high character of the exhibits, giving them a setting that will greatly enhance their value and effectiveness. This is a radical departure from previous shows, and will be appreciated by exhibitors who will be relieved of a great deal of work and worry incidental to the preparation for their exhibits in previous shows. All booths, railings, signs, wiring, etc., will be installed by the Exposition Company.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutical Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, New York, December 3-6, 1907.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col.

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ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

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ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 7, 1907.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS & ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

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ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New England, Philadelphia, Pittsburg and Chicago. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles West. Next meeting, Chicago, January 21, 22 and 23, 1908.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

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KENTUCKY INDEPENDENT ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

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MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

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NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn. Next meeting, Chicago, January 21, 22 and 23, 1908.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

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SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

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STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 22, 1907

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

868,648. SEMAPHORE SIGNAL; Fred B. Corey, Schenectady, N. Y. App. filed March 27, 1907. Mechanical and electrical features of construction of a motor-driven semaphore, with a stop-motion switch by which the motor is controlled

[illegible] EXPRESSION MECHANISM FOR SELF-PLAYING INSTRUMENTS; George H. Davis, West Orange, N. J. App. filed April 18, 1905. The keys of the instrument have depending levers [illegible]

[illegible] INSULATED METAL [illegible] Pittsburg, Pa. App. filed Dec. 31, 1906. Metallic cross-ties with a bushed [illegible]

[illegible] PROCESS OF MAKING [illegible] desired shape, and then fitting solder strips over the portions of the same [illegible]

868,670. ELECTROLYSIS OF FUSED ALKALINE CHLORIDS; Franz von Kugelgen and George O. Seward, Holcombs Rock, Va. App. filed June 13, 1905. The process which consists in electrolyzing a mixture of an alkaline chlorid with a fluorid of higher decomposition voltage.

868,674. ELECTRIC SIGN; Carl O. Lindstrom, Chicago, Ill. App. filed April 7, 1906. Relates to sockets for electrically operated signs, and aims to provide a structural formation by which the ordinary socket can be adapted to illuminate the face of a sign in any desired plane.

868,696. SELF-WINDING ELECTRIC CLOCK; Arthur F. Poole, Wheeling, W. Va. App. filed Jan. 24, 1906. Relates to self-winding clocks of the type rewound at proper intervals by mechanical means brought into action by the automatic closure of an electrical circuit.

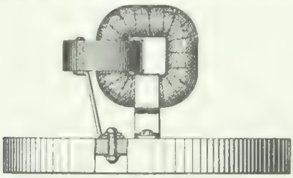
868,723. CONTROL OF MOTOR-OPERATED DOORS; David W. [illegible] Relates to the control [illegible] controllable at the local point. Provides means by which the man at the door can take the control away from the distant operator as long as he has his hand on the controller.

[illegible] BATH FOR [illegible] ELECTROLYTIC METALLIC [illegible] filed June 4, 1906. A bath for producing electrolytic metallic deposits comprising one or more sugars and a ferment.

868,740. ELECTRICAL PIANO-PLAYING ATTACHMENT; Joseph Weber, Brooklyn, N. Y. App. filed Sept. 14, 1905. Provides a frame [illegible] self-playing attachment for pianos, such housing being arranged to oc- [illegible]

868,751. ELECTRICAL CONNECTORS; Frederick H. Ayer, Chicago Heights, Ill. App. filed Feb. 23, 1907. The bond connector wire has a three-sided transverse section of such a character that it co-operates with a notched tapering plug to completely fill a circular-drilled hole in the rail web.

868,752. VARIABLE REACTIVE COIL; Ralph E. Barker, Lynn, Mass. App. filed Jan. 23, 1907. Construction of coils of variable reactance [illegible]



868,752.—Variable Reactive Coil.

a core forming a closed magnetic circuit of varying cross-section, and a winding thereon, the core and winding being relatively adjustable.

868,769. PROCESS FOR THE RECOVERY OF NICKEL FROM ORE; Charles H. Ehrenfeld and Jacob R. Grove, York, Pa. App. filed Jan. 27, 1906. Relates to processes by which metal is completely exhausted from an ore and incorporated into a suitable solution by electrolysis at the anode, being deposited in metallic form upon the cathode.

868,780. TROLLEY WHEEL GUARD; Charles Harkness, Providence, R. I. App. filed Feb. 16, 1905. Patentee has a pair of arms swinging on each side of the trolley harp and carrying at their extremities convex rollers.

868,781. ELECTRIC SWITCH; Chester S. Hill, Williamsport, Pa. App. filed July 16, 1906. The car carries a specially shaped magnet depending in close proximity to the ground and which causes the magnetic actuation of certain circuit closing devices in the track bed when energized.

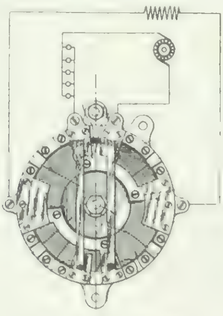
868,806. ELECTRIC MOTOR; Oscar H. and Alphonse F. Pieper, Rochester, N. Y. App. filed Nov. 25, 1905. Relates to a governor controlling apparatus for an electric motor for keeping it at constant speed.

868,864. ELECTRIC-CONTROLLING SYSTEM; Ray P. Jackson, Wilkinsburg, Pa. App. filed Nov. 23, 1904. Provides means for preventing a circuit breaker of a system from closing after it has been caused to open by an overload on the motors until after the reversing switch has been moved to its off position.

868,880. SOUND TRANSMITTER AND RECEIVER; Arthur J. Mundy, Boston, Mass. App. filed April 23, 1902. Has a globular shell sunk beneath the surface of the water in submarine signaling, and which contains sensitive transmitters adapted to operate with telephone receivers at a distant point.

868,889. TROLLEY-OPERATING VALVE; Robert H. Rogers, Schenectady, N. Y. App. filed Nov. 17, 1905. A pneumatic apparatus for controlling the shoes or trolleys and for electric locomotives.

868,911. ELECTRIC RAILWAY SYSTEM; John L. Crouse, New York, N. Y. App. filed Dec. 29, 1904. Relates to electric railway systems which employ both trolley and third-rail conductors alternately used



868,98[illegible].—Pole Changer.

at different points of the system. Covers electrical means for controlling the respective shoes or collectors.

868,929. ELECTRIC-CONTROL SYSTEM; Ray P. Jackson, Wilkinsburg, Pa. App. filed April 3, 1905. Provides a means for retaining the reversing switch in closed circuit position after it has been moved to that position until after the circuit breaker is opened.

868,933. TELEPHONE EXCHANGE; Frank A. Lundquist, Chicago, Ill. App. filed May 20, 1904. Mechanical features and electric cir- [illegible]

868,967. AUTOMATIC TOOL-OPERATING DEVICE; Arthur Clem- [illegible] of solenoids, the circuits of which are completed by plunger switches.

[illegible] POLE CHANGER; [illegible] ber having a lost motion connection with the switch and engaging the wheel at said recess.

[illegible] FILAMENT FOR INCANDESCENT [illegible] The process of making incandescent filaments which consists in dip- [illegible] metallic light-emitting particles in mechanical suspension whereby a coat is deposited on said core through which said particles are dispersed, and carbonizing said coat to render said coat and said particles integral with said core.

869,013. INCANDESCENT FILAMENT AND PROCESS; E. McQuat, et al., Springfield, Ohio. App. filed Dec. 6, 1905. The process of making incandescent lamp filaments which consists in incorporating a metal and silicon in the filament and forming a silicid by reaction between the metal and the silicon components.

869,014. ELECTRIC FIRE ALARM; John A. Obester, Passaic, N. J. App. filed April 25, 1907. Relates to apparatus for detecting the location of fire in buildings and includes a thermometer which closes a circuit ringing an alarm bell at a plurality of points.

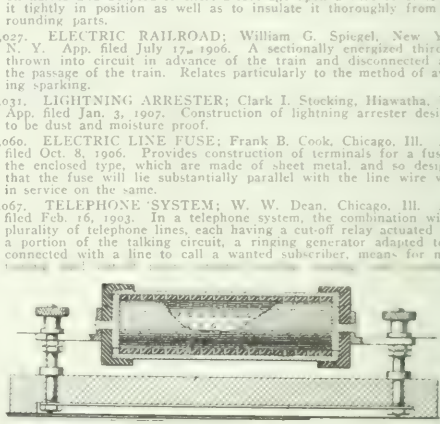
869,018. CLAMP INSULATOR; George Pollock and William E. Werd, Deer Lodge, Mont. App. filed May 9, 1907. Type of insulator made on halves and adapted to exert a leverage upon a wire so as to grip it tightly in position as well as to insulate it thoroughly from surrounding parts.

869,027. ELECTRIC RAILROAD; William G. Spiegel, New York, N. Y. App. filed July 17, 1906. A sectionally energized third-rail thrown into circuit in advance of the train and disconnected after the passage of the train. Relates particularly to the method of avoiding sparking.

869,031. LIGHTNING ARRESTER; Clark I. Stocking, Hiawatha, Kan. App. filed Jan. 3, 1907. Construction of lightning arrester designed to be dust and moisture proof.

869,060. ELECTRIC LINE FUSE; Frank B. Cook, Chicago, Ill. App. filed Oct. 8, 1906. Provides construction of terminals for a fuse of the enclosed type, which are made of sheet metal, and so designed that the fuse will lie substantially parallel with the line wire when in service on the same.

869,067. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Feb. 16, 1903. In a telephone system, the combination with a plurality of telephone lines, each having a cut-off relay actuated over a portion of the talking circuit, a ringing generator adapted to be connected with a line to call a wanted subscriber, means for main- [illegible]



[illegible]—Lightning Arrester.

[illegible] controlled by the called subscriber for disconnecting said generator at the central office, substantially as described.

869,094. METHOD OF PRODUCING SULFURIC ACID; Isidor Kitsee, Philadelphia, Pa. App. filed July 21, 1906. The method of producing sulfuric acid which consists in subjecting a continuous stream of sulfurous gas in the presence of necessary moisture to the action of an electric current adapted to modify the chemical constituents of said gas to convert the same into sulfuric acid.

869,102. DYNAMO ELECTRIC MACHINE; Mathias Pfatischer, Philadelphia, Pa. App. filed July 5, 1907. Provides a construction of magnetic circuit of the commutating field in dynamo electric machines where it is advisable or necessary to create an auxiliary magnetic field for the purpose of effecting good commutation.

869,114. MASSIVE BORON CARBID AND PROCESS OF MAKING SAME; Samuel A. Tucker, New York, N. Y. App. filed Dec. 19, 1906. The method of producing practically pure boron carbon, which consists in bringing a boron compound and carbon in an enclosure to the requisite temperature to produce the reaction, and controlling the pressure within the enclosure.

869,119. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 13, 1902. In a telephone system, the combination with a telephone line, of two line relays therefor, a cord circuit, a pair of supervisory relays associated therewith, and means for connecting said relays in shunt to said line relays when a connection is established with the line.

869,163. INSULATOR; William J. Devine, Norwalk, Conn. App. filed July [illegible] tail or rabbitt together and which have grooves for the passage of the conductors.

[illegible] SELF-EXCITING ALTERNATING-CURRENT DYNAMO; M. Latour, Sevres, France. App. filed July 9, 1901. In a self-exciting alternating current generator, an armature having a distributed winding, a field having a distributed winding and a many-part commutator, and means for supplying polyphase currents to said field winding through said commutator.

[illegible] SHUNT-WOUND SELF-EXCITED ALTERNATOR; M. [illegible] A. Latour, Sevres, France. App. filed Aug. 8, 1903. In combination, an alternating current generator comprising relatively rotatable [illegible] provided with a distributed winding, polyphase shunt connections joining together said windings to provide paths for currents whereby [illegible] current from said generator.

[illegible] COMPOUND SELF-EXCITED ALTERNATOR; M. [illegible] [illegible] polyphase currents taken part in derivation from the armature, and part in series with the line.

[illegible],196. RAILWAY SIGNAL; Robert D. Peters, Knox, Ind. App. filed [illegible] revolution

Electrical World

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NEW YORK, SATURDAY, NOVEMBER 9, 1907.

CONTENTS.

THE INDUSTRIAL SITUATION.

The financial events of the second half of October have been notable in their immediate effect on industrial conditions. There have been some pretty sharp convulsions in the last two or three years, and the decline in stock values began some time ago; but the steady march of commerce and industry was in no wise interrupted. Through it all consumption kept ahead of production, prices rose, labor demanded more and more, and real estate booms affected well-nigh every part of the country. Now for the first time in a long period, and dating from the sensational drop in copper, the industrial situation has changed, and with it we see contraction everywhere. It is now simply a question how far this check to industry associated so closely with financial troubles, can go as a result of what will be known hereafter as the panic of 1907.

It may not be unsafe or unwise to hazard the prediction that a turn has already come for the better, shortening the inevitable period of dullness and restriction. Each succeeding trouble of this nature finds the American people richer in accumulated wealth, stronger in developed resources, and with no loss of resilience. A continent with less than one hundred million population capable of sustaining in comfort one thousand million is not likely to be seriously checked or chilled by such trivial spasms as those of October, or by even great disasters like a civil war. Fortunately, at the present moment, there is general understanding of the soundness of all the underlying conditions and everywhere a resolve to repair by swift, well-directed endeavor the damage of the storm. The insanity of hoarding, shown as an intense craze of panic a couple of weeks ago, is again succeeded by normal confidence in banks and other depository institutions. It is felt, and the feeling cannot be manifested too strongly in actions, that the best policy for every business man is to pay up promptly. It is a mere truism that ten thousand dollars passed out in settlement of one account can liquidate in ten days ten times that amount of indebtedness as it goes from hand to hand, and come back ready to create new values.

Of course the effect of the troubles precipitated by the copper gamblers has been sharply felt in the electrical industries, ever in the vanguard of progress and calling for large sums in development. Several energy-transmission enterprises of inherent merit have been checked, and the underwriting on many trolley and lighting schemes is temporarily stopped. We do not think this will last long, but while it lasts the occasion is certainly a good one for pushing the manufacture and sale of all manner of minor appliances, apparatus and energy-selling plans. Now if ever is the time to prove the oft-asserted claims of electricity on the score of economy, comfort, safety, convenience and adaptability. In fact, the public utility companies have a great opportunity in pushing their business, rather than in contracting it, to be a powerful factor in alleviating the

situation and in laying deeper foundations for the larger prosperity of the near future. One thing we may now hope for, and that is at least a partial, if not a complete cessation of the corporation baiting that has gone on so long. It is well that the arrogance as well as the avarice of some modern leaders of finance and industry should be hit hard by the law, wherever evil and criminality have developed; but let us not forget that the corporate principle lies at the basis of our great modern development and is capable of infinite good if properly utilized. We do not need any more sumptuary laws, but rather fewer of them, enforced in a conservative spirit, and then every inhabitant of the country will be benefited.

Culmination of Wireless Telegraph Impulse at the Antipodes of the Sending Station.

The letter from Mr. Ernest F. Smith in our correspondence columns this week on the subject of the intensity of wireless telegraph signals at great distances from the sending station affords an opportunity for interesting speculation. Mr. Smith points out, although the same suggestion has been published before, that a wave which spreads at uniform speed and with uniform attenuation in all directions from a sending station on a sphere, should continually weaken in local intensity until it reached the equator of the globe with respect to that station. Beyond that distance the wave front tends to shorten and not to lengthen, until at the antipodes of the ending station it should tend to collect into a point with a splash or culmination. This would depend, of course, upon whether the rate of absorptive attenuation fell below a certain critical value. If, for instance, the absorption were so great as to make the wave inappreciably faint at a distance of say 100 miles, then it is clear that there would be no use looking for an antipodal splash 12,000 miles away. On the other hand, if the wave could be safely detected up to the equator from the sending station, or up to the ring 6000 miles off, so as to start fairly on its narrowing career, it would be reasonable to hope for a distinct culmination at the antipodes. Thus far we believe that there is no authentic or reliable information as to the reception of signals over 6000 miles away from their base, though there have been certain newspaper reports. There is, of course, no reason why they should not be found at such distances, if they are sufficiently strong at the start. All wireless telegraphists scattered about the ocean world should be encouraged to keep watch for, and record of, faint signals from afar, in order to transfer antipodal wireless telegraphy from the class of interesting speculation into the class of determined fact.

The Inductance of a Solenoid of Given Number of Layers.

The recent introduction of very high frequency currents into practical use for various purposes, such as wireless telegraphy, has brought the inductance of coils into prominence. Not only must the inductances of coils be known if their performances are to be under control, but these inductances must also be known to a relatively high degree of accuracy, hence in timing circuits as it is in target shooting with a rifle—a small deviation makes all the difference between hitting and missing. With low-frequency currents the inductance of coils is not so frequently [illegible] duction coils almost always employ iron cores, and once we put an iron core into a coil, we can make the inductance of the coil almost what we please. The inductance of an iron-cored or ironclad coil is almost a meaningless term, since so much depends upon the permeability and previous magnetic history of the core. An air-cored coil, on the other hand, has a very definite inductance, that does not appreciably vary with the strength of the current in the coil. The article by Mr. Louis Cohen, on page 920 of this number, points out that Maxwell's formula for the inductance of a many-layered helix involves the assumption that the magnetic flux is uniform and parallel through all the turns. In other words, the formula applies only strictly to an indefinitely long helix. In ordinarily short helices the correction due to the divergence of the magnetic flux at the ends may be considerable. Formulas are given for reaching a closer determination of the inductance in a many-layered helix. These formulas are lengthy, but are not difficult to handle, and they ought to be of material service to those who have occasion to determine such constants with precision. The ordinary simple formula for the inductance of a single-layered helix without correction for divergence of magnetic flux near the ends depends only on the volume of the helix and on the number of turns of wire per linear centimeter of the winding. If we call this number the multiplicity of the winding, the simple formula makes the inductance in absolute henrys equal to 4π times the cylindrical volume enclosed by the winding in cubic centimeters, times the square of the multiplicity. The article supplies a brief and seemingly valuable formula of closer approximation.

The Influence of Transoceanic Wireless Telegraphy on Submarine Cable Traffic.

Now that wireless telegraph messages are being forwarded across the Atlantic Ocean, and it is announced that an ether circuit has been opened between Ireland and Cape Breton Island for traffic, it is worth while considering what effect wireless transoceanic telegraphy is likely to have on the submarine transoceanic cable telegraphy. Up to the present time, the field and scope of wireless telegraphy have been practically confined to maintaining communication with or between ships at sea. In this field, wireless telegraphy is without a rival, and its effect has been profound. Formerly, a vessel outside of legal three-mile shore limits was virtually beyond the pale of knowledge, government guidance or communication, except in so far as other incidentally passing vessels might bring knowledge or communication. We have changed all that forever. Already the large passenger steamers crossing the Atlantic are commonly within receptive range of news and communication, either from one shore or the other, all the way across. It is reasonable to hope that in times to come no large vessel will ever be out of receptive communication with her head office. This will mean that the ocean, which as we know represents about three-fourths of the surface of the globe, is already in process of being transformed from vacant unreclaimed territory to controlled territory, and the control will no longer be merely vested in the government or governments possessing the largest and most efficient navies, but also in those which possess the best wireless telegraph equipments. It is hardly possible for this to work otherwise than in the direction of international unity. The ether surrounding the globe belongs as much to Switzerland, without a port, as to England or Japan, which are nearly

all port. When persons or countries are all inhabitants of the same vehicle or environment, mutual friendship and forbearance are forced upon all alike. Hitherto wireless telegraphy has had so much to do with building up and establishing communication with floating stations and ships at sea that it has had hardly any effect on submarine-cable traffic. Now, however, it attempts to come into competition with the submarine cables. It must take a long time, however, before that competition can become serious. If wireless telegraphy were not to advance beyond its existing stage of development it is doubtful whether it could ever become a serious competitor. But wireless telegraphy is still young, and the atmosphere above our globe is responsive to all kinds of artificial electromagnetic stimulus. We cannot foretell what advances wireless telegraphy may make as it grows older, whereas cable telegraphy has remained almost at a standstill for many years. In time, it might be that no more cables would come to be laid; but for the present the competition has only just commenced, and much growth must take place before it becomes serious.

The Power Factor of Condensers.

A condenser is known to be a highly efficient piece of apparatus for storing small quantities of electric energy during brief periods of time, under favorable conditions. An air-condenser is only able to store a relatively small quantity of energy at ordinary atmospheric pressures, owing to the electric weakness of air. At ordinary atmospheric pressures air breaks electrically when the electric intensity reaches about 100 units, and consequently air will only hold about 400 ergs of electric energy per cubic centimeter. Nevertheless, a well-insulated air condenser, taking its electric energy from alternating source of e. m. f., will hold it during each half cycle and return it to the circuit with extremely little loss. The great bulk of an air-condenser of appreciable storage capacity limits the applicability of the apparatus. A cubic meter of ordinary air in an air-condenser can hardly hold 40 joules, although under a pressure of, say, five atmospheres it may hold 25 times as much. With condensers of solid dielectric, such as mica, paper or glass, we can stow away more energy to the unit of space, partly on account of the greater dielectric constant, or specific inductive capacity, with which the energy stowage rises proportionately, and partly on account of the greater electric strength, or voltage capability of the insulator, with which the energy storage rises as the square. A glass condenser may stow away 25,000 ergs per cubic centimeter, or about 60 times as much as air; so that for the same energy contents, or for the same horse-power under alternating voltage, the glass condenser may be about one-sixtieth as large as an atmospheric air condenser. The practical advantage thus in favor of the glass condenser is great.

Unfortunately, however, the condenser of solid material, although it gains so much in compactness, loses markedly in efficiency. There is leakage of the electric charge in the condenser, and there is hysteresis or a lagging behind of the stowage with reference to the impressed e. m. f. If simple alternating e. m. f. be impressed upon the solid condenser, the charging current will not be exactly 90 deg. ahead of the e. m. f. in phase. It may be, say, 88 deg. ahead. This would mean that the particular condenser had a power factor of 3.5 per cent, or that this condenser absorbed 3.5 per cent of the energy which it received for storage. An efficiency of 96.5 per cent might still be regarded for many practical purposes as satisfactory; but this is not the worst of the defect. The principal objection lies ordinarily in the fact that the energy flow makes the dielectric hot, and dielectrics behave worse at high temperatures than at low temperatures. Their leakage increases, their hysteretic loss increases, and their dielectric strength decreases. Consequently, the power which can be safely given to the solid condenser is much less than could be given to it if it kept cool. Compressed air is, therefore, perhaps the most absorbtive substance, and the most compact energy receiver of all, under practical conditions.

The power factor of a condenser is an important property of the condenser in view of the above considerations. For some purposes the power factor is more important than either the capacity of the condenser, or its maximum watts. The August number of the *Bulletin* of the Bureau of Standards contains a paper on the measurement of the power factor of condensers, by Mr. F. W. Grover. A number of methods of measurement are discussed, all modifications of alternating-current Wheatstone-bridge tests. The results obtained with these different methods are compared, and are shown to be in satisfactory mutual agreement. The results are stated in terms of the angle of quadrature defect, or the complement of the angle of lead of the condenser current with respect to the simple alternating charging e. m. f. A good mica condenser is shown to have a quadrature defect of from half a minute to five minutes of arc, corresponding to a power factor of from 0.015 per cent to 0.15 per cent. Some mica condensers are stated to have a quadrature defect of more than 10 deg. How they can be so defective without breaking down altogether it is difficult to imagine. Among the paper condensers tested, the quadrature defect varied from 6 minutes up to 8 deg. Telephone condensers seem to have had the largest defect. In most cases of telephonic central-station use, a small defect is not of great importance, but in paper insulated telephone cables it is of considerable importance. In such paper cables it is known that the presence of even a small quantity of water-vapor has a marked influence upon the quadrature defect and upon the power factor. Whether the paper condensers, which are usually soaked in melted paraffin wax, contained water-vapor is not stated.

The important practical result is indicated by the research that absorption in a condenser, or the property of accumulating residual charges; as well as the property of presenting a different capacity by direct deflection with different times of charging, are all closely connected with the power factor, so that if the power factor can be kept very small, the polarization, hysteresis, and absorption in the condenser will be likewise very small. Another important fact deduced from the research is that the quadrature defect of a certain good mica one-microfarad condenser was 90 seconds of arc at 50 cycles, 75 seconds at 100 cycles and 38 seconds at 970 cycles per second; so that the defect and the power factor appear to diminish with the frequency. The research has marked value because not only in power applications, but also in wireless signalling, the condenser has increasing utility, and a low power factor is of [illegible]

How to Deal with the Trusts.

At the close of the recent special convention on trusts in Chicago, of the National Civic Federation, the committee on resolutions presented the following report: "After 20 years of federal legislation, as interpreted by the court, directed against the evils of trusts and combinations and against railroad rebates, beginning with the Interstate Commerce Act of 1887 and the Anti-Trust Act of 1890, a general and just conviction exists that the experience gained in enforcing these federal acts and others succeeding them demonstrates the necessity of legislation which shall render more secure the benefits already gained and better meet the changed conditions which have arisen during a long period of active progress, both in the enforcement of statute law and in the removal of grave abuses in the management of railroads and corporations. These changes now demanded are:

"First—Immediate legislation is required, following the recommendation of President Roosevelt and the Interstate Commerce Commission, permitting agreements between railroad corporations on reasonable freight and passenger rates, subject in all respects to the approval and supervision and action of the Interstate Commerce Commission.

"Second—The enforcement of the Sherman Act and the proceedings under it during the administrations of Presidents Harrison, Cleveland, McKinley and Roosevelt have accomplished great national results in awakening the moral sense of the American people and in asserting the supremacy and majesty of the law, thus effectually refuting the impression that great wealth and large corporations were too powerful for the impartial execution of law. This great advance has rendered more secure all property rights, resting as they must under a popular government, on universal respect for and obedience to law. But now that this work is accomplished, it has revealed the necessity for legislation which shall maintain all that the Sherman Act was intended to secure and safeguard interests it was never expected to affect.

"As the next step in executing the determination of the American people to secure in all industrial and commercial relations justice and equality of opportunity for all, with full sympathy and loyal support for every effort to enforce the laws in the past, we urge upon Congress without delay to pass legislation providing for a non-partisan commission, in which the interests of capital, of labor and of the general public shall be represented.

"This commission, like a similar commission which proved most successful in Germany in 1870, shall consider the entire subject of business and industrial combinations, and report such proposals as to the formation, capitalization, management and regulation of corporations (so far as the same may be subject to federal jurisdiction) as shall preserve individual initiative, competition and the free exercise of a free contract in all business and industrial relations. Any proposed legislation should also include modification of the prohibition now existing upon combinations on the following subjects:

"1. National and local organizations of labor and their trade agreements with employers relating to wages, hours of labor and conditions of employment.

"2. Associations made up of farmers intended to secure a stable and equitable market for the products of the soil, free from fluctuations due to speculation.

"3. Business and industrial agreements or combinations whose objects are in the public interest as distinguished from objects determined to be contrary to the public interest.

"4. Such commission should make a thorough inquiry into the advisability of inaugurating a system of federal license or incorporation as a condition for the entrance of certain classes of corporations upon interstate commerce, and also into the relation to the public interest of the purchase by one corporation of the franchises or corporate stock of another.

"On no one of these subjects must what has been gained be sacrificed until something better appears for enactment.

"On each of these the conference recognizes differences between good men. On all it asks a national non-partisan commission to be appointed next winter to consider the question and report at the second session of the approaching Congress for such action as the National Legislature, in the light of this full investigation, may enact.

"The examination, inspection and supervision of great producing and manufacturing corporations, already begun by the Department of Commerce and Labor and accepted by these corporations, should be enlarged by legislation, requiring, through the appropriate bureaus of the Department of Commerce and Labor, complete publicity in the capitalization, accounts, operations, transportation charges paid, and selling prices of all such producing and manufacturing corporations whose operations are large enough to have a monopolistic influence. This should be determined and decided by some rule and classification to be devised by the commission already proposed.

"The conflicts between the State and federal authority raised in many States over railroad rates, being now under adjudication and under way to a final and ultimate decision by the federal Supreme Court, this conference deems the expression of any opinion on these issues unfitting, and confidently leaves this great issue to a tribunal which, for 118 years, has successfully preserved the balance between an indissoluble Union and indestructible States, defining the supreme and national powers of the one, and protecting the sovereign and individual powers of the other."

The resolutions were adopted as read, after which the conference adjourned sine die.

Mr. Acheson Before New York Electrical Society.

At Columbia University, New York, on October 30, before the New York Electrical Society, Mr. E. G. Acheson presented a very interesting paper, entitled "A New Departure in Lubrication." It dealt with his invention and researches in "deflocculated" graphite, to which attention has already been directed in these pages.

Aquadag is the name Mr. Acheson has given to the new lubricant made by suspending graphite in the water, while Oildag is the name he has selected for the lubricant made by suspending graphite in oil. Deflocculated graphite in water has been found to make an excellent lubricant for light work, the graphite preventing rust of any of the parts, while for heavier work the Oildag lubricant has been found ideal, he said. He went on to tell that both Professor C. H. Benjamin, dean of the engineering schools of Purdue University, and himself had made exhaustive tests, each one of which demonstrated the wonderful efficiency of these new lubricants.

Possibly the most satisfying test of all was that made at the works of the General Electric Company at Schenectady, N. Y., under the supervision of W. L. R. Emmett. These tests were not made to include the co-efficient of friction, but of the temperature and the surface speed of the shafts in the bearing. The shaft measured 7½ ins. in diameter, resting in a bearing 21 ins. in length. The test covered both forced lubrication and oil-ring lubrication. Not a great deal of advantage was shown in the case of the forced feed lubrication, the presence of the graphite holding down the temperature but a very little. In the test on the oil ring feed, however, very pronounced advantages were shown in favor of the graphite.

It is astonishing to think that the graphite content as used in these tests was 0.35 of 1 per cent of the weight of the oil, but the tests showed that with the same pressure and temperature "a shaft can be run from 50 to 100 per cent faster with the graphite in the oil than with the plain oil."

"The world was shocked a short time ago," said Mr. Acheson, "by the appearance in the daily press of an account of the utter annihilation of one of the plants of the Du Pont Powder Company. The account informed the world of the sacrificing

of the lives of a number of Du Pont employes, the maiming and crippling of many more, and of a property destruction extending over many square miles, and, further, this was caused by the overheating of a bearing. I believe I am quite within the truth when I state that this frightful catastrophe might have been entirely obviated had that bearing been lubricated with Oildag. A thin film of graphite between two metallic surfaces will prevent their seizing, cutting or heating from friction."

Mr. Acheson stated he had run a heavy car lubricated with Oildag over 6000 miles without the necessity of cleaning the spark plugs, and, what is still more remarkable, without the necessity of grinding the valves, while materially reducing the consumption of oil. The results would indicate that the use of Oildag in the gas engine will eliminate the pitting of the valve seats.

The surfaces produced on the valve seats are remarkable, being much finer than is possible of attainment by any mechanical finishing, the graphite being incorporated in the body of the metal.

The address closed with the intimation that the use of this new and modern lubricant will greatly reduce the consumption of lubricating oils, and the audience realized that another leg is about to be knocked from under the Standard Oil Company, the major part of whose business has been the sale of lubricating oils. Tests recorded give assurances that the oil consumption can be reduced over 25 per cent, which will be a tremendous volume considering the immense quantity of lubricating oils used annually.

Lighting Effect at Jamestown Exposition.

Thanks to the talent and ingenuity brought to bear by illuminating engineers on each new exposition in America, we have come to look to these shows for novel lessons and effects in lighting. In this respect, the Jamestown Exposition maintains the traditions very successfully, and strikes a new note in the illumination of the Administration Building, facing on Raleigh Court. We are able to present herewith a good view showing admirably the effect obtained. Just back of the dome of the building, a battery of search lights and projectors has been placed, and their beams, eight in number, are fanned out so as to produce a superlatively beautiful crown of light, resembling closely an aurora. Several of these broad bands of white light stream across Hampton Roads, and while passing under them on the ferry boats, at a distance of a few miles, it is curious to note how suddenly and absolutely the rays disappear, as though sawn off. It will be understood that a colored or spectrum effect can readily be obtained by the use of color screens.

The general use of search lights at Jamestown is indeed quite notable, the General Electric Company having furnished no fewer than 12 18-in. and 10 30-in projectors, all of whose light is, of course, supplemental to the decorative and service incandescent lighting, much of which is also seen in our illustration.

Lighting Effect, Illumination of Jamestown Administration Building.

Electric Vehicles at the Madison Square Garden Automobile Show.

The eighth national automobile show of the Association of Licensed Automobile Manufacturers was held in Madison Square Garden, New York, Nov. 2-9, inclusive. Unlike the show held the week previous in the Grand Central Palace, under the auspices of the Automobile Club of America, the Garden show contained many electric vehicles of both the pleasure and commercial types. To be sure the gasoline vehicles continue to monopolize space and attention; but the past few years have seen a wonderful advance in the use of electrically-propelled vehicles, ascribable to a number of causes.

While the design of the electric pleasure vehicle has always followed carriage makers' standards where lines, construction and finish are concerned, so that in appearance these vehicles remain practically the same, attention to details has resulted in a greater mileage with the same motor and battery equipment than was heretofore attainable. The manufacturers no longer make immoderate claims or guarantees for their equipments; most of them supplying the motor and vehicle and equipping the outfit with whatever make of storage battery the purchaser specifies. The latter is not deluded; and while it is only natural that he should desire some approximation as to the capabilities of the vehicle, the manufacturer simply states that such and such results have been obtained with a certain equipment under certain conditions. In order that some estimate of the mileage capabilities of the electric vehicle may be had, it might be well to state that nearly, if not all the manufacturers of electric vehicles have built machines which have exceeded 100 miles on a single battery charge under favorable conditions; one maker claiming 140 miles at a speed of 12 to 14 miles per hour.

To this day no one questions the superiority of the electric vehicle for commercial purposes; one great feature in its favor being that any driver of ordinary intelligence can operate it, whereas the gasoline vehicle must at all times be in the hands of an experienced man. The features of the various designs of electric vehicles are pointed out in the brief descriptions which follow:

The Anderson Carriage Company, of Detroit, Mich., builder of the "Detroit Electric," showed two pleasure vehicles, a

victoria and a coupé. An Elwell-Parker motor rated at from 2 to 3 horse-power is used, and the power is transmitted from the motor to a countershaft through a Renold chain running in oil. The countershaft, on which is placed the differential gearing is fitted with ball bearings. The controller allows forward speeds of from 8 to 23 miles per hour and on reverse, gives speeds of from 8 to 13 miles per hour. In pulling the controller handle backward, the circuit is opened and an emergency brake applied. A feature of the equipment is the lock switch, which is operated by the foot through two push buttons in the toe-board of the vehicle. The battery consists of 24 cells divided into two units of 12 cells and placed in the front and in the rear parts of the vehicle under detachable hoods. Drip pans under the battery prevent any acid from reaching any part of the vehicle or wiring. Generous battery space is provided, permitting the use of various size cells.

The Studebaker Automobile Company, of South Bend, Ind., exhibited an ambulance, runabout, stanhope, victoria, 14-passenger 'bus, light delivery wagon, 2500-lb. express wagon and a 1500-lb. car chassis. The pleasure vehicles are equipped with a single motor, and the battery is divided into two units and mounted over the wheels under hoods. The vehicles are designed for a speed of 15 miles, although the speed varies according to the tire equipment. The omnibus is fitted with two motors and 40 cells of battery divided into four units. The battery is carried beneath the body of the car in a trussed compartment suspended from the frame of the running gear. The light delivery wagon is specially designed for light work. A single Westinghouse motor is used with an Exide battery. The chassis of a 1500-lb. car for delivery work is built of re-enforced angle iron, and is equipped with two motors and a 40-cell battery. The 2500-lb. wagon is also equipped with two motors and a 40-cell battery. Chain drive is used on all the vehicles.

The Columbus Buggy Company, of Columbus, Ohio, had four pleasure vehicles on exhibition. The vehicles are equipped with Elwell-Parker motors and a 24-cell Exide battery. The latter is arranged half under the front hood and half under the rear hood, and the motor is located under the seat. The motor, battery, controller, wiring, etc., are all easy of access and are fitted to a pressed-steel chassis frame. Double chain drive is used and the axles are non-revolving, the hubs being provided with roller bearings. The motor, which is equipped with ball bearings, is set in an aluminum supporting frame. The controller is of the radial type with combined reversing switch, self-cleaning contact points and interlocking device preventing reverse changes being made until energy is shut off by the operation of the speed control lever. Speeds from 5 to 20 miles per hour forward and backward are arranged for.

The Babcock Electric Carriage Company, of Buffalo, N. Y., showed four models of pleasure vehicles—a roadster, victoria phaeton, special stanhope and a coupé, each meriting attention. The roadster can develop a speed of 26 miles per hour with an intermediate range of from 6 to 26 miles per hour. Double chain drive from a 2-hp motor suspended beneath the seat is used. The battery equipment consists of 36 cells of the company's own make, half of the cells being placed in front and half in the rear of the vehicle directly over the wheels. The chassis is of reinforced wood. The company recommends certain types of tires, claiming that any other type of tire will materially reduce the speed and mileage. The controller used is of the company's own design and allows five forward speeds and two reverse speeds. A stock car of this type has traveled 100 miles on a single charge. The victoria-phaeton and the coupé have similar battery and motor equipments. The special stanhope is equipped with a 3-hp motor and 40 cells of battery. Ball bearings are provided on the front wheels and roller bearings on the rear wheels. The controller allows three forward and two reverse speeds. The stanhope has in addition an accelerator whereby all of the speeds may be increased, the highest speed being 18 miles per hour. In all of the cars except the stanhope the speed is controlled almost entirely by a foot lever. After the controller handle has been set for the desired speed it is not necessary to touch the handle again, unless the rate of speed is changed. Once under way the car can be slowed down, allowed to coast, or the countershaft brake applied and the car brought to a stop, with but one movement of the foot lever.

The Pope Motor Car Company's Waverley Department, Indianapolis, Ind., builder of Pope-Waverley electric vehicles, exhibited 11 cars, eight pleasure vehicles and three commercial wagons. The pleasure vehicles comprised a surrey, coupé, stanhope, victoria-phaeton, coupé-phaeton, phaeton with English canopy, and two runabouts. The motors used on all of the vehicles are of Pope-Waverley design and either Exide or National batteries are supplied. The surrey is equipped with two motors and 42 cells of battery. Speeds ranging from 5 to 15 miles per hour are provided. The coupé is equipped with a single motor and 30 cells of battery, 10 in the front compartment and 20 in the rear compartment. The stanhope is also equipped with a single motor and 30 cells of battery. The three phaetons are equipped with single motors and 30 cells of battery. Both of the runabouts are similarly equipped with single motors and 30 cells of battery. All of the vehicles are driven through "herring-bone" type gearing running in oil and protected in dust-proof cases. The single-motor vehicles are equipped with double brakes acting on the rear hub. There is also a brake on the armature shaft. The double-motor vehicles are equipped with two double-acting brakes on the rear hubs. The commercial vehicles shown comprised an express wagon equipped with two 6-hp motors and an open-body and a closed-body delivery wagon. The latter vehicles are equipped with single motors and 42-cell batteries.

The Baker Motor Vehicle Company, of Cleveland, Ohio, made a display of five pleasure vehicles and one commercial wagon, the latter a police patrol. The pleasure vehicles shown were a victoria, coupé, special roadster, a landaulet and a polished chassis for any body. Annular ball bearings are used on all revolving parts of the Baker vehicles. The motors used are specially built by the General Electric Company and are claimed to be fool-proof. The victoria is equipped with a 2-hp motor and 24 cells of battery of any make The cylindrical controller gives six forward and three reverse speeds. The transmission is by silent chain reduction, single chain drive. The coupé has a motor and battery equipment similar to the victoria. The roadster is equipped with a 3½-hp motor and 40 cells of battery. The transmission is by planetary gear reduction, shaft and bevel gear drive. The controller gives nine forward speeds and three reverse. The batteries are connected in parallel to the fifth speed and after that in series. Eight speeds forward from 8 to 40 miles per hour are obtained without the use of a resistor. The mileage capacity of the roadster at 14 miles per hour is practically 100 miles on a single charge. The landaulet is equipped with a 6-hp motor and 40 cells of battery. The mileage capacity at 12 miles per hour is 50 miles on a single charge, and at the rate of 16 miles per hour, 40 miles.

The Rauch & Lang Carriage Company, of Cleveland, Ohio, showed a stanhope, a coupe and a landaulet. The vehicles of this company are equipped with motors built by the Herter Electric Company of Cleveland, and with Exide batteries. Roller bearings are used in the wheel hubs and the batteries are located in front and rear over the springs. Annular ball bearings are used on the motor and on the countershaft and the latter are supported in a sub-frame which is itself suspended from the chassis at three points. The motor brake and controller are also assembled to the sub-frame. Transmission from motor to countershaft is by means of a silent chain. The motor is designed to operate on a potential of 48 volts for all speeds. Two starting speeds are provided. The third position on the controller gives the first running speed, which is obtained by having powerful shunt coils along with the series coils. The second and third running speeds are obtained without the use of the shunt field coils. The fourth speed is obtained by reversed shunt field coils operating in conjunction with the series field coils. The controller is of the flat radial type, two movable copper-leaf contacts making the necessary connections to obtain the various speeds. The stanhope is equipped with 24 cells of

battery and the radius of action on a single charge is claimed to be as high as 100 miles, depending on the tire used. The coupé's equipment is similar to that of the stanhope. The landaulet is equipped with 24 cells of battery of a different type and has a maximum speed of 18 miles per hour. All the vehicles are equipped with a patented controller handle which possesses many valuable features.

The Electric Vehicle Company, of Hartford, Conn., builder of the Columbia electric cars, displayed five pleasure vehicles—a brougham, landaulet, hansom, victoria-phaeton and victoria. The leading features of the phaeton include a divided Exide battery of 24 cells with the weight distributed over both axles; motor and all working parts are attached to the body, making it possible to run over rough surfaces at high speeds; reduction gear and enclosed chain connecting the motor to the balance gear on the live rear axle, which runs in a tubular casing with all parts of the mechanism housed to exclude dirt; three forward speeds up to 15 miles per hour and two reverse speeds. The other vehicles have the running and operating parts attached to a chassis of cold-pressed steel. The motor is of special design and is connected to the driving axle by double-reduction, noiseless, helical gearing. There are five forward speeds provided up to 18 miles per hour and three reverse speeds. The battery consists of 44 cells of the latest Exide type and is carried in a single tray beneath the carriage body.

The General Vehicle Company, of New York, displayed four pleasure vehicles and a number of commercial trucks and wagons. The latter have unusually long wheel bases and low suspension so that they differ somewhat in appearance from the wagon that one is accustomed to see and from those previously made by the company. The pleasure vehicles also reveal departures from the company's previous practice. The landaulet, victoria-phaeton and runabout, all have pressed-steel frames with long, semi-elliptical suspension, single motor with differential countershaft, silent chain transmission and roller bearings. The landaulet is patterned to some extent after gasoline practice, the battery being placed forward under the bonnet.

The Alden Sampson Manufacturing Company, of Pittsfield, Mass., had one of the most striking exhibits in the commercial vehicle section of the show. A special form of tractor which has been given the title of the gas-electric road train, because the motive power is originally supplied by a gasoline engine of standard type direct-connected to a C. & C. generator. The latter furnishes energy to the tractor motors and to the motors on two trailers. Each car has a capacity of 6 to 8 tons and each is equipped with its own motors. The tractor contains the power plant located in front and has a carrying capacity of 3 to 4 tons. Owing to the use of steel tires a separate spring supported frame is provided for the power plant. The voltage can be varied through a fairly wide range and series-paralleling is effected by a rotary switch which is interlocked to the starting rheostat making it impossible for the operator to damage the apparatus. Switches are provided enabling the tractor to operate the train with its own motors only or to enable a car or cars to be operated without running the tractor through an extension cable of suitable length. The train is easily handled by one man, the control and steering gear being centered on the tractor. The speed of the train loaded with 20 tons on level roads is 6 miles per hour.

Western Electrical Inspectors Convention.

The third annual meeting of the Western Association of Electrical Inspectors was held at Hotel Ryan, St. Paul, Minn., Oct. 22, 23 and 24, 1907. Thirty members were present, including fourteen municipal inspectors. The following special committee reports were submitted and discussed: Committee on national electrical code, committee on outside wiring, committee on theater wiring and local ordinances, committee on show window and display lighting, committee on instructions to the public concerning the safe operation of electrical wiring and apparatus, committee on wiring for electric cranes, committee on laws and ordinances, committee on architects' specifications.

The following addresses were delivered: Approved Electrical Fittings, by Dana Pierce, electrical engineer, Underwriters' Laboratories, Chicago. Joint Construction Pole Line, by H. B. Gear, general inspector, Commonwealth Electric Company, Chicago. Electrical Inspection from the Viewpoint of the Central Station, by A. G. Munson, assistant superintendent, St. Paul Gas & Electric Company, St. Paul, Minn. Electrical Inspection from the Viewpoint of the Telephone Exchange, by C. M. Mauseau, general manager, Northwestern Telephone Exchange Company, Minneapolis, Minn. Flexible Cord for Pendants, by H. T. Wreaks, secretary, Wire Inspection Bureau, New York.

Of seventy-three proposed changes in the National Electrical Code, twenty-four were approved and thirteen were referred back to the committee for further consideration, with instructions to report back to the executive committee with power to act.

Tours of inspection were made to electrical installations, including underground system of tunnels operated by the St. Paul Gas & Electric Company; conduit installation in reinforced concrete building; open wiring in can manufacturing plant; theater wiring equipment in two houses, one new and up to date, the other old.

Waldemar Michaelsen, city electrician of Omaha, Neb., exhibited a number of fittings and materials used in electrical construction work in Berlin, Germany. In most instances they suffer by comparison with those bearing Underwriters' approval in the United States.

The following officers were elected for the year 1907-8: President, E. R. Townsend, Chicago; first vice-president, Geo. D. Bayle, Chicago; second vice-president, H. C. Harris, Columbus, Ohio; secretary and treasurer, W. S. Boyd, Chicago. Executive Committee—Chairman, Fred G. Dustin, Minneapolis, Minn.; Geo. D. Bayle, Chicago, Ill.; F. R. Daniel, Indianapolis, Ind.; H. C. Harris, Columbus, Ohio; Waldemar Michelsen, Omaha, Neb.; J. H. Montgomery, Detroit, Mich.; W. C. Stewart, St. Joseph, Mo.; E. R. Townsend, Chicago, Ill.; F. D. Varnam, St. Paul, Minn.; secretary, William S. Boyd, Chicago.

The next meeting will be held in Chicago, in October, 1908.

Some Interesting Steam Turbine Data.

The improvement in economy brought about by the use of steam turbines, as compared with reciprocating engines as a class, is due in great part to the fact that a turbine can operate effectively in the lower pressure ranges, while with reciprocating engines mechanical conditions prevent a possibility of high degrees of expansion. An illustration of the wide range of pressure that can be utilized to advantage, is furnished by the following tests on a 9000-kw Curtis generating unit installed in Chicago:

Load in Kilowatts	Gauge Pressure Pounds	Vacuum Inches	Superheat Degrees F.	Water Rate Pounds per Kw-hour
8,374	182	29.42	[illegible]	[illegible]
[illegible]	179	[illegible]	[illegible]	[illegible]
10,186	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	182	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

To take the set of readings nearest to full load, it will be seen that the steam was worked from a pressure of 179 lbs. gauge to a vacuum of 29.55 ins.; that is, to a point within less than a quarter of a pound of an absolute vacuum. In this state of vacuum, steam has a volume over four times as great as under a 28-in., and eight times as great as under a 26-in. vacuum.

The ease with which the turbine can handle this large volume of steam, and utilize the additional energy that becomes available, is clearly expressed in the water rate of 13 lbs. per kw-hour which was obtained. This rate, it might be added, represents the largest return from the fuel which has so far been realized by any steam process.

As a further instance of the high economy of turbines, the test of a 5000-kw unit installed in Boston may be cited. This test gave a water rate of 13.52 lbs. per kw-hour with a load of 5195 kw, a steam pressure of 173.7 lbs., a superheat of 142 degs. F. and a vacuum of 28.8 ins.

In this connection, it is decidedly interesting also to note the range of, and increase in, size of turbine units. Commercial shipment of Curtis turbo-generators began about four and a half years ago. In the short period of time that has elapsed since then, shipments have been made aggregating in normal rating over three-quarters of a million kilowatts, while the total number of units sold to date is considerably above a thousand, with an aggregate capacity of over 1,000,000 kw. The demand for the various sizes is indicated in a general way by the following abbreviated list. Over two hundred and fifty of 500-kw units have been sold, about seventy-five of both the 1000 and 1500-kw sizes and some fifty 2000-kw units. Orders have been received for a number of the new 14,000-kw units.

Electrically-Operated Reduction Mill.

The Boston Consolidated Mining Company is just completing at Garfield, on Salt Lake, a short distance from Salt Lake City, Utah, a stamp mill of 3000 tons daily capacity, which is to depend for its operation on electric motors receiving energy from the long-distance transmission line network of the Telluride Power Company. Three separate lines of this company enter the sub-station at this mill. The lines are operating now at 40,000 volts, and are designed to be raised later to 60,000 or 80,000 volts. The sub-station is of 5000 kw capacity. Westinghouse induction motors are used in the mill.

The Depression in Public Utility Securities.

It is well known that in the recent panic, as in the long depression that preceded it, public utility corporation stocks and bonds have suffered severely. Indeed, a point has been reached from which it should now be possible to begin the return to quotations nearer real values. A short table compiled by the *Wall Street Journal*, ranging over a year, gives a good idea of the situation. Out of nineteen of the most active public utility securities, stocks and bonds, traded in on the New York Stock Exchange, fifteen show declines of 50 or more points from their high prices of 1906, while Consolidated Gas and Third Avenue each show a decline of more than 100 points. The depreciation in market values of the nineteen issues from the high of 1906 to the low of 1907 amounts to $468,014,286 Of this amount Inter.-Met. common and preferred, and the company's 4½ per cent bonds, together furnish $107,877,463.

Below are exhibited the amount of outstanding stock or bonds of the nineteen issues, with the high for 1906 and the low for 1907, the number of points decline and the depreciation in market values:

	Amount Outstanding.	1907. Low.	1906. High.	Dec.	Depreciation.
B. R. T. [illegible]	$[illegible]	[illegible]	[illegible]	[illegible]	$[illegible]
B. R. T. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Brooklyn United Gas.	15,000,000	99⅞	178	78⅛	11,718,750
Consolidated Gas.....	80,000,000	74	181¼	107¼	85,800,000
Consolidated Gas [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Detroit United [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Inter-Met., com [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Inter-Met., pfd [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Inter-Met., 4½s......	67,805,000	49¼	90¼	41	27,800,050
Manhattan Railway...	60,000,000	100⅞	162	61⅛	36,675,000
Met. Street Railway..	52,000,000	30	127	97	50,440,000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
People's G. L. & C...	32,969,100	70¼	103	32¾	10,797,380
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tol. Railways & Light.	15,000,000	11½	36	24½	3,675,000
Twin City..........	20,100,000	70¾	122¼	51½	10,351,500
United R. I., com....	19,400,000	12	98	86	16,684,000
United R. I., pfd.....	15,000,000	20⅛	93½	73⅜	11,081,250
Total depreciation					$468,014,286

As before stated, the high prices of practically all the issues shown above were made in January of 1906. The high prices for the Inter.-Met. issues were made within the first few weeks in which they were traded in. Most of the low points shown above have been made during the last week. In addition to general market conditions there have been many things to help depress market values of the public utility securities. The passing of the 80-cent gas bill by the State Legislature had a greater effect on Consolidated Gas and Brooklyn Union Gas than did any other event on any security. The cutting of the Consolidated Gas dividend and the passing of the Brooklyn Union Gas dividend resulted from this legislation. The securities of these two companies have also suffered from the attacks of various officials and from the fear that the companies may be made subject to the inquisitorial terrors of the Public Service Commission. On the other hand, there is much in the display of public temper just now to indicate that corporation baiting will not be allowed to go much further.

CURRENT NEWS AND NOTES.

WIRELESS IN ALASKA.—We [illegible] Mr. [illegible] E. Harper, first class sergeant, U. S. Signal Corps, now at the wireless station, St. Michael, Alaska, for the following data in comment on an article in our columns last August: "It gives me great pleasure to state that the Signal Corps, U. S. A., are operating, and have been, since Aug. 17, 1904, a successful commercial wireless system between Safety Harbor and St. Michael, Alaska, a distance of 110 miles, handling from 100 to 150 messages and press daily without interruption or error. The system used is in greater part equipped with instruments devised by men of the Corps. Another year, with instruments now in use, will see a chain of wireless stations daily handling a large amount of business between Safety Harbor, St. Michael, Fairbanks, Circle and Valdez."

ENGLISH MUNICIPAL CRAZE.—A further reaction is noted in England against the violent socialistic, public-ownership craze of the past 25 years. A special cable dispatch from London, of Nov. 2, remarks that the fact that Socialism has not gained such a hold on British constituencies as the result of the last Parliamentary election led many persons to believe, has been shown in the municipal elections held in England and Wales last week. At the general elections the Socialists succeeded in electing members of Parliament principally in three-cornered fights with such success that both the great parties, the Liberals and the Conservatives, entered on a strenuous campaign against what they termed the "dangerous propaganda of the Socialists." This has resulted in the overwhelming defeat of the Socialists throughout the country, that party even losing many seats formerly held by it. To do this the Liberals and Conservatives, or Unionists, combined in some instances, but even where fusion was not resorted to the more conservative candidates were elected.

GEMS MADE BY RADIUM.—Further details are to hand of the work done in France by Prof. F. Bordas in transforming ordinary corundum or oxide aluminum crystals into rubies, emeralds, sapphires and topazes by the use of radium. The jeweler who sold Prof. Bordas the original corundums, valued at about 50 cents a carat, has appraised several of the transformed jewels at $100, and even $150 a carat. Some of them are exceedingly beautiful in brilliancy and color. Prof. Bordas decided to experiment with the hardest crystalline substances, and selected for the purposes of economy the cheapest form of corundums. Under the influence of a molecular bombardment produced by the emanations of bromure of radium the corundums underwent a remarkable change. The hitherto white crystal became to all appearances a topaz; blue corundum became an emerald; a green-pink one became a ruby, and a violet crystal a sapphire. By graduating the radio-active emanations the professor even secured a mixed gem, half sapphire and half topaz. When he submitted the newly created gems to the expert lapidary from whom he had purchased the original crystals the latter declared that it was impossible to distinguish his gems from natural ones. Prof Bordas, who is the Director of the Laboratory of the Ministry of Finance, repeated his experiments time and again before he finally reported the result of his researches to the Academy of Sciences, a small tray of radium-made gems being submitted to the scrutiny of the members of the learned body at the same time. These stones have been declared to be genuine.

INSPECTION TRIP OF CLASS.—Thirty-five members of the senior class in electrical engineering at the University of Illinois, accompanied by Prof. Morgan Brooks, professor of electrical engineering, are making an inspection trip through the East, the itinerary including Schenectady, New York and Pittsburg. The party attended the meeting of the A. I. E. E. Friday evening of this week.

CIVIL SERVICE EXAMINATION.—The New York State Civil Service Commission will hold examinations Nov. 30 for various positions, including that of electrical engineer of the Public Service Commissions. The salaries of these positions are $1,500 to $3,600. Further information with application forms may be obtained from the chief examiner of the commission at Albany, Mr. Charles S. Fowler.

A. I. E. E. MEETING.—As announced last week, the American Institute of Electrical Engineers will hold its two hundred and twenty-second meeting in the auditorium of the Engineering Societies Building, on Friday of this week, at 8:15 p. m., when Mr. A. H. Armstrong, of the General Electric Company, will read a paper entitled "Comparative Performance of Steam and Electric Locomotives." Several prominent engineers have been invited to participate in the discussion.

UNIVERSITY OF TORONTO.—The University of Toronto Engineering Society has decided to discontinue the publication of its annual transactions and to replace them by a regular publication issued monthly during the academic year. The standard will be maintained and raised. This monthly, it is stated, will have a guaranteed circulation of 1500 at the start, and this is to be increased to 2000 before the first volume is complete.

ILLUMINATING ENGINEERING SOCIETY.—The next meeting of the New York Section of the Illuminating Engineering Society will be held at the United Engineering Societies Building, 33 West Thirty-Ninth Street, Thursday evening, Nov. 14 at 8:15 o'clock. Mr. W. S. Andrews, of Schenectady, will present an illustrated lecture on "Pioneer Electric Lighting." This lecture will treat of the early development of the incandescent electric lamp and central station practice, and of the men associated with these early enterprises.

A GRAND RAPIDS CLUB.—An electrical educational club has been formed by the 50 or more employees of the Grand Rapids-Muskegon Power Company. A course of lectures on electrical subjects, extending over a period of six months, will be given at the company's office. The first was given Oct. 30 by F. E. Greenman on "Building and Operating Dams and Transmission Lines." Following this, twice a month, lectures will be given on the use of electric motors in factories, illuminating engineering, new methods of lighting, the latest ideas in electrical heating devices and kindred subjects. Discussions will follow the lectures.

STILL USING WAX CANDLES.—It is stated that the Earl of Mansfield has entered into a contract with the Hampstead (London) Council for the supply of electricity for lighting his mansion at Ken Wood, adjoining Hampstead Heath. The work of wiring and fitting is being proceeded with. In this case electric light takes directly the place of wax candles, as the successive Earls of Manchester have refused to use gas lighting, which accounts for the excellent preservation of the many art treasures in the mansion. In many of the famous old ancestral libraries, etc., of England it was found that gas could not be used on account of the quick rot that ruined the choice bindings.

TWENTY-FIVE YEARS OF THE INSTITUTE.—Before the Schenectady chapter of the American Institute of Electrical Engineers, Mr. T. C. Martin gave an address dealing with the history of the institute since the first steps were taken for its formation in 1883. Details were given of that formative period, and a number of points of general interest were touched upon by the lecturer, who has held every office in the Institute except that of treasurer, and who was president in 1887, being now, therefore, the senior survivor of the 19 who have occupied the chair. One interesting part of the address was that giving data as to the manner in which this the youngest of the four national engineering societies has already a considerable lead over the others in membership. Mr. D. B. Rushmore, chairman of the local section, presided.

ARC-LAMP IRON ELECTRODE.—A patent granted Oct. 29 to Richard Fleming describes an electrode for an arc lamp consisting of an iron tube filled with iron in a divided state, such as iron filings, cast-iron chips, or the like. It is stated that such an electrode possesses considerable mechanical advantages, and is easily and cheaply made. As an electrode for a luminous arc, it is but slowly consumed in operation, and the arc given thereby—of the flame or luminous type—possesses high illuminating powers. Another patent issued on the same date to the same inventor, but on application filed some months later (March 26, 1903), describes a similar electrode, but the iron tube is filled with magnetite. In both cases the electrode is intended for use as the lower electrode in an arc lamp.

NEW INSULATING MATERIAL.—A patent granted Oct. 29 to Robert Muller, of Munich, Germany, describes an insulating material which is claimed to be fireproof and to have a high specific resistance sufficiently near to rubber or porcelain to make it satisfactory for use in the electric art. Although pitch is one of its constituents, it is stated that the material is so non-inflammable that it may be subjected temporarily to an electric arc without being burned up and without being softened. The process for making the material consists in combining intimately a fire resistant material, such as asbestos in a comminuted state, with a bituminous material, such as mineral pitch, dissolved in a suitable solvent, such as benzol, and so proportioned that a consistent, plastic mass is formed, which is then subjected to heavy pressure, preferably in a cold state, and dried by the evaporation of the solvent. The proportions of the several constituents mentioned is 100 parts of mineral pitch dissolved in 20 parts, by weight, of a volatile solvent: from 25 to 75 parts of the solution is used with 100 parts of asbestos.

AN ELECTRIFIED MATTERHORN.—It is stated that English mountain climbers and other selfish admirers of Alpine scenery have taken up the protest made by many Swiss against the building of an electric railway on the Matterhorn. Sir Martin Conway, the well-known explorer, presided recently at a meeting of the English branch of the Swiss League for the Preservation of Picturesque Switzerland. Here a protest to the Swiss Federal Council against the projected railway was drawn up. The Bishop of Bristol, representing the Alpine Club said that, in the eyes of all to whom sublimity of nature appeals, the projected railway would act as a profanation and that the sacrifice of such a mountain as the Matterhorn to sectional interests and to the materialization of the age, would involve an irreparable loss to humanity and a wrong to succeeding generations. The matter will shortly come up before the Swiss Parliament. Meantime work on the Jungfrau Railway is proceeding at such a pace that non-climbers who visit the Alps may expect to find it in operation to the summit within two years. It is just 10 years since the building of the Jungfrau Railway was begun, and it is now complete to Jungfraujoch, which has an altitude of 11,200 ft. About 2300 ft. more of altitude remain to be surmounted. The necessary roadway for 2000 ft. of this altitude will be placed in the open, but for the last 300 ft. the engineers have planned an elevator which will be operated through the heart of the mountain. Thus invalids and others who cannot climb the higher Alps are enabled to enjoy the beauties that hitherto have been the exclusive possession of people with strong legs.

A FRATERNAL KISS.—Sarah Bernhart uttered a pretty sentiment when sending a wireless message across the sea, she made it read: "This fraternal kiss of Europe and America across space is the most poetic manifestation of science."

TELEPHONE APPARATUS.—At the October convention of the Pennsylvania State Independent Telephone Association resolutions were adopted unanimously not to use Bell apparatus and to expel any member company purchasing, using or connecting such apparatus. The cause of this is the recent action in placing Bell telephones freely on sale to every comer.

THREE NAMES.—In noting the success of commercial wireless telegraphy, the *Wall Street Journal* names Morse, Field and Marconi in connection with their great work in land and submarine and wireless systems, and says: "The three names identified with this less than half a century of progress deserve to be kept in memory as among those who have done most to contribute to the welfare of mankind by the shrinkage of distances through improved means of communication."

ENGINEERING LIBRARY OPEN EVENINGS.—On and after Wednesday, Nov. 6, 1907, the reference libraries of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Institute of Mining Engineers, at 29 West Thirty-Ninth Street, New York, will be open evenings until 9 o'clock on all week days except public holidays. These libraries, constituting practically one library of engineering, are available to members of the above-named societies, engineers and the public generally, subject to proper regulations. Strangers are requested to bring letters of introduction from members or to secure cards from the secretaries of the respective societies.

TELEGRAPHS IN PERU.—U. S. Consul C. C. Eberhardt, of Iquitos, reports that a contract has been approved with a German company for the extension of the wireless telegraph system from Masisea to Iquitos. The operator of the station at Masisea states that the supplies are now being shipped from Europe for this extension. He also says that the company is greatly elated over the success of the system between Puerto Bermudez and Masisea, the first of its kind, members of the company assert, that has been successful in overcoming such distances under difficulties of forest and mountain, though various other attempts have been made in tropical South America and in the Kongo districts.

THE TECHNICAL PUBLICITY ASSOCIATION, of New York, devoted its meeting of Oct. 31, to "The Mailing List" in securing foreign business. The discussion, introduced by F. F. Coleman, advertising manager of the Lidgerwood Manufacturing Company, became general. Mr. Steven de Csesznak, of the *American Exporter,* gave an address on the subject. The following were elected to membership: Randolph T. Ode, Providence Engineering Works; C. Dickens Sternfels, Standard Roller Bearing Company; J. Mason Knox, General Electric Company; L. D. Gibbs, Boston Edison Electric Illuminating Company; Walter S. Rogers, Crane Company; H. S. Snyder, Joseph Dixon Crucible Company. It was announced at this meeting that organizations modeled on the Technical Publicity Association are being started in Chicago and in London.

ELECTRICALLY DRIVEN OCEAN LINERS.—A special cable message from London states that experiments are now being conducted with the object of providing an electrical connecting link between the low-speed propeller shaft and the steam turbine which operates to best advantage when the speed is high. The turbines are to be direct connected to either direct-current or alternating-current generators and the propellers are to be similarly connected to corresponding electric motors. Among the advantages claimed for the "electrical gearing" are flexibility in placing the various machines to best advantage and designing each for its specific duty, ability to reverse the propellers at will, and to control the whole movement of the ship from the polit-house. It is claimed that a speed of 30 knots per hour can be obtained with the electrical equipment.

ZONE TROLLEY FARES.—A rather sharp criticism is made by *Concerning Municipal Ownership* in its November issue as follows: "Mayor Johnson, of Cleveland, when put on the witness stand recently was forced to admit that his much-advertised low-fare scheme would not supply transportation equivalent to that now being given by the Cleveland Electric Railway Company, since it would be operative only within the city limits. Inasmuch as a large part of the passengers now carried reside in the suburbs, and as under his plan they would have to pay two fares, the 'low-fare' proposition would be an expensive arrangement for them. Shorn of the glamour of Johnsonism, the plan practically involves a change from the American 'one ride, one fare' principle to the zone system which has so effectually restricted traction development in Europe. The serious objection to this method is that it tends to keep population crowded within the limits of the inner zones, and thus to perpetuate the tenement evil. In doing anything to restrict the movement to the suburbs, Mayor Johnson is showing himself an enemy to the health and morals of his city. But what do they count when political power is at stake!"

REBUILDING SAN FRANCISCO.—Mrs. Gertrude Atherton, in the course of her noteworthy article in the current *Harper's Weekly* entitled "San Francisco and Her Foes," gives, incidentally, some surprising figures showing the remarkable and little-realized extent to which the stricken city has been rebuilt—and rebuilt, says Mrs. Atherton, in such a way that its appearance is in many places greatly improved. These are the exact figures: Up to August 1st, 1907, San Francisco building permits since the fire amounted to $79,152,447. The number of Class A buildings erected are 47, costing $11,969,500; Class B buildings, 76, costing $5,953,050; Class C buildings, 941, costing $26,716,319. Frame structures, complying with building laws and classed as permanent, 2191, costing $28,072,475. For repairs and alterations, including permits for rehabilitation of Class A buildings damaged by the fire, $6,441,112. To this estimated cost must be added fifteen per cent. as actual costs are proven to be that much higher than the architect's estimates. Of this expenditure labor has received forty-five per cent—$35,618,590. During the two years following the Baltimore fire building permits in that city amounted to $28,000,000. During one year following the San Francisco fire building permits have amounted to $60,169,923. This new work has involved, of course, an immense amount of new electrical interior work, some of which has been noted in these columns.

OVER-CAPITALIZATION.—Discussing the subject of trusts before the recent special convention of the National Civic Federation in Chicago, Mr. Isaac N. Seligman said: "The question of capitalization in the case of the trust is one that primarily affects the investing public. Entirely too much, in my opinion, has been made of over-capitalization of industrial enterprises. So far as the control of capitalization is intended to safeguard the investor I can only record my conviction that the judgment of the market invariably discounts the nominal capitalization of the company. If this capitalization is larger than the facts warrant the securities sell at a discount; if smaller, they sell at a premium. The actual basis of such market valuation is not the par value, nor yet the actual assets of the company, but it is in every case earning capacity. The anti-trust policy should not proceed faster than is compatible with public welfare. The investing public have too much interest in such securities, and the shock to business interests is too violent. The law should be so modified as to reach only those who have really committed a crime against the well-considered interest of the community as a whole. The attempt vigorously to enforce a law which is based upon erroneous premises is [illegible]"

Steam-Driven Transmission Stations of the Societa Lombarda, of Milan, Italy.

IN June, 1900, the Società Lombarda opened its first hydro-electric power house at Vizzola Ticino, Italy, and succeeded in loading it to its maximum capacity in a little more than three years. From this power house electrical energy is supplied directly to about 110 consumers, 20 of whom redistribute the energy for lighting and small motor loads, they having obtained rights from the Società Lombarda to sell energy in certain districts.

The rated capacity of the Vizzola Ticino station is 12,000 kilowatts. Electrical energy from it is distributed over a network more than 125 miles long, to which are connected about 700 electric motors and 30,000 incandescent lamps. The territory covered includes 40 towns, and there are in all about 2000 consumers connected to the line.

The principal large centers of energy consumption are Legnano, Busto-Arsizio and Gallarate. In these communities, and in some of their suburbs, the cotton industry alone requires more than 12,000 horse-power, or two-thirds of the maximum capacity of the Vizzola station.

It was readily apparent, therefore, that the demands for electrical energy would soon surpass the output of the station at Vizzola, and the Società Lombarda, in 1901, decided to construct a second hydro-electric station at Turbigo, 7.5 miles further down the valley on the banks of the Ticino River, where 5000 horse-power could be developed; the water being taken from the canal of Naviglio Grande. This power house is now finished, and in regular operation; and before the end of the present year arrangements will be completed for transmitting energy from this station to all parts of the network now fed from the Vizzola station.

At the time of the construction of the Turbigo hydro-electric station it was foreseen that the demand for electricity would become so great before the completion of the plant as to exceed the rated capacity of the station of Vizzola and would require the continuous operation of [illegible] units. Accordingly, the company decided to build a steam-driven [illegible] station, which would act as a [illegible] reserve to the hydro-electric stations.

The first units installed in the steam-driven station have an aggregate rating of [illegible] horse-power, which is equal to the maximum rating of the new station at Turbigo, the idea being that the steam station could carry the entire load of the new station in case of delay in construction.

The steam-driven station is situated at Castellanza, which is an important center of energy consumption. This location was chosen for the following reasons: It could easily be connected to the transmission system; it was not far from the hydro-electric stations, in conjunction with which it was to operate; there is ample and suitable supply of water for condensing purposes; and it is near two railway lines, the Milano-Gallarate and the Novara-Seregno, over which the coal can be economically supplied.

The work of construction on the steam station was commenced in May, 1903, and in little over a year the station was put in operation. The masonry work was done by the Brambilla Company; the steam machinery was supplied by Franco Tosi, of Legnano, and the electric machinery by Brown, Boveri & Company, of Baden. The first units installed consist of two horizontal triple-expansion steam engines directly coupled to three-phase alternators; each unit rated at 2700 horse-power. The frames of the engines are of the bayonet type, cast in one piece with the crank bearings. There are two low-pressure cylinders, one being placed in tandem with the high-pressure cylinder, the other in tandem with the intermediate-pressure cylinder. The cranks are displaced 90 deg. from one another on the driving shaft. Each cylinder is equipped with two admission and two discharge valves; the high-pressure cylinder valves being controlled by a Porter governor, which can vary the cut-off from 0 to 60 per cent. The governor is arranged to permit the adjustment of speed by hand for use when paralleling the alternators. Forced lubrication is used for the cylinders, the crank-pin and all working parts of both engines being supplied with oil from a common reservoir.

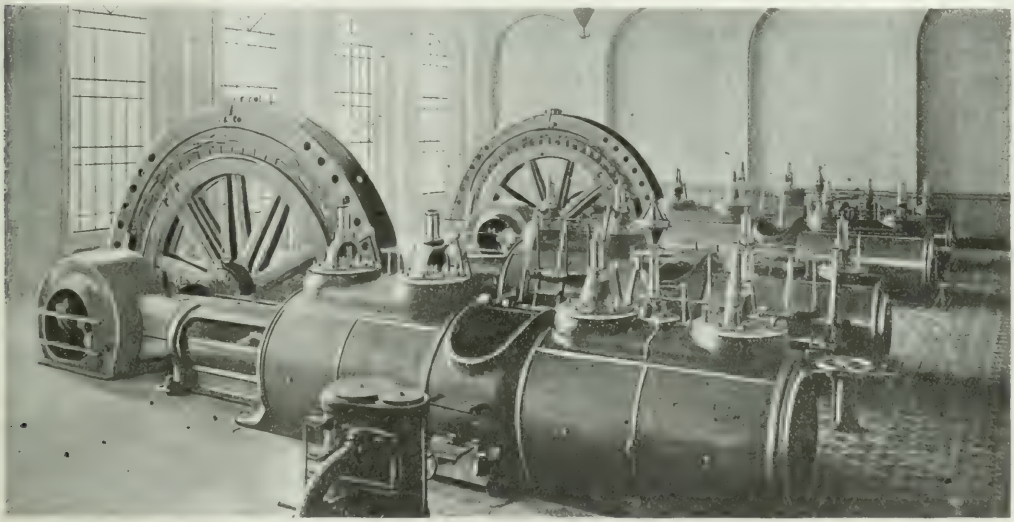


FIG. 1.—STEAM DRIVEN ALTERNATORS IN THE CASTELLANZA POWER HOUSE

The power, guaranteed efficiency, and steam consumption, the engine operating condensing with superheated steam having a temperature between 250 deg. and 280 deg. C., and having an initial pressure of 180 lbs., are as follows:

Cut-off in the high-pressure cylinder, per cent	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net horse-power	[illegible]	[illegible]	[illegible]	2000	[illegible]
Efficiency, per cent	[illegible]	[illegible]	[illegible]	88.5	[illegible]
Steam consumption (superheated), pounds per h.p.-hour	[illegible]	[illegible]	9.18	[illegible]	[illegible]

The alternators are of the revolving-field, solid-pole type, rated at [illegible] kilowatts for power

[illegible] part is 40 tons.

The guaranteed efficiency and regulation are as follows:

[illegible]	[illegible]	per cent
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
Drop of potential from no load to full non-inductive load (1920 kw), excitation and speed remaining constant.....	9	"
Drop of potential from no load to full load (1920 kw), excitation and speed remaining constant for power-factor = 0.8	23	

The alternators are separately excited by means of two independent exciters, one of the groups being driven by a small tandem-compound steam engine running at 375 r. p. m., and the other being driven by an electric motor.

Steam is furnished to the two prime movers by six water-tube boilers constructed for an effective pressure of 195 lbs., each having a heating surface of 3175 sq. ft. The aggregate heating surface of the plant being 19,050 sq. ft., and the superheating surface being 3875 sq. ft. A battery of 16 economizers, having a heating surface of 5186 sq. ft., is installed for heating the feed-water.

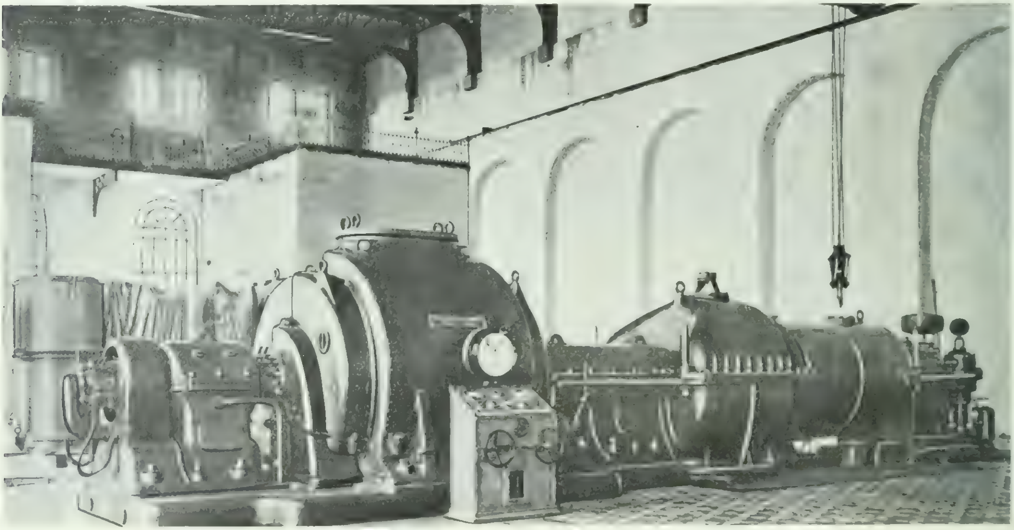


FIG. 2.—ONE OF THE 5000-KW [illegible] IN THE CASTELLANZA [illegible]

The boiler feed-water is forced by two electrically-driven pumps from a well into a large cement tank placed under the floor of the boiler room. From this tank, the feed pumps, three in number, two driven by electricity and one by steam, deliver it to the boilers. For condensing purposes, a specially constructed canal from the Olona River conducts water from the river into a large tank directly under the condensers, where it is mixed with condensed steam and returned to the river at a point further down the stream.

The exciter motors, the lamps, the motor for the traveling crane, the motors driving the feed-water pumps, the motors operating the automatic cleaners of the economizers, the coal and ash conveyors, the repair shop, etc., are all supplied with electricity either from the station itself or from the hydro-electric plants at Vizzola and Turbigo.

A small Tudor storage battery is placed under the switchboard to secure continuity of excitation and illumination. The battery is large enough to supply electricity for excitation and for illumination for an hour.

The switchboards are arranged so that the alternators can be operated either independently of those in the hydro-electric plants, or in parallel with those in one or both of the hydro-electric stations. Experience has shown that the three plants can be operated very successfully in parallel; the steam station being used to supply the peak loads of the hydraulic stations, thus permitting the latter to work continuously at their maximum capacity.

In June, 1904, a company was organized at Basilea for the development of certain important concessions of hydraulic power given to the Swiss towns of Poschiavo and Brusio, in the Canton of Grigioni. The principal promoters of this company are the Società Lombarda and Alioth Company, machine builders, in Basilea. The capital was supplied from Swiss, Italian and English sources.

The most important concession was the first to be developed. This concession is on the Poschiavino River, near the Italian frontier, between the town of Campocologno and the valley Tirano, where 20,000 horse-power can be obtained with a head of 1312 ft. The continuity of flow is assured by the Lake Poschiavo, which is located above the falls.

The Società Lombarda acquired a lease covering a period of years from the Brusio Company for the purchase of the output of the first station, and, in addition to this, it secured an option on the major portion of the energy which the Brusio Company could supply in the future when other concessions were developed.

The energy obtained from the Brusio Company's first plant was to be used to supply the increase of business in the neighborhood of Busto, Legnano, Gallarate and Saronno, where a market for the energy from Vizzola and Turbigo had rapidly been built up. The rest of the energy was to be distributed to a network in the neighborhood of Como, which is a large industrial center.

The plant for developing and transmitting electricity was begun a little before the end of 1904, and is now nearly finished; the companies expect to begin operation at about the end of this year. The transmission line is 100 miles long, and is one of the largest Italian systems that develop electricity in the Alps and transmit it to a long distance.

During the construction of the hydro-electric plant on the Poschiavo River, the Società Lombarda was confronted by the same conditions as existed during the construction of the plant at Turbigo, and resorted to the same methods of meeting them, namely, by the construction of a steam-driven electric station.

This new steam station is an extension to the old station at Castellanza; the new units consisting of turbo-alternators of the Brown, Boveri-Parsons type. One 5000 kilowatt unit was installed immediately to take care of the most urgent needs, and later a second and equal unit will be installed, which, together with the first, would constitute a complete reserve for the Brusio system.

Castellanza being one of the most important distribution centers, it was decided to construct a transformer sub-station at the steam power house at the same time that the other additions were being made. A second transformer sub-station was constructed at Lamazzo, from which center the Lombarda Company expects to develop a large business in the Comense region.

The sub-station is equipped with seven 50-cycle, 1250-kva single-phase transformers, reducing the e. m. f. from 35,000 volts to 11,000 volts. The guaranteed efficiency of the apparatus is 97.5 per cent, and the regulation, at a full inductive load, 3 per cent. Six of the transformers are in continuous service, the seventh being held in reserve. The six transformers are connected in two groups, each group being connected in star, thus forming two three-phase transformer groups, each group having a rating of 3750 kilovolt-amperes.

The turbo units were built by Franco Tosi at Legnano, and

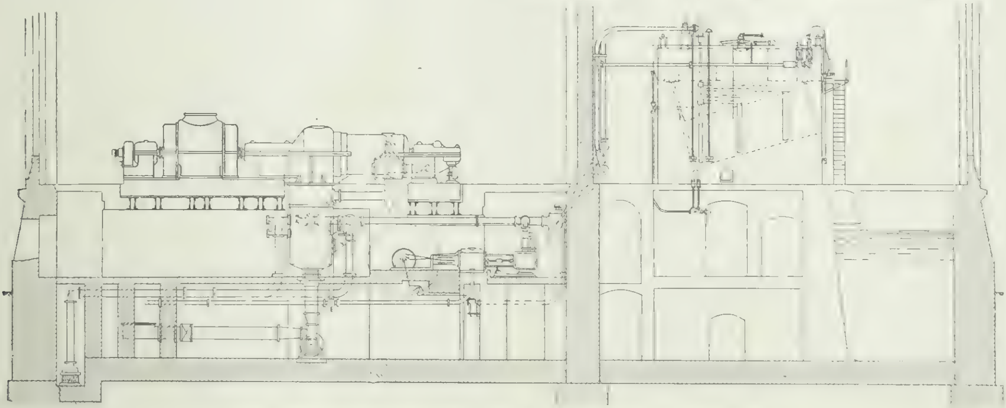


FIG. 3.—PARTIAL CROSS SECTIONAL VIEW OF CASTELLANZA POWER HOUSE.

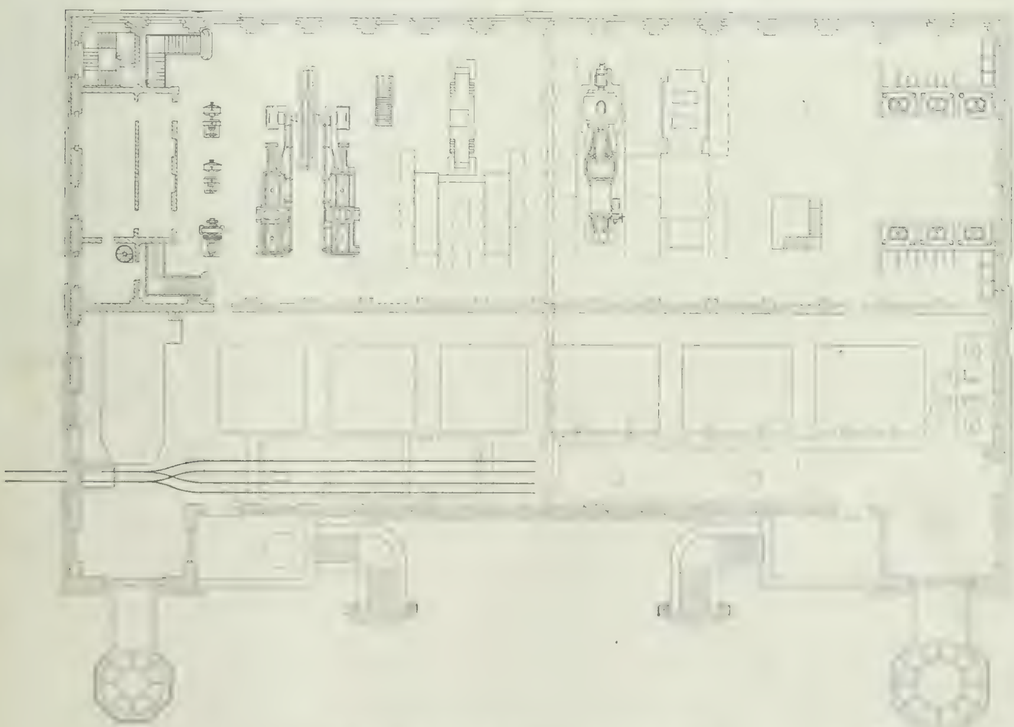


FIG. 4.—PLAN VIEW OF CASTELLANZA POWER HOUSE.

each is rated at 5000 kilowatts at a power-factor of 0.8 when operating with superheated steam at 275 deg. C., and at a speed of 1000 r. p. m. Each unit has its own direct-connected exciter and its own condenser, which is of the partial barometric type equipped with a centrifugal pump and an air pump. The guaranteed steam consumption when operating with superheated steam at 275 deg. C. and a pressure of 180 lbs. condensing with water at about 16 deg. C., is:

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Coal consumption, kg. per kw-hr....	0.79	0.825	0.905	1.27
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The condenser system is of a type patented by Franco Tosi. The steam is condensed by a spray of cold water; the condenser water being removed by a centrifugal pump placed directly below the condensing chamber. The column of water over the pump serves to regulate the load on the pump by varying the static head, the speed remaining constant. A check valve is placed in the exhaust pipe to prevent the return of water to the condenser in case of the stoppage of the centrifugal pump. In case of an accident to the centrifugal pump which would prevent the removal of the condensed steam, provision is made to stop the turbine and shut off the supply of injection water. The devices for doing this are operated by a float located in the lower part of the condensing chamber.

The moist air is removed from the condenser by an air pump of the Tosi vertical, compound, twin-cylinder type, the cylinders of which are cooled by water jackets. The two pumps of one turbo unit are driven by a 120-hp steam engine; those of the other unit being driven by three-phase motors operating at 500 volts, which is the potential of the distribution system.

The number of boilers was increased by the addition of six water-tube boilers built by Franco Tosi, of Lagnano. These boilers have an aggregate heating surface of 5920 sq. ft., and a superheating surface of 1615 sq. ft., and are built to operate at 190 lbs. The furnaces are fitted with automatic stokers of the underfeed type arranged to burn Cardiff coal.

The Società Lombarda has lately placed orders for delivery within this year of two turbo-generators, each rated at 2500 kilowatts, and operating at 1500 r. p. m.

Self-Inductance of a Solenoid of Any Number of Layers.

By Louis Cohen.

The only formula now available for the calculation of the self-inductance of a long coil or solenoid of more than one layer is that of Maxwell, which is as follows:

$$[illegible] \qquad (1)$$

where l is the length of the solenoid, n is the number of turns per unit length, x and y are the external and internal radius of the solenoid. This formula, however, was developed on the assumption of a uniform field within the coil, which means that the end effects can be neglected. The assumption may lead to an error as great as 12 per cent, as I shall show later, even in the case of a comparatively long solenoid, with a length ten times the radius. It is quite evident that such a formula is not of very great value where accurate results are desired. It is, however, a very simple and convenient formula for numerical computations and is useful when only a rough approximation is desired.

The formula given below for the self-inductance of a solenoid of any number of layers will give results accurate to within one-half of a per cent even for short solenoids, where the length is only twice the diameter, the accuracy increasing as the length increases.

For most practical purposes this degree of accuracy is amply sufficient.

The formula is as follows*:

$$[illegible] \qquad (2)$$

Where

m is the number of layers

a_0 is the mean radius of the solenoid

$a_1, a_2, a_3, \ldots a_m$ are the mean radii of the various layers

l is the length of the solenoid

δ_d is the radial distance between two consecutive layers

n is the number of turns per unit length.

For a long solenoid where the length is about four times the diameter, the above formula will reduce to the following:

$$[illegible] \qquad (3)$$

The formulæ as given by equations (2) and (3) are very simple and convenient for numerical computations.

Below are two numerical examples to show the per cent error that Maxwell's formula (1) will introduce.

Example (1)

[illegible]

Introducing these values in (2) we get

[illegible]

The same example calculated by Maxwell's formula gives

[illegible]

The error is a little over 12 per cent.

[illegible]

By formula (2) we get:

[illegible]

By Maxwell's formula we get for this case

[illegible]

The error in formula (1) is, therefore, about 35 per cent.

In the development of formula (2) I have incidentally obtained a very simple and convenient formula for the calculation of the self-inductance of a single-layer solenoid, which [illegible]

$$[illegible]$$

where a is the mean radius and l is the length of the solenoid.

Lighting by Electricity and Gas.

[illegible] (British) Municipal Electrical Association and based on returns from various lighting plants in 150 towns is given in *Electrical Engineering*, London. The total candle-power of gas lighting in these 150 towns was 10,136,000, while the total candle-power of electric lighting in the same towns was 11,024,500. The av- [illegible] and 14.8 cents for electric light.

* [illegible] is given will be published shortly in the *Bulletin* of the Bureau of Standards.

Distribution and Breadth Coefficients of Alternators.

By N. Stahl.

The formula ordinarily stated for the electromotive force of alternators is derived by the aid of three assumptions, as follows: (a) that the distribution of magnetic flux follows the Law of Sines, (b) that the conductors are not distributed, that is, every conductor on one side of a coil occupies the same position relative to the flux, (c) that the coil subtends the whole pole pitch.

This formula may be written,

$$E = 2.22\,NfZ \times 10^{-8} \text{ volts, where}$$

E is the effective e. m. f. between collecting rings,

N is the maximum value of the pole flux in c. g. s. lines of force,

f is the frequency, and

Z the number of conductors joined in series.

In so far as the above assumptions are not borne out in actual machines, the formula will require readjustment by the insertion of factors representing the ratios of the actually generated electromotive forces to those hypothecated.

In many machines, by a proper shaping of the polefaces a flux curve is obtained which is very closely sinusoidal. This is largely empirical work, aided of course, by due considerations of the permeability of the particular magnetic material, the ratio of pole-span to pole-pitch and the reluctance of the entire magnetic circuit. Where the flux curve departs from the sine law, it would be necessary to know its analytical equation in order to derive a rational formula for the electromotive force.

Since, on the assumption of equal pole strengths and flux-distributions, the flux must necessarily be periodic, it will always be possible to express the equation for any flux curve, by Fourier's theorem, as a series of sine and cosine terms of odd order.

The terms of even order do not occur since the flux distribution around any N-pole is the exact reverse of that around a S-pole, and therefore the flux curve is symmetrical with respect to half-periods. Where, as is usually the case for alternators on full load, there is distortion of the flux, producing asymmetry in the first and second quadrants, cosine terms would enter into the Fourier's series.

The complication so introduced is, however, merely tedious, as each of the harmonics would be treated in the same way as the fundamental for the effective electromotive force when the flux is sinusoidal. In what follows, however, we shall assume that the law of sines obtains for the magnetic flux.

When the conductors are equally spaced around the periphery or distributed for any coil in several slots, it is obvious that the instantaneous electromotive forces in the several con-

[illegible]

[illegible] addition of the separate electromotive forces.

In Fig. 1, let [illegible] in any conductor, in direction and magnitude. Then ab will [illegible] conductor, differing in phase from Oa by the angle ϕ, where $\phi = \frac{\pi}{l}$ radians, l being the number of equally spaced conductors in any polepitch.

Let n be the number of conductors in any half-coil; then OP will be their resultant e. m. f. Were they all generating the same electromotive force at the same instant, their resultant would be $OQ = ne$. To obtain the actual e. m. f. generated, we shall need to multiply our coefficient 2.2 by some factor, k_d, which represents the ratio of $\frac{OP}{OQ}$. The angle aOb is obviously $\frac{\phi}{2}$, and similarly for bOc, cOd, etc.

$$\text{Now, } OP = OX \sec (n-1)\frac{\phi}{2}$$

$$\text{But } OX = e\cos 0\phi + e\cos\phi + e\cos 2\phi + \cdots e\cos(n-1)\phi = e\sum_{s=0}^{s=n-1}\cos s\phi$$

$$\text{and } OP = e\sec(n-1)\frac{\phi}{2}\sum_{s=0}^{s=n-1}\cos s\phi$$

$$k_d = \frac{\sec(n-1)\frac{\phi}{2}\displaystyle\sum_{s=0}^{s=n-1}\cos s\phi}{n} \qquad \text{(A)}$$

The value of k_d may be obtained in another and rather simpler form for computation, by projecting Oa, Ob, etc., directly upon OP.

$$OP = e\cos(n-1)\frac{\phi}{2} + e\cos\left[(n-1)\frac{\phi}{2} - \phi\right] + \cdots$$

$$\cdots + e\cos\left[(n-1)\frac{\phi}{2} - (n-1)\phi\right]$$

$$= e\left[\cos(n-1)\frac{\phi}{2} + \cos(n-3)\frac{\phi}{2} + \cdots\right.$$

$$\left.\cdots + \cos(3-n)\frac{\phi}{2} + \cos(1-n)\frac{\phi}{2}\right]$$

[illegible]

Whence $k_d =$ [illegible] (B)

[illegible]

When the coil-span is only a fraction of the pole-pitch, we have the condition represented in Fig. 2, for maximum flux through any loop consisting of two conductors. $\frac{\theta}{2}$ represents, in electrical radians, half the angle by which the coil-span fails of the pole-pitch.

Both sides of the loop being in equal flux regions, the electromotive forces generated in them annul each other, but completely so, for this position only, in any polar region. For other positions, the effect of the partial annulments on the e. m. f. generated may be seen by integrating, for each side of the loop, through half a cycle.

Let N_t be the instantaneous value of the flux; then

$$N_t = N \cos \theta \text{ and } e = -\frac{dN_t}{dt} = N \sin \theta \, d\theta$$

Now, assume that the right side of the loop is at the position of zero flux; the angular displacement of the left side from it

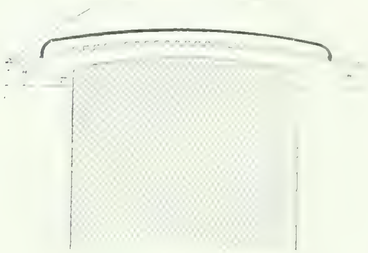


FIG. 2.—FRACTIONAL POLE-PITCH WINDING.

will be $\pi - \Theta$. While the loop moves through the angle $\frac{\Theta}{2}$, the average e. m. f. generated will be

$$e' = \frac{1}{\frac{\theta}{2}} \int_{0}^{\frac{\theta}{2}} N \sin \theta \, d\theta - \frac{1}{\frac{\theta}{2}} \int_{\pi - \theta}^{\pi - \frac{\theta}{2}} N \sin \theta \, d\theta$$

$$= \frac{2N}{\theta} \left(1 - \cos \theta - 2 \cos \frac{\theta}{2}\right)$$

During the passage through the next angle $\frac{\theta}{2}$, the average e. m. f. would be

$$e'' = \frac{1}{\frac{\theta}{2}} \int_{\frac{\theta}{2}}^{\theta} N \sin \theta \, d\theta - \frac{1}{\frac{\theta}{2}} \int_{\pi - \frac{\theta}{2}}^{\pi} N \sin \theta \, d\theta$$

$$= \frac{2N}{\theta} \left(1 - \cos \theta - 2 \cos \frac{\theta}{2}\right)$$

Thus the average for the periods of partial annulment is $\frac{e' + e''}{2} = 0$, and the only part of the flux effective in producing the resultant e. m. f. of the machine lies between $\frac{\theta}{2}$ and $\pi - \frac{\theta}{2}$.

[illegible] other,

$$e = [illegible] \int_{\frac{\theta}{2}}^{\frac{\pi}{2}} N [illegible] \theta \, d\theta [illegible] \int_{\frac{\theta}{2}}^{\frac{\pi}{2}} [illegible] \theta \, d\theta [illegible]$$

[illegible] have

$$[illegible] \int [illegible] \theta \, d\theta [illegible] \int [illegible] \theta \, d\theta [illegible]$$

The actual e. m. f. stands to the assumed in the ratio of $\frac{e_a}{e} = \cos\frac{\theta}{2}$. Call this ratio k_b.

Thus where all the loops have the same breadth, the formula would read, $E = 2.22\, k_e k_b N f Z \times 10^{-8}$ volts.

Where each coil is composed of several loops having different breadths, the coefficients for the several loops, beginning with the outer, run as follows, $k'_b = \cos\frac{\theta}{2}$; $k''_b = \cos\frac{3\theta}{2}$ - - - - $k_b{}^n = \cos(2n - 1)\frac{\theta}{2}$, and [illegible] k_b, is

$$k_b = \frac{k' + k'' + \cdots + k^n}{n}$$

$$= \frac{\cos\frac{\theta}{2} + \cos\frac{3\theta}{2} + \cdots + \cos(2n-1)\frac{\theta}{2}}{n} =$$

$$\frac{\sum_{S=1}^{S=2n-1} \cos S \frac{\theta}{2}}{n}$$

Where the conductors are arranged singly in slots, it is evident that $\Theta = \phi$, and the complete formula may be written,

$$E = 2.22 \frac{\sum_{S=1}^{S=n-1} \cos S\frac{\phi}{2} \times \sum_{S=1}^{S=2n-1} \cos S \frac{\theta}{2} N f Z}{n^2 \times 10^8} \text{ volts.}$$

Even where several conductors to be joined in series are laid in the same slot, the above formula may be used for all practical purposes, though for extreme accuracy the above methods may be extended to any cases, however complicated.

It is to be observed that if n is defined as the number of conductors per pole per phase, the above reasoning is not invalidated; the formula applies to any number of phases, E being the e. m. f. generated in any single circuit through the armature, for any one phase, and Z is the number of conductors in that circuit, the different values of the angle ϕ for different phases causing the variation in the values of the coefficients.

Polyphase alternators are often "coil-wound," with the turns of a single coil distributed in several slots, so that the current in traversing the coil spirals in or out through the successive loops, some of which then span more than a pole pitch. By an integration analogous to that given for the case of a loop-span less than a pole pitch, it appears that, for such a loop, the only effective portion of the flux is included between the positions $\frac{\Theta}{2}$ and $\pi - \frac{\Theta}{2}$, where Θ is again the angular difference between loop-span and pole pitch. A discussion similar to the above leads to a breadth coefficient $k_c =$

$$\frac{\sum [illegible] \frac{\theta}{2}}{[illegible]}$$

which takes account of the fact that here there will be some loops of more, and others of less than a pole-pitch, and provides also for the case of an odd number of loops per coil, where the middle loop would obviously span exactly a pole-pitch.

Tables of coefficients worked out from the above formulae are appended. It is interesting to observe that the coefficients have the same numerical value for the same number of slots per phase per pole, whether the winding be a lap, or wave, or whether it be "coil-wound," which was, of course, to be expected, inasmuch as the conductors are all in series, and the different windings are merely tantamount to different methods of end-connecting.

It will be noticed, however, that a lap or wave winding in

which one of the winding pitches is fractional, would have a breadth coefficient as well as a distribution coefficient.

$$K_d = \sum_{S = 1 - n}^{S = n - 1} \cos S . \frac{\phi}{2} \div n$$

TABLE I.—DISTRIBUTION COEFFICIENTS.

No. slots per pole per phase.	1	2	3	4	5	6	7	8	9	10
θ	180°	90°	60°	45°	36°	30°	25°7′	22°30′	20°	18°
Kd.	1.000	0.707	0.667	0.653	0.647	0.644	0.642	0.6405	0.640	0.639

$$K_b = \sum_{S = 1}^{S = 2n - 1} \cos S . \frac{\phi}{2} \qquad K_c = \sum_{S = 1 - n}^{S = n - 1} \cos S . \frac{\phi}{2}$$

$$n \qquad\qquad n$$

TABLE II.—BREADTH COEFFICIENTS.

SINGLE PHASE.			TWO PHASE.				THREE PHASE.			
No. slots per pole.	θ	*Kb*	Slots per pole.	Slots per pole per ph.	θ	*Kb*	Slots per pole.	Slots per pole per ph.	θ	*Kb*
1	—	—	2	1	90°	1.000	3	1	60°	1.000
2	90°	0.707	4	2	45°	0.924	6	2	30°	0.966
3	60°	0.866	6	3	30°	0.911	9	3	20°	0.960
4	45°	0.924	8	4	22.°5	0.906	12	4	15°	0.9575
5	36°	0.951	10	5	18°	0.904	15	5	12°	0.9562
6	30°	0.966	12	6	15°	0.903	18	6	10°	0.9560
7	25.°7	0.975	14	7	12.°86	0.902				
8	22.°5	0.981								
9	20°	0.984								
10	18°	0.988								
12	15°	0.991								
16	11.°25	0.995								
20	9°	0.997								

It is to be carefully noted in the use of the summation signs occurring in the formulas, that from the very manner of their derivation, the coefficient of $\frac{\theta}{2}$ consecutive to $(n - 1)$ is not $(n - 2)$, but $(n - 3)$; the next $(n - 5)$, etc.

Electric Driving in English Spinning Mills.

By T. [illegible]

Electric driving in England has not made the progress it has in the United States; the number of installations is extremely limited both in spinning and weaving mills, and there appears to be no immediate prospect of its displacing steam to any great extent. It may be of interest to readers to place on record the actual opinions held by English experts in favor and against a system which has been largely adopted both in America and many European countries.

The electric driving of cotton-spinning mills is strongly opposed by those in favor of the existing system. They maintain that no larger production per spindle can be obtained by the introduction of electricity, which could not also be obtained without it. They insist that it is difficult to see how the regularity of speed of a rim shaft driven at from 800 to 900 revolutions through leather belting from a well-arranged line shaft, rope-driven from a suitable type of steam engine, can be improved upon. To which those in favor of electric driving reply that an increase in speed is not altogether necessary to yield a greater production; without any increase of speed it is possible by electric driving to get an increase of production due to greater steadiness. This simply means that the steadier driving would cause less breakage in the yarn and less stoppage from other causes; therefore, mules could be kept more constantly in motion and could produce more yarn. Bigger rims are being tried in many spinning mills to-day to increase speed; the practice is not always successful, due to the quality of the cotton used and to irregular driving, but the increased speed could be continued, it is maintained, under a system of electric driving; it follows that the production could be greatly improved in quantity. Electric driving may be introduced in two distinct classes of circumstances, namely, into entirely new factories, and into existing mills. In the former in general a modern plant on modern mechanical lines would be at least as economical, it is asserted, as the electrical; but in existing factories or mills circumstances need to be carefully considered and no general statement can be made as to which system will be best. In electrical transmission of power more than elsewhere circumstances alter conditions and results. Electric driving is after all only a method of transmitting energy and needs in addition to the prime mover, a generator and a motor, the two being connected by a wire cable. These, then, take the place of the driving and driven pulleys connected by a rope or belt, the usual ordinary method of transmitting energy, and in this sense the driven pulley is as much a motor as the electric motor. Just as in an ordinary rope or belt drive a certain amount of energy is lost in friction, so in an electric drive losses occur. Taking the efficiency of the electric generator, motor and transmission cable each at 95 per cent, the combined efficiency is about 85 per cent. To this, which represents a loss of 15 per cent, must be added that due to rope, belt or other mechanical connection between the motor and the line shaft or the machine as well as that between the prime mover (steam or other engine) and the electric generator, unless the latter is mounted on the flywheel shaft (direct coupled).

The friction losses of these latter-mentioned gears being roughly proportioned to the power transmitted, it will be evident that as much will be lost as in the usual rope, belt or gear drive and when to this is added the above-mentioned 15 per cent electrical losses, it is further evident that the saving in power will be a minus quantity to the extent of 15 per cent. It is asserted as a point in favor of electric driving that heavy shafts are replaced by small ones, but this will not effect such a saving as at first sight appears, when it is recognized that the friction of a quick-running shaft, the proper size for the power it has to transmit, is the same as that of a slow-running and larger shaft of the proper size for the same power. Moreover as light shafting is not generally sufficiently stiff even when large enough in diameter for the power to be transmitted, it is often necessary to increase the diameter, thus making an equal length more wasteful in friction than the usual slow-running shaft.

It is not denied that a substantial saving could be effected by substituting electrical transmission for an ancient, unduly heavy, out of repair wheel, belt or gear transmission; but in most cases an equal or greater saving would be effected by properly modernizing the drive on ordinary lines. In general there is little or no prospect of reaping any benefit in the direction of a reduction in power by the adoption of the electrical drive. The power in the factory is derived from the engine, the generator being only for electricity for the purpose of feeding distant electric motors; it is therefore difficult to see how the electric drive can be steadier than the elastic rope transmission drive would be from the same engine; the increased output claimed for the electric drive depends on this increased steadiness. There is no doubt that a change of speed in any part of the factory can be most readily effected by a judiciously split up electrical drive and any desired part can by its means be easily and gradually accelerated to the utmost speed limit, [illegible] factories where the speed of

he several parts of the plant depends on the feeding ability of each other, there is no advantage in speeding up a part and all can be easily speeded up at the engine as gradually as with the electrical drive.

In the cotton-spinning district of England (Lancashire) the possibility of economically driving cotton mills by means of electricity seems to many authorities entirely out of the question, except under one condition, viz., the concentration of the power plant of a number of mills. This idea is by no means new; years ago schemes were proposed involving the erection of central power stations in close proximity to the coal mines and the distribution of the electric energy by means of a high-pressure system of cables and wires to mills erected round about in the vicinity, along frontages of railways and canals. It is one of the most important and attractive points about electric driving that the motive power need not necessarily be generated at the spot where other considerations render it desirable to have the mill built. But for every mill to have its own generating plant for steam and electricity cannot possibly be economical and would be on a par with fitting every locomotive of an electric railway with its own steam and electricity-generating plant.

In some countries Nature has practically provided the sites for such central power stations, in the shape of rivers with a plentiful water supply, and as a consequence we find in South Germany, Switzerland, Savoy and Northern Italy many fine installations of this description sending out the power to mills many miles distant. Indeed the geological nature of the sites of the power installations in many cases absolutely precludes the building of mills in close proximity.

Such centers of water power being practically absent in England, the next best thing would be the building of huge central power stations driven by steam plant in close proximity to large coal mines as already suggested.

It would certainly be both interesting and gratifying to see such a concentration of power carried out in Lancashire and in other pronouncedly industrial districts for commercial and economic reasons. The use of electric drives with regard to departmental driving is a partly imaginary advantage, as such driving is in practice impossible in a cotton mill because the whole of the machinery is put down and sub-divided in such a manner as to form a harmonious whole and the various operations carried out in succession are in most direct interdependence. If the scutchers or the carding engines cease working the self acting mules must in due course do so likewise, for want of material to feed them and so on right through the entire plant of the factory. Short or overtime must therefore in most cases affect the whole mill and not one department only. In other manufactures departmental driving may at times be indispensable and can easily be arranged for by disengaging gear at various points.

Departmental driving increases the risk of breakdowns, inasmuch as the possibility of a breakdown of the various motors has to be taken in addition to that possibly ocurring to the prime mover, while the shafting in either case is practically immune. Moreover, the various departmental motors must be in the aggregate of considerable higher power than one main steam engine would have to be for running the same machinery plant satisfactorily. This is particularly evident where self-acting mules are at work, as the power absorbed by these machines varies abruptly between distant extremes. The momentum of the great flywheel of a large steam engine in connection with a well-designed sensitive governing arrangement meets temporary overloads without any speed variation and if the overload is continued simply slows down. But the same variations involve for the departmental electric motor considerable risks, as sudden overloads involve the blowing of the safety fuses, and if these are not set correctly the motor may be ruined instantly. In either case a stoppage of the machinery plant is involved.

Of course break downs of departments may be guarded against to some extent by the duplication of the electric plant, but then there is the double initial outlay, the interest on the money expended, the up-keep and so on to be considered. Comparing electric driving with ordinary steam driving from another point of view, it must be remembered that whichever is adopted the prime mover has always to supply the power and to be kept going although only one department of the works or mill may be running. With a sensibly laid-out arrangement for the main-line shafts and with pulleys, bearings, etc., of the best modern construction, the whole driven by a first-class steam engine of ample power, it is simply impossible to see where the advantage would come in under present conditions of cotton-mill building, of driving mills individually with electricity generated on the premises.

Experience in England, so far as it is available, goes to prove that isolated plants cannot compete with large power stations, where reliability as well as economy in both capital and running charges is an essential condition of supply. A saving in capital expenditure of about £10,000 can be effected in a 1500-hp mill where electric motors are installed and are driven by power obtained from an outside source, as compared with the older system of the mill engine, combined with rope driving. This large saving is brought about chiefly owing to the elimination of the engine, boilers and chimneys; but there are other factors, such as the use of high-speed and consequently lighter shafting, the abolition of leather belting, etc., all of which contribute materially to the reduction in expenditure. A modern central power house must be equipped with steam turbines in order to keep down the capital charges and as is well known the turning moment of electric power produced through the agency of a turbine is the very best that can be devised, owing to the purely rotary motion and the continuous flow of steam in the prime mover. Where reciprocating engines, on the other hand, are used, every irregularity in the turning movement of the engine is transmitted to the mill shafting, whether the power is conveyed electrically or through ropes. The result of the smooth drive and the elimination of belts is an undoubted increase in the output amounting to about five per cent, the comparison being between modern mills.

A highly important advantage which an outside supply of power has over either a rope drive or an isolated electrical drive, is that at a central power house a stand-by machine is always kept in reserve in case of accident to the running sets and as a result the stoppages at the mill are reduced to a minimum. A turbo-electric mill with isolated plant and no stand-by must always be a very risky undertaking. In ring spinning mills there is a great reduction in the up-keep of ropes and belts, where coupling has been adopted, which is practically negligible. Where doubling frames are used the ease with which a limited speed variation can be obtained is very great. A number of electric motors have already been attached direct to doubling frames, which are furnished with means of obtaining, by the turning of a handle, a speed variation of 10 per cent, which is usually all that is required. Such an arrangement is much more convenient and economical than the usual rather cumbersome system of changing gear. It is estimated that a textile mill with more than 300 horse-power installed can put down its own electrical plant, including buildings, boilers, engine, generators, motors, etc., can pay the whole of the running and establishment charges, can put aside 10 per cent for interest and depreciation on its capital expenditure and can rely upon getting its energy for about 0.4d. per unit.

The ordinary price for building and equipping a central power house in England ranges from £35 to £65 per kilowatt. The first cost of electricity and steam generated on the premises in a cotton-spinning mill should be about the same, including boilers, superheaters, condensers, turbo-alternators and three-phase motors, and buildings. The most modern practice in the electrical equipment of textile mills is to put down duplicate turbo alternators; each capable or running half the plant under normal conditions at the maximum efficiency and with the lowest steam consumption. Each is capable of giving an overload of 100 per cent for 10 hours, with an increase of about 12 per cent in the steam consumption.

The power required to drive a modern spinning mill, includ-

ing the engine, main rope drive, shafting and belts, but not the cotton machinery, is about 20 per cent of the indicated horse-power required to drive the mill when fully at work. In a weaving shed it amounts to about 25 per cent, but may be less. The loss in the main rope drive between the engine shaft and the mill shafting averages five per cent. In the electric drive there is a loss of five per cent in the generator, there is some loss, two to five per cent, between the generators and the motors in the cables and the gear, and the loss in the motors for cotton-mill work will average 10 per cent.

A cotton-spinning mill may be electrically driven by one of three methods: first, by using one large motor, replacing the steam engine and driving like the latter the various departmental line shafts by means of ropes laid in the rope race; second, by separate motors for each of the departmental shafts; the third method extends the idea of the second to each individual machine, dispensing with main-line shafts, pulleys and bearings. Several practical drawbacks make themselves felt when the second method is adopted and to a greater degree with the third; they arise from the fact that motor makers have not yet put motors on the market which with any speed and output combine economy. As a rule the smaller the output the higher the speed for economical running. The slow-going motor of small power is very dear and uneconomical and so is its prototype of the opposite extreme conditions. In most Englinsh cotton-spinning mills the number of main-line shafts is about eight or nine; of these the ring room, the mule rooms and the blowing room shafts usually go at a great speed, perhaps up to 350 revolutions per minute and the power absorbed is also rather great, so that we approach more nearly to the normal conditions for working a motor economically by connecting it direct to these line shafts. However, in the case of the blowing room, the power is rather against this simple application, since it is as a rule much less than in the two other rooms referred to. For the preparation room containing carding engines, drawing frames and the flyer frames, the speed of the line shaft is not so high and the power absorbed is less; thus both these conditions work against putting the motors direct on the line shaft and resort has to be taken to large pulleys with belt or rope driving. If we take the speed of these shafts too high we have difficulty with proportioning the belt pulleys driving the machines. Moreover, it must not be forgotten that other conditions remaining equal increase of speed of the line shafts means expenditure of additional power.

It will be found on looking through the lists of motor makers that they recommend high speed for the line shafts. The reason why they do so is evident from what has just been stated. It is evident from what has been stated that even with the full adoption of the second method gearing cannot altogether be dispensed with. Turning now to the third method under which a separate motor is used for each machine, it will only be necessary to refer to the preparation room. If we take an installation of 120 carding engines, by no means an exceptionally large plant, we find that each consumes on the average three-quarters indicated horse-power and makes 170 revolutions per minute, with driving pulleys 16 to 18 ins. diameter. Should 120 small motors be put down, each costing say £18, without the necessary wiring, etc., the total expenditure for the cards alone would amount to £2,160, with the cost of up-keep, repairs, etc., in addition. These small motors work at something like 1300 revolutions per minute and the speed relationship to the machines to be driven is about 7⅔ to 1. Assuming a pulley 6 ins. diameter as practical for efficient driving by belt, a pulley would be required for each machine about 46 ins. diameter, a monstrosity and expense, which cotton-machinery makers would condemn, as it is much larger than the normal size. There are other difficulties in such individual driving which are also very serious, such as the difficulty of keeping these motors clean, free from dust and above all, cool.

The spinning rooms have to be kept at a comparatively high temperature and moist, whereas the motors, to run at their best, ought to be in as cool surroundings as possible. In the case of ring spinning frames, separate motors to each machine are feasible enough, or for driving the counters of openers and scutchers, but they will not do for the separate driving of self-acting mules on account of their violently irregular absorption of power between far distant extremes. The best way to drive a mule room is after all a powerful and ample motor driving the common line shaft from which all the counters of the self-acting mules are driven. In English cotton-spinning mills, which have been filled throughout with electric driving, the group system has been adopted; the speeds of the shafts are extremely high, involving expenditure of power of the prime mover and sectional motors.

As ropes and pulleys form an essential feature of both steam and electrical driving, the following details should be noted: The transmitting power of driving ropes does not depend so much upon tensile strength as upon flexibility and consequent grip of both grooves and pulleys. It will be readily understood that by constantly reducing the periphery round which a rope passes, a point is reached when it absolutely refuses to yield further and its grip completely fails. Ropes differ in pliability, therefore the factor of safety should be such as will meet the demands of a fair average rope. Thirty diameters has undoubtedly proved a safe minimum. For example, if a rope 1¼ ins. diameter will transmit 10 horse-power at 2000 ft. per minute, running upon a pulley 30 times its own diameter or say 38 ins., the power of the same rope at the same speed, but running on a 30-in. pulley should not be reckoned at more than say 8 horse-power. It may always be best to adopt 1-in. ropes for a 30-in. pulley. The durability of a rope is in proportion to its sectional area. Therefore the comparative lives of 1¼ in. and 1 in. ropes stand in the relation of 25 to 16, minus abrasions due to contraction below the accepted minimum. The construction of grooves is very important; it may be definitely stated that experience has thus far decided in favor of angular as against curve-sided grooves, as it encourages that even compact and compression which adds so materially to the driving value and longevity of ropes. An angle of 40 deg. has been found best to answer the requirements for the ordinary sizes of ropes, say above 1 in., and as smaller ropes demand a more acute angle, 30 deg. for all below that diameter. Nothing is gained by imposing flanges upon the mid-feathers; the same angle should be carried from root to terminals, the latter being simply rounded off. The depth of the groove should be such as to prevent the rope from reaching the bottom when compressed to the utmost.

Well-made 1¾-in. ropes representing the standard are found capable of comfortably transmitting 10 horse-power, which means 50 horse-power for 5000 feet per minute. All other sizes are calculated upon the basis of the comparative sectional area. Thus a 2-in. diameter rope equals 13 horse-power; a 1½-in. rope, 7.4 horse-power; a 1¼-in. rope, 5 horse-power; a 1-in. rope, 3.3 horse-power, and intermediate sizes in the same ratio.

The initial cost of electrical driving in cotton-spinning mills in England may be summarized as follows, say in a 1500-hp mill: The ordinary horizontal cross-compound engine costs £5,000 to £5,500, including rope-pulley and condensing plant. Two 750-hp turbo-alternator sets would cost about £8,500. The electric drive also requires cables, switch gear and motors. The cost of the first-mentioned may be assumed to be balanced by the cost of the second motive pulleys of the engine drive. The cost of the motors may be put at about £4 per horse-power or £6,000 in all.

British Central Station.

Last year's report of the Burton-on-Trent municipal electricity works is published in the London *Electrician*. During the year the restricted-hour system has been adopted for motor users. The total number of kw-hours generated during the year was 1,164,355, that is, 20 per cent more than last year. The maximum load was 866 kilowatts. The total expenditure, including operating costs and capital charges, was 4.252 cents per kw-hour generated, while the corresponding receipts were 4.572 cents per kw-hour.

Practical Application of Wireless Telephony.

As noted on page 799 of our issue for Oct. 26, the United States navy has arranged to install De Forest wireless telephone equipments on its Pacific vessels on account of the satisfactory results obtained with equipments on the battleships *Virginia* and *Louisiana* of the Atlantic fleet. It is believed that an outline of the transmitting and receiving apparatus will prove of interest to our readers.

In the transmitting circuit there are produced "sustained" oscillations having a frequency of about 40,000 per second;

FIG. 1.—AUDION DETECTOR.

that is, the sustained frequency is considerably above the audible range. The oscillations are transferred from the circuit in which they are produced to the antenna circuit by means of an air-core transformer. A microphone transmitter inserted in the latter circuit serves for varying the circuit resistance, and thereby varying the strength of the transmitted oscillations in consonance with the words spoken into the mouthpiece of the microphone. For the production of the "sustained" oscillations,

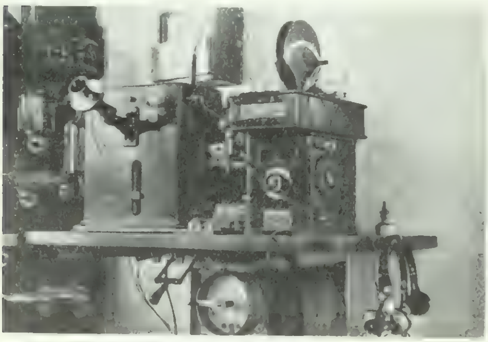


FIG. 2.—WIRELESS TELEPHONE TRANSMITTER AND RECEIVER.

use is made of the flame of an alcohol lamp placed in shunt across the terminals of a 220-volt direct-current generator and in series in a circuit containing an induction coil and a condenser; the frequency depends upon the inductance of the coil and the capacity of the condenser.

The receiving circuit is "tuned" to correspond in frequency to the "sustained" oscillations of the transmitting circuit. Associated with the receiving circuit is an "audion" and a telephone receiver. The fluctuations in the strength of the received oscillations affect the conductivity of the heated gas within the "audion," and the variations in the strength of the current from a battery in the telephone circuit are manifested as sounds in the receiver.

A view of the audion, a detailed description of which was given in our issue of Nov. 3, 1906, is shown in Fig. 1. A complete equipment of transmitting and receiving wireless tele-

FIG. 3.—TELEPHONE ANTENNA.

phone apparatus is shown in Fig. 2, while the telephone antenna in place on the U. S. flagship *Connecticut* is indicated in Fig. 3. Similar apparatus will be installed on 27 other United States war vessels. Although the contract requires telephonic transmission for only 5 miles, it is stated that communications have been heard at a distance of 22 miles.

New Telephone Patents.

For a long time there has been an occasional demand for a loud-speaking telephone, and this demand has been met by a very powerful receiver equipped with a megaphone. Such a receiver can be adjusted to speak with the usual volume of the human voice. Articulation is not good, however, except with careful adjustment, because of the abnormal excitation of the diaphragm. J. A. Baker, of Seguin, Tex., has proceeded upon another principle in developing a loud speaker. He has arranged a considerable number of instruments in a single rectangular casing and has arranged their circuits in such electrical relation that they act simultaneously.

J. A. Gordon, of Shawnee, Oklahoma, has invented a transferable transmitter antiseptic device. This is a cup of metal adapted to mount upon the transmitter mouthpiece. The tip of the mouthpiece slips within the cup and is secured by two clamping levers which are operated by springs and two buttons projecting at diametrical points through the walls of this cup. The usual antiseptic is placed in an aperture which registers with the transmitter opening.

A step-by-step lockout selective party line ringing device forms the subject of a patent granted to J. H. Blythe, of Denver, Col. This embraces the usual electromagnetic pall and ratchet devices to step ahead and restore a commutator device at each station.

Some time ago Mr. F. E. Mayberry of Medford, Mass., obtained a patent for a step-by-step party line selective system, the successful use of which with common battery systems requires a special arrangement of cord circuits at the switchboard. This selective system provides controlling switches at the stations which are advanced by current in one direction and restored by a reversal of this. The present invention relates to the central-office end of this system. The supervisory relays are polarized; the armature remains at rest in any position. The hook switch at the station when operated puts a momentary ground on one predetermined side of the line and in descending upon the other. These grounds cause the supervisory relay armatures to oscillate to one side or the other to light or extinguish the supervisory lamp as the case may be.

LETTERS TO THE EDITORS.

Distortion in Telephonic Transmission.

To the Editors of Electrical World:

SIRS:—Referring to the article by Mr. Louis Cohen in your issue of Sept. 21, entitled "Distortion in Telephonic Transmission," I wish to point out that Mr. Cohen is mistaken when he says that all previous investigators assumed that the constants of the line are the same for all frequencies. He will find by a closer inspection of Heaviside's writings that such is not the case. He will find that the attenuation constant

$$\beta = \sqrt{\tfrac{1}{2}\omega C\left\{\sqrt{\omega^2 L^2 + R^2} - \omega L\right\}}$$

is true, even if R is not the true ohmic resistance as determined by Wheatstone bridge, but the effective resistance taking into account the skin effect.

The distortion on a New York-Chicago line due to a cause of this kind is small in comparison with the distortion produced by the terminal apparatus, and nobody pays any attention to it. The chief trouble on overhead lines is not distortion, but loss of volume. In the case of telephonic transmission over cables it is different; here the distortion is a very serious factor, but it is not influenced appreciably by the skin effect, because the size of wire employed is small.

There are patents covering the employment of stranded wire for telephonic transmission, so as to avoid the skin effect. Nobody pays any attention to them, because the troubles arising from the skin effect are of no practical consequence.

Columbia University, M. I. PUPIN.
NEW YORK.

Long-Distance Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—It has been reported that the Port Morien wireless station of the Marconi Company, in Cape Breton, recently picked up a message transmitted from the wireless station at Manila, P. I., announcing the arrival of the American cruiser, *Philadelphia.* Whether or not the accuracy of this report has been officially confirmed I am unable to state, but the circumstance has suggested to me a line of thought which I should be pleased to have published and discussed in your columns.

In such a wireless transmission the wave front is progressively attenuated during its propagation in all directions, until it has reached the circumference of the great circle 90 deg., or approximately 6000 miles distant from the sending station, and the minimum intensity of the wave should exist at points located on or near this circle. Beyond this circle the intensity of the wave should progressively increase until that meridian is reached which is 180 deg. from the sending station; and, furthermore, the intensity should continue to increase along that meridian until a position corresponding to that of the antipodes of the sending station is reached, at which point the intensity should again be at a maximum.

This would seem to be true by reason of the fact that after passing the great circle 90 deg. removed from the sending station, the wave front would progressively contract and thereby regain intensity until, by concentration at the point located diametrically opposite to the sending station, the intensity would be theoretically equal to that at the sending station. The actual intensity would, of course, be much less than that at the sending station, owing to the dissipation of energy in transmission.

It is a peculiar circumstance that the difference in longitude between Port Morien station and the Manila station is approximately 180 deg., which former station, from the above considerations, would be especially favorably situated for receiving waves transmitted from the Manila station, although it would appear that the intensity should be greater and, therefore, the transmission better at a point much farther south on the meridian passing through Port Morien, *i. e.,* at approximately Long. 60° W. and Lat. 15° S., corresponding approximately to the position of Manila's antipodes.

In conclusion, it would seem that the most difficult transmission in any direction should be over the first 90 deg., and that there should be a progressive improvement thereafter up to the meridian 180 deg. from that of the sending station, with a further uniform improvement along that meridian to the position thereon diametrically opposite to the sending station.

CHICAGO, ILL. ERNEST F. SMITH.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Alloy Steels.—E. A. WATSON.—Special alloy steels have recently been introduced (as repeatedly noticed in the Digest) for transformer construction on account of their comparatively small hysteresis and eddy-current losses. Little use is made of these steels, however, in dynamo electrical machinery, possibly on account of their expense or on account of their lower permeability. It can be shown, however, that the saving due to the adoption of the alloy steel "when reduced to capital far outbalances the extra cost of the machine." The lower permeability is of greater importance since the output for a given copper loss is determined by the flux density which can be allowed in the teeth of the armature, and it is hence desirable that the permeability of the material should be as high as possible. The author has tested four samples of special alloy steels with an apparatus of Kapp intended for measurements of high flux densities. The four alloys are No. 1, called Stalloy, and No. 4, Lohys, of British make, while samples 2 and 3 were of German origin. The analysis of sample 2 is 0.03 per cent C, 3.40 Si, 0.01 P, 0.32 Mn and 96.20 Fe. The results of the tests are given in Fig. 1. The curves show the relation between flux density and ampere turns. The permeability of sample 4 is highest, although it is probably not as high as that of ordinary armature sheets. The alloy steels differ considerably among themselves, the one specimen of German manufacture (No. 3) having a considerably higher permeability than the other (No. 2) and having the knee of the curve considerably higher up. In no case, even with a magnetization of upward of 1000 ampere turns per cm, did the flux density for the alloy steels reach the

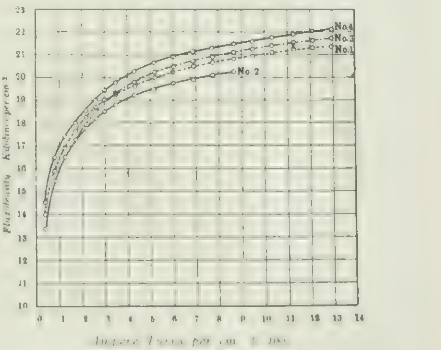


FIG. 1.—RESULTS OF TESTS.

true value of 22,000 lines per sq cm. Flux densities obtained in these measurements are the true flux densities in the steel, there being no paper or any other insulation interposed between the strips. The apparent density in the teeth is con-

siderably higher than the true value, and the author deduces the excitation required for a given apparent density with different ratios of slot to tooth. He shows that although it is not possible to exceed more than 24,000 or 24,500 lines apparent density with the special alloy steels, yet it is possible to go about as high as it is usual in modern practice. In order to obtain this density with alloy steels somewhat more excitation is required than with ordinary steel, but in direct-current machines, at any rate where the air gap is greater than that necessary for mechanical clearness, this might to a large extent be avoided by decreasing the air gap, the increased reluctance of the teeth at such high densities being practically equivalent to an air gap. Indeed from the point of view of good regulation it is better to have highly saturated teeth than a long air gap as the reluctance of air is a constant quantity. Considering the great decrease of the constant losses with alloy steels, the extended use of these in electrical machinery of all descriptions deserves the attention of designers.—Lond. *Elec.* Oct. 18.

Lamps and Lighting.

Efficiency of Lamps.—H. LUX.—Continuations and conclusion of his long serial giving an account of his very extended experimental researches as to the efficiency of various sources of light. The final results are given in the following table.

Source of Light.	Power consumption in watts.	Total spherical radiation in watts.	Spherical light radiation in watts, between 0.4 and 0.8 μ wave length.	Ratio of light radiation to total radiation in per cent.	Ratio of light radiation to power consumption in per cent.	Mean horizontal cp in Hefner candles.	Mean spherical cp in Hefner candles.	Watts consumed per mean spherical Hefner candle.	Electrical power equivalent of one mean spherical Hefner candle.
Hefner candle	[illegible]	[illegible]	0.089	0.89	0.103	1.	0.825	[illegible]	[illegible]
Kerosene lamp	508.0	102.2	1.26	1.23	0.25	14.2	12.0	42.3	0.105
Acetylene flame	96.0	[illegible]	0.62	6.36	0.65	7.7	6.04	15.9	0.103
Incandescent gas lamp.									
[illegible] without cylinder / with cylinder	[illegible]	147. / 112.[illegible]	3.28	[illegible] / 2.92	0.46	107.	[illegible]	7.98	0.037
[illegible] without glass / [illegible]	[illegible]	143. / 97.6	2.9	[illegible]	0.51	107.	82.3	6.97	[illegible]
[illegible] without glass	[illegible]	[illegible]	2.03	[illegible] / 2.7	2.07	31.5	24.5	4.09	0.085
[illegible] without series resistance / [illegible]	181.4	122.2	6.96	5.7	4.21 / 3.85	120.1	94.9	[illegible]	0.073
Tantalum lamp	44.0	25.2	2.15	8.5	4.87	34.6	26.7	1.65	[illegible]
Osram lamp	38.3	22.5	2.05	9.1	5.36	36.3	27.4	1.43	0.075
Direct-current arc lamp	435.0	301.8	24.3	8.1	5.6	190.	524	0.83	[illegible]
[illegible] arc lamp	[illegible]	286.	6.2	2.2	1.15	200.	295.	1.31	0.021
Flame arc, yellow light	349.7	295.	[illegible]	17.7	15.00	907.	1145.	0.31	0.046
Flame arc, white light	[illegible]	304.5	26.3	8.6	[illegible]	602	760	0.46	[illegible]
Alternating-current arc lamp	[illegible]	[illegible]	[illegible]	3.7	1.84	109.	89	2.06	[illegible]
[illegible] Mercury Vapor Lamp	[illegible]	[illegible]	5.3	5.8	2.24	[illegible]	[illegible]	[illegible]	0.015

A comparison of different sources of light must, of course, be based on the spherical radiation. The efficiency might be defined in two different ways. One definition which is purely physical would be to define the efficiency as the ratio of the radiation within the visible part of the spectrum (arbitrarily defined as being between 0.4 and 0.8 μ wave length) to the total radiation. The figures for this efficiency are given in the fourth column of the table. In the second definition of efficiency the physiological effect on the eye is taken into account and "efficiency" is determined from the ratio of hefner candles produced to watts consumed. The reciprocal values of this "efficiency" are given in the eighth column of the above table. While the figures of "efficiency" for these two definitions are, of course, different, yet if a series of the different sources of light is arranged according to their efficiency, about the same series is obtained for the two definitions. The fifth column gives the ratio of light radiation to power consumption in per cent, and it is very interesting to note that in this respect all electric lamps are far superior to flames and gas lamps, etc. The last column gives the so-called electrical equivalent of one mean spherical hefner candle, that is, the ratio of the watts of spherical radiation within the visible spectrum to the mean spherical hefner candle. From the concluding remarks of the author the following may be noted: While a carbon incandescent lamp of 16 horizontal candle-power consumes about 3.5 watts per candle-power, a continual increase of the voltage raises the candle-power to about 2000 just before the filament is destroyed. The specific consumption is simultaneously reduced to about 0.13 watt per candle-power. That means that in the moment of most intensive incandescence with the present means one is able to transform more than 56 per cent of the consumed power into light by means of purely thermal radiation. The goal should be to find a material which is able to be used under such conditions for a length of time. The author believes that the metallic filament will not solve this problem, because the fusion point represents a limit. Only a carbon filament would be able to withstand such a temperature for any length of time, and it would have to be absolutely homogeneous, since only then would it be able to resist the danger of cracking, which is primarily the result of the liberation of occluded gases. In order to develop lamps of higher efficiency it seems more promising at present to make use of light production by luminescence instead of by means of pure thermal radiation. This is shown by the development of the flame-arc lamps and the mercury-vapor lamp. The last column in the above table shows that the electrical equivalent of light is not a constant for all different sources of light. This is, of course, clear because in the above definition of the electrical power equivalent of light the spectral composition of the light has not been considered. However, the above figures justify one interesting conclusion. The sources of light in which finely divided carbon is brought to incandescence, and also the electric incandescent lamps, have an electrical power equivalent of light ap-

proximately equal to 0.1 watt per candle-power. These are the sources of light which operate on the principle of pure thermal radiation. In the electric arc lamps the values average about 0.04 watt per candle-power, while the value for the mercury-vapor lamp is as low as 0.015. These are those sources of light in which luminescence phenomena are made use of. In the latter, therefore, there is required only one-half the power necessary for pure thermal radiators, and the reason for this is easily understood if the mechanics of lighting is reduced to the electronic theory. From this point of view it is interesting to note that the figures for the Welsbach gas lamp are near those for the electric arc lamps. It may be concluded therefrom that the specific composition of the Welsbach mantle permits the use of pure thermal radiation for the production of electronic oscillations in a manner that is possible otherwise only by electrical means. The strongly selective radiation of the Welsbach mantle is not sufficient to explain the very low value for the electrical power equivalent of light for this mantle.—*Zeit. f. Beleucht*, Aug. 10, 20, 30, Sept. 10, 20, 30.

Train Lighting.—An illustrated description of the following method of the British Thomson-Houston Company. The principle is shown in Fig. 2, where 1 is the armature of the generator to be regulated. The main field winding is at 2, while an auxiliary differential winding is at 3. This winding is arranged to be supplied with voltage varying at a greater rate than the variation in speed in driving. For this purpose it is connected across a resistor, 4, having a high positive temperature coefficient of resistance, such as the iron wire used as ballast in the Nernst lamp. The lamps to be supplied with energy are shown at 5, 6, 7, 8; they are in series with the iron-wire resistors 9, 10, 11, 12 which consume any excess voltage. The storage battery, 13, supplies energy to the load when the voltage of the generator becomes too low, while it receives energy from the generator at other times. The aluminum cell, 14, acts as an electrolytic interrupter which prevents the storage battery from discharging backward through the generator at times when the voltage of the generator is below normal. Whenever the generator tends to increase the voltage due to an excessive speed, there is in the first place an increase in the resistance of the iron wire, 4. This not only tends to keep down the current in the winding, 2, but the division of the current between the resistors 4 and 3 is altered so that the winding, 3, now carries an increased proportion of the total current. Thus the effect of any small increase of voltage on the generator is met by a multiplied demagnetizing effect on the generator field by reason of the presence of the iron resistor, 4. The maximum variation of voltage is thus rendered small. Any variation which still remains is taken care of by the iron resistors 9, 10, 11, 12.—Lond. *Elec. Eng'ing*, Oct. 10.

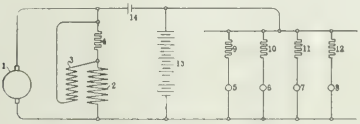


FIG. 2.—DIAGRAM OF CONNECTIONS FOR TRAIN LIGHTING.

Arc Lamp.—An illustrated description of a new lamp of British make, called the "Newarc" lamp. It is suitable for burning as an enclosed lamp (single globe) on both alternating and continuous circuits, under the normal conditions which commonly obtain with arc lamps—that is, it operates equally well in parallel or series. The lamp depends for its working on the well-known expanding and contracting properties of steel and iron wire when heated by the presence of an electrical current and cooled when the current ceases. In the "Newarc" lamp a steel band is utilized to perform the hot-wire function of the lamp, the width being [illegible] in. and the gauge about 0.004 in. In Fig. 3, F is the steel heating strip, the ends of which are fixed at the point W, being one of the terminals, and at the point V, this latter being the short end of a lever, G, pivoted to the bracket O. To the long end of this lever the spring R is attached, this spring being adjustable from the wing-nut N, which is screwed into the hook holding the lower end of the spring. The porcelain roller X acts as a pulley for the heating strip F, and also affords a means of adjustment for the length of the arc by the turning of the wing-nut A to which the pulley bearing is attached. Movement of this nut alters the tension of the heating strip. There is also attached to the lever G, in addition to the controlling spring and heating strip, a short length of brass or steel chain, K, which passes several times round the brake drum S, and is finally attached to a flat spring in the hood of the lamp. A larger pulley wheel, O, is fitted to the same spindle, and over this pulley the flexible metallic cord T for the carbon holder D and the balanced weight P passes. The weight D is heavier than that at P. The action of the lamp is very simple. With the circuit open, the pull of the strip F is sufficient to counterbalance the pull of the spring R to keep the brake chain free of the brake drum. When the circuit is closed the strip F expands, and the spring R, getting the ascendency, draws down the chain K and strikes the arc by slightly revolving the drum to which the cord T is attached. The current variations due to the lengthening of the arc while burning tend to alter the balance of the strip and spring, and by this means the lamp feeds. It does not, however, go out before feeding, the automatic adjustment being sufficiently sensitive to ensure a constant feed during the time of burning. A cut-out is fitted in the hood of the lamp to safeguard the strip and prevent its being fused by the passage of an excess current. The contacts of this cut-out, which is a simple thermostat, are shown at I. The heating strip F, upon which, of course, the action of the lamp depends, is made of watch-spring steel heavily nickel-plated to resist the effects of dampness and moisture, particularly in salt-laden atmospheres on the sea-coast.—Lond. *Elec.*, Oct. 18.

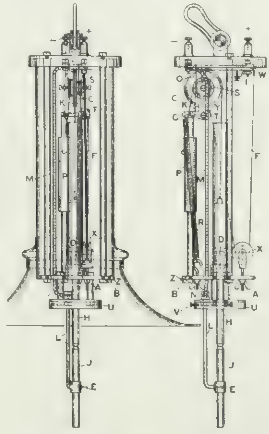


FIG. 3.—MECHANISM OF ARC LAMP.

Metallic-Filament Lamps.—Notes of two recent British patents. According to one granted to the Consortium für Elektrochemische Ind. Ges., metallic filaments of tungsten for incandescent lamps are bent to shape while heated in an inert or reducing atmosphere. It is stated that tungsten is not ductile or malleable except at very high temperatures. According to a patent granted to Lake (Parker-Clark Electric Company), filaments for incandescent lamps are made by heating a carbon filament in an atmosphere containing marsh gas, olefiant gas, carbon dioxide and in presence of a substance containing silicon; by the resulting reaction a deposit of pure silicon is obtained on the filament.—Lond. *Elec. Eng'ing*, Oct. 10.

Metallic Flame-Arc Lamp.—C. E. STEPHENS.—An illustrated article describing the principles of the metallic flame-arc lamp and its advantages for street lighting from the operating point of view.—*Electrical Journal*, October.

Projector Arc Lamps.—An illustrated description of a recent improvement of arc lamps for projectors patented by Siemens [illegible] mechanism for feeding the negative electrode. The positive electrode is moved and controlled by electromagnetic devices in the usual manner.—Lond. *Elec. Eng'ing*, Oct. 17.

Power.

Munich.—The hydroelectric station at Moosberg, on the Iser, which feeds Munich, is, with the single exception of the station at Kykelsruth, in Norway, the only one in Europe with three-phase transmission at 50,000 volts. This station, which was recently opened, transmits energy a distance of about 30 miles, 6 per cent being lost in the line. Two feeders erected on poles, and each consisting of three copper wires 16 sq. mm in section transmit the required 4200 kilowatts. The usual lightning protectors are provided. At present the station is working at only three-quarters of its output, as the power consumption is least in the summer. In spring and autumn the station will be fully loaded, while in winter it will require help from the existing steam station. Next year, when the hydroelectric station to the south of the town will also be opened, Munich will possess two cheap sources of energy, and great savings in coal and oil will be effected.—Lond. *Elec.*, Oct. 11.

Large Gas Engines.—A fully illustrated account of a recent trip made by English engineers to Continental Europe. The primary object was to inspect examples of large gas-engine installations at work. Among the engines inspected were three 1650-hp engines running on blast-furnace gas at a French steel works, and driving alternators in parallel, a 1300-hp engine running on coke-oven gas at a German Government mine, where three more of the same size are in course of erection and a further 3000-hp engine is to be put down, and a pair of 2200-hp engines driving continuous-current generators, and working on blast-furnace gas, at a large iron and steel works in addition to some smaller sets and gas-driven blowing machines. The works of Ehrhardt & Sehmer at Saarbrücken, and of the Felten-Guilleaume-Lahmeyer-Werke Company at Frankfurt, were visited, and the opportunity was taken to visit the electrical main shaft winding-plant at the Matthias Stinnes mine.—Lond. *Elec. Eng'ing*, Oct. 17.

Electricity in Copper Works.—H. R. Speyer.—An illustrated description of the electric equipment of the Mansfield copper mines in Germany. The gas-driven electric station generates three-phase alternating currents at 3000 volts. The distribution is by underground cables partly at 3000 volts and partly at 10,000 volts. Curves of cost show a considerable advantage for electric working as compared with the steam winding carried out under identical conditions in some of the same company's other mines.—Lond. *Elec. Eng'ing*, Oct. 10, 17.

Low-Pressure Steam.—J. R. Bibbins.—An article giving notes on the possible development of low-pressure steam-turbine work. It is shown that the turbine can utilize low-pressure steam to so much greater advantage than is possible with steam engines that it becomes desirable to run a piston engine at high pressure, and use a low-pressure turbine between the engine and the condenser. Thus the turbine acts as the third cylinder in a triple-expansion system, but at a much higher efficiency than is possible with piston engines.—*Electric Journal*, October.

Electric Crane Works.—An illustrated description of a British crane factory which has arranged during the past few years for the manufacture of the electrical equipment of cranes supplied by them.—Lond. *Elec. Eng'ing*, Oct. 10.

Pumps.—An illustrated article on centrifugal turbine pumps for high lifts.—Lond. *Elec. Review*, Oct. 4.

Traction.

Electric Traction in England.—In the annual railway returns of the British Board of Trade for 1906, some statistics are given of the electric railways in the United Kingdom. Excluding the electric lines of the Lancashire & Yorkshire and North-Eastern Companies (for which separate details are not given), the number of passengers carried was 267,826,481, or nearly 25 per cent of the total number of passengers carried on all the railways in the Kingdom. The total quantity of electrical energy used for all purposes (including the L. & Y. and N. E. Railways) was 159,581,401 units, compared with 100,977,467 units in 1905.—Lond. *Elec. Eng'ing*, Oct. 17.

Railway Signals.—J. B. Struble.—In a continuation of the long serial on railway signaling, the double-rail return system is discussed, in which both rails are used as return conductors for the train propulsion current simultaneously with the alternating block-signaling current. The use of this method on direct-current traction systems is first described, and then its application to alternating-current traction is briefly discussed.—*Electric Journal*, October.

Installations, Systems and Appliances.

Berlin.—K. Wilkens.—Continuations of his very long and fully illustrated description of the Berlin electricity works at the beginning of 1907. In the present installment the electric equipment is dealt with, the dynamos, transformers, converters, switchboard and the safety devices being described in detail.—*Elek. Zeit.*, Oct. 10.

Automatic Method of Starting Motors.—M. Kallmann.—A translation in abstract, with illustrations, of his German paper recently noticed in the Digest on an automatic method of starting motors by using iron resistors like the ballast in the Nernst lamp.—Lond. *Elec.*, Oct. 11.

Three to Two-Phase Transformation.—E. C. Stone.—An article in which the author employs the notation of C. H. Porter for the determination of the current in the several windings of two transformers connected in the ordinary method for transforming from three phase to two phase.—*Electric Journal*, October.

Wires, Wiring and Conduits.

Porcelain.—D. Harvey.—An article on the designing and testing of porcelain for electrical purposes. The use of a glaze on porcelain insulators is usually desirable, as it provides a smooth, glossy surface which does not accumulate dust and moisture as readily as does the rougher unglazed surface. The brown glaze has become practically the standard color. The dry process of porcelain manufacture is suitable only for such pieces of porcelain as can be formed by metal dies and which are to be used on comparatively low voltages. The clay, which is rather dry when pressed in the die, does not have the compact body obtained by the wet process and necessary for high-potential porcelain. Porcelain should be as nearly uniform in thickness as possible, as this facilitates uniform drying of the material. Pieces having considerable variation in thickness are very likely to become cracked or warped during the process of drying and firing. While porcelain of the best quality has a very high dielectric strength, yet with increasing thickness it becomes much more difficult to obtain well-vitrified ware without small cracks or other flaws in the interior. This fact practically limits the voltage which a single piece of porcelain can withstand, and it is therefore customary to use multiple-part insulators for the higher voltages. In general, insulators should be so designed that no single piece will be tested at more than 80,000 volts, and a somewhat lower test is desirable. There is a common impression that breakdown over a high-tension insulation is due to surface leakage. But there is no appreciable leakage unless the surfaces are wet or covered with some conducting material. The principal cause of the breakdown seems to be the rupture of the film of air immediately adjacent to the insulator, on account of excessive electrostatic strain. Glass insulators have been used to quite an extent on circuits of less than 25,000 volts. They have the advantage of low cost and cheap inspection. Porcelain is somewhat more expensive than glass but has greater mechanical strength and is less brittle. The metal pin is considered preferable to the wooden pin for use with insulators which have ample margin of safety for the service conditions. When this margin of safety cannot be obtained by the insulator alone a wooden pin is advisable in order to obtain the necessary insulation. However,

with long spans, especially with high voltages, metal pins are necessary in order to obtain the required mechanical strength. The conditions under which porcelain insulators are tested should correspond as nearly as possible to the conditions of service. A very convenient method of testing porcelain-lined insulators is to place them inverted in water, with the head immersed in water so as to cover the side wire groove, this water forming one terminal, while the hole for the pin is filled with water in order to serve as the other terminal.—*Electric Journal*, October.

Enamel Wire.—R. Apt.—A paper read before the Berlin Electrical Society. The author remarks that enamel wire was introduced first in the United States, thin wires (up to about 0.2 mm diameter) being insulated by so-called cellulose-tetra acetate, while for thicker wires a special enamel was employed. The Allgem. Elek. Ges. is now using a cheap enamel for all kinds of wire down to a diameter of 0.05 mm and up to 1.8 mm. Various data and diagrams are given concerning the better utilization of space which thereby becomes possible in comparison with other kinds of insulation. The flexibility is so good that the wires may be wound in a coil 3 to 4 times their own diameter. In general the flexibility is greater at higher than at lower temperatures. The insulation resistance of the wires against mercury is about 10 megohms per km. The perforation e. m. f. against mercury is from 500 to 700 volts for wires up to 100 mm, while for thicker wires it increases up to 2500 volts. If the wires are placed in water the perforation voltage is smaller because the water enters into the very fine pores of the surface. In general, a perforation e. m. f. of 200 volts may be obtained for wires up to 0.1 mm and 300 to 400 volts for thicker wires. The insulation is not uniform enough to guarantee the perforation voltage within a few per cent. The maximum temperature at which the coils can be used is 150 deg. C., but a lower temperature should be employed if the windings are subjected to a mechanical stress.—*Elek. Zeit.*, Oct. 10.

Diameter of a Cable.—H. Luckin.—A note giving a formula for finding the diameter of a cable composed of a number of small wires. This formula is $D = d\sqrt{n\,c}$ where $D =$ diameter of cable over bare copper, $d =$ diameter of one wire, $n =$ number of wires, $c =$ constant to allow for clearances between wires owing to wires being round; its value is 1.33.—Lond. *Elec.*, Oct. 11.

Electrophysics and Magnetism.

Electric Radiations.—W. H. Bragg.—We know now a number of different types of radiation each of which is able to ionize a gas, to act on a photographic plate and to excite phosphorescence in certain materials. The present paper contains an attempt to find whether there is anything to be learned from a comparison of the properties of the various rays. It appears to the author to be a first deduction from such a comparison that in all cases the bulk of ionization which the rays effect is of the same character, and consists in the displacement of slow-moving electrons or delta rays, from the atoms of the gas or other substances which they traverse. In other words, the ionization which is measured in the ionization chamber is due almost wholly to the emission of slow-speed electrons from the atoms of the gas contained in the chamber or of the chamber walls, and this is true for all forms of radiation. Moreover, there is some evidence to show that the speed of the delta rays is almost independent of the cause and manner of their production. If attention is turned to all secondary radiation other than the delta rays, it seems to be in general a rough reflection or scattering of the primary. The author then discusses the law of absorption of different types of radiation in passing through matter. He then attempts to estimate the properties of some rays which might exist, though the fact has not been proved as yet. He considers the possibility of the emission of neutral particles such as a pair consisting of one alpha or positive particle and one beta or negative particle. On this view it would be possible for a portion of a disintegrating atom to break away, to pass over an appreciable distance, and finally to become part of another atom, the atomic weight of which would thereby increase. Internal atomic energy might be transferred at the same time. In the second part of the paper the author discusses the possibility that the gamma and Roentgen rays may be of a material nature. Since the properties of gamma rays are among the properties of Roentgen rays, an hypothesis which will suit one form of radiation will also suit the other. However, much more is known about Roentgen rays than about gamma rays. It is of interest, therefore, to consider the extent to which the additional knowledge can be fitted to a neutral pair hypothesis. It is true, of course, that the æther pulse theory has been most ably developed, and is now widely accepted. Nevertheless, the evidence for it is all indirect; and indeed some of it is overrated. It is quite possible that æther may not, after all, constitute the bulk of Roentgen radiation. The author concludes that a stream of Roentgen rays contains some æther pulses, but it is not easy to explain all of the properties of Roentgen rays on the æther pulse theory. The explanations are easier if the rays are supposed to consist mainly of neutral pairs; and the existence of such pairs is not improbable *à priori*. —*Phil. Mag.*, October.

Units, Measurements and Instruments.

Photometry.—A full account of the third meeting of the International Photometric Commission held in Zurich in July, concerning which previous notices have already appeared in the Digest. The following is the official resolution which was unanimously adopted. The International Photometric Commission, after having heard and discussed the reports of the work carried out in the German, English and French laboratories, on the proposition of the sub-committee composed of Messrs. Vautier (president), Brodhun, Laporte and Paterson, accepts the following values for the ratios of the luminous intensity of the flame standards now in use:

Carcel	10.7_5	Hefner
Vernon Harcourt	10.9_5	"
" "	1.02_0	Carcel

The above ratios have been chosen in order to avoid numbers which are less than unity. These values are correct within the limits of plus or minus 1 per cent. The values apply to the luminous intensity of the lamps when burning respectively under their normal atmospheric conditions; that is to say—

Barometric pressure, 760 mm.
Humidity:

Carcel	10.0	litres of water vapor per cubic meter of dry air
Hefner	8.8	" " " " " "
Vernon Harcourt	10.0	" " " " " "

The ratios given below are deduced with sufficient accuracy from the data already given:

	Carcel	Hefner	Vernon Harcourt
Carcel	1.0	10.75	0.980
Hefner	0.093	1.0	[illegible]
Vernon Harcourt	[illegible]	[illegible]	1.0

—Lond. *Electrician*, Oct. 18.

Production of Alternating Currents of Any Frequency.—R. Ruedenberg.—Continuous low-frequency alternating currents are produced by dynamos, while for the production of high-frequency oscillations electric oscillating circuits, containing capacity and inductance, are made use of. The latter method, however, produces in general waves which are gradually damped. The author shows that it is possible to combine the two methods in such a way that the oscillating circuit serves simply for producing the right frequency while the dynamo supplies the energy consumed. The e. m. f. of a series-wound dynamo is proportional to the current for a low magnetic density in the iron. If such a dynamo is connected to a circuit containing resistance, inductance and capacity in series, then Ohm's law gives directly a differential equation which when integrated shows that an alternating current can be produced in the circuit and that three different cases are possible. If the e. m. f. of the dynamo is Ki where i is the current, then K is constant and depends only on the construction and the speed of the dynamo; it is the e. m. f. of the dynamo per unit of current. If R is the resistance of the total internal and external circuit, then the three different cases mentioned above are, first,

that K is smaller than R; second, K equals R, and third, K is greater than R. In the first case, if K is smaller than R, the energy supplied by the dynamo is not sufficient to supply the whole energy consumed in the circuit so that the oscillations will gradually diminish. If now the speed of the dynamo is increased, its e. m. f. and the coefficient K also increase and finally the condition in which K equals R is reached. The oscillations of the circuit are then maintained undamped since the energy consumed in Joulean heat radiation, etc., is supplied solely from the dynamo. The frequency of the oscillations depends simply on the self-inductance and the capacity of the oscillating circuit. If the speed is further increased, the oscillating circuit would receive more energy from the dynamo than it can give off. This condition, of course, cannot exist for any length of time. The second case, in which K equals R, is the important one. The author has made experiments with a small direct-current series motor, the armature and poles of which were made of laminated iron. The machine was connected to small paper condensers and no special inductance was required, the self inductance of the machine itself being sufficient. He obtained in this way alternating currents the frequency of which could be changed from 20 to 70 periods per second when the capacity was changed from 20 to 2 microfarads. A method of this kind is thought to be specially suitable for producing high-frequency currents for wireless telegraphy. An arrangement which may be used to advantage is

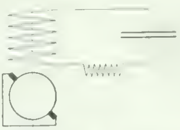


FIG. 4.—DIAGRAM OF ARRANGEMENT.

shown in Fig. 4, where the machine is not in series with the oscillating circuit but is connected to the latter by electromagnetic induction. The armature brushes are displaced from the neutral zone and are short-circuited while the ends of the field windings are directly connected to the condenser. Besides a smaller voltage at the commutator, a smaller self-induction of the whole machine is hereby obtained so that it is possible to obtain higher frequencies. This arrangement may be considered as a modified "repulsion" motor, the wattless magnetizing current being supplied from an external source—the condenser.—*Phys. Zeit.*, Oct. 15.

Resistor Coils.—C. V. DRYSDALE.—Continuations of his long paper on resistor coils and comparisons. In the present instalments the author discusses the desirable features and the temperature compensation of resistor coils. The temperature compensation of a resistor coil may be made either by connecting it in series or in shunt with another coil. A special case of shunt connection is the disposition of another suitable metal on the coil itself whereby at the same time a protective effect is obtained. Experiments of the author have shown that with nickel-plated resistor wire a very good compensation can be obtained. He then passes over to the discussion of a comparison of resistor coils. The paper is to be concluded.—Lond. *Elec.*, Oct. 11, 18.

Watt-hour Meters.—H. MILLER.—An illustrated article on the construction of watt-hour meters. After some remarks on alternating-current watt-hour meters of the induction type the author gives general notes on bearings, the torque, weight and friction of watt-hour meters, the counter frictional torque, regulation, recording mechanism, energy losses, accuracy, meters of large rating, the checking by means of standard instruments and operating conditions.—*Electric Journal*, October.

Telegraphy, Telephony and Signals.

Electric Oscillators.—J. A. FLEMING.—The conclusion of his article giving an elementary theory of electric oscillators. The practical applications of the theory are as follows: If a vertical Marconi antenna be set up for wireless telegraphy, and it be gradually inclined over or placed in a slanting position, then for equal distances round it, the radiation is enfeebled by such inclination, but is also made unsymmetrical, remaining strongest in the direction opposite to that towards which the antenna leans. Many observers have experimentally noted this fact, and some of them have stated the direction of maximum radiation of the inclined antenna wrongly. A point of some importance to notice is that electric wave antenna, being radiators, fulfil the laws of all other radiators, and in particular the law of exchanges, in that they not only absorb the radiation of that wave length which they emit, but they absorb best on that side towards which they radiate best. Hence a bent or inclined antenna is not only an unsymmetrical radiator; it is also an unsymmetrical absorber. If, then, a bent antenna, having a small part of its length vertical and a much longer part horizontal, is employed as a receiving antenna, it will receive best from the direction opposite to that towards which the free end points. If, then, the horizontal part points north, it will receive best waves coming from the south, and if the horizontal part can be swivelled round, such a receiving antenna can be employed to locate within certain narrow limits the direction of the sending station. Mr. Marconi employs also combined bent sending and receiving antennæ placed back to back, the one radiating best in the direction opposite to that in which the free end points, and the other absorbing best in a similar direction. These results were discovered by a laborious process of experiment and practical trial, but they are capable of being fully explained on the theory given that such a bent radiator is equivalent to the combination of a magnetic or closed oscillator with an electric or open oscillator. The limitation which has to be imposed on the discussion to render the mathematical analysis not intractable is that the current in the oscillator has the same value at all parts of its length at the same instant, and that the free charges are confined to the extreme ends. Neither of these assumptions is strictly true of the real wire antennæ used in radio-telegraphy, but it is approximated in the case of a wire antenna with a capacity or metal plate at the top. Experiment, however, shows that the observed results obtained with bent or inclined antennæ in radio-telegraphy are in general accordance with the predictions of the elementary theory given, but the problem of discussing mathematically the case of inclined or bent antennæ with distributed capacity and inductance, and, therefore, with currents varying from point to point in it, is one of extreme difficulty.—Lond. *Elec.*, Oct. 11.

Training of Telegraph Engineers.—O'MEARA.—An address delivered by the author who is engineer in chief of the British General Post Office, before the Post Office Institution of Electrical Engineers. He laid stress upon the value of the personal equation in the make-up of an engineer, and in particular the power of an individual to solve the personal equations of his subordinates. Commercial aptitude ranks second, in his opinion, and he emphasized the importance of a training in commercial subjects, such as accounting, patent law, the law of contract, etc. Finally, the value of a study of sociology was touched upon, together with the necessity for constantly maintaining the attitude of a student towards all progress.—Lond. *Elec. Eng'ing*, Oct. 17.

Miscellaneous.

[illegible] points out that there are very few manufacturers who recognize the fact that a student of to-day is the potential buyer of tomorrow. It pays the manufacturer to try to reach him. This may best be done through his professor or lecturer, by supplying the latter, if desired, with some form of a cabinet in which samples of the products of the manufacturer are laid loose. Each of the samples should bear the maker's name and description which becomes impressed on the student's mind so that in after years when in a position to place orders he remembers that such and such a firm makes such and such goods and that is the firm which gets the business.—Lond. *Elec.*, Oct. 11.

[illegible] electric power station and sewage disposal works at Muizen-

berg have been opened, that street lighting by osram lamps is to be introduced at Woodstock at a cheaper rate than quoted by the gas company, and that electric train lighting is making considerable progress in South Africa.—Lond. *Elec. Eng'ing*, Oct. 10.

Sales Contracts.—D. A. Brennan.—The conclusion of his serial. In the present instalment the author discusses damages in general, liquidated damages and penalties, assignments and statutes of limitation.—*Electric Journal*, October.

Electrical Laboratory.—S. P. Smith.—A fully illustrated description of the equipment of the Elektrotechnic laboratories of the Institute of Technology of Karlsruhe, Germany.—Lond. *Elec.*, Oct. 11.

BOOK REVIEWS.

The Elements of Electrical Engineering. A text book for technical schools and colleges. Vol. II, Alternating Currents. By Prof. W. S. Franklin and Prof. William Esty. New York: The MacMillan Co. 378 pp., 290 ills. Price $3.50.

The present book is the companion volume to the above authors' book on direct-current machinery, a review of which appeared in our issue for July 14, 1906. The authors throughout the second volume have well maintained the high standard reached by the first volume. There are 15 chapters dealing with the general theory of the alternator and the representation of alternating voltage and current, the characteristics of synchronous motors and converters, stationary transformers, induction motors, single-phase series motors, and transmission lines. Appendix A is devoted to a discussion of the phenomena in circuits containing inductance and condensance, while Appendix B gives a large number of practical engineering problems that will prove of great value to the student.

The explanatory matter throughout the book is based on the geometric representation of the alternating quantities and the trigonometric and algebraic determination of their numerical values. One chapter of the book, however, is devoted to an outline of the complex-quantity method of determining numerical relations; attention is called to the fact that this method is merely a systematic scheme for carrying out the combined trigonometric and algebraic method. Although a large percentage of the writers on alternating-current subjects fail to distinguish between such familiar quantities as "power" and "energy," the present authors have kept their text singularly free from such sources of confusion to the uninformed reader, and have consistently considered "power" in its true significance as "flow of energy." The treatment of "electric resonance" is exceptionally good in all respects except one: In section 36, on "Multiplication of Current by Resonance," the diagrams are so arranged, and the statements are so worded, that the uninitiated reader would be justified in assuming that if in a certain circuit containing an inductive impedance coil there be connected in parallel with the coil a condenser of certain capacity the current in the coil will be greatly increased. The exact conditions under which the increase can take place should have been stated definitely and not left to the untrained imagination of the reader. The above criticism does not apply to the descriptive matter itself, but to the interpretation to which it may lead.

The discussion of the voltage and the voltage regulation of alternators, to which the 24 pages of Chapter VII are devoted, is probably the best simple and effective treatment of this subject to be found in text-book literature. That portion of the treatment of synchronous motors which deals with the normal operation and the hunting of these machines is excellent for its simplicity in presentation, but certain of the results derived from calculation of the excitation characteristics seem to need checking. The most systematic treatment in the book is that dealing with the general alternating-current transformer, including the in- [illegible] sis is placed on the advantage of using the "equivalent circuits" of the transformer and the induction motor, and the diagrammatic representation of the current and e. m. f. relations on the basis of the equivalent circuits. The chapter on the single-phase series motor discusses briefly the characteristics of the series and the repulsion motor, and suggests several novel methods for preventing sparking.

The book will serve excellently for the purpose for which it was intended, namely, a text-book for engineering students in technical schools and colleges.

Exercises et Projets d'Electrotechnique. Par Eric Gerard et Omer de Bast. Tome I. Applications de la Théorie de l'Electricité et du Magnétisme. Paris: Gauthier-Villars. 239 pages, 96 illustrations. Price, 6 francs.

This is the first of two volumes of problems prepared by the authors for students in their course at L'Institut Montefiore, Liège, Belgium, in order to fix more firmly in their minds the principles of which the problems are applications. The present volume relates to the theory of electricity and magnetism, and a second volume will be devoted to practical applications of theory to apparatus and electrical installations. The plan pursued is excellent in that it involves more than the mere working out of problems by a mechanical operation of little benefit to the student. In each case the numerical operations are preceded by a deduction from the fundamental principles, of the necessary formulas, so that the student cannot escape connecting the theory with its practical application. The problems are well chosen, having for the most part a practical bearing.

The subjects covered in the six chapters of the book are magnetism, electrostatics, laws of the electrical current, electromagnetism, electromagnetic induction and alternating currents. In the latter case, many of the solutions are based on both a graphical method and on the use of complex quantities. If the authors had not been constrained to follow the methods of text-books used by their students, they might have simplified to an extraordinary degree most, and perhaps all, of the solutions of alternating-current problems, by separating the various steps in the analysis or synthesis and using simple triangles in computing numerical results—a method by which the most complex problems in alternating currents may be solved with a mathematical knowledge extending little beyond arithmetic. The book will be found of much value to all teachers of electricity, and furnishes an admirable means for a review of electrical theory to men whose knowledge has become rusty and who would not care to return to the ordinary text-book for a course in repolishing.

Specifications for Street Roadway Pavements. By S. Whinery, Mem. A. S. C. E. New York: Engineering News Publishing Company. 56 pages. Price, 50 cents.

The preface states the object of the specifications included in this book is to set out definitely and clearly as practicable the requirements for construction of good pavements of the several standard kinds. For the case when circumstances require the engineer to provide for the construction of new kinds of pavement not covered by the specific forms given, a general form is also provided.

Telephones at a Rifle Range.

By F. A. Cornell.

The successful use of telephones in the Japanese army during the late war with Russia has thoroughly aroused the American war department to the advantages of such means of communication, and this enthusiasm has imbued the National Guard of several states with a similar determination to develop the best facilities in this line. This policy includes the use of telephones in rifle-range equipment, as well as in the complicated signalling mechanism of sham maneuvers.

Camp Perry, Ohio, has been so well equipped with modern appliances that the National Shoot was held there during the late summer and early fall. Part of this equipment included over two score complete telephone circuits for use in reporting each shot from "pit" to "firing line." These were operated by the Signal Corps of the Ohio National Guard, and while they

are really an adjunct to the regular reporting routine, their value in case of delays and misunderstandings was very evident, and rendered them indispensable. On the long ranges, from 1000 yards up, the opportunities for their use are, of course, vastly increased, and in such instances they enable the range officers to dispense with the services of a large detail of mounted orderlies.

On the firing line the instruments are mounted on suitable desks about 8 yards in the rear of the competitors and about yards from the rear of the scoring tables. The standard

FIG. 1.—WORK IN THE LONG RANGE PIT, CAMP PERRY.

government field sets, manufactured by the Dean Electric Company, of Elyria, Ohio, are used, and the wiring is laid through underground ducts. Each instrument in "the pit" is in charge of an operator, and there is a complete circuit from target to firing line for each fifth range.

When a team takes its position on the range, the officer in

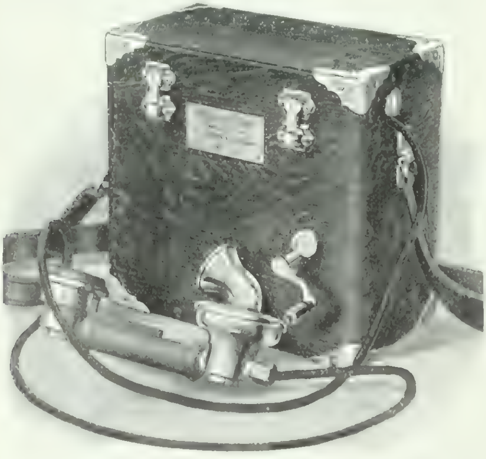


FIG. 2.—SET OF PORTABLE TELEPHONE INSTRUMENTS.

charge is continually advised of the exact state of affairs in "the pit" (where the targets are handled) by the use of these field sets. Red markers are raised in front of the targets when they are not in use, and at the command from the officer in charge of the range, transmitted over the telephone to the officer in charge of the pit, these markers are removed and the first volley fired. The targets are arranged on rollers, two per set, and so constructed that when one is in position the other drops down into the pit below the protecting bank of earth on the side facing the firing line. After each shot the position of the "hit" is indicated to the scorers, who are located two yards to the rear of the firing squads, by placing a metal disc marker on the hole in the target. These discs are of various colors—white for bull's-eye, white cross on black ground for four points, and black for three, while the red range flag is waved in front of the target in case of a miss. Should the scorer fail to get the report of any shot the signal corps telephone operator at the firing line rings the pit and calls for the "last shot on range No. 65," or whatever the case may be. Detailed information over the line enables the scorer to keep his records up to

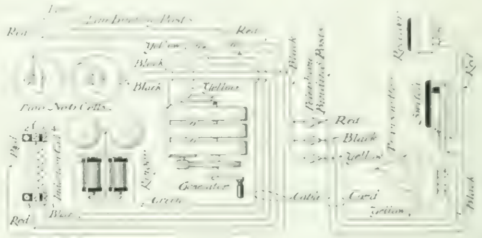


FIG. 3.—CIRCUIT DIAGRAM OF TELEPHONE SET.

scratch, and gives the competitor the advantage of the exact location of his shot, so that he may make proper sight adjustment or wind allowance.

The telephone instruments, shown in the accompanying illustration, are compact, and at the same time complete. The cabinet provides spaces for two No. 6 dry cells, a three-bar ringing generator, a ringer, an induction coil, and a hand microphone set. This microphone is of an improved pattern which combines convenience in using with strength and freedom from trouble. The body of the set is of aluminum, the receiver and transmitter shells are of nickel-plated brass, to properly protect those parts against the most inclement weather. To assist in installation and in the location of any troubles that may arise, each set is provided with a circuit diagram, which enables even a layman to connect and operate the apparatus.

Electrical Gold Mining in Mexico.

The Lluvia de Oro Gold Mining Company has purchased through L. L. Nunn, of Provo, Utah, the machinery for a complete power plant to be operated in connection with its mines in the Sierra Madre Mountains, near El Fuerte, Mexico. It is to consist of a 500-kw Allis-Chalmers steam turbine, running at 3600 r. p. m., direct-connected to one of the same company's alternating-current generators designed especially for operation with it at 60 cycles, three-phase and 600 volts. Excitation at 120 volts will be obtained from two small exciter sets, each of 15 kilowatts capacity, one driven by a high-speed engine and the other by an Allis-Chalmers induction motor. There has also been built by the Allis-Chalmers Company, to be installed with the turbo-generator unit, a Tomlinson barometric condenser, with 36-in. head, and an 8-in. x 16-in. x 20-in. dry vaccum pump. The water for the condensing system will be brought by gravity to a cold well near the condenser at a height to be forced into the condenser by atmospheric pressure.

The complete equipment, which was shipped soon after the placing of the order, will be installed in a substantial stone power house. The fact that the plant has been designed by Mr. Nunn, who is one of the best known constructing and consulting engineers in the country, insures its being a model one in every respect. As all of this apparatus will have to be carried along a difficult road over the mountains, after being taken by boat from Guaymas to Topolobampo, and thence by rail a part of the distance, the transportation of it has been a problem.

Electric Furnace and Pyrometer Outfits.

A preliminary model of the new patented quartz-lined electric furnace, designed by Prof. Wm. H. Bristol, was described in the Electrical World, January 5, 1907, page 9, and a few of the possible applications of it for practical work were mentioned. This furnace has now been developed into a suitable form for use with the Bristol recording electric pyrometer (described in the Electrical World, Nov. 10, 1906, page 929), in such a way that the temperature inside the furnace may not only be controlled but also automatically recorded on a chart. A special laboratory unit consisting of the electric furnace and a recording pyrometer with attachments, designed for determining the recalescent points of steel and for hardening small tools, is shown in Fig. 2, with the various parts all mounted on the same standard in such compact form that the complete unit may even be conveniently used on an office desk, the electric energy being obtained from a lighting circuit.

The electric furnace itself is of very simple construction, its special feature being the lining of fused quartz which makes it possible to apply the full value of current suddenly and thus to heat up the furnace quickly without danger of cracking its interior. Even when the furnace is heated to a bright red, a cold piece of steel may be introduced without injury to the quartz lining which at the same time serves as a perfect insulation between the metal and the heating coils. A rheostat may be used to regulate the temperature, but for some applications it may be dispensed with, as, for instance, in the use of the furnace as a soldering copper heater with direct lamp plug connection. In that case, the winding of the heating coil is so arranged that the maximum temperature of the furnace will be correct for continuous service and not so high as to oxidize the soldering copper. For many other applications, as for tools and for laboratory work, both a rheostat and a pyrometer are used with the furnace to great advantage.

Fig. 2 shows the new laboratory unit especially designed for determining the recalescent points of various kinds of steel. The electric furnace is here shown in circuit with a rheostat so that after the full value of the current has been turned on, bringing the furnace up to a bright red heat on the inside

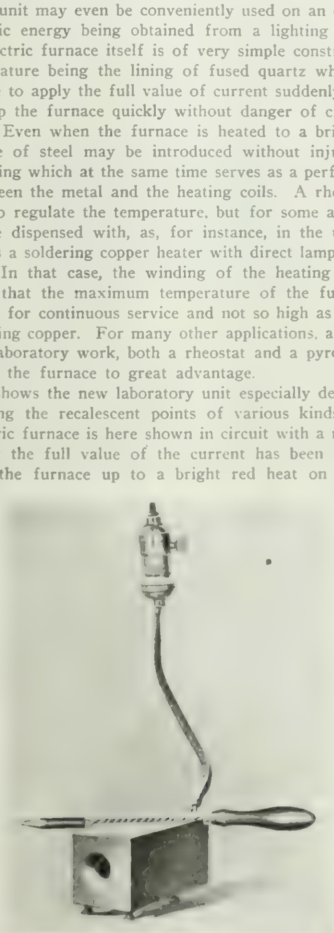


FIG. 1.—QUARTZ-LINED FURNACE FOR HARDENING SMALL TOOLS.

almost immediately, the rheostat may be adjusted so as to maintain the desired temperature.

The illustration also shows the complete recording pyrometer mounted on one standard and consisting of a platinum-platinum-rhodium thermo couple and a recorder. The couple of the pyrometer fits into the furnace and has its "cold junction" (or point where the flexible leads begin) inserted into a breaker of ice water. The e. m. f. of this thermo couple varies directly with the temperature inside the furnace and actuates the recording instrument of the electric pyrometer, the recording arm of which makes a continuous record automatically on its circular chart. The recording pyrometer is equipped with a semi-transparent smoked chart and a special vibrating device which brings the sensitive surface of this chart in contact

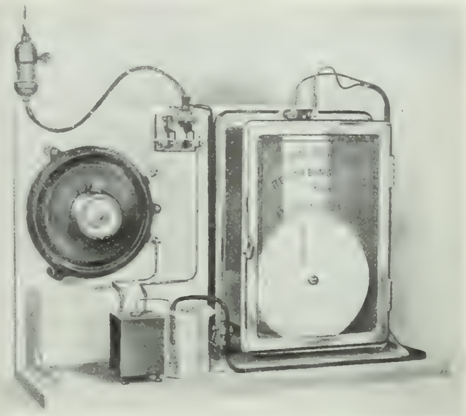


FIG. 2.—FURNACE AND PYROMETER OUTFIT FOR DETERMINING RECALESCENT POINTS OF STEEL.

every half second with the recording arm. As friction between the recording arm and the chart is eliminated, a perfectly accurate record is obtained directly without the use of relays or other complicated devices. In order that very quick variations of temperature may be recorded, the chart is arranged to revolve once in sixty minutes.

The special design of this laboratory unit makes it very convenient for measuring the recalescent points of steel, or in other words the temperature at which a molecular transformation occurs below which the steel cannot be hardened. After the electric furnace has been heated up by turning on the current, a small cylindrical sample of the steel is inserted into the top of the furnace and the tip of the thermo couple is introduced into the hole of the sample. As the steel is gradually heated up by the furnace, the rising temperature inside it will be recorded on the chart. After the temperature has been raised as far as desired, the piece of steel may be withdrawn from the furnace without disturbing the couple and as the steel cools, its fall in temperature will also be recorded on the chart. The records of these rising and falling temperatures will be shown as curves on the charts on which the recalescent points will be easily discovered.

The temperature which would be right to harden one kind of steel would not be the right one to produce good results with another kind of steel. By making series of tests like those described above, the manufacturer can find out what temperature is the best one for him to use in hardening each particular lot of steel. The old-fashioned idea that steel could be hardened by guess-work is fast giving away to the realization that a piece of steel may become either worthless or precious according to the heat treatment which it receives.

The special laboratory outfit described above is being manufactured by Wm. H. Bristol, at 45 Vesey Street, New York City.

Storage Batteries in Isolated Plants.

One of the recent examples of the value of a storage battery for continuous service in isolated plant work is that of the Hotel La Reine, Bradley Beach, N. J., which is equipped with the "Unit" Accumulator type of battery. The Hotel La Reine was first opened to the public early in July of this year, and is one of the finest of the Atlantic Coast seaside resorts. The house contains 120 rooms, all of which afford a view of the

[illegible] character of the place.

The electric service equipment is particularly notable, in that it has been designed to afford absolute reliability and continuous service. No expense has been spared to this end. The power plant contains two Northern direct-current 110-volt generators direct-connected to Secor kerosene engines. In the power house, but partitioned off from the engine room, is a [illegible]

STORAGE-BATTERY EQUIPMENT.

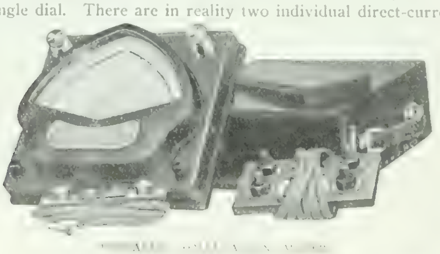
glass jars. In the engine room a suitable booster is provided for charging purposes, and a special panel containing battery meters, circuit-breakers, end-cell switches, etc., is installed with the main switch board.

The battery has a rating of 40 amperes at 220 volts for eight hours on one charge and is principally designed to operate the elevator service of the hotel. The plant is arranged, however, so that the battery may be used for break-down lighting service or for watchman's lighting when it is not desired to run the main dynamos. The importance of continuous service —particularly for hotels—is readily appreciated, which has brought the auxiliary use of storage batteries to supply this indispensable feature, ordinarily lacking in isolated plants, into prominence.

The electric service equipment, as well as the hotel itself, was designed by Mr. John E. Nitchie, of New York City, and the entire battery plant, which has been particularly satisfactory, was furnished and installed by the National Battery Company of Buffalo, N. Y.

Combination Current, Electromotive Force and Power Meter.

The combination meter shown herewith has been designed especially for the purpose of economizing bench space, and at the same time producing an accurate instrument that will replace three ordinary type of direct current meters. It gives simultaneous indications of volts, amperes, watts and horse-power on a single dial. There are in reality two individual direct-current



[illegible]

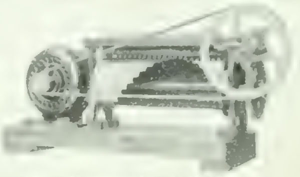
instruments, a voltmeter and an ammeter, each of which is made on the d'Arsonval galvanometer principle; that is, a rectangular coil of wire rotatable in a small annular gap between a cone and pole pieces. The voltmeter may be used with external resistors in order to increase the e. m. f. and power range. The ammeter is equipped [illegible] of 200 amperes. For two or more ranges the instrument is provided with interchangeable shunts, either separate or contained in one compact box.

The Victor combination meter as outlined above is manufactured by the H. W. Johns-Manville Company, 100 William Street, New York, which also applies the combination scheme in a line of compact switchboard instruments.

A Flasher With Handwriting Effects.

A new device that has made its appearance called the "Model C Flasher," for use where lamps are to be lighted one after another until all are lighted. The application of this flasher is, for instance, in a script letter sign where a writing effect is desired. However, it may be used to produce streak of lightning effects, or in any other manner where a rapid movement of light is desired by the use of incandescent lamps. The drum of the flasher can be made to revolve very quickly without causing excessive wear in any of the moving parts.

The construction is simple, as well as substantial. On cast-iron uprights is mounted a slate strip. Underneath this, and



[illegible]

secured to it, are phosphor bronze springs, one for each circuit, or individual flash. These springs carry the current. There is a binding post on top of the slate strip for each spring, and in addition one for the return wire. The drum, which is mounted on the main shaft, is used only in a mechanical way, as no current passes through it. This flasher is made for practically any number of circuits, ranging from 25 to 110. It is made by the Electric Motor & Equipment Company, of Newark, N. J.

Puddled Semi-Steel Valves.

The increasing use of high pressures and superheated steam has created a demand for something better than the ordinary cast iron, brass mounted valves, and to meet this demand, the Lunkenheimer Company offers its line of "Puddled" Semi-steel valves. The manufacturers state that "Puddled" Semi-steel is an extremely high grade iron and steel alloy, of very close grain and great strength, and not to be confounded with the mixtures made in cupolas where the admixture of steel with the iron is beyond control, and the resulting metals sadly lacking in uniformity. The method employed is to melt the iron and steel together in a specially modified "puddling" furnace, thoroughly mixing them during the process, and by pouring off at the proper time and temperature, an invariably uniform alloy is secured. The best grade of Lake Superior charcoal iron is used exclusively. In "Puddled" Semi-steel, the percentage of deleterious chemical elements is kept very low, a result which is absolutely impossible to obtain in any cupola. By this process, the tensile strength can be controlled at any point between 30,000 and 40,000 pounds per square inch. Ordinarily, the strength maintained is 35,000 pounds, which is over 100 per cent stronger than the cast iron used in the majority of valves. "Puddled" Semi-steel valves have been extensively used in high-pressure plants carrying superheated steam, and in other places where the physical demands on a valve are great, and in every case they have given complete satisfaction. The body, disc gland and yoke are made of "Puddled" Semi-steel, the seat ring and disc lock-nut of nickel bronze, the gland, stuffing-box [illegible]

This is a combination which cannot be too highly commended.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports indicate that there was a contraction in business as a result of the financial crisis, but only to the extent compelled by inability to get money. The general uneasiness arising from the same cause has almost entirely calmed down, and more confidence is manifested. Coincidently with the enforced employment of credit instruments has been witnessed a marked increase of transactions on a purely cash basis, and large quantities of stocks, grain and other produce have changed hands at concessions in most cases. There was a sensible diminution of jobbing trade activities, some reduction of forces in railroad improvement work and in other industries and some retarding influence upon retail trade. Collections, naturally, showed some effect of the disturbance. The most noticeable feature of the readjustment of conditions has been the lowering of prices of commodities to a basis where lagging demand is expected to revive. Grain and cotton were quick to respond and live stock and meats are lower. The iron and steel industry reports new demand quiet as a whole, and copper felt the effect of the sharp decline in quotations in sales of many million pounds. Lumber, hardware, and in fact building materials of all kinds are in slow demand. Car shortage is widespread, affecting the movement of grain at Buffalo, of coal at all leading points east and west and of lumber in the Pacific Northwest. New business in structural material was of small proportions, and steel rails were a little more active in comparison with recent marked dullness. Copper was much firmer, lake brands having risen rapidly to 14¼c. after being quoted at a shade under 12c. Electrolytic ranged from 13¾c. to 14¼c. The recovery is attributed to heavy speculative buying, but domestic business was not of marked proportions. The improvement, however, may not be permanent until conditions in the brass goods, wire and electrical trades take a turn for the better. *Bradstreet's* reported 223 business failures last week, against 220 in the week previous and 163 in the corresponding week last year.

EXPORT OF MANUFACTURES.—Manufactures are forming a larger share of the exports of the United States than ever before, and a larger share of the imports than at any time since 1890. They formed practically 44 per cent of the exports during the nine months ending with September, 1907, while they had never but once reached 40 per cent in any fiscal year covered by the records of our export trade. Manufactures formed in the fiscal year 1880 14.78 per cent of the exports of domestic products; in 1890, 21.18 per cent; in 1900, 35.3 per cent; in the fiscal year 1907, 39.94 per cent, and in the nine months ending with September, 43.83 per cent of the total exports of domestic products. The total value of manufactures exported was, as shown by the official figures of the Bureau of Statistics of the Department of Commerce and Labor, in round terms, in 1880, 122 millions; in 1890, 179 millions; in 1900, 484 millions; in the fiscal year 1907, 740 millions; and in the nine months ending with September, 574 millions; the average per month being, in 1880, 10 millions; in 1890, 15 millions; in 1900, 40 millions; in 1907, 62 millions, and in the nine months ending with September, 63 millions. In 1880 the average value per day of manufactures exported was one-third of a million dollars; in 1890, a half million; in 1900, 1⅓ millions; in 1907, 2 millions, and in the nine months ending with September, 2 1/10 millions.

SNOW MOUNTAIN POWER.—It is stated from San Rafael, Cal., that the Snow Mountain Electric Power Company, a new concern backed by former United States Senator Felton, will enter the field soon as a competitor of the Pacific Gas and Electric Company in Mendocino, Sonoma and Marin Counties. The company has been in existence but a short time, but already has erected several sub-stations and strung a number of miles of high tension wire in Sonoma and Mendocino counties to carry the electrical energy from the central power plant at Snow Mountain, which is 150 miles from San Rafael. Manager McGrath has petitioned for a franchise to erect poles and supply current to consumers in San Rafael. He will apply for franchises in San Anselmo, Sausalito, Mill Valley and Belvedere. Should he be successful, the service will be inaugurated within a year. The company intends to run feeders throughout the counties in which the Pacific company has lines.

HAWAIIAN LUMBER.—The largest contract ever made in the Hawaiian territory has been signed between the Hawaiian Mahogany Lumber Company and E. W. Faulkner, representative of the Atchison, Topeka & Santa Fé Railroad Company, for 90,000,000 feet of ohia lumber, which will be cut into 2,800,000 ties and delivered within two years. The price is $2,000,000 at the rate of 71½ cents a tie. It is understood that the Santa Fe will make its own arrangements for shipment and probably will bring from 50 to 75 vessels to Hilo for the freight. This contract also means the establishment of small industries to utilize the by-products, for the shipment of firewood, for making telegraph and telephone pins, charcoal, wagon parts and arms for electric light, telegraph and telephone poles.

DEVELOPMENT OF SILVER FALLS.—The Town Council of Port Arthur, Ont., has authorized the firm of Smith, Kerry & Chace, 126 Confederation Life Building, Toronto, Ont., to commence work on the development of Silver Falls on the Kaministiquia River, about 25 miles northwest of Port Arthur. The development will have an ultimate capacity of about 30,000 hp; the equipment proposed to be immediately installed being 6000 hp. The operating head is about 220 ft. The city has at present in use a development of 1000 hp on the Current River and within the municipal boundaries, but the requirements have outgrown the capacity of this station.

BUSINESS WITH FRANCE.—One of the American consular officers in France sends the name of an electric company there which is open to accept agencies of first-class American electric devices and supplies. Correspondence with this company may be carried on in English. He also sends a list of other firms engaged in this business. The address can be had from the Bureau of Manufactures of the Department of Commerce and Labor, Washington.

UNITED KINGDOM.—An American consul in the United Kingdom states that there is no importing of electrical apparatus at the place in question, but a merchant there, whose name he gives, would like to communicate with makers of such apparatus and thinks it probable that he and others might become importers. The address can be had from the Bureau of Manufactures of the Department of Commerce and Labor, Washington.

ALLIS-CHALMERS STEAM TURBINES.—The Tremont & Suffolk Mills, of Lowell, Mass., will add to the present power equipment, recently purchased, a 1500-kw Allis-Chalmers turbine direct-coupled to a 2000-kw generator, wound for 60-cycle, 3-phase circuits, to operate at a speed of 1800 r. p. m. The new equipment includes in addition to the main unit two exciter units, one motor and the other engine driven 50 kw.

ELECTRIC FANS.—One of the American consuls in Europe gives the name of a business firm in the city in question who would be glad to hear from makers of or dealers in electric fans. The address can be obtained from the U. S. Bureau of Manufactures, Department of Commerce and Labor, Washington.

TELEPHONE MATERIAL.—Bids will be received until Dec. 10 by the Deputy Postmaster-General, Melbourne, Commonwealth of Australia, for the supply and delivery there of fifty telephones, wall sets.

PLANT FOR BRAZIL.—Another step in the development of South America is recorded in cable dispatches from San Paulo, Brazil, announcing that the government has accepted the bid of Guinle & Company, of New York City, to furnish electric power in San Paulo. The electric energy will at first be used for operating the public water works system and later for lighting purposes. Steam plants are very expensive in Brazil owing to the scarcity of coal, and electrical energy generated by water power at a distance has been the solution of the power question. The action of the Brazilian Government in giving this important

contract to an American concern is regarded as of the greatest importance in the development of San Paulo and other cities in that country.

THE NORTHERN ENGINEERING WORKS, crane and hoist builders, of Detroit, Mich., are adding a new power station to their plant. The boiler and coal storage station will be built at once and will be approximately 60 x 60 ft. in size, one story, fireproof construction throughout, with reinforced cement roof, iron doors, etc. It will be equipped with Wickes boiler, Murphy stoker and Webster heater. Contracts have been let. The plans were made by Smith, Hinchman & Grylls, engineers and architects, Detroit.

Financial Intelligence.

THE WEEK IN WALL STREET.—Early in the week the stock market suffered from a severe liquidation due to the calling of loans by banks. Standard railroad shares in particular fell in many cases to the lowest figures in a decade. Speculative buying was generally discouraged by banking authorities. The action of the Clearing House Association in issuing loan certificates and the adoption of similar methods at other cities, together with the violent break in foreign exchange and the announcement of gold imports from Europe to the extent of fully $27,000,000, allayed the panicky feeling and gave assurance that the leading financial interests would be able to control the situation. The buying of metal copper on a large scale was regarded with satisfaction, the effect being shown in the greater firmness of Amalgamated Copper and other copper stocks. The United States Steel Corporation's report for the September quarter was also favorably received, notwithstanding the reported decrease of a million and a half tons in orders on hand Sept. 30. At the close of the week the market was irregular and prices tended downward on the sharp advance in foreign exchange rates. Greater strength was shown in the principal electric stocks and some recoveries from the low figures of last week are noted. Westinghouse was active and advanced 5 points on sales of 3,420 shares. Western Union suffered a decline to the extent of 5 points net and touched the lowest quotation for the year—62. The curb market was narrower, with a little improvement in copper shares. Trading was on a smaller scale and conditions were nearly normal. Following are the closing quotations of Nov. 4:

NEW YORK.

	Oct. 29	Nov. 4		Oct. 29	Nov. 4
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	10[illegible]	[illegible]
Allis-Chalmers Co. pfd.	[illegible]	14⅝	Hudson River Tel.	—	[illegible]
Am. Dist. Tel.	[illegible]	[illegible]	Interborough Met. com.	[illegible]	[illegible]
American Locomotive	36	39	Interborough Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	84	86	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable	80*	65	Mackay Cos. pfd.	53	[illegible]
American Tel. & Tel.	—	—	Marconi Tel.		
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	[illegible]	
Electric Boat	—	—	N. Y. & N. J. Tel.	[illegible]	
Electric Boat pfd.	—		Western Union Tel.	[illegible]	[illegible]
Electric Vehicle	—	—	Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd.	—	—	Westinghouse pfd.	—	—

BOSTON.

	Oct. 29	Nov. 4		Oct. 29	Nov. 4
American Tel. & Tel.	97	93½	Mass. Elec. Ry. pfd.	38	39
Cumberland Telephone	—	96¼	Mexican Telephone	—	—
Edison Elec. Illum.	197½	188	New England Telep.	100	[illegible]
General Electric	106	—	Western Tel. & Tel.	—	[illegible]
Mass. Elec. Ry.	[illegible]	[illegible]	West. Tel. & Tel. pfd.		—

PHILADELPHIA.

	Oct. 29	Nov. 4		Oct. 29	Nov. 4
American Railways	44	[illegible]	Phila. Electric	[illegible]	[illegible]
Elec. Co. of America	[illegible]	[illegible]	Phila. Rapid Transit	16	[illegible]
Elec. Storage Battery	33	31	Phila. Traction	85	[illegible]
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Oct. 29	Nov. 4		Oct. 29	Nov. 4
Chicago City Ry.	[illegible]	[illegible]	National Carbon		—
Commonwealth-Edison	70	—	National Carbon pfd.	—	—
Chicago Subway	[illegible]	—	Union Traction		
Chicago Tel. Co.	[illegible]	—	Union Traction pfd.	—	—
Metropolitan Elec. com.	20*				

*Asked.

WILMINGTON, N. C., CONSOLIDATION.—The control of the Consolidated Railways, Light and Power Company has been transferred to the Tidewater Power Company, under a lease which will continue for 99 years. The terms of the lease were agreed on last July, and the transfer was practically made at that time, but formal ratification of the stockholders on the action of the directors was not gained until now. The purpose of transferring the control of the Consolidated Railways, Light and Power Company to the Tidewater Power Company by purchase of a majority of the stock of the Consolidated Company, and a lease of the Consolidated Company to the Tidewater Power Company for a period of 99 years, is to have an operating company which is large enough and which has sufficient financial strength to take care of the extensions and improvements which have been necessitated by the rapid growth of the city of Wilmington. The Consolidated Company was planned and organized on financial lines which were adequate five years ago, in 1902, but not adequate for the present time, and especially, could not provide for the future.

KEYSTONE TELEPHONE ANNUAL.—The full annual report of the Keystone Telephone Company, of Philadelphia, has just been published for the year ending June 30, 1907. The figures show a surplus of $107,740 after reserves and charges, equal to 5.52 per cent on the $1,936,850 preferred stock of the Keystone Telephone Co. of New Jersey. The statement, with comparisons, follows:

	1907.	Increase.
Gross earnings	[illegible]	[illegible]
Expenses and taxes	[illegible]	[illegible]
Balance	[illegible]	[illegible]
Reserve for renewal and interest charges	365,976	72,100
Surplus	[illegible]	[illegible]
Adjustments	[illegible]	[illegible]
Surplus	$107,740	[illegible]
Previous surplus	423,361	[illegible]
Profit and loss surplus	$531,101	$107,740

A very large amount of development work has been accomplished during the year, involving heavy expenditures. A new line was constructed from Camden to Cape May, two circuits put in operation, and a complete conduit system established in the latter city. Five additional circuits were placed in service between Philadelphia and Atlantic City, requiring 100,000 lbs. of copper wire. This relieved congestion on this line, and greatly facilitated business between Atlantic City and Keystone points in Pennsylvania. It was deemed advisable by the directors to proceed at once to meet the requirements of the public for increased facilities, and it was therefore decided to issue $600,000 three-year 6 per cent collateral trust gold notes. They are secured by $720,000 first mortgage 5 per cent bonds of the Keystone Telephone Company, of Philadelphia.

EARNINGS IN CALIFORNIA.—The combined income account of all the properties owned and controlled by the Pacific Gas & Electric Company, including the California Gas & Electric Corporation, the San Francisco Gas & Electric Company and properties directly operated, for the year ended June 30, 1907, is as follows:

Gross earnings from all sources	$12,164,399
Oper. exp., maintenance, taxes, etc.	7,016,507
Net income available for bond interest	[illegible]
Int. and sink. funds of subsidiary corporations	[illegible]
Surplus available for interest and sinking funds of Pacific Gas & Electric Company	$2,650,478
Bond interest and sinking funds Pacific Gas & Electric Company	1,010,673
Balance	[illegible]
Preferred stock dividends accrued	[illegible]
Balance	[illegible]

The California Gas & Electric Corporation reports as follows for the year ended June 30, 1907:

Gross earnings	[illegible]
Operating exp., maintenance, taxes, etc.	4,062,920
Net earnings from operations	$3,123,213
Other income	[illegible]
Total net income available for interest	[illegible]
Interest	[illegible]
Balance	[illegible]
Sinking fund	[illegible]
Surplus	[illegible]

LOS ANGELES EDISON REPORT.—The Edison Electric Company, of Los Angeles, reports for the year ended June 30, 1907, as follows:

	1907.	1906.	1905.
Gross	$1,989,293	$1,494,500	$[illegible],038,812
Expenses	841,560	[illegible]	[illegible]
Net	[illegible]	[illegible]	[illegible]
Charges	[illegible]	[illegible]	[illegible]
Surplus	[illegible]	[illegible]	[illegible]

SPRINGFIELD UNITED ELECTRIC.—The United Electric Light Company, of Springfield, Mass., has petitioned the State Gas & Electric Commission for its approval for an issue of capital stock to realize $750,000 for the retirement of floating debt, etc.

AUTOMATIC ELECTRIC.—After a sharp legal and financial struggle terms have been agreed upon by the Strowger Automatic Telephone whereby the company will pass to the control of the Automatic Electric Company. Nearly three-fourths of the stock of the Strowger company is represented by those who formulated and agreed to the plan. Holders of Strowger stock are to receive equivalent to $20 per share in 6 per cent 20-year first-mortgage bonds to be issued by the Automatic Electric Company, covering all of its property. If all the Strowger shareholders assent to the terms, that company will go out of existence, and all its assets, patents and patent rights, both in the United States and in Europe, will become property of the Automatic Electric Company. The deal will be beneficial to all parties concerned, as the Automatic Electric Company obtains by an issue of $1,000,000 additional securities 50,000 shares, or $5,000,000 par value, of Strowger stock, and thus ends an almost endless chain of litigation. The Strowger stockholders receive for their shares a bond at guaranteed interest which figures equal to 1.20 per cent per annum on stock now paying nothing, and the payment of the principal is guaranteed at the end of 20 years. Moreover, the interest return on the new bonds is equivalent to about 12 per cent on Strowger stock at an average of $10 per share, the price at which these securities have averaged in the market over a period of years. Further benefits to be derived by both interests lie in the removal of litigation, which has prevented the closing of many contracts with prospective telephone concerns, whose legal advice has been that if they bought their plants from the Automatic Electric while the Strowger suits were pending, they would be made parties to the litigation and that they might be compelled to honor the royalties which the Automatic Electric had to refuse to pay the Strowger Company.

WESTERN ELECTRIC EARNINGS.—Advices from Boston state that the official estimate of $50,000,000 gross earnings for the Western Electric Company for the year to end Nov. 30, showing a decrease of nearly $20,000,000 from the 1906 total of gross, is in line with the predictions that the decline in earnings would come in the last quarter of the year. For the nine months ended Aug. 31 the gross sales of the company were about 15 per cent less than for the corresponding period of 1906, or, in other words, had averaged at the rate of about $58,000,000 for the year, as compared with nearly $70,000,000 for the previous twelve months. The decrease this year of approximately $20,000,000, or 28 per cent in gross, is the second actual decrease and the first of more than $1,000,000 in the gross sales of the company during the last twelve years. Of the $69,245,331 sales in 1906, about one-third, or say, $23,000,000, was made up of "outside" business. Included in this outside business were sales of every description made to other than American Telephone subsidiary companies. The Western Electric sells considerable amounts of telephone apparatus abroad. In the year 1906 the American Telephone subsidiaries consumed $46,000,000 of the $69,000,000 gross business of the Western Electric Company. This year it is probable that the Bell companies' business will not be more than $30,000,000, this estimate being based on the assumption that "outside" gross will be 40 per cent of the entire total, an estimate which seems conservative in view of the official statement that general electrical business outside of the telephone department is one-third larger than a year ago.

NORTH GEORGIA ELECTRIC.—A bill in equity asking the foreclosure of a mortgage for $481,500 against the North Georgia Electric Company, which is already involved in bankruptcy proceedings, was filed recently in the United States Circuit Court at Atlanta, Ga., by the Knickerbocker Trust Company, of New York, acting as trustees for the holders of 482 bonds which aggregate $482,500 and on which, it is alleged, the North Georgia Electric Company has failed to pay $14,537.50, the amount of interest due Sept. 1, 1907. The court is asked to issue an injunction restraining the North Georgia Electric Company from transferring, encumbering or disposing of any of its property and also to appoint a receiver who shall have an accounting of the company's assets and perform such other duties as usually pertain to his office. Some time ago the president of the company, D. M. Stewart, concurred in a petition that the company be adjudged bankrupt. This step, together with those of other alleged creditors, has been vigorously fought by officials and stockholders, however. Some are of the opinion that there will be a general reorganization of the company, and that, after a slight delay, its work will continue without interruption. The total authorized bond issue of the North Georgia Electric Company amounts to $7,500,000. The $482,500 worth of bonds mentioned above were delivered to the Knickerbocker Trust Co. between Sept. 1, 1906, and July 26, 1907.

DETROIT UNITED RAILWAY.—At Montreal recently the local stock market experienced a panic as the result of the passing of the quarterly dividend on the Detroit United Railways. A rally followed. Mr. H. S. Holt, the only Canadian director of the Detroit United Railway, discussing the action of the board in passing the quarterly dividend, says: "The Detroit United Railway by its charter could not issue bonds for more than 75 per cent of the many improvements and additions that have been made. Even then any bonds issued could be sold only at a ruinous discount and no money could be borrowed under the circumstances now existing in the United States. There remained but one thing to do, and that was to use the profits for betterments. This the directors did, and to do it had to pass the dividend. That does not mean that the property is worth less than when the stock was issued at par On the contrary, it is worth more, because the system is greater and better equipped than at any previous time and the profits are correspondingly expanding. The road will be in a position to pay a dividend just as soon as financial conditions have somewhat recovered from the present slump, and the passing of the dividend has in no way reduced the value of the stock to those who understand the situation."

NEW HAVEN ELECTRIC LINES.—The fact that the New York, New Haven & Hartford has gone so far in controlling suburban electric lines which compete with its steam lines adds interest to the report of the earnings of its electric lines which the New Haven just submitted in its annual report. The New York Central also has extensive interests in electric lines, but their earnings are not included in the New York Central's annual reports. The New Haven's electric traction lines last year earned $10,638,057 gross and paid out in operating expenses $7,022,158, leaving net earnings of $3,615,899. The electric companies controlled by the New Haven are engaged not only in the business of transporting passengers, but also to some extent in supplying light and power. The detailed statement of earnings submitted in the New Haven's report shows that the earnings of its electric companies included $742,629 earned from the sale of gas, water, electric light and power, and from other miscellaneous sources. These lines also do considerable business in the way of transportation of freight, from which they earned last year $130,581, in addition to $122,786 earned from express business. The earnings from the transportation of passengers reached the large total of $9,410,432.

WESTCHESTER ELECTRIC REPORT.—The annual report of the Westchester Electric Company for the year ended June 30, 1907, is as follows:

	1907	1906
Gross	[illegible]	[illegible]
Expenses	[illegible]	[illegible]
Net	[illegible]	[illegible]
Other income	[illegible]	[illegible]
Total income	[illegible]	[illegible]
Charges	105,835	103,168
Deficit	[illegible]	[illegible]
P. & L. deficit	[illegible]	[illegible]
Betterment	[illegible]	[illegible]

HALSEY ELECTRIC COMPANY.—James P. Murray, of Plainfield, and Charles H. and Howard Williams, of New York City, have filed a petition in the United States Court against the Halsey Electric Generator Company, of Jersey City, alleging an indebtedness of $25,550. George R. Beech, of Jersey City, has been appointed receiver for the concern. The petitioners allege that the business of the concern has been on the decline, but a preferential payment was made. The assets of the concern are $25,300; liabilities, $31,052.

MANSFIELD ANNUAL REPORT.—The Mansfield Railway, Light & Power Company reports for the year ended June 30, 1907, as follows:

Gross	[illegible]
Expenses	[illegible]
Net	[illegible]
Interest	[illegible]
Surplus	[illegible]

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company reports $4,345,788 gross for the nine months and $1,302,811 net after all charges and taxes. The gross showed a gain of about $400,000.

GENERAL NEWS

Construction News.

[illegible] to develop additional power for the electric light and proposed water works system of the Jackson Light & Power Company. B. H. Warren is president.

TALLADEGA, ALA.—The city has entered into a contract with the Power Development Company to light the city for the next five years.

KINGMAN, ARIZ.—Plans are being considered to install heavier machinery to be operated by electricity in the Pyramid mills and mines. Charles Sutro and J. F. Littlefield are interested in the project. The Gold Road Company will also modernize and electrify its mill at Little Meadows.

PHOENIX, ARIZ.—The directors of the Octave mine at Congress are considering plans for the enlargement of the mill and installing a new power plant.

GREEN FOREST, ARK.—The Farmers' Union, of Carroll County, has organized a telephone company with a capital stock of $3,000. S. S. Buel is president.

ASHDOWN, ARK.—T. C. Aubrey, of Verda, La., is interested in the organization of a company to establish an electric light and ice plant in this place.

CRESCENT CITY, CAL.—T. B. Cutler, of this city, has been granted a franchise by the Board of Trustees to construct and operate an electric light plant, and to erect poles and wires for the transmission and distribution of electricity on the roads and highways of Del Norte County. The franchise is for a term of fifty years.

GRASS VALLEY, CAL.—F. T. Busch, of Goldfield, Nev., has sold the Ethel mine to a new company, the officers of which are: Major Charles Chralston and B. Goodwin, secretary and treasurer, both of San Francisco. It is the intention of the new company to erect a power plant between the mine and Canyon Creek.

LOS ANGELES, CAL.—The City Council has awarded the two franchises offered for sale at $100 each to Frank W. Flint, Jr. It is understood that he is acting for the Los Angeles-Pacific Railroad.

LOS ANGELES, CAL.—A 600-kw turbine generator at the Edison Electric Company's plant was recently burned out, entailing a loss of about $10,000. Power will be secured from the Huntington plant at Redondo until the generator can be repaired.

LOS ANGELES, CAL.—The Board of Public Works has awarded contracts for the machinery for the city's cement plant at Tehachapi as follows: For two steam turbine sets to the D'Olier Engineering Company for $50,830, the Pacific Coast Manufacturing Company for 26 motors at $13,044 and boilers for $19,550. E. Duryee will have charge of the plant.

NAPA, CAL.—Surveys are being made by the Stone & Webster Engineering Company for an electric railway through Jamison Canyon for the Lakeport & Napa Valley Railroad, which is being promoted by Theodore A. Bell and Richard Hoatling.

OAKLAND, CAL.—E. M. Downer, of Pinole, has filed a petition with the Board of Supervisors for a franchise to establish and maintain an electric light plant for a period of fifty years; also to erect poles and wires along the streets and highways for the transmission and distribution of electricity for all purposes in Alameda County.

OROVILLE, CAL.—The Oroville Water & Light Company is preparing to erect a new plant at Coal Canyon, eight miles above Oroville, where 2000 hp will be developed and provisions will be made to increase the capacity of the plant as required. This plant will also supply Oroville with electricity, power and light.

RED BLUFF, CAL.—The Haze Company has deeded to the Battle Creek Power Company 2380 acres in this county. About 4000 inches of water in Ripley Creek will be used to operate a 2000-kw hydro-electric plant.

RED BLUFF, CAL.—At a meeting of the board of directors of the Pacific Power Company, held recently, J. A. Whitehead resigned both as president and director. Dr. A. P. Tarter was elected president, and Herbert S. Gans as director to succeed Mr. Whitehead. To meet the liabilities of the company it was decided to levy 7 cents a share on all stock outstanding. It is understood that the company will acquire the rights of the Mill Creek Power Company, which, with other developments in view, will give it about 35,000 horse-power.

REDLANDS, CAL.—Work will soon commence on the transmission line between this place and San Bernardino for the Home Gas & Electric Company. The company expects to finish the line by Dec. 1, and to furnish electricity in San Bernardino, Colton and Rialto. The contract is for a term of ten years.

REDDING, CAL.—The Northern California Power Company has purchased the Canyon Creek water right owned by Nils A. Jacobson. The property is in Millville Township and the water right is designed as a feeder for the Kilare power house on old Cow Creek.

RIALTO, CAL.—The newly organized Rialto Electric Light Company [illegible] vice-president; I. F. Martin, secretary. A sub-station is to be erected at once; also the placing of poles for the high line from a connection with the Edison Company to some place near the intersection of Riverside and San Bernardino avenues.

SAN DIEGO, CAL.—The directors of the San Diego Electric Railway Company have called a meeting of the stockholders to consider the question of increasing the capital stock of the company from $500,000 to $5,000,000.

SAN DIEGO, CAL.—Plans are being considered by the Los Angeles & San Diego Beach Railway Company for electrifying its line between this city and La Jolla. It is expected that the power house will be located at Pacific Beach. C. M. Warnecke is chief electrician.

SAN DIEGO, CAL.—The Consolidated Gas & Electric Company has reduced its rates for electricity and proposes to double the capacity of its plant, the work of which will be carried out at once. Orders have already been placed for additional equipment and machinery.

SAN RAFAEL, CAL.—It is reported that petitions will soon be filed by the Snow Mountain Power Company with the Trustees of San Rafael, Mill Valley, San Anselmo, Sausalito and Belvidere for a franchise to construct transmission lines. The company plans to construct a substation in Marion County to supply the various towns. Charles N. Felton is one of the principal stockholders of the company.

STOCKTON, CAL.—Reports have reached this city that the Union Construction Company, which is constructing the reservoirs, power plant and lines of the Stanislaus Power & Water Company, at Camp Relief, Toulumne County, was forced to stop operations Oct. 24 and discharge 1400 men employed at the camps. The reason given was the suspension of the Knickerbocker Trust Company, of New York, N. Y., which was supplying capital for the Union Construction Company. The officers of the company state that the suspension is only temporary. The company has a contract for the construction of the plant of the Stanislaus Power & Water Company, which will cost about $10,000,000, of which $3,000,000 has already been spent.

DENVER, COL.—C. W. Stiff, of Colorado Springs; C. E. Pond, of Colorado City, and Dr. Newton N. Brumback, of Denver, have purchased from the Pikes Peak Hydro-Electric Company the cable railway running from the company's plant in Manitou to the top of the mountain to the west, which forms one of the foothills of Pikes Peak, and are organizing a company to build a scenic railway up to the mountain. The company will be capitalized at $200,000. Electricity will be used as the motive power. The new company will expend about $50,000 on the road, and expects to have it in operation by next summer.

MILFORD, CONN.—At a recent town meeting the citizens voted to appropriate $5,500 for street lighting for the ensuing year. The motion to increase the appropriation to $7,000 was defeated.

TAMPA, FLA.—The directors of the Tampa & Sulphur Springs Traction Company have decided to extend the line into West Tampa, a distance of about four and one-half miles. Material for the new line will be ordered at once.

SAVANNAH, GA.—The City Council has awarded the contract for lighting the city to the Savannah Electric Company.

SPARKS, GA.—At an election to be held soon the proposition to issue $20,000 in bonds for the construction of an electric light plant and water works will be submitted to the people.

POCATELLO, IDAHO.—The Idaho Consolidated Power Company, with a capital stock of $2,000,000, has absorbed the American Falls Power, Light & Water Company, the Pocatello Electric Light & Power Company and the Blackfoot Power & Water Company. James H. Brady will be president of the new company. The plans include the development of 50,000 horse-power at American Falls and transmission of electrical energy to surrounding towns. The plant at American Falls now has a capacity of 2500 horse-power, and 4000 horse-power can be added to the output inside of sixty days.

BRUCE, ILL.—The Bruce Mutual Telephone Company has filed an amendment to its charter increasing the capital stock of the company from [illegible]

SPRINGFIELD, ILL.—John H. Brinkerhoff has declined to accept the amended ordinance for an electric light franchise offered by the City Council, and has presented a statement to the Council asking to be allowed to withdraw the original ordinance, which was granted.

CLAY CITY, IN[illegible] pany will soon begin operation in this city. The streets of the city have been in darkness since the electric light plant was destroyed last May.

EVANSVILLE, IND.—The Evansville & Southern Indiana Traction Company is contemplating the construction of a new city line in the northeastern section of the city.

LAFAYETTE, IND.—The Board of Public Works is advertising for bids for lighting the streets and buildings of the city for a period of ten years. The present contract will soon expire.

HUNTINGTON, IND.—The Fort Wayne & Wabash Valley Traction Company has declined to accept the franchise offered it by the City Council, which provided that 10 per cent of the gross earnings on electricity for light and power should be paid to the city. The company has built a large power plant in Fort Wayne for the purpose of supplying electricity to the surrounding towns and cities. Huntington was the first place in which a franchise was asked.

MICHIGAN CITY, IND.—The Michigan Central Railroad has taken steps to install a heating and electric light plant for the purpose of heating the building by steam and furnishing electricity to light the depot building and premises.

PLYMOUTH, IND.—The City Council has granted the Indianapolis, Logansport & South Bend Electric Railway Company a franchise for a right of way over Michigan Street in this city. It is said that the Logansport-Plymouth division will be built at once.

PRINCETON, IND.—The Princeton Telephone Company has decided to make extensive repairs, improvements and extensions to its system in this city and locality.

SOUTH BEND, IND.—The South Bend & Southern Michigan Railroad Company has entered into a contract with the Indiana & Michigan Electric Company, of this city, to furnish electricity to operate its railway from South Bend to St. Joseph, Mich. The company will abandon its power plant at Scottsdale, which has furnished power for operating the line in the past.

CHICHASHA, I. T.—The Chichasha Water Power Company is contemplating the construction of a dam on the Washita River, near Chichasha, to develop the water power for an electric light and power plant. The company will install two 500-hp water wheels, two 500-hp generators and other necessary equipment. The lighting system will consist of 75 arc lamps of 2000 cp and 3000 incandescent lamps of 16 cp. C. E. Ross is the designing engineer.

SULPHUR, I. T.—A company consisting of White Frost, O. G. Adams, R. S. Bonham and N. B. Ruggles has purchased a tract of land, including the Mystic Cave. The company proposes to enlarge the entrances to various chambers and install a water wheel and dynamo at one of the falls in the cave and light the caverns by electricity and operate boats on the river and lakes, etc.

DAVENPORT, IA.—The J. C. Settle Construction Company, of St. Louis, Mo., has been awarded the contract for the construction of the power house of the Independent Light Company.

IDA GROVE, IA.—The Ida Grove Electric Company has been granted a franchise to operate its system in this place.

KEOTA, IA.—The local electric light plant owned by J. W. Harding has been purchased by William Morris, who has taken possession of the property.

PLEASANTVILLE, IA.—The Swan Telephone Company has applied to the town for a franchise to operate a local exchange. The matter will be submitted to a vote of the citizens on Nov. 18.

LEAVENWORTH, KAN.—The contract for the addition to the electric light and power plant at the Federal prison has been let to E. E. Newberry & Company, for $8,126. The additional equipment will double the present capacity of the prison plant, which is now about 300 hp.

NEW ORLEANS, LA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Nov. 23, for an electric freight elevator in Building 6, naval station, New Orleans. William M. Smith is acting chief.

BUCKSPORT, MAINE.—The Penobscot Bay Electric Company will soon commence work on the construction of a new transmission line between Bucksport and East Orland.

ASHBURNHAM, MASS.—At a special town meeting, held Oct. 29, the citizens voted to issue $10,000 in notes, half of which will be used to purchase the street lighting equipment of the Green Electric Company, and the other half to put it in repair. The power plant of the company was not purchased, as it was decided to purchase electricity from the Gardiner Electric Light Company. The town has decided to make a contract with the Gardiner Electric Company to furnish electricity at the rate of [illegible] about Jan. 1.

HAVERHILL, MASS.—[illegible] made a new contract with the Haverhill Electric Company for a term of [illegible]

MARLBORO, MASS.—[illegible]

MONTAGUE, MASS.—The Selectmen of this village have granted the [illegible] Electric Light [illegible] line to Millers Falls [illegible] for the electric lighting system. The citizens have voted to abandon the [illegible] Light Company.

TURNERS FALLS, MASS.—[illegible] for authority to issue $10,000 additional capital stock to retire floating indebtedness.

WEST SPRINGFIELD, MASS.—The Selectmen have awarded the contract to extend the street lighting system by the addition of 10 new lamps and to extend the lines for residential lighting to the Fitzpatrick Electric Company, of Springfield.

CHARLOTTE, MICH.—The Union Trust Company, of Detroit, has filed a bill of foreclosure in its mortgage against the Charlotte General Electric Company. The action was taken on the representation of minority stockholders Messrs. Russell, Campbell, Buckley and Ledyard that interest coupons on $13,000 in bonds had been defaulted. The city recently refused to renew its contract with the company, and this also prompted the present action.

GRAND HAVEN, MICH.—F. W. Weber, superintendent of Public Works, writes that the city will receive sealed proposals for furnishing one 150-kw, two-phase, 2300-volt alternator; one 220-hp engine for direct connection to this alternator; a series alternating-current arc lighting system, complete with switchboard and 100 alternating-current series enclosed arc lamps. Plans and specifications may be secured of the city clerk.

LUVERNE, MICH.—The City Council is considering the question of installing storage batteries in the municipal electric light plant.

POMPEII, MICH.—The citizens of this town and Washington Center have organized a telephone company, to be known as the Washington Center Telephone Company. Frank Cammeth is president.

DULUTH, MINN.—The Great Northern Power Company has installed its second unit of 10,000 horse-power at its power plant on the St. Louis River, above Fond du Lac. The company is now furnishing power to the Duluth-Edison Company, the carbolite works and the Berwind-White coal docks. With the two units in operation the company has ample power for present needs E. P. Coleman is manager.

FERGUS FALLS, MINN.—It is reported that F. G. Barrows and Vernon Wright are constructing a hydro-electric plant at Dayton Hollow, and are contemplating erecting transmission lines for the distribution of electricity to various places in this vicinity.

KANDIYOHI, MINN.—It is reported that C. E. Kroona is contemplating the installation of an electric lighting plant.

GULFPORT, MISS.—The Gulfport & Mississippi Coast Traction Company has awarded a contract to the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., for the installation of a 1500-kw turbo-generator set, the necessary auxiliary condensing machinery and additional machinery. A. M. Lockett & Company, of New Orleans, La., are the engineers in charge of the work.

NATCHEZ, MISS.—Chancellor Hicks, of the Warren County Chancery Court, upon the application of Harry K. Johnson et al., has granted a decree and appointed W. A. Pollock receiver of the Southern Light & Traction Company, of Natchez, and the Southern Securities Company, of New Jersey. The property will be operated by the receiver, with W. B. Moorman continuing as superintendent. The receivership grew out of the recent litigation, culminating in the decision of the Supreme Court in the case of S. S. Bullis vs. the Southern Electric Securities Company, in which the court held the company to be a trust and combination, and operating here in violation of the laws of the state. The Southern Light & Traction Company also operates plants in Vicksburg, Jennings, La., and Beaumont, Tex.

EDINA, MO.—Geo. W. Newman, the proprietor of the electric light system here, is contemplating establishing a day service, beginning next spring, if enough patronage can be secured to use electricity for operating motors, etc.

PAPILLON, NEB.—The citizens are considering the question of establishing an electric light system.

SCOTTS BLUFF, NEB.—L. L. Raymond, city secretary, writes that J. C. Cain is interested in the construction of an electric light plant in this town, which will cost about $10,000.

WOOD RIVER, NEB.—D. D. O. Kane, village clerk, writes that bids will be received about Jan. 15 for the construction of water works and an electric light plant to cost $17,000. An engineer has not yet been selected.

ATLANTIC CITY, N. J.—The City Council, on Oct. 29, passed the bill appropriating $35,000 for the installation of a new system of illumination for Atlantic Avenue.

GLOUCESTER, N. J.—The City Council has entered into a contract with the Public Service Corporation for lighting the streets for another five years, at the rate of $85 per lamp per year, a reduction of $10 per lamp per year, making a saving of about $7,000 on the contract.

BROOKLYN, N. Y.—C. B. J. Snyder, superintendent school buildings, New York City, on Oct. 28, awarded the contract for installing electric equipment in School 5, Borough of Brooklyn, to T. Fred. Jackson, Inc., [illegible] New York City, for [illegible]

[illegible] Heat & Power Company is contemplating the construction of a new cement dam. W. S. [illegible]

FULTON, N. Y.—The Fulton Light, Heat & Power Company will immediately install generators, switchboard and belts. L. W. Emerick is [illegible]

LANCASTER, N. Y.—The new power house of the Lancaster & Depew [illegible] will be received soon.

[illegible]

[illegible] and profile of the proposed electric railway between Hamilton and Nor-[illegible]

YORKTOWN, N. Y.—The Northern Westchester Lighting Company, [illegible]

[illegible] soon be selected to prepare plans and specifications for water works, electric lighting plant and sewerage system, and an election will be called to vote on the proposition to issue bonds for the construction of same.

LIMA, OHIO.—It is reported that the Board of Public Service has recommended establishing a municipal electric lighting plant.

GUTHRIE, OKLA.—It is reported that the Fort Smith & Western Railway Company is contemplating converting the St. Louis, El Reno & Western line between Guthrie and El Reno, a distance of forty miles, which it recently purchased, to an electric interurban line. If this plan is carried out by the Fort Smith & Western, an attempt will be made to prevail upon the Rock Island & Santa Fé companies to make the Guthrie-Kingfisher and Guthrie-Chandler lines also electric interurbans.

OKLAHOMA CITY, OKLA.—Plans have been definitely decided upon by the Oklahoma City Street Railway Company for an extension of its Capitol Hill line. The proposed extension will cost about $25,000.

OKLAHOMA CITY, OKLA.—The Citizens' Light & Power Company, recently organized with a capital stock of $250,000, is planning to begin work at once on the construction of a plant to furnish electricity for light and power in the Putnam addition, and later will probably supply the entire city. F. H. Peck, of St. Louis, Mo., will have charge of the construction of the plant.

MILTON, ORE.—The city officials are considering the question of increasing the capacity of the municipal electric light plant. City Recorder Craig has filed on 3600 miner's inches as instructed by the City Council. It is proposed to extend the barrel flume up the river a distance of 5000 feet. By this extension it is estimated that 500 additional horse-power could be secured at a cost of $15,000. This would not include the cost of enlarging the power house and purchasing the necessary additional machinery, which is estimated would cost from $10,000 to $15,000 more.

PORTLAND, ORE.—The Water Board has accepted the offer of the Portland General Electric Company to furnish electric power for the water pump carrying water to Portland Heights, at an estimated cost of $247.50 per month for four months.

TILLAMOOK, ORE.—The electric light plant owned by the Tillamook Lumber Company was entirely destroyed by fire recently, entailing a loss of [illegible]

ALTOONA, PA.—The Citizens' Electric Light, Heat & Power Company has contracted with the Juniata Water Power Company to furnish energy to operate its system for a term of ten years. By the terms of the contract the Citizens' company is to receive all the electricity sent west on its lines, to be delivered at a substation on the outskirts of Altoona. The substation has not yet been built. The contract is to go into effect ninety days from the date of agreement. The Citizens' company is at present installing an 800-hp boiler in its plant, and will extend its lines to the residential and outlying districts around the city.

CRESSON, PA.—The Cresson Electric Light Company is contemplating the installation of an additional 60-kw, 1100-volt, 133-cycle, belt-driven generator to furnish electricity for operating the arc lighting system for street lighting, which will be put in operation Jan. 1. A day service will also be established after that date. The company has a contract with the city to furnish 21 arc lamps of 1200 cp at $60 per lamp [illegible]

DONORA, PA.—The Donora & Eldora Street Railway Company has secured a right of way for its electric line to connect Donora and Eldora. J. A. Sprowles, of Donora, is one of the incorporators.

HARRISBURG, PA.—The Water Supply Commission has approved the plans of the Mill Creek Water Company, which will operate in Huntingdon County.

PHILADELPHIA, PA.—Director Stearns, of the Department of Public Works, on Oct. 28, awarded the contract for the electrical equipment at the Torresdale filter plant to the D'Olier Engineering Company for [illegible]

PITTSBURG, PA.—The high school committee of the Board of Education has decided to install an electric light plant in the Fifth Avenue High School.

SWATARA, PA.—The Swatara Light & Power Company is considering [illegible]

PROVIDENCE, R. I.—[illegible] tion at Point Judith was entirely destroyed by fire Oct. 25, entailing a loss of about $5,000.

[illegible] R. I.—The Westerly Gas & Electric Company [illegible] of Stonington and Mystic, and will hereafter furnish electricity for lighting the streets of both places from the Westerly power house.

WOONSOCKET, R. I.—The Woonsocket [illegible] soon be installed to be used in connection with the railway service. The company will transmit electricity to the sub-station at Lincoln, where power will be furnished to the Providence & Burrillville line.

[illegible] by the Southern Power Company for the construction of a 50,000-hp steam power plant to cost about $2,000,000. The plant will be built in sections as needed, and construction will probably begin during 1908. The plant will be used as an auxiliary, during the low-water periods, to the various hydro-electric plants which the company is building for transmitting electricity in North and South Carolina. The Southern Power Company has two plants completed, furnishing 40,000 hp, and two under construction to furnish 60,000 hp more, and will eventually develop more than 200,000 hp. The main office of the company is at Charlotte, N. C. W. S. Lee is engineer in charge.

[illegible] planning to rebuild its entire plant and develop water power to the extent [illegible]

SPEARFISH, S. D.—To meet the increase in demand for electricity the Black Hills Traction Company is preparing plans for the construction of a power plant at Beulah, Wyo. The company recently completed a hydro-electric plant, having a capacity of 1200 hp. The new plant will also furnish power for the operation of the proposed electric railway between Deadwood and Spearfish.

NEWPORT, TENN.—[illegible] and improve its plant. The company will build a hydro-electric plant of 300 hp, which will include the construction of dam and installation of turbines and necessary machinery to generate electricity to operate its shops and foundry. All the machinery has not been purchased, but the plant is expected to be installed at an early date.

FORT WORTH, TEX.—It is reported that the Tarrant County Commissioners are contemplating the installation of an electric light plant to furnish electricity for lighting the court house and jail.

GALVESTON, TEX.—Extensive additions are being made to the plant of the Brush Electric Light & Power Company. A 500-kw Allis-Chalmers turbo-generator set has just been installed in the power house. The company is also installing another turbine of 1000 kw capacity, a 300-hp motor generator set, one 300-kw rotary converter, two 600-hp Sterling boilers and barometric and turbo jet condensers. A new switchboard has also been installed. In addition to new machinery being installed, the old machinery is being overhauled, by which it is expected to add 600 kw to its output. When the plant is completed it will have an equipment for 500,000 incandescent lamps of 16 cp, which is an increase of 300,000 lamps. The entire city will be rewired. The power house has been enlarged. The cost of the improvements to the plant will amount to about $100,000.

HOUSTON, TEX.—The Houston Electric Company has been granted a 28-year franchise by the commissioners, which will permit the company to extend its lines to a point near Harrisburg.

HUBBARD CITY, TEX.—The Union Central Light & Ice Company has awarded the contract for construction and equipment of its electric power plant and extensions to Mt. Calm, Dawson, Cooledge and Malone to the General Electric Company, of Dallas, Tex.

ESSEX JUNCTION, VT.—Arrangements are being made by the Burlington Light & Power Company to operate the new grist mill of William B. Johnson & Son by electricity, and also the wheelwright shop of H. S. Wood & Son in this place.

BRIDGEWATER, VA.—The Bridgewater Manufacturing Company is planning to build a reinforced-concrete dam, which will furnish 500 additional horse-power to the electric light plant and the Bridgewater mills. It is expected to have the work completed by Dec. 1. James McDonald is superintendent.

ROANOKE, VA.—We are informed that the Roanoke Water Power Company will install a 1000-kw steam turbine auxiliary plant next spring. [illegible]

DEER PARK, WASH.—The County Commissioners have granted a franchise for the Deer Park Telephone system. Louis Olson, A. M. Johnson, D. B. Throop and Antone Iversen applied for the above franchise.

TACOMA, WASH.—Mr. Beall Foster, of the Foster Lumber Company, of Tacoma, writes that he expects to install electrical equipment to generate electricity to furnish light for about 1000 houses, and would like to receive estimates for furnishing equipment for the same.

TACOMA, WASH.—[illegible] the superior Court by the Cascade Public Service Corporation for the purpose of securing a right of way through the property of the Nisqually Power Company. The Cascade company represents the Pacific Traction Company's interests and was formed for the purpose of erecting a power [illegible] the Pacific Traction Company's lines and also proposes to furnish electricity for lighting, heating and manufacturing purposes in Pierce, King, Thurston, Lewis and Chehalis counties. The plant will have a capacity of 15,000 horse-power. Ellis, Fletcher & Evans are the attorneys for the Cascade company.

FAYETTEVILLE, W. VA.—[illegible]

HAMBLETON, W. VA.—The city has accepted the offer of the Parsons Electric Light & Power Company to light the streets of the city.

SHEPHERDSTOWN, W. VA.—The municipal electric light plant has been sold to John L. Livers for $3,200. The new owner will make improvements to the system, and will soon furnish electricity from the power plant now being built on the Potomac River.

APPLETON, WIS.—John S. Seaman, of Sheboygan, president of the Fox River Valley Interurban Company, states that all surveys for the interurban line from Fond du Lac around the east shore of Lake Winnebago to Kaukauna and Appleton have been completed, and that construction work will commence early next spring. The cost of the new road will be about $600,000.

ASHLAND, WIS.—It is reported that A. E. Appleyard, of Boston, Mass., has purchased a majority of the stock of the Ashland Power & Street Railway Company from Henry F. Blade, of Minneapolis. Thomas Barde, George F. Merrill and other Ashland capitalists own the remaining stock.

LA CROSSE, WIS.—The La Crosse & Winona Electric Railway Company has applied to town officials of Onalaska for a franchise to operate a street railway through the town. The company is making arrangements to secure franchises in the smaller towns, and then will apply for a franchise in Winona. The electric railway is a branch of the La Crosse Water Power Company, which will supply electricity to operate the railway. The La Crosse Water Power Company is building a large dam at Hatfield.

MARINETTE, WIS.—It is reported that a survey is to be made at once for the Holmes Lighting & Power Company for the development of the water power of Grand Rapids for electric power purposes. The work of construction will be started in the spring, and energy transmitted to Marinette and Menominee.

MILWAUKEE, WIS.—The Chicago & Milwaukee Electric Railway Company has filed with the city clerk its acceptance of the franchise recently passed by the Council. The ordinance gives the company permission to use several of the streets on which to operate its cars. A. C. Frost is general manager.

PARDEEVILLE, WIS.—The Fox River Milling & Power Company is contemplating extending its lines and establishing a 24-hour service.

PESHTIGO, WIS.—The large water power plant of the Perley Lowe Company at this place has been completed, and arrangements will soon be made to furnish energy for lamps and motors in this city and Oconto. This plant is the first one of several planned by the company. The second one at High Falls will be finished next spring and will generate electricity, which will be transmitted to Marinette and Menominee.

EDMONTON, ALB.—The City Commissioners are considering the construction of an addition to the civic power plant which will double the capacity of the present plant. A gas producer plant will be installed to operate the engines. Address Mayor Griesbach.

NANAIMO, B. C.—The Nanaimo Electric Light Company will soon commence work on the construction of a large dam at Westwoods Swamp, about three miles from the city, to increase the water capacity for the electric plant.

CAMPBELLFORD, ONT.—The citizens have voted in favor of issuing $60,000 in bonds to develop a municipal electric power plant at Middle Falls.

FORT ERIE, ONT.—Thirty arc lamps are being placed along the river and lake shore drives in the village of Fort Erie. Electricity for operating the system will be furnished by the Canadian Niagara Power Company, which is building a substation at [illegible] Queen Street. A. Monro Grier, of Niagara Falls, is secretary of the company.

TORONTO, ONT.—Plans of the proposed Niagara Peninsula Railway Company have been filed with the Ontario Railway and Municipal Board, and have been certified by the board. The line will run from Port Colborne through the townships of Humberstone and Wainfleet.

MONTREAL, QUE.—The Southern Counties Railway Company has made application for permission to construct and operate an electric railway from the Victoria Bridge to McGill Street [illegible] Montreal [illegible] of Mill Street and Riverside.

TISDALE, SASK.—The Tisdale Telephone Company is being organized for the purpose of building a telephone [illegible]

MUZQUIZ, MEX.—[illegible]

Company Elections.

WOONSOCKET, R. I.—[illegible]

[illegible]

New Incorporations.

MAGNOLIA, ARK.—The Standard Light & Ice Company has filed articles of incorporation with a capital stock of $50,000. The incorporators are: R. L. Moore, J. O. Hutchinson, J. L. Davis and others.

MERCED, CAL.—The Sierra Nevada Electric Company has filed articles of incorporation with a capital stock of $1,000,000. The directors are H. E. Huntington, William Kerkchoff and A. C. Balch, of Los Angeles; J. S. Eastwood and Frank H. Short, of Fresno.

SONORA, CAL.—The Consolidated Stanislaus Water & Power Company has been incorporated with a capital stock of $1,000,000 and the following directors: C. T. Tullock, R. R. Bigelow, W. B. Cadman, C. B. Beise and Anna C. Lane, all of San Francisco.

DENVER, COL.—The Holly Light, Power, Water, Heat & Ice Company has been incorporated with a capital stock of $75,000 by R. H. Graham and others.

BELLEVILLE, ILL.—The Belleville & Interurban Railway Company has been chartered with a capital stock of $100,000 for the purpose of building a railway from Belleville to Smithton. The incorporators are: Jacob Gundlach, Jr., Benjamin H. Gundlach, R. W. Hofsommer, George Hippard and Thomas A. Bell.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago, Fox Lake & Lake Geneva Railroad Company with the Secretary of State. The company is capitalized at $2,000,000 and the incorporators are George M. Seward, Sidney F. Mallette, Lewis E. Starr, Maurice B. Louis and Harry Y. Yaryan.

MURPHYSBORO, ILL.—The Murphysboro & Interurban Railway Company has been organized to build an electric railway in and around Murphysboro and to Carbondale. A. B. Minton, Willard Wall, W. C. Alexander, John G. Hardy and P. H. Eisenmayer are interested in the project.

BROWNSTOWN, IND.—The Home Telephone Company has been incorporated with a capital stock of $25,000 by C. E. Brown and others. The company was granted a franchise recently by the City Council.

FT. WAYNE, IND.—The Ft. Wayne Power Company has filed articles of incorporation with the Secretary of State. The company proposes to establish and equip a plant to manufacture and distribute electricity for mechanical power and commercial purposes. Fred H. Schmidt, F. H. Cutshall and L. M. Morris are the directors.

GOSPORT, IND.—The Gosport Electric Light & Power Company has been incorporated with a capital stock of $5,000 by W. A. Montgomery and others.

JEFFERSONVILLE, IND.—The Jeffersonville Independent Telephone Company is asking the Board of Public Works for a new franchise. Jacob Eberts is president.

HARTLEY, IA.—Articles of incorporation have been filed for the Sioux City & Spirit Lake Railway Company with the Secretary of State. The company is capitalized at $50,000. The incorporators are: J. F. Conn, G. E. Kusack, D. A. Fletcher, George Coleman and Frank Patch.

TAMA, IA.—The Columbia Telephone Company has been incorporated with a capital stock of [illegible]

NEW ORLEANS, LA.—The Mamou Power Company has been incorporated with a capital stock of $20,000 by Charles D. Hill, John Clegg and Philip S. Gidere. The company proposes to construct and operate electric light and power plants.

STRONG, ME.—The Strong Lighting & Improvement Company has been incorporated with a capital stock of $10,000 by F. H. Daggett, Charles W. Bell, Diah Sweet, H. J. Bates, P. D. Stubbs, M. A. Will, of Strong, and C. W. Waldron, of Auburn.

COLUMBIA, MISS.—The Columbia Ice & Power Company has been incorporated with a capital stock of $60,000 by G. W. Grayson, of Biloxi; Lee Elder, of Biloxi; L. A. Lundy, of Ocean Springs, and others.

BILLINGS, MONT.—The Yellowstone River Power Company has been incorporated with a capital stock of $500,000 for the purpose of building a power plant to furnish electricity to operate an electric light and street railway system in Billings. The incorporators are: Christian Yegan, Peter Yegan, Fred T. Mashaw, Fred Inabnit and Charles T. Stewart.

JERSEY CITY, N. J.—Articles of incorporation have been filed with the Secretary of State for the Northwestern Interurban Railway Company. The company is capitalized at $1,500,000, and the incorporators are: [illegible] Nye is appointed agent and attorney for the company in this state.

WALTON, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Walton People's Telephone Company. The [illegible]

KENMARE, N. D.—[illegible]

LEEDS, N. D.—[illegible]

DAYTON, OHIO.—[illegible]

[illegible], OHIO.—The [illegible] Telephone Company has [illegible] with a capital stock of [illegible] by W. H. McC[illegible] [illegible].

SEAMAN, OHIO.—The Seaman Bell Telephone Company has filed [illegible] with a capital stock of [illegible] by C. J. Kirk-patrick and others.

BRITTON, OKLA.—The Britton & Rural Telephone Company has been incorporated with a capital stock of $3,000 by Dr. B. F. Stewart, Henry Halsey, of Britton, and George W. Collett, of Edmond.

CHOCTAW, OKLA.—The Choctaw City Telephone Company has been [illegible] by [illegible] McL[illegible], J. J. B[illegible] and George F. K[illegible].

DILL, OKLA.—The Dill Farmers' Telephone Company has been incorporated with a capital stock of $10,000 by W. P. Beam, C. C. Hickman, of Dill, W. C. Farmer and George L. Bishop, of Cordell.

HYDRO, OKLA.—The Deer Creek Telephone Company has been organized with a capital stock of $600. The incorporators are Ira Smith and J. P. Jansen.

KERN, OKLA.—The German Telephone Company has been incorporated with a capital stock of $1,500. The incorporators are P. F. Kliewer, P. F. Fransen, H. H. Dyke, John Balster, P. L. Heidebrecht, George Sawatzky and C. F. Nikkel.

OKLAHOMA CITY, OKLA.—The Evansville Telephone Company has been incorporated with a capital stock of $1,500 by W. L. Lambert and others.

SHATTUCK, OKLA.—The Northwestern Telephone Company has been chartered with a capital stock of $15,000 by S. H. James, B. R. James, W. H. Springfield and O. H. James.

SHAWNEE, OKLA.—The Independent Light & Power Company has been incorporated with a capital stock of $150,000 by J. E. Rubey and others.

STELLA, OKLA.—The Farmers' Independent Telephone Company has been incorporated, with a capital stock of $5,000, by J. A. Herring and A. V. Hulse, of Stella, and T. J. Witten, of McCloud.

WINTON, OKLA.—The Highland Telephone Company has filed articles of incorporation. The company is capitalized at $3,600 and the incorporators are Martin Daniel and others.

BUTLER, PA.—Articles of incorporation have been filed for the Butler & Chicora Street Railroad Company with the Secretary of State for the purpose of building a railway from Butler to Chicora and Kaylor, a distance of fifteen miles. The company is capitalized at $90,000, and the directors are: John Daly, of Pittsburg, president; W. C. Criswell, W. J. Horgan, W. G. Stein and E. W. Dervey.

ALAMO, TENN.—The Crockett County Telephone Company has been incorporated by C. H. Scales, L. B. Harwell, Dr. John F. Sanders and others.

UNICOI, TENN.—The Unicoi Telephone Company has been incorporated with a capital stock of $5,000 by J. F. Toney and others.

DALLAS, TEX.—The Delrio Telephone Company has been incorporated with a capital stock of $30,000 by T. C. Sharpe and others.

DEWITT, VA.—The Dinwiddie Telephone Company has been incorporated with a capital stock of $5,000. W. M. Sterne is president.

ROANOKE, VA.—The Roanoke County Telephone Company has been incorporated with a capital stock of $5,000. Monroe Grast is president.

TACOMA, WASH.—Articles of incorporation will soon be filed for a new company, which will be known as the Anacortes Improving & Developing Company. The promoters are: E. S. Morton, W. W. Robinson and R. P. Ball, of Anacortes; Benjamin F. Weeks and H. B. Spear, of Tacoma. The company proposes to construct an interurban railway connecting Anacortes and Sedro Wooley. H. B. Spear will be chief engineer of construction of the new road, and Benjamin F. Weeks, general manager.

Legal.

LIABILITY OF ELECTRIC RAILWAY COMPANY FOR INJURIES RECEIVED AS RESULT OF FRIGHT AT BURNING OF FUSE.—In an action against an electric street railway company it appeared that a passenger on one of the company's cars, becoming frightened at the noise and flame caused by the burning out of a fuse, either jumped or fell from the car into the street, thereby sustaining various injuries. The fuse-box in which the trouble occurred, which might have well been placed under the vestibule or in some equally safe place, was, in fact, attached to the outside sills of the car. It was held that the defendants were liable. They knew the location of the fuse-box. They were aware that the fuse was designed to burn out whenever the wires were overloaded; that no one could foresee such a happening or predict the violence of the explosion and the extent of the electrical display accompanying it, and that passengers were sometimes so frightened by the noise and flame that those in charge of the cars had difficulty in averting accidents. It was incumbent upon the defendants so to equip and operate their cars as to render it improbable that passengers who were themselves in the exercise of care would suffer injury; and this obligation was imposed for the benefit of those whom the defendants either knew, or ought to have known, were liable to be injured by a non-performance of the duty. Lord vs. Manchester Street Railway, Supreme Court of New Hampshire, 67 Atl. Rep. [illegible].

ELECTRIC RAILWAY COMPANY HELD NOT LIABLE FOR DEATH OF CONDUCTOR STRUCK BY ELECTRIC LIGHT POLE AT SIDE OF TRACK.—An action was brought against the Rhode Island Company to recover damages for the death of a conductor [illegible] while climbing around passengers on the running-board of his car by being struck by an electric light pole. In an opinion which reversed a verdict of $5,000 in favor of the plaintiff, the court said upon the question of contributory negligence: "We are satisfied that the plaintiff has not proved that the deceased was in the exercise of due care at the time of the accident. So far as the evidence introduced by the plaintiff is concerned, it does not appear that the deceased conductor, at the time he was on the running-board, took any precautions whatever by looking ahead to see whether he could safely swing out to pass by a passenger standing upon the running-board at the time when he did so attempt to pass and was injured. It must have been known to him that there were poles and trees or similar obstructions all along the line of the road; and, while be would be justified (in the absence of special warning or of actual knowledge) in assuming that he could safely stand and pass along the running-board without danger in the ordinary way, he would not be justified in assuming that he could at any time or place swing out to any distance he might find convenient for the purpose of passing passengers standing upon the running-board. [illegible] swing out and pass, it would plainly be his duty to look ahead and see that he could pass safely in that manner." Negligence on the part of the defendant was claimed on account of the rate of speed at which the car was traveling at the time of the accident, but it was answered that the speed of the car must at all times be subject to the control of the conductor, both because of the duty to obey municipal ordinances relating to speed, and because it might often be necessary to lessen the speed as a matter of safety to the passengers as well as to the conductor himself. He had full right to regulate the speed of the car as he saw fit—to slow down or even to stop, if necessary—in order that he might safely collect his fares. Savage vs. Rhode Island Company, Supreme Court of Rhode Island, 67 Atl. Rep. 633.

LIABILITY OF LIGHTING COMPANY FOR ACCIDENT DUE TO DEFECTIVELY INSTALLED ARC LAMPS.—The plaintiff in an action against a light and power company sought to recover damages for personal injuries received under a novel state of facts. It appears that a furniture company doing business at Waverly, N. Y., employed the plaintiff as a clerk in its store. A main aisle ran from the front to the rear of this store in the centre thereof, over which were suspended three large arc lamps. About three months after the lamps were put up the plaintiff was engaged in sweeping out the store, when the hook holding the lamp in the rear of the store pulled out, thus permitting it to fall suddenly, and the lamp, in its descent, struck the plaintiff upon the head. The result was that the plaintiff, who was alone in the store, was rendered unconscious, and when he revived had no recollection of the falling of the lamp and the blow upon his head; he was found lying on the floor, bleeding profusely from a scalp wound and feeling faint and confused. In regard to the installation of the lamps, the manager of the furniture company testified that he called upon the defendant and it undertook to put arc lamps in the store. It was proved that the furniture company assumed no responsibility whatever as to the lamps. There was no written contract between the furniture company and the defendant company, but the oral agreement was in brief that the defendant company was to remain the owners of the arc lamps—was to place them in position and continue in the exclusive management and control of them; that its representative was to call weekly, keep them in repair, furnish carbons and clean them; and they were to present to the furniture company monthly bills for the use of the lamps and for the services rendered. An employee of the defendant company, who had been selected by it to place these lamps in position, swore that his business was that of a trimmer of electric lamps, and that it was not part of his duties to put up arc lamps, and that there were a number of men there connected with the company whose business it was to install the arc lamps. While no case was cited presenting a precisely similar state of facts, it was held to be clear that the liability of the defendant might be sustained upon well settled principles of law that have been applied to kindred cases. By virtue of its contractual relations with the furniture company, it was held liable to the exercise of reasonable care in placing its own property in the store of the furniture company, for which it was receiving monthly compensation. To this extent the defendant company placed itself in the position of tenant in possession of the store as to all persons lawfully entering it. Fish vs. The Waverly Electric Light & Power Company, New York [illegible].

Personal.

MR. GEORGE G. WILSON [illegible] Light, Heat & Power Company [illegible]

MR. CHARLES [illegible] ANDERSON [illegible] of the American Electrical Works, Phillipsdale, R. I., has [illegible] the Westchester [illegible] N. Y.

MR. [illegible] SCHIDEN [illegible] general manager of this district of the Ozark Bell Telephone Company to accept a position in the telephone sales department of the Standard Electrical Company, at Cincinnati, Ohio, which is a branch of the Western Electric Company.

MR. FRED McKINNEY has resigned as manager of the [illegible] Telephone Company, of Edgerton, Wis., a position he has held for eight years. Mr. McKinney has been appointed general superintendent of the

toll lines of the Badger State Telephone Company's lines in Wisconsin. Edgerton will be his headquarters for the present.

MR. EDWARD POTTER, superintendent of the Union and the Dartmouth & Westport Street Railway companies, of New Bedford, Mass., has been appointed assistant manager of the Seattle Electric & Power Company, of Seattle, Wash. Mr. Potter will assist in the entire management of the property.

MR. EDGAR E. STARK, formerly employed as engineer with John Martin & Company on the Pacific Coast as agents for the Stanley Electric Manufacturing Company, and more latterly as engineer with the Waipori Falls Electric Power Company, and assistant engineer with Noyes Brothers, Dunedin, New Zealand, has been appointed city electrical engineer for Dunedin. He assumed the duties of the office on Sept. 28, after having served as acting city electrical engineer for two months. The municipality has a large street railway and electric lighting department.

MR. BION J. ARNOLD has arrived in this city from Chicago to take up his special work as a consulting engineer for the Public Service Commission. He is in much better health and has practically recovered from his serious accident of last summer. He is to prepare a report upon the equipment and operation of the subway, and to advise the commission how the service may be increased—how a greater number of trains and cars may be run and how the movement of passengers may be facilitated. If he considers it advisable to recommend a new type of car or the reconstruction of the present cars he is at liberty to do so. No restrictions have been imposed, and the commission expects and desires a full report suggesting anything that, in his opinion, will increase the service of the subway and the comfort of the passengers. It is expected that the report will be filed very soon.

MR. GEORGE WESTINGHOUSE.—A very interesting review of the life work of Mr. George Westinghouse appears in the *New York Times* of Nov. 3. It begins as follows: "Westinghouse could make brakes to stop every railroad train in the country, but he couldn't brake himself. He could invent signals so perfect that a mile a minute became a commonplace railroad speed, but when he was running himself far beyond that clip he wouldn't even look out of his cab window to see if the financial danger signals were up. In this way a wise old Wall Street man accounted one day last week for the temporary check that came to George Westinghouse in the appointment of receivers for several of the great enterprises in which he is the dominating factor. Not that the financier thought for a moment that Westinghouse had been wrecked; he knew the man too well, even if his familiarity with the conditions of the receivership had not been sufficient to contradict any supposition of that order."

Trade Publications.

LIDGERWOOD MANUFACTURING COMPANY, 96 Liberty Street, New York City, has issued a quarto four-page bulletin on its slip-drum electric winches for hauling in car floats. The device operates under the control of one man. The winch was first adopted by the Pennsylvania Railroad and is now being generally introduced.

POND TURRET LATHE.—The Niles-Bement-Pond Company has issued a 44-page catalogue devoted entirely to the Pond rigid turret lathe, a machine designed for producing work ordinarily done on engine lathes, and especially adapted to such work as gear blanks, fly wheels, gas engine cylinders, etc. A large number of illustrations show different types of the lathe and of its application to various classes of work.

AUTOMATIC REFRIGERATION.—The Automatic Refrigeration Company, Hartford, Conn., has issued a folder in which is pointed out in concise form the advantages of its system of automatic refrigeration. In this system the apparatus is run by an electric motor in connection with automatic devices, so that the instant a desired temperature is reached, the system suspends operation and all expense ceases.

MINNEAPOLIS STEEL & MACHINERY COMPANY, of Minneapolis, Minn., has issued in a very neat little pamphlet a clever article by Elbert Hubbard on the Mammoth Cave, now in its innocuous desuetude. It is called "What Happens When Advertising Stops" and is well worth reading. Besides for so small a pamphlet it carries a very big moral. Incidentally there is some engine data and a word about the [illegible] heavy duty Corliss engine.

THE PITTSBURGH TRANSFORMER COMPANY has issued for October a very interesting folder, giving some data as to how many of its transformers fail from various causes and have been returned to the factory. The number in [illegible] was only [illegible] and thus far in [illegible] the number is only four. In [illegible] [illegible]. The gain in output has been [illegible] to [illegible] per cent in same year. The test of time and endurance is evidently a good one for the Pittsburgh Transformer Company.

NERNST LAMP COMPANY, Pittsburg, Pa., has recently issued a most dainty little pamphlet called "Lux," comprising several issues of the [illegible] magazine [illegible] that [illegible] devoted to the introduction of the Nernst lamp by the process of reasoning and argument. Another handsome and interesting publication is that entitled "[illegible] and Office Lighting by Electricity," just issued, which describes and illustrates a number of installations in which the Nernst lamp [illegible] its [illegible] and special uses.

THE CRESCENT COMPANY [illegible] has issued [illegible] lars descriptive of its [illegible] These are manufactured in a [illegible]

of finish. The company has also a line of novelties in its portable guard, its "Innovate" cord adjuster; the Crescent time switch; coloring fluid and lamp frosting; soldering paste; electric flasher, universal cord spools; toggle bolts, etc., and its literature illustrating and describing these will be gladly sent to any address upon application.

MERCURY-VAPOR RECTIFIERS.—Much information concerning the installation and operation of single-phase mercury-vapor current rectifiers. is given in circular No. 1148 of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. The rectifiers are built for ratings of from 40 to 120 volts and from 5 to 30 amperes on the output side. It is stated that at the maximum e. m. f. the efficiency is more than .80 and the average power factor at any e. m. f. is approximately .90.

VICTOR COMBINATION METERS.—The H. W. Johns-Manville Company, 100 William Street, New York, has issued a handsome catalogue illustrating and describing the Victor combination meter and its auxiliaries. This interesting type of meter, which is a direct-current instrument, is a combination of a voltmeter, ammeter and wattmeter. One of the two hands plays along an ampere scale, the other hand along a volt scale, and the intersection of the two hands comes over a watt scale, the latter occupying the central portion of the dial.

ELECTRIC LIGHTING LITERATURE.—Several thousand copies of the "Electric Jingles" and "When the Sad Iron Smiled," written and issued by Miss C. Beckwith, have been sold to central station companies, and a number of large orders have been received during the past month. Both text and illustrations of these clever brochures render them excellent matter for public distribution in any "electricity sales" compaign, while their low price is quite a consideration. Sample copies and prices can be had upon inquiry addressed to her office at the Flatiron Building, New York City.

FRANKLIN BULLETIN.—The Franklin Electric Manufacturing Company, Hartford, Conn., has issued its Bulletin No. 3 giving some points concerning its Novi and Femco incandescent lamps. The bulletin is handsomely gotten up. It is printed in colors, each page having an artistic head and tailpiece, and illustrations show the general construction of the lamps above named, besides other subjects. The front cover is of artistic design and attractively colored. The bulletin was gotten up especially for distribution at the Atlantic City convention of the Street Railway Association this week.

GOULD STORAGE BATTERY COMPANY, 341 Fifth Avenue, New York City, has just issued a third revised edition of its excellent pamphlet devoted to a description of its Gould storage battery plates, entitled "Facts." This is a compilation of good technical data. It has also issued for October two quarto pamphlets, one devoted to the storage battery plants of the Dayton & Western Railway, and the other to the plant of the Rutland (Vt.) Railway, Light & Power Company, in which the Gould batteries are used in conjunction with rotaries and the alternating current system, to a total capacity of 1100 amperes.

BLAKE SIGNAL & MANUFACTURING COMPANY, 246 Summer Street, Boston, Mass., has issued a handsome and interesting pamphlet, entitled "Requirements for Efficient Telephone Train Dispatching." It deals with the Blake telephonic apparatus and methods for this purpose, and brings out their superiority to the telegraph. A number of testimonials are quoted from traction companies embodying their experience with the system. The front and back covers, outside pages, show the signal itself, in red, in and out of operation, as governed from the dispatcher's desk. The full modus operandi is carefully explained.

MERCURY ARC RECTIFIERS.—Mercury arc rectifiers are the subject of Bulletin No. 4530, issued by the General Electric Company. A brief outline of the theory of the apparatus is given in the bulletin, and various types of rectifying sets are described and illustrated, including ignition battery charging outfits for gasoline automobiles; internal combustion engines, etc.; small motor rectifier outfits for supplying direct current for small dental motors, etc.; garage panels for charging vehicle batteries, and standard commercial outfits for charging storage batteries in general, operating arc lamps, searchlights and similar apparatus, for railway signal systems, electroplating, etc.

HEATING AIR AND WATER.—A 16-page booklet has recently been issued by the Green Fuel Economizer Company, of Matteawan, N. Y. The first seven pages of the booklet are devoted to a reprint of an article by Herr C. Eberle, of Munich, on "The Influence of Boiling by Steam on the Boiler Plants of Breweries," in which it is shown that the highest economy is reached only when both the exhaust steam from the different machines about the brewery and the waste gases from the boiler furnace are utilized for producing hot water. An example is fully worked out with diagrams and layout of machinery to show this. The second part of the pamphlet takes up the use of warm or cold and moistened air for promoting germination, and of the use of hot dry air in the malt kiln. By utilizing blowers to move this air, much quicker and better results may be obtained than by methods relying upon natural draft. It is [illegible] the plant to [illegible] capacity at all times of the year [illegible]

WRIGHT DEMAND INDICATORS.—Bulletin No. 4533, of the General Electric Company, [illegible] the Wright [illegible] indicator, which has been extensively adopted for central station meter service, and is also used in [illegible] output of generators, transformers, [illegible] differential thermometer, having [illegible] all, or a definite [illegible] The expansion of air in the

[illegible]
the opposite leg and causes it to overflow into a central or index tube con-
[illegible]
index tube is read on the indicator scale and marks the maximum demand of the circuit. The bulletin describes and illustrates the several sizes of instruments manufactured, together with capacities, prices, dimension diagrams, scales, etc.

H. T. PAISTE COMPANY has issued an attractive number of "Paistery" for October, dealing with its specialties in weatherproof plugs, Paiste rosette sockets, bracket Fielding rosettes, panelettes, etc.

[illegible]
varying the field strength of shunt connected motors are described and [illegible] Westinghouse Electric & Manufac-
turing Company, East Pittsburg, Pa.

LIGHTNING PROTECTIVE APPARATUS.—A [illegible] of lightning phenomena and of the apparatus that may be employed for protecting electrical disturbances is given in circular No. 1132 of the Westinghouse Electric & Mmanufacturing Company, Pittsburg, Pa.

BRONZE.—The Ansonia Brass & Copper Company, 99 John Street, New York, has issued a booklet describing tests and applications of Tobin bronze. Tobin bronze is remarkable for its high elastic limit, tensile strength, hardness and uniform texture. It is adapted for a variety of purposes where a strong non-corrosive metal is required.

CONTROL RESISTORS.—Circular No. 1122, of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., deals with grid type resistors for use with railway motor equipments. The resistors are formed of cast-iron grids, insulated at the supporting points by means of mica.

DIRECT CURRENT MOTORS.—Two-pole motors rated at from [illegible] to 1.5 hp and four-pole motors rated at from 2.5 hp to 12.5 hp are described in Bulletin No. 147 of the B. F. Sturtevant Company, Hyde Park, Mass. Eight-pole motors rated at from 7.5 hp to 225 hp are discussed in Bulletin No. [illegible] of the same company.

BENJAMIN SPECIALTIES.—The Benjamin Electric Manufacturing Company, Chicago, has just issued a supplementary bulletin containing additions and changes affecting its catalogues B-17 and B-17A. A number of new devices worthy of the attention of the lighting fixture trade are listed therein.

CONTROLLERS FOR CRANE AND HOISTING MOTORS are described in circular No. 1143, of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. The controllers are designed for regulating the speed and reversing the direction of rotation of series-connected and compound-connected direct-current motors.

ELECTRO-STATIC VOLTMETER.—Folder No. 4086, of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., describes a type of electro-static voltmeter for which it is claimed that it eliminates the faults common to the ordinary construction, and represents the most convenient and satisfactory apparatus available for high-pressure measurements.

ELECTRIC MACHINERY COMPANY, of Minneapolis, Minn., has recently issued bulletins Nos. 77 and 84. The former illustrates and describes its direct current motors and generators, while the second deals with its revolving field alternating current generators. Very full details are given. The company has also issued a list of 100 first-class institutions using its apparatus.

DIELECTRIC COMPANY OF AMERICA, of Belleville, N. J., has just issued a circular on underground transmission, in which its system of conduits with bridge blocks of porcelain and fibre, protected with insulating compound, is fully explained. A number of testimonials are included as to the Dielectric compound, and the whole system is fully illustrated in detail.

TIME STAMP FOR TELEPHONE TOLL LINE SWITCHBOARDS is fully described in a booklet recently issued by the Automatic Time Stamp Company, 160 Congress Street, Boston, Mass. The stamp prints the hour, minute and second, a. m. and p. m., and the day, month and year, when a telephone toll line conversation begins and when it ends, and it computes and records the elapsed time to a second.

IDEAL ENGINES.—The latest edition of the catalogue of the Ideal engine, made by A. L. Ide & Sons, Springfield, Ill., is a handsome specimen of trade literature. The Ideal engine is described in complete detail in connection with admirable illustrations and a number of full-page cuts showing application, most of the latter views being of direct-current generating units.

STEAM [illegible] Pittsburg, Pa., has issued an exceptionally well worded illustrated folder, entitled "Two Hundred Per Cent Investments," more than one-half of which is devoted to a discussion of economy in business and the remainder of which deals with economy in steam production. The 200 per cent investment relates
[illegible]
year equal to twice the total cost of the appliances.

CATENARY LINE MATERIAL.—In Bulletin No. 4538, of the General Electric Company, 32 pages are given to a very complete description of the devices manufactured for catenary overhead construction. A
[illegible]
[illegible]
essentially of a slack messenger cable, from which the trolley wire is
[illegible]
practically without sag between suspension points. The catenary system offers mechanical advantages of longer pole spacing and straighter trolley wire and a flexibility in the line which avoids the hammer blow of the collector at suspension points and reduces the danger of mechanical breakage.

THE NAVY BULLETIN.—A booklet which should prove exceedingly useful to all who sell electric motors or motor-driven machinery to the Navy Department has just been issued by the Cutler-Hammer Manufacturing Company, of Milwaukee, maker of electric-controlling devices. This company for many years has made a special study of Navy Department requirements, and in this booklet full descriptions, illustrations, dimension diagrams and shipping weights are given on starting panels, speed-regulating panels, machine-tool controllers, resistances, circuit-breaker panels, etc. In the preface to the booklet in question attention is called to the fact that navy specifications preclude in nearly all instances the use of ordinary controlling panels, and, furthermore, that apparatus acceptable for use in navy yards will not always be acceptable if supplied for use on shipboard. How to select the proper piece of apparatus in each case is fully explained, and in addition to numerous illustrations of electric-controlling appliances conforming to Bureau of Construction and Repair and Bureau of Equipment specifications, the booklet includes several views of battleships equipped with Cutler-Hammer controllers.

MOTOR-STARTING RHEOSTATS.—The General Electric Company describes in Bulletin No. 4532 some recently perfected lines of direct-current motor-starting theostats in ratings up to 50 hp and 550 volts. Type SA rheostats are made for one-minute duty, with no-voltage release, and are suitable for use with shunt, compound or series-wound motors. Type SO are similar to type SA, but have in addition to the no-voltage release attachment an overload coil in series with the motor armature. Slight variations in design are made for rheostats of different capacities in order to meet more suitably required conditions, and the bulletin illustrates the various styles. An improved type of resistance unit, known as the Form P, is used in the smaller capacities. This is an enclosed unit made of low-temperature coefficient resistance wire wound on a strong tube. The tube is not brittle and is treated with a special compound, which forms a coating both inside and out, thus reinforcing it and making a very strong and solid construction. The unit is afterward thoroughly baked, and when completed is claimed to withstand very rough usage.

CURTIS STEAM TURBINES.—In Bulletin No. 4534, recently issued by the General Electric Company, horizontal shaft type Curtis steam turbine sets up to 300-kw capacity, both direct current and alternating current, are described, as arranged to operate either non-condensing or condensing. The generators have commutating poles and special commutator construction, particularly adapting them to continuous operation with little attention. Among the advantages pointed out are that these turbines require less floor space than any type of horizontal engine and about the same floor space as vertical engines, but have much less height. Owing to their light weight, small size and the absence of reciprocating parts, massive foundations are unnecessary. These features, together with the small attendance required and the smoothness of operation, make them particularly suitable for supplying light and power in mills, machine shops, laundries, apartment houses, for heating and lighting plants on steam vessels, office buildings, railway stations and for train lighting. They are also extensively used for exciting alternating-current generators in central power stations.

ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has just issued two new bulletins. One of these is devoted to the chloride accumulator for alternating current regulation, with a split pole variable ratio converter developed by the company and with its carbon regulator. The other pamphlet describes such regulation as applied to the single-phase system of the Spokane & Inland Railway. Mr. J. B. Ingersoll, general manager of the company, in consultation with the engineers of the Electric Storage Battery Company, conceived the idea of combining in one piece of apparatus an induction motor to operate from the supply power, a single-phase generator to deliver the required power to the load and a direct current machine to act either as a generator or a motor, according to whether the railway load is momentarily below or above its average value, the three machines being direct connected and mounted on a common bed plate. The direct current machine gives power to or takes power from a battery of "chloride accumulators" connected across its terminals in series with a regulating booster controlled by the carbon regulator. The latter is operated by the alternating current in the 60-cycle supply line, and insignificant changes of current in this line acting on the regulator cause the battery to charge from or discharge into the direct current machine and relieve the line of the load fluctuations. The action of the combination is as follows: The single-phase generator delivers current to the railway according to the demand, power for driving it being furnished by the 60-cycle, three-phase induction
[illegible]
condition the battery "floats" across the direct current generator, neither charging nor discharging. As soon as the railway load falls off, however, the carbon regulator causes the direct current machine to charge the battery and take the surplus power from the induction motor. On
[illegible]

direct current machine immediately inverts and runs as a motor to assist the induction motor, drawing power from the battery, which, of course, is forced to discharge. The action of the carbon regulator in maintaining a constant load has been so often described that nothing need be said on this point here, except to add that by a proper design of its actuating solenoid it can be made to act as effectively on alternating current as on direct current systems.

Business Notes.

THE BALL ENGINE COMPANY, Erie, Pa., has opened a sales office at 1001 Arcade Building, Philadelphia, Pa., under the management of Mr. H. P. Penfield, that it may be better able to handle the growing demand for its automatic and Corliss engines.

FAHN & McJUNKEN, 201 East Sixteenth Street, New York, have been appointed agents for the Fleuss vacuum pumps, made by the Pulsometer Engineering Company, 61 Queen Victoria Street, London, E. C., England, for the exhaustion of incandescent lamps.

THE SUTHERLAND MANUFACTURING COMPANY, of Cincinnati, Ohio, manufacturers of gas and electric fixtures, has closed negotiations by which its business will be merged with that of the Black & Boyd Manufacturing Company, of New York, N. Y., and the business will be transferred to New York on Jan. 1.

THE ALLIS-CHALMERS COMPANY has opened an office at Deadwood, S. D., with Mr. O. F. Purnell as district manager. Special attention will be given by Mr. Purnell and the members of his staff to the sale of mining, crushing, pumping, power and electrical machinery, many installations of which have been made by the Allis-Chalmers Company and its predecessors throughout that section of country.

THE DEAN ELECTRIC COMPANY has recently increased its power facilities for manufacturing purposes by the installation of two Crocker-Wheeler generators—two complete units operating independently—and a four panel switchboard built for handling the total output of 600 kw. The generators are direct coupled Ball type, horizontal cross-compound engines which receive steam at a pressure of 600 lbs. per sq. in. from boilers of the Stirling type.

ALLIS-CHALMERS BRASS FOUNDRY.—The brass foundry department of Allis-Chalmers Company's works at Cincinnati, Ohio, is one of the best arranged and equipped in the country. This department turns out 50,000 pounds of castings and upward per month, and it is necessary to produce a large variety of work, including brass, bronze and aluminum, also various special alloys. The foundry at present employs about sixty men. A large proportion of the molds are put up on Tabor machines, which are situated at one end of the foundry, the molds being carried back and arranged in rows down the length of the floor. The sand tempering and mixing machinery is arranged in the center of the room. The cleaning department is also located in the center. This places the molding floors on the sides nearest the windows where the best of light is obtained. A trolley track is arranged over the floor where the heaviest work is made for handling both molds and metal. The cleaning department is equipped with metal band saws and all of the other machinery necessary for cleaning the castings. A large proportion of the castings made are very light and intricate in form, so that the number of pounds produced is but a small indication of the amount of work necessary to turn them out. This is especially true of the bench work and floor molding. A large amount of aluminum castings is also turned out. Aluminum castings, weighing over 700 pounds and some 12 feet in diameter, have been made here. Most of the metal is melted in a battery of four Monarch oil furnaces, which are fired with crude oil. There is no difficulty whatever in melting aluminum or any of the other alloys in furnaces of this type. For special alloys a battery of seven crucible furnaces is provided. Back of the crucible furnaces there is a core oven which is heated by the waste heat from these furnaces. The core department is also situated back of these furnaces, so that the cores can be placed in the oven as soon as they are finished.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 29, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

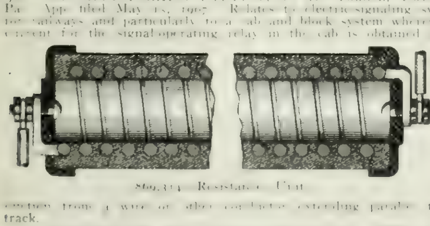
869,2[illegible]. MOTOR CONTROL; E. R. Carichoff, East Orange, N. J. App. filed Jan. 28, 1904. A system for controlling electric motors particularly designed for elevators, and having contactors controlled by a pilot circuit.

869,243. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, et al., Greenwich, Conn. App. filed March 31, 1905. Relates to electrical systems of distribution employing a branch circuit containing storage batteries to steady the load on the main generators, and automatic means for regulating the battery current to make the generator load constant within close limits.

869,244. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, et al., Greenwich, Conn. App. filed July 2, 1906. Relates to modifications of the above.

869,248. ENGINE STOP VALVE; J. L. Kimball, Salem, Mass. App. filed June 20, 1906. A spring-impelled puppet valve normally kept in open position by a magnet which is de-energized to release the valve member.

869,27[illegible]. BLOCK-SIGNALING SYSTEM; [illegible] H. Thullen, Swissvale, Pa. App. filed May 15, 1907. Relates to electric signaling systems for railways and particularly to a cab and block system wherein the current for the signal-operating relay in the cab is obtained by a current from a wire or other conductor extending parallel to the track.



869,314. Resistance Unit.

869,2[illegible]. PROCESS OF REDUCING COMPOUNDS WITH ELECTRICALLY DEVELOPED HEAT; F. J. Tone, Niagara Falls, N. Y. App. filed Sept. 22, 1906. The process of producing silicon, which consists in subjecting a mixture containing silica and a compound containing silicon, oxygen and carbon to electrically developed heat, and [illegible] the silicon thereby to the [illegible] form.

869,[illegible]. ELECTRICAL SYSTEM OF DISTRIBUTION; [illegible] Van Wagenen, New York, N. Y. App. filed July 2, 1906. Relates to electrical systems of distribution and the automatic regulation of the same. [illegible] storage battery and a booster employed in connection with a [illegible] to steady the load on a [illegible] alternating current generator.

869,[illegible]. ELECTRICAL SYSTEM OF DISTRIBUTION; W. [illegible] [illegible], New York, N. Y. App. filed M[illegible]. Relates to electrical systems of distribution employing [illegible] storage batteries to steady the load on an alternating-current generating plant. Provides [illegible] battery [illegible] to the [illegible] of the alternating-current [illegible] the battery.

869,[illegible]. ARC LAMP ELECTRODE; [illegible]. App. filed [illegible]. [illegible].

869,[illegible]. ARC LAMP ELECTRODE; [illegible]. App. filed March 6, [illegible]. [illegible].

869,[illegible]. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed June 20, 1906. Relates to alternating-current systems of distribution supplied by an alternating current generator and especially to the arrangement therein of a special character of transformer connected to a regulating circuit.

869,314. RESISTANCE UNIT; Campbell Macmillan, Schenectady, N. Y. App. filed Dec. 1, 1905. A resistance unit comprising a material having a negative temperature co-efficient, and a resistor having a positive temperature co-efficient embedded therein.

869,317. APPARATUS FOR CEMENTING THE FILAMENTS OF ELECTRIC LAMPS TO THE STEM WIRES; N. Marshall, Newton, Mass. App. filed July 27, 1906. Has a stem-holding device, a filament-holding device, and means operating to cause a relative movement between the devices which brings a wire and filament end into juxtapositon.

869,318. APPARATUS FOR CEMENTING THE FILAMENTS OF ELECTRIC LAMPS TO THE STEM WIRES; N. Marshall, Newton, Mass. App. filed Feb. 8, 1906. Relates to modifications of the above.

869,321. INSULATING MATERIAL AND METHOD OF MANUFACTURING SAME; Robert Muller, Munich, Germany. App. filed Jan. 6, 1905. An insulating composition comprising a fragmentary mineral fireproof material united by filmiform layers of a pitchy substance having a relatively high fusing point.

869,348. STORAGE-BATTERY GRID; R. N. Chamberlain, Depew, N. Y. App. filed Feb. 5, 1906. In order to have a mechanically stronger storage-battery electrode, and one which is also electrolytically superior, patentee rolls the lead base plate with deep, narrow, V-shaped grooves in which the active material is imbedded.

869,352. MOTOR-CONTROL SYSTEM; M. W. Day, Schenectady, N. Y. App. filed March 6, 1907. Has an electric motor adapted to drive the load at low speed, a second motor adapted to drive the load at a higher speed, and means for controlling the circuits of the motors to operate in a definite sequence.

869,356. MOTOR CONTROLLER; Wilhelm Fiedler, Berlin, Germany. App. filed April 3, 1906. Relates to devices for controlling electric motor circuits and provides means by which the motor may be retarded or quickly brought to rest in a reliable, safe and efficient manner. Has a centrifugal device on the motor armature.

869,359. RELAY FOR CIRCUIT BREAKERS; Max Fiss, Berlin, Germany. App. filed Aug. 26, 1904. Relates to relays for use in connection with circuit breakers and the like, and has mechanism by which the circuit may be broken instantaneously upon an excessive voltage, or after an interval upon a slight voltage, and also upon a reversal of power.

869,364. AIR-BRAKE SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed Feb. 3, 1906. Electrically operated air-brake system having magnet operated valves.

869,365. BLOCK-SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed March 28, 1906. A block-signal system for electrically operating roads employing the rails as return conductors for power current. Has inductive bonds for connecting the block sections.

869,368. ADJUSTABLE SUPPORT FOR TELEPHONE RECEIVERS; Ross Hoggan, [illegible], Ohio. App. filed [illegible]. [illegible] holding device for telephone receiver.

869,398. AUTOMATIC DEVICE FOR PROTECTING TRAINS; E. Unverricht, Altona, Germany. App. filed Jan. 8, 1906. Automatic means for protecting railway trains and controlled by electric circuits. Designed to prevent a collision of trains running in opposite directions [illegible].

869,403. STRAIN INSULATOR; Albert Anderson, Boston, Mass. App. filed March [illegible]. A strain insulator [illegible] metallic [illegible] [illegible] the conductor [illegible].

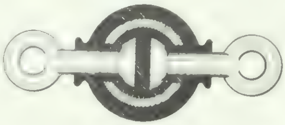
869,404. STRAIN INSULATOR; Albert Anderson, Boston, Mass. App. [illegible]

[illegible] dict, Kansas City, Kan. App. filed March 10, 1906. Relates to electric alarm attachment for incubators. Has thermostat device which [illegible]

[illegible] blades with intermediate insulating material.

869,413. FREQUENCY CHANGER; W. S. Bralley, Schenectady, N. Y. App. filed Feb. 5, 1907. Relates to frequency changes and provides means for tying together two transmission systems of different frequency so as to enable one system to supply power to the other.

869,420. PRINTING TELEGRAPH; B. W. Cochran, Los Angeles, Cal. App. filed April 19, 1905. Printing telegraph of the type in which



869,403—Strain Insulator.

a plurality of printing magnets are selectively operated by a series [illegible] series of impulses having distinguishing characteristics.

869,432. ELECTRIC FURNACE; G. Gin, Paris, France. App. filed Jan. 25, 1906. A furnace designed to simultaneously and uninterruptedly effect the several operations which occur in the production of steel, namely, fusion, oxidation of impurities, reduction of the [illegible]

869,446. PROCESS FOR MAKING DRY CELLS; P. L. Meyer, New York, N. Y. App. filed Feb. 19, 1906. The zinc casing of the dry cell is revolved on its axis so as to cement the plaster coating uniformly on its interior wall by centrifugal force.

869,449. MEASURED SERVICE SYSTEM FOR TELEPHONE LINES; J. L. McQuarrie, Oak Park, Ill. App. filed Feb. [illegible] The combination with a telephone line extending to two connection terminals, of a connection register associated with each terminal, means for completing connection with either terminal, and means adapted to actuate either connection register placed in operative relation therewith in making connection with the associated connection terminal.

869,450. MEASURED SERVICE SYSTEM FOR TELEPHONE LINES; J. L. McQuarrie, Oak Park, Ill. App. filed Feb. 23, 1906. Relates to modifications of the above.

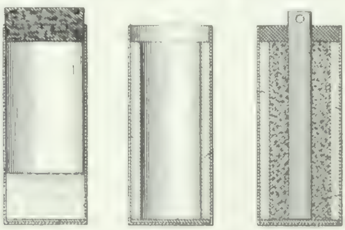
869,454. AUTOMATIC TESTING AND RESETTING MEANS FOR ELECTROTHERMAL PROTECTORS; F. B. Cook, Chicago, Ill. App. filed May 19, 1906. A testing device for a heat cartridge operable in a given direction, comprising means for applying current to the cartridge to heat the same, and for operating the cartridge still farther in the same direction when thus heated, as a test on the latter.

869,4[illegible] MOTOR CAR; S. Otis and H. S. Hart, Chicago, Ill. App. filed July [illegible] A car in which the motor mechanism is so located as to take up a minimum amount of space and be readily accessible at all times to the motorman; also to provide an improved motor, and other objects.

869,456. MOTOR RAILWAY TRUCK; S. Otis, Chicago, Ill. App. filed Nov. 7, 1906. A motor truck in which the main driving motor may be operated continually in the same direction of rotation, while the drive wheels of the truck may have their direction of rotation reversed. Has beveled gear mechanism with clutches.

869,459. ELECTRIC RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed April 3, 1900. Relates to sectional electric railway systems provided with means for preventing trains from approaching nearer to each other than the length of the section. Has arrangements for operating the brakes and signaling devices especially adapted to the system.

869,4[illegible] ELECTRIC HEATING FABRIC; W. [illegible]



[illegible] Process for Making Dry Cells.

Tenn. App. filed June [illegible] A resistance wire is wound on asbestos cord and the latter disposed in a spiral [illegible]

869,462. ALARM DEAD LOCK; M. Sheinman, New York, N. Y. App. filed Aug. 8, 1906. Alarm locks for doors having means for closing an electric alarm circuit should an attempt be made to force open the locking bolt from the outer side of the door by means of a knife [illegible]

869,464. ELECTRIC HEATER; G. E. Stevens, Lynn, Mass. App. filed [illegible] through which the water flows and between which the spiral resistance elements are disposed.

869,465. THIRD-RAIL CONTACT SHOE; S. B. Stewart, Jr., Schenectady [illegible] mechanical features of construction.

[illegible]

[illegible] direct current and employing polarized relays.

[illegible] July 2, 1906. Provides means for mechanically and electrically con- [illegible] circuits by which each letter can be attached wherever desired.

[illegible] App. filed June 28, 1906. Relates to the use of apparatus by means of which an alternating current in the railway conductors may be changed to direct current and used in circuits for controlling the [illegible]

869,552. SIGNAL APPARATUS; C. W. Coleman, Westfield, N. J. [illegible] and normally operates to go to danger position in response to said bias. Has a fluid-pressure piston motor for moving the signal to safety position.

869,555. BLOCK-SIGNAL SYSTEM; W. Daves, Bloomington, Ill. App. filed April 22, 1907. Provides a signal system in which any negligent action on the part of the signal man in the manipulation of the apparatus at his station will positively result in the display and maintenance of a danger signal until normal conditions are resumed.

869,576. SIGNALING SYSTEM; E. E. Kleinschmidt, New York, N. Y. App. filed Aug. 10, 1906. Block-signaling system for single-track electric roads in which the return current is carried by rails. Has means for registering the number of cars which enter a block in both directions.

869,591. METHOD OF PREPARING METALLIC POWDERS; W. P. McNulty, Alleghany, Pa. App. filed Jan. 25, 1906. The method of treating metallic powders for electroplating purposes consisting in cleansing them from greasy impurities.

869,595. TRANSFORMATION OF ELECTRIC CURRENTS; Wm. T. Taylor, Chihuahua, Mexico. App. filed March 14, 1907. Composite [illegible]

869,599. HYGIENIC CARTRIDGE BATTERY; W. Thompson and J. C. Martin, Spokane, Wash. App. filed July 26, 1906. A medical battery consisting of two cylindrical sections rotatably jointed together, one section containing a dry cell, and the other section containing an induction coil and having an insulated cap, the sectional cylinder and insulating cap being respectively in circuit with the terminals of the secondary winding of the induction coil.

869,602. ELECTRICAL APPARATUS; T. W. Varley, New York, N. Y. App. filed Feb. 21, 1906. Relates to an electrical apparatus adapted to operate at a constant speed ratio irrespective of changes in the operating circuit.

869,634. WIRELESS TELEGRAPHY; W. S. Hogg, United States Navy. App. filed Feb. 6, 1907. A spark gap apparatus employing two electrodes having rounded terminals with proximate edges of highest potential parallel throughout and concentrically arranged with respect to each other.

869,711. TROLLEY; S. D. Hunt, Youngstown, Ohio. App. filed April 24, 1907. In place of a trolley wheel, patentee has a pair of rounded fingers with ball and socket connections to the part and which are guided between separate trolley wires.

869,714. WIRELESS SIGNALING SYSTEM; J. L. Jones, Kizer, Tenn. App. filed Aug. 24, 1906. Relates to systems of intercommunication between moving railway trains, or between trains and stations by wireless telegraphy.

869,728. ALARM MECHANISM; L. Paisley, Waverly, Ohio. App. filed May 8, 1906. Relates to alarm mechanism for rural free delivery mail boxes to notify the user of the presence of mail matter in the box.

869,737. MULTIPLE SOCKET FOR INCANDESCENT LAMPS; F. J. Russell. App. filed May 29, 1907. A multiple lamp socket having a body part carrying a series of lamp-holding contacts with a detachable lid carrying a series of corresponding center contacts for the lamp.

869,760. ELECTRICALLY CONTROLLED ELEVATOR; C. T. Westlin, [illegible] trolled elevator, a door lock in the controlling circuit, said door lock arranged to break the path of the circuit when the door lock is open, and means for shunting a part of said current around the door lock.

869,780. ELECTRIC MOTOR; J. F. Hayes, Pittsburg, Pa. App. filed March 8, 1907. Relates to electromagnetic motors of the reciprocating type, and provides a motor of this character so constructed as to insure powerful and efficient action of the reciprocating armature.

869,796. SERIES SHUNT FOR DYNAMO ELECTRIC MACHINES; E. T. Mug, Norwood, Ohio. App. filed Nov. 17, 1905. Relates to resistance elements, particularly to series shunts for compound-wound, dynamo-electric machines. Has a plurality of strips of metal, means for clamping the ends of the strips and means for forcing said clamping [illegible]

869,8[illegible] CONTROLLER; F. W. [illegible] App. filed Aug. 17, 1904. Motor-control system for a plurality of motors designed to obtain a uniform acceleration of the motors through series and parallel connections.

869,824. CONTROL SYSTEM; L. M. Aspinwall, Wilkinsburg, Pa. App. filed Jan. 3, 1905. Controlling systems for electrical translating devices. Provides means for preventing the formation of such circuit connections in the power motors that they may act as generators and deliver current to the controlling devices.

869,825. MECHANICAL SHAFT OSCILLATOR; W. F. Bouché, Nor- [illegible] the shaft of a motor or generator in its bearings and including an eccentric disc contacting with the end of the shaft and freely revoluble on roller bearings.

[illegible] DENTAL ENGINE; W. [illegible] App. filed Feb. 21, 1907. Details of a supporting arm for the flexible shaft of a dental motor.

[illegible] TROLLEY HEAD FOR ELECTRIC TRACTION; [illegible] and A. D. Allen, Wellington, New Zealand. App. filed Aug. 7, 1907. The axle of a trolley wheel is mounted in journal blocks which have a slidable yielding movement.

[illegible] CLIP FOR ELECTRICAL APPARATUS; [illegible] such as knife switches, fuse holders and the like, which are adapted [illegible] plate-like members to which a switch blade may be attached.

[illegible] AUTOMATIC RESETTING AND TESTING FOR THERMAL PROTECTORS; F. B. Cook, Chicago, Ill. App. filed April [illegible] central operable member, comprising electro-mechanical means for heating the protector and operating the central operable member in one direction to set the protector for another operation in a reversed direction.

Electrical World

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ELECTRICAL GROWTH.

One evidence of the rapid development of the electrical field has been the growth of the American Institute of Electrical Engineers. In membership it is now the premier national engineering body in America, although the youngest. According to the figures presented by Mr. Martin before the Schenectady chapter of the Institute, the Electricals have over 5000 members, the Civils about 4400, Mechanicals 3335 and Mining 4179—the last two being for October. The maintained rate of growth seems to be higher in the Electrical Engineers, but it will be interesting to compare these figures with those of 1917. Meantime here is a splendid total enrollment of 17,000 engineers, in the four national bodies, with an infinite potentiality of usefulness.

FUTURE OF LAND WIRES.

The use that is being made of the Marconi wireless telegraph service by the *New York Times* is a splendid example of well-directed journalistic enterprise. Column after column of news is given from this source, and thus the basis is laid for a tremendous extension of the same service, both for press work and for commercial messages. But when our contemporary says "there is little doubt that the use of land wires will eventually be dispensed with," we fail to follow it. If it means to concede that there will still be ocean cables, we can agree with it heartily, yet it is over the sea that the wireless has its best chance of success. When it comes to land lines, the wireless depends heavily on such lines, and has not yet shown itself able to deal with even some of the rudimentary problems of regular long-distance land service. The land lines will be with us for many years to come. But we can get along with fewer of them. What is needed is the adoption of automatic and rapid systems of transmission that will enable one wire to do the work of several, better and cheaper than it is now done by poorly-paid manual operators, who constitute one of the greatest anachronisms of modern electrical development.

AN ALTERNATOR WITH A COILLESS ARMATURE.

An article by Messrs Punga and Hess on page 962 directs attention to the conditions under which an e. m. f. may be produced in the shaft of revolving-field machines. That such an e. m. f. could exist and not be noticed in machines in regular service is attributable to the small value of the e. m. f. and to the good insulating qualities of the films of oil in the bearings. Only when there exists a dissymmetry of the magnetic circuits such as is seldom found in practice, does the shaft e. m. f. reach a value sufficient to produce appreciable current in the bearings. As pointed out by the authors, the shaft e. m. f. may be entirely eliminated by making the reluctance of the magnetic path symmetrical with reference to the field magnets. An interesting feature of the article is the discussion of the excitation characteristics and the voltage regulation of a generator whose only active e. m. f. is that produced in the shaft by reason of the dissymmetry of the magnetic circuit. The authors find that there must be an enormous difference between

the reluctance of the several main magnetic paths through the stator if the rotor e. m. f. is to reach a desirable value at a moderately high speed, and the e. m. f. is to be maintained reasonably constant under a suitable rating of full-load current. However, the construction of an alternator with a coilless armature is shown to be readily possible for a rating of 30 volts and 8000 amperes. The low value of the e. m. f. of such a machine would not prove objectionable, provided the machine possessed sufficient compensating advantages. The machine proposed resembles in certain of its operating characteristics an alternator of the "inductor" type, while in its constructive details it is not unlike a "unipolar" direct-current generator without copper on the rotor. It would probably possess the poor regulation of the former machine and the low efficiency of the latter.

Keeping Down the Peak.

It has been suggested that illuminating engineering furnishes an admirable means for keping down central-station peak loads. It is one of the fundamental principles of sound central-station business policy that the ratio of the peak to the average load be kept as low as possible; or, in other words, that the load factor be kept high. Certain classes of business which use energy many hours per day yield enough revenue to the central-station company to pay for operating expenses and the fixed charges on the investment necessary to serve them. Customers using energy only a short time per day are an unprofitable class, provided their demand comes at the time of peak load. In order to keep down the demand of this unprofitable class of business, which comprises mainly stores and offices which close early, it is proposed that the central-station company shall attempt to engineer such customers' installations so that they will get satisfactory lighting with the smallest possible demands, thus aiding to keep down the unprofitable portion of the central-station company's investment. While this may seem like rather finely spun theory, it undoubtedly indicates a wise line of policy for a central-station company to pursue. It is not to be expected that the pursuance of such a policy will work any great changes in the company's load factor for several years, but the load factor of every central-station company certainly needs helping; and it is only by combining all the slight possible improvements that any change worth while can be accomplished.

High-Speed Direct-Current Generators.

Generators of any type arranged for direct connection to steam turbines require great care in design from mechanical considerations, on account of the high centrifugal force. In alternators a solution for the problems encountered is found in placing the armature winding on the stator, where it will be free from mechanical stresses. It is evident at once that the design would be more difficult if the designer were forced to place the armature winding on the rotor. The difficulty reaches a maximum when he must place on the rotor not only an armature winding, but also a many-part commutator, and must so arrange the latter with reference to the former and to the stationary field winding that no sparking is produced at the brushes. Solutions of the many electrical and mechanical problems thus involved in the design of direct-current turbo-generators form the subject of an article by Mr. H. I. C. Beyer on page 964 of this issue. The machine described in [illegible] held in place by shrink-rings, a type of construction that has proved well suited to high-speed operation. The armature winding proper differs from the type employed with low-speed machines in that each conductor is formed in two parts so that use may be made of partially-closed slots, and the winding may be bound into place as a mass integral with the armature core. The field winding consists of shunt-connected coils for producing the main excitation, series-connected coils for increasing the e. m. f. with increase in load, distributed series-connected coils for preventing field distortion by the armature m. m. f., and concentrated series-connected coils for perfecting the commutation. Probably the most interesting feature of the article is that dealing with the proportioning of the latter coils. The author considers that since a conductor in which the current will be reversed during the commutation period is surrounded by a "reactance flux" of a certain value in one direction just previous to commutation, and surrounded by an equal flux in an opposite direction immediately after commutation, the "reactive" e. m. f. may be completely neutralized by causing this same conductor, during the commutation period, to cut across a stationary flux equal in value to double the "reactance flux." The improved commutation observed when combined carbon and copper brushes are substituted for copper brushes he attributes, in part at least, to the increased arc of brush contact; that is, to the lengthened period of commutation and increased stationary flux cut during this period. That is to say, the added contact resistance of the carbon brush need not be depended upon for perfect commutation, provided the commutating field bears the proper relation to the "reactance flux."

Effects of Short-Circuits on Watt-Hour Meters.

Nearly all modern watt-hour meters are little electromagnetic motor-devices, directly coupled to disc magneto-generators operating on short-circuit. This provides a frictionless load, in which the resisting torque is automatically rendered proportional to the speed of rotation. The disc is usually composed of copper, and runs between the poles of permanent magnets. The constancy of calibration of the meter depends, among other things, upon the permanence of the magnetism in these drag-magnets. If they should increase in magnetic strength, their torque per unit rate of disc rotation would likewise increase, and the device would tend to underregister. If, on the contrary, they should depreciate magnetically with age, their torque on the disc rotating at given speed would diminish and the device would speed up accordingly, and over-indicate. In the first case the monthly meter bills tend to be too small, or the error goes against the company; in the second case, the bills tend slightly to increase, or the error goes against the consumer. When a sudden great excess of current passes through the series coils of motor-meters, as in the case of a momentary short-circuit on the consumer's mains, the series coils become momentary powerful electromagnets that are capable of disturbing the magnetic condition of the permanent drag-magnets. It is well-known to central-station meter men that such short-circuits are liable to affect the calibration of a meter. It has been generally supposed that if the magnetic axis of the series coils stood at right-angles in the horizontal plane, to the lengths of the drag-magnets, the magnetic disturbance due to an accidental short-circuit current was minimized.

In an article published on page 969 of this number, Prof. A. A. Radtke describes some experiments which he made with

an actual watt-hour meter when fitted with certain auxiliary series coils. A conclusion drawn from these experiments is that when the series coils act along the direction of the drag-magnets, a sufficiently intense excitation of these coils always increases the strength of the magnets. Although that may have been the actual result produced in the tests described, it would perhaps be unsafe to generalize the conclusion and assume that this result must always follow with either direction of short-circuit current, or with all geometrical dispositions of the essential parts. In the case described by the article, the magnetic force from the violently excited series coil acts along the two sides of the drag-magnet, aiding or reinforcing the magnetization on one side, and opposing or weakening the magnetization on the other. But the magnetic force so exerted will be greater on the side lying nearer to the series coil, and the difference between the two magnetic forces acting on the respective sides will depend on the shape of the permanent magnet and on its proximity to the disturbing coil. It may be a fact that when half a permanent magnet is strengthened and the other half weakened by the simultaneous momentary action of the same intensity of magnetic force, the resultant effect is to strengthen the magnet. Even this seems an unsafely wide generalization that should be carefully checked experimentally; but when the two simultaneously acting magnetic forces are not symmetrical, the conclusion seems open to much uncertainty. Nevertheless, the experiments recited in the article are valuable as showing that the generally accepted notions on this matter are unreliable, and that the possible effects of short-circuit currents on meter calibration should be carefully investigated.

Studies on the Metallic Arc.

A recent paper by Cady and Arnold, which is abstracted in the Digest, throws some new light on the behavior of the arc between metallic terminals. The subject is now of some commercial importance since the so-called luminous arcs worked at low current values are steadily coming into use. The especial point of the paper under discussion is the study devoted to the critical conditions of stability when the current is near its minimum practical value. The arc drawn between iron terminals, for instance, passes through two well-defined stages, to lay aside minor considerations. In the first, the cathode is the chief source of activity and the phenomena near the anode are comparatively insignificant. The arc is stable, it is true, but far from brilliant, and existing chiefly as a cathode glow. This condition is preserved quite steadily until the current is pushed up above a certain value, fairly definite for each given arc. Then the arc suddenly reaches over and involves the anode, the potential difference falls about 12 volts and the arc becomes powerfully luminous. The change is in some respects analogous to that connected with the hissing state of the carbon arc, but differs greatly in its practical significance. For in case of the iron arc the running condition must always be, for any sort of efficiency, the second stage just mentioned, and the small currents employed in such arcs are likely to involve conditions which may come perilously near to causing a shift to the first stage.

Cady and Arnold made a critical examination of the causes leading to the sudden change from the first to the second stage, and after very ingeniously eliminating various possibilities, have [illegible] vaporization of the anode begins. In other words, during the first stage the arc is due to cathodic radiation and continues steadily enough until the heat becomes sufficient to furnish vapor from the anode. Then the transition fall of potential between the integral metal of the anode and the surrounding hot gases merges into the new phenomenon of a true vapor stream, and the arc assumes its normal luminous condition. The close connection of the first stage with the cathode glow in a Geissler tube is indicated by the fact that under proper conditions one may get with metallic arcs the striæ often found in Geissler tubes. Moreover, at very low values of the current there was noted a preliminary state quite corresponding to the weaker stages of the Geissler tube excitation, in which the visible phenomena are limited to a fairly distinct cathode glow and a weak anode glow. Many of the experiments were carried on in an atmosphere of nitrogen, which eliminates the secondary phenomena due to excitation, especially conspicuous in the carbon arc and associated with the hissing state. In the case of most metals the critical point between the first and second stages of the arc is not well shown in free air owing to these secondary effects. Iron and copper, the metals most used commercially, show it best, owing chiefly to their high vaporizing points. Evidently a volatile constituent would tend to remove the critical point by providing the needful vapor bridge at low current values. Volatile metals like lead and silver could be coaxed into showing a distinct first stage only in nitrogen at reduced pressure.

Experiments of this sort are seldom lacking in practical value, and in this instance their value is apparent in their bearing upon the new arcs. They show plainly that with iron or copper terminals of similarly high vaporizing temperature, the critical point is, especially with a fairly long arc such as is desirable for the proper distribution of light, somewhat dangerously near the currents actually used. Two and three-ampere arcs are being seriously considered, and the tendency is towards such low currents. For an iron arc the critical current for an arc of commercial length is nearly one and one-half amperes, and very small disturbances on the circuits or very moderate drafts are competent either to put the arc wholly out of business or to degrade it into a useless stage. One can blow out a three-ampere arc between iron terminals more easily than a candle. A very small disturbance breaks the continuity of the vapor stream and sends the arc into the glow condition, even if it is not broken entirely. In short, one is working with some of these recent arc lamps in the limiting region near to impracticability. A larger current or more vaporizeable electrode is very desirable in the interests of stable working. The former recourse seems the more desirable, since easy vaporization means more rapid waste and more objectionable débris to dispose of. Raising the current will not escape the waste and débris, but it at least gives one a system less disturbed by trivial grounds and a somewhat better range of materials with which to work. There are limits to the subdivision of the electric arc even with metallic electrodes, and they cannot be escaped. Incidentally, Cady and Arnold found even above the critical point some very singular conditions of instability, with rotation of the arc and other curious phenomena. The subject is one that needs further investigation: for in changing the electrodes from carbon to iron it is clear that new conditions come to the front which the older experiments on the arc do [illegible]

Prohibiting an Increase of Capitalization.

An important decision has been given by the New York Public Service Commission of the Second District, against a proposed increase of capital. The decision permits a new corporation, the Lockport Light, Heat & Power Company, to purchase the Lockport Gas & Electric Company and its rival, the Economy Light, Fuel & Power Company, of Lockport. But it forbids the new company, however, to issue securities for a capitalization above $700,000, equivalent to the total issues of the two old companies. The new company desired to issue stock and bonds to a total of $1,200,000. The decision also makes it plain that increases of the price of gas and electricity will not be permitted to follow the combination of competitive companies. The companies have been engaged, as is well known, in a bitter war in Lockport, as a result of which the prices of energy for lamps and motors in that city are lower than in most cities, and below cost, it is claimed. The combination was planned to put an end to the war.

The merger clause of the new law prohibits the issue of securities of such a corporation to an amount exceeding the total of those of the corporations merged. The new Lockport Company asserted that it was not a merger, but a new corporation, and therefore was not subject to this provision. Its application to do business was opposed by the city of Lockport and by the Attorney General. The city objected to the increased capitalization, and held that the elimination of competition would result in increased charges. The Attorney-General declared that the promoters proposed the formation of a monopoly in contravention of the statutes of the State.

"Technically speaking," says the commission, "the case in question is neither a consolidation nor a merger, but the purchase by a newly-formed corporation of the property and franchises of two existing companies. It will be observed, also, that the prohibition of the statute is confined to an increase in a merger or consolidation of 'capital stock,' and such prohibition does not expressly apply to increase of bonded indebtedness.

"The purpose behind the statute, however, is perfectly clear. The provision of law in question is designed to prevent those large increases of capital issues which have so often accompanied the consolidation of public service corporations in the past, and which have imposed heavy burdens upon municipalities in the way of inadequate service and excessive prices through the endeavor by the overcapitalized company to earn interest and dividends on the excessive issue of securities. If this beneficent purpose of the statute can be evaded simply by effecting consolidation in fact through the form of a newly organized purchasing company, without technical merger or consolidation of the existing companies, or if it can be evaded by leaving the aggregate capital stock unchanged, but imposing the same burden upon the community through a greatly increased issue of bonds, the statute totally fails to accomplish the intended purpose.

"We think it quite clear that the policy of this commission, in case two or more gas or electric companies in any community are permitted to sell out their property and franchises to one newly formed company, should be to disapprove such sale, unless the total capitalization of the consolidated or new company, whether stock or bonds, issued in exchange for the securities of the old companies, is kept down so as not to exceed the total capitalization of the vendor companies."

In taking up the objection raised by the city that the price of electricity would be increased as a result of the deal, the commission points out that this is likely to prove a test case. "A business which supplies to a community a public utility like gas, or electricity for light and power," it says, "is one in which free and full competition between two companies engaged in the same business cannot be expected to prevail permanently. It can doubtless be demonstrated beyond any possibility of successful contradiction that better service and fair prices in the way of furnishing such public utilities to a community can, as a general rule, be given by one corporation than by several, and that this can be done with the use of less capital." Such duplication, it says further, involves public inconvenience in the erection of unnecessary and unsightly pole lines, tearing up of pavements, and so on, and while temporary benefit may result from competition, the usual result is eventual consolidation, poor service, and enhanced prices—the latter in an effort to make the city and its inhabitants bear the burden involved in paying returns on the unnecessary capital invested in the duplicated plants.

"It is our belief that the provisions of the Public Service Commission law show a full appreciation of these facts by the Legislature of the State. While the law forbids consolidation, either directly or indirectly, without the approval of this commission, it at the same time permits such consolidation whenever in the opinion of this commission it is for the public advantage to do so, and recognizes that this may be the case by placing in the hands of the Public Service Commission great power, designed to secure the community in that case against poor service or extortionate rates." The commission accordingly prohibits the increase of prices over those that obtain at present.

The objection of the Attorney-General to the consolidation is dismissed with citations of the Appellate Division's decision in Rafferty vs. the Buffalo Gas Company and the recent decision of Justice McCall in the Consolidated Gas Company case in New York City, in which "the courts held that such consolidations do not create monopolies within the meaning of the statute."

Trolley Plant in New South Wales.

The street car lines of the State of New South Wales were opened in 1879, and in 1890 the first electric line was equipped, within five years from which time the whole system in Sydney and suburbs was converted to the overhead trolley system. The tramways of New South Wales are owned by the government and operated by a chief commissioner of railways and tramways, with an assistant commissioner appointed every seven years to manage both. Tramways are not subject to municipal control or rates. The single track electric mileage of the system is 137. A number of electric extensions are now in contemplation for city and country lines.

The power plant comprises seven units with a total capacity of 7900 kw. Each of the generators is driven by an Allis-Chalmers engine built in Milwaukee. Three of these engines are vertical cross compound units of 2500 hp each, and the other units are 1500 hp horizontal cross compound direct connected units.

There has recently been installed a Parsons turbine unit of 1750 kw rating, and there are two 5000-kw turbine units of the same type on order. These units are similar in design to those now built by Allis-Chalmers Company. There are forty-eight Babcock & Wilcox 350 hp boilers which furnish steam for the units mentioned. In addition to the main power house there are seven car houses, seven sub-stations and four battery houses belonging to the system. The rolling stock comprises some 700 motor cars, 50 trailers and 45 service cars.

Bright Plated Metal Surfaces.

As a rule, articles plated by the galvanic process—that is, in electrolytic baths—have a matt surface. Microscopic examination shows that this is because the surface is composed of minute crystals which disperse the light reflected therefrom even when they are not oxidized. In plating with copper this is especially noticeable. For many purposes this matt surface is desirable—as, for instance, where it is intended to subject the copper to the action of an acid or other solution, in order to give it a patina, or to produce the effect called "blood bronze," but where a bright surface is desired, it is necessary to resort to some mechanical means, such as burnishing or

polishing with the wheel, which, besides delaying delivery, increases the cost of production. The same is the case where iron or steel is plated with zinc; furthermore, the hot process is, for many classes of work, not applicable.

A recent German patent refers to a process by which it is intended to produce by electrolytic methods, in baths of ordinary temperature, a bright surface. This is attained by the addition to the bath of glykocides, phloroglukocides or other similar substances, or nitrogenous glykocides or their derivatives; or, instead of these substances, the extracts of plants or barks, as, for instance, althea, panama or licorice extract, which contain the substances above mentioned.

The employment of these materials enables the production in the bath, says the patentee, of a brilliant surface on the plated articles, without any mechanical aid. The metal is said to adhere well, so that, for example, zinc-plated iron sheets may be bent backwards and forwards at will without the zinc coming loose, which up to the present has not always been the case with sheets plated by the hot galvanic process.

Twenty-Five Years of Institute History.

Before the Schenectady chapter of the American Institute of Electrical Engineers, on Nov. 1, Mr. D. B. Rushmore presiding, a paper was read by Mr. T. C. Martin on 25 years of Institute history. It was pointed out in the paper that work for the formation of the society began in 1883, thus justifying the title. Mr. Martin remarked that he had filled every office in the Institute except that of treasurer, and added: "Speaking as the senior surviving president of the Institute, it might be expected that I should make some allusion to the 19 men who have held the office since the beginning in 1884. How some persons get elected to presidential office is a mystery, even granting their great individual qualifications; and it is equally strange how others miss the distinction. It does not follow that because a man is a great engineer or inventor he has the executive ability for leadership; and moreover he may be right in shunning instinctively that which would only be a distraction from his true work. Two of our most distinguished members, known throughout the world, have not accepted this office; yet it is surely a matter for congratulation that of the 19 men, not fewer than 15 have been engineers very distinctively, and the names of 17 are attached to inventions some of which are the greatest of the last 50 years. This is a large proportion, particularly when it is borne in mind that no fewer than 8 of the 19 have followed the profession of teacher, and three have been journalists, who speak not as those having authority but as mere scribes. Perhaps the most striking fact about the list and the testimony it bears to the catholicity of the American engineering spirit as well as the manner in which our national strength is reinforced, is that 7 of the 19, including the present incumbent, were not natives of this country. The career open to talent that was regarded by Napoleon as such a desideratum, is obviously to be found in this country as nowhere else in the world." He pointed out, however, that the method of selecting presidents had shown itself susceptible of improvement.

Reference was made to the importance of the secretarial position and the fact that Mr. Ralph W. Pope had held the office almost from the beginning. Mr. Martin said: "It was a providential dispensation which gave us Mr. Pope's services, for with instant sympathy he took up the work of development that has gone on without cessation to the present moment. Unhasting and unresting, of him it cannot be said that anybody ever saw him in a hurry, but the work has always got done. The possession of the lymphatic temperament is, as in him, sometimes associated with a remarkable ability to accomplish. A few years ago, it is said, the pastor of a leading church died, whereupon, having in mind his virtues and labors the vestrymen put up a tablet on the walls with this quotation: 'Now the people of God have rest.' I can well imagine that when some administrations have faded into the background, our good secretary has felt like emulating the example of that vestry, for he has never fallen into the error of mistaking restlessness for achievement. Disraeli once compared his Liberal opponents to little children pulling up their plants every morning to see how much they had grown in the night. From such practice, the conservatism of our secretary has always saved us, and we have had the growth just the same and all the more. His first report, presented in May, 1886, showed a net total of 250 members. We now have over 5000 not including students, so that our membership has multiplied 20 times in the period. The average budget was then less than $1,000. It is now $70,000. Granting the tremendous development in our field of engineering, it remains evident that only conscientious care and a thorough grasp of the situation could have brought us through all these years to the firm, stable and prosperous position we now hold. Comparisons were long since given a bad name, but it is only by noting the progress of other societies that we can realize how far and fast our own Institute has traveled. In the year when the A. I. E. E. was organized, 1884, the American Society of Civil Engineers had 838 members. At the beginning of this October, it had 4287, and by the end of this year will have 4400. In 1884, the American Institute of Mining Engineers had 1381 members; on Oct. 5 it had 4179. At the close of 1884, the American Society of Mechanical Engineers had 557 members and on Oct. 1 it had 3335 members. Hence, in spite of their flying start and time allowance, the A. I. E. E. has outrun all the other societies, and with its 5000 members is distinctly in the lead. I don't know that there is any special credit in this; it is simply a fact worth noting; it may carry an implication or prophecy as to relative numerical importance later on. The growth of these sister societies is reason for hearty congratulation all around. The enrollment in four national technical bodies of nearly 17,000 professional members is surely an indication of the growing influence of engineers and engineering in a civilization that they at least as much as any other factor have created."

Mr. Martin pointed out how much of the work of the Institute realized the hopes and ideals of its founders, and was still being carried on along lines laid out originally. He referred to the new Engineering Building, and the Institute fund of $160,000 already raised, and said: "The joint library in the new Engineering Building, given us by Mr. Carnegie, is one of the best evidences of the good that flows already from the creation of the new home. There we have what is probably, even now in the earlier stages of organization, the best collection of engineering literature in the world. It is constantly securing valuable accessions, and students more and more frequent it. Together with the grand Public Library on the next street, now being finished, it will constitute the best center of scientific and literary investigations, through the printed word, to be found on this continent. When our past president, Dr. Wheeler, with generous impulse, gave us the Latimer Clark Library, he little thought that from such a nucleus, or so soon, would come in reality, both the building and the splendid larger library it now enshrines. We Electricals are, indeed, not as appreciative as we ought to be of what has come through Dr. Wheeler's initiative and liberal gift—a critical event in Institute history determining all the future."

After referring to the successful creation of branches; the transactions now embracing 25 substantial volumes of some 16,000 pages; and the exchange of international courtesies, Mr. Martin comented on standardization and code work and said: "To make laws is a confession of human weakness; but the desire to legislate for fellow men springs ever in our breasts. The Institute has found abundant occupation in standardization of material and more latterly has branched off into the standardization of morals. In all, this only commendation can follow, but there always lurks the peril of petrifaction. 'Our little systems have their day. They have their day and cease to be. They are but broken lights of Thee, and Thou, O Lord, art more than they.' No standardization must be final; it is only a basis for new departure if it is worth anything. Of all others, the electrical arts are to-day most in a state of flux and transition, and the bondage of prescription cannot be laid upon

them. The greater the number of conditions we agree upon, the larger should be the freedom for all else."

"Codes of ethics are the latest efforts at standardization to occupy our thoughts in the Institute. It is a sign of the times, an admission on the part of the individual that before he flays alive a corporation he ought to examine his own credentials as executioner. We must of course all be in sympathy with the effort to secure affirmation for such a code as is proposed for the Institute, but no virtue of purity or salvation lies in the code itself. It is a mere formula of words and phrases. The moral law has never been observed by a single human being since it was given shape, yet the world has steadily grown better through the unconscious striving of our race upward and onward. Codes of ethics are besprinkled thickly through the ages; declarations of faith and fervor come into political platforms once a year; and the man who when asked to sign the Thirty-Nine Articles regretted there were not forty does not stand unique. By all means let us have a code but do not let us expect too much of it. Not long ago a northerner went into a southern village store and asked for a pair of socks, size No. 10. The storekeeper was sorry, but he kept only one size, No. 12. 'Why,' said the astonished northerner, 'surely you don't mean to say that every man and boy in this village wears the same size sock?' 'Oh, no!' was the cheerful, ready answer, 'but if the socks happen to be too long they pull 'em up at the heels, and if they are too short they tugs 'em down at the toes.' It is thus with all codes made like ancient torture beds, to fit all cases and all men."

The paper concluded with an appeal to the younger members to interest themselves in Institute work.

November Meeting of A. I. E. E.

At the meeting of the American Institute of Electrical Engineers, held on Nov. 8, the comparative performance of steam and electric locomotives was discussed, a paper on this subject being presented by Mr. A. H. Armstrong. An abstract of this paper is given on page 971 of this issue.

In a written communication, Mr. W. J. Wilgus, mentioned the striking advantages of the electric over the steam locomotive as found in the New York Central installation. In this installation coal consumption per car-ton mileage in high-speed service, as compared with slow-speed service, is 165 per cent, whereas under exactly the same conditions, the increased consumption of energy for electrical equipment is only 18 per cent, a difference in favor of electrical operation of 147 per cent. The net results of all of the economical advantages of electric operation, over steam, for the conditions existing on the New York Central, after including all elements of cost of additional plant, shows a saving in summer months of from 12 per cent to 27 per cent, depending on the character of the service. A larger saving may be expected under winter conditions.

In addition to the above saving, the nuisance and dangers from smoke and gas in the Park Avenue tunnel have been eliminated, and the passenger service of the Grand Central terminal has been increased by about one-third. Later, when the New Haven Company completes its change of system, exclusive electrical operation in the tunnel will permit the use of shorter blocks, and correspondingly increase the service of the four-track main line entrance to the terminal.

Because of less cost of maintenance of electrical equipment, and less idle time in shops, the greater cost of interest charges and depreciation is not only neutralized, but a net saving in repairs and fixed charges over steam equipment is effected of 19 per cent. Electric locomotive inspection and light repairs, as compared with coaling, watering, drawing fires, repairs, etc., of steam locomotives, shows a saving in time in favor of the former of over four hours per day, equal to 18 per cent. The electric locomotive, while busy, is a much more nimble and efficient machine than the steam locomotive, showing an increase in daily ton-mileage of 25 per cent.

While not so important in freight service, the question of locomotive weight is a large factor in a comparison of the relative economy of handling passenger traffic by steam and electricity. For instance, in switching service at the Grand Central terminal, 65 per cent of the total steam ton-mileage is due to locomotive or "dead" weight, while the electric locomotive percentage is only 54 per cent, a saving for the latter of 11 per cent. In the regular schedule service, the steam locomotive shows 51 per cent dead ton-mileage, as against 35 per cent for the electric equipment, a saving for the latter of 16 per cent. When it is realized that this saving of "dead" ton-mileage has a direct proportionate effect on the cost of fuel and electric energy, and an indirect effect on wages and fixed charges, its importance is manifest.

Dr. Cary T. Hutchinson said that the constant-speed characteristic of three-phase motors was looked upon as a distinct advantage by the engineers of the Great Northern road. It is advantageous to be able to limit the speed of trains going down grade, not so much on account of the energy recuperated as of the simplicity in handling the train and the reduction in the required generating station equipment.

Mr. N. W. Storer called attention to the fact either three-phase, single-phase or direct-current locomotives offer sufficient advantages over steam locomotives to justify the substitution in many localities. He stated his belief that the substitution will take place just as rapidly as the manufacturing companies of the country are able to handle it.

Mr. W. S. Murray stated that the saving in cost of coal when electric are substituted for steam locomotives should not be ignored, because it represents one of the most important advantages of the former. The following table shows the saving of fuel which will be effected on the New York division of the New York, New Haven & Hartford Railroad when all freight and passenger trains, now operated by steam locomotives are hauled electrically:

	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	Steam	Electric	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	29,870	$183,830	[illegible]	[illegible]
[illegible] (local) . .	[illegible]	[illegible]	28,600	186,560	85,800	100,760
[illegible]	2,223,000,000	187,844	139,010	563,530	[illegible]	[illegible]
Total	3,163,240,000					[illegible]

The above values have been based on tests of ten locomotives throughout eighteen consecutive days of operation. Express locomotives required 28 lbs. of water per indicated hp-hour, and freight locomotives 30 lbs. The cost of repairs and maintenance average 8.1 cents per locomotive-mile in freight service and 5.6 cents in passenger service. An electric locomotive requires about 2 cents per locomotive-mile for repairs.

Mr. Wm. McClellan remarked that it is extremely difficult to obtain reliable data as to the economies that may be obtained by eliminating the steam locomotive. Not until a complete steam locomotive stage has been electrically equipped, so that the electric locomotive can entirely displace the steam locomotives, and the electric locomotives have been operated for a considerable time, can an accurate estimate be made of the economies of substitution.

Prof. C. L. De Muralt gave data showing that a certain double-track road eighty miles in length, which had reached its limit in haulage under steam locomotive conditions, could be equipped with two additional tracks for about $15,000,000, while it could be provided with complete electrical equipment for the former two tracks for about $3,000,000. With the electrical equipment the saving in operating expenses would be about $200,000 out of $8,000,000 per year, while a 40 per cent increase in traffic could be obtained over the same tracks.

Dr. C. P. Steinmetz stated that the leading conclusion of Mr [illegible]

trically equipping steam roads is to be found in the ability of the road with the same trackage to handle a greater amount of traffic. This, however, means that the change from steam power to electric power is not a mere substitution of the electric locomotive for the steam locomotive, but a readjustment of the ways of operation, that is, an increase of the speed of operation of freight service by taking advantage of the feature of the electric locomotive being able to maintain a high drawbar pull at a higher speed. When one kind of motive power is substituted for another, it always means, not a mere substitution, but a rearrangement. Nearly a century ago the stage coach was replaced by the steam engine. The first attempts to attach the steam engine to the stage coach and pull it over the country roads naturally came to naught, and it was successful only when the carriage was put on an iron track, and thus the present steam locomotive traction was developed. One characteristic of the steam locomotive is that it is essentially a constant power motor. The steam locomotive can give approximately the same power whether running at high or low speed. The limit is the steaming ability of the boiler. When the ability of the boiler to produce steam is exceeded drawbar pull is lessened. In the electric motor, however, the limitation essentially consists in a constant loss of power. The limit of the electric locomotive is that it can lose only so much power in the motor, to be within sufficient heating limits. Since efficiency rapidly increases with the speed, more power can be obtained at higher speeds up to a certain limit, and, therefore, the electric locomotive is better at the higher speeds than is the steam locomotive, and advantage must be taken of this feature if the best results are to be obtained. There must, therefore, be a readjustment, especially of the most important part of the railway, the freight traffic must be readjusted to higher speed. Higher speeds necessarily mean increased service from the system, even without any increased drawbar pull, and even with lesser drawbar pull. In this feature lies the main advantages of electric traction, but it becomes necessary to readjust the method of operation to the changed condition of railroad motive power in order to get the best results of the electric locomotive.

The Wireless Station at Glace Bay.

Various details have been given in these pages recently as to the resumption of regular commercial business across the Atlantic by the Marconi system, and we are now able to present a view of the interesting plant at Glace Bay, Nova Scotia, which communicates with Clifden, in Ireland. The building to the left with the high stack, is the engine house. The two large buildings near the towers are the condenser rooms, and the house with the white trimmings contains the operating rooms proper.

The towers are 215 feet high and the small poles on the top of them are about 50 ft. in height, giving a total height of about 265 ft. The aerial wires are about 50 in number and are run from the top of the poles before mentioned, practically horizontally for several hundred feet in a westerly direction, dropping at the easterly end from the towers to the operating room, advantage thus being taken of Mr. Marconi's directive system.

At the time of the erection of the station, it was expected that a large radial aerial would be employed and for this reason the towers were surrounded by circles of 8 and 16 masts, each 175 ft. high, but this arrangement has been discarded for the present directive one, so that actually four towers and four masts only are now employed. Indeed, the necessity for heavily constructed wooden towers no longer exists. At the Clifden station in Ireland, they are done away with, and six poles only are used for the support of the aerials.

MARCONI WIRELESS TELEGRAPH PLANT AT GLACE BAY.

Employed at the Glace Bay station are the manager, Mr. R. N. Vyvyan, four assistant electricians, four telegraph operators, two engineers, two firemen, two carpenters, two machinists and two riggers, so that altogether, with the families of all these people, there is quite a little colony on the cliffs.

As the source of prime power, the plant has a 500-hp Browett condensing steam engine, driving by direct couple a 350-kw, 3-phase alternator, generating at 2000 volts, although so far only 70 kilowatts is utilized for the transmission of messages.

Signals, when this amount of power is used, are very strong, quite sufficiently so to preclude any possible interruption of the service by atmospheric disturbances of the strength usually obtaining at this time of the year.

We are indebted to Mr. W. W. Bradfield, chief electrical engineer of the Marconi Wireless Telegraph Company, for the photograph and data. Mr. Marconi, who has just sailed from Canada for England, is to lecture soon on his work before the Royal Institution, in London; and he has promised also to appear before the American Institute of Electrical Engineers on his return to America during the winter.

Three-Phase Locomotives for Swiss Railroad.

Work has just been started on one of the most important electric railway projects undertaken either in this country or abroad. Among the trunk lines crossing the Tyrolean Alps the Arlberg line is probably the busiest. It is a link in the line from Vienna, through Switzerland to Paris, and being the only direct line east and west between these two points, it carries the greater portion of the traffic. For some years past traffic congestions have been unavoidable during certain seasons, and it was principally to ameliorate these conditions that electric traction was decided upon. Electric locomotives more powerful than any steam locomotives available will handle trains of considerably greater weight, and they will be run at speeds of from 25 to 30 per cent higher than the present locomotives. It is estimated that the total service of the line will be increased by at least 50 per cent, with a comparatively small capital outlay as compared with the tremendous expense which would have been involved in any grade reduction or in the building of additional tracks, the only other means for increasing the service of the road. It is stated that the electrical equipment will cost only one-fifth of the double-tracking, and the operating expenses will be decreased by 25 per cent.

The Arlberg line is a typical mountain division between Insbruck and Feldkirch, about 140 miles long, single-track except for a double-track tunnel at the summit about 7 miles long. The maximum grade on the east side of the tunnel is 3.14 per cent, and that on the west side 2.64 per cent. The curves are numerous, but are of fairly large radius. At the present time there are about 40 daily trains going over the line in each direction, about one-third being passenger and the balance freight. Prof. C. L. de Muralt, of the University of Michigan, has been appointed consulting engineer in charge of this project by the Austrian State Railways. Prof. Muralt has decided to equip the line with three-phase alternating-current locomotives, principally because it has been found that the three-phase locomotive is more powerful for any given weight than either the direct-current or single-phase. This point is of considerable importance in determining the solution of a problem involving the particular considerations that obtain on the Arlberg line. As a matter of fact, the drawbar-pull and speed which are specified demand an output of practically 3000 horse-power for a locomotive weighing not more than 60 tons, a requirement which has not thus far been met by any but three-phase locomotives. In addition to this it is estimated that some $200,000 will be saved annually by the return of energy to the system by trains descending the grade, in addition to the saving in maintenance of brake rigging and wheels made possible by electric braking. While it is true that any electric system can be made to return energy to the system while coasting down a grade, certain modifications from the standard equipment must be made in the case of the direct-current and single-phase locomotives, while the three-phase equipment will regenerate automatically and without any complications whatever.

There will be about 50 locomotives, of which five or six will be for reserve. A regular system of inspection and repairs will be instituted with the intention of keeping the equipment at all times at the highest possible efficiency. The hydro-electric station will have a maximum output of about 40,000 kilowatts. It is probable that two separate stations will be built, one on either side of the tunnel. Two years is the estimated time for the completion of the entire plant, and at the expiration of that time the entire steam equipment of the road will be supplanted by the three-phase locomotives.

CURRENT NEWS AND NOTES.

A. I. E. E. AT PITTSFIELD.—The opening meeting of the Pittsfield, Mass., section of the American Institute of Electrical Engineers was held there on Nov. 2, at the Wendell House. Mr. Joseph Insull, chairman of the section, presided and spoke, and an interesting address on Institute work and policy was delivered by Mr. D. B. Rushmore, chairman of the Schenectady section. A report was also made by Mr. H. W. Tobey as to institute branches in general. Mr. H. L. Smith, the secretary, announced a number of topics and papers for the current season, including as authors, Messrs. H. H. Barnes, Jr., W. Stanley, Ernst J. Berg, C. E. Eveleth. E. B. Merriam, W. S. Moody and S. H. Blake, all specialists in various fields. The meeting was followed by a reception.

ELECTROMETALLURGY IN FRANCE.—The Société Electrometallurgique, which has applied the electrometallurgical processes of Paul Girod, has now in operation plants in France and Switzerland consuming 14,000 kilowatts of electrical power, all of which is produced by water power. A fourth plant of 5000 horse-power will be completed this year, and when other water powers in the Alps owned by this company are developed, the total electrical power available will be raised to over 40,000 horse-power. The productions of this company consist of ferro-chrome, ferro-tungsten, ferro-molybdenum. ferro-vanadium and pure vanadium, ferro-silicon, titanium and ferro-titanium, ferro-manganese, cupro and nickel vanadium, silico-chrome, silico-manganese, ferro-boron, ferro-tantalum, ferro-uranium, cupro-silicon, etc. The largest products are, in the order named, ferro-silicon, ferro-chromium and ferro-tungsten; 6000 tons of the former were produced last year. The total sales amount to about $2,000,000 per year.

LIGHTING RATE REGULATION.—Last week in New York City, speaking from the bench of the United States Circuit Court, Judge Hough, who is hearing argument on the report of Mr. Masten, the Master, on the constitutionality of the 80-cent gas law, declared that it was exceedingly difficult for the courts to determine where regulation ceased and confiscation began. The attitude of legislative and judicial bodies is such at present, he said, that there is no form of industry that is not likely to be made the subject of intervention by the Legislature and the courts. He also intimated that his present views on the case coincided closely with those of the gas company's lawyers. James M. Beck, of counsel for the Consolidated Gas Company, was arguing that the 80-cent gas bill was confiscatory and therefore unconstitutional, when Judge Hough interrupted: "I find it very difficult at the present time," he said, "to define the difference between regulation and confiscation. I have asked for the opinion of other counsel, and I now ask yours." "Regulation is the orderly ascertainment of what is a reasonable rate, with its enforcement," replied Mr. Beck, readily. "Confiscation is the seizing of all property or earning power without any allowance as to compensation." He went on to say that the matter of regulation was one of fact, connected with the laws of business which were infinitely greater than constitutions and governments, "for, as we speak of governments they are a sort of glorified police force at best." "It appears to me," said the judge, "that if this 80-cent rate should be declared unjust another bill, for 85-cent gas, might be introduced and an entirely different set of facts and conditions would have to be determined upon. And if gas can be made the subject of such regulation then bread can likewise be affected. There is, in fact, no form of industry that cannot be, that is not likely to be, as a matter of fact, the subject of just such intervention by the Legislatures and the courts within a very short time. Then there is a tendency to do away with the judicial review. The Keppler bill is an attempt in that direction. The courts, of course, must be guided by the constitutionality of various acts and by decisions which have previously been made bearing upon it. I am inclined at present to assent to your view with regard to the subject."

TELESTEREOGRAPHY.—Edouard Belin, a Frenchman, has, according to a Paris despatch, invented a method of transmitting pictures by telegraph, which is distinguished from Prof. Korn's system by being wholly mechanical. Several of the Paris papers recently reproduced photographs transmitted by the new system which has been called telestereography.

TELEGRAPH STRIKE ENDED.—Having long since proved a fizzle, the telegraph strike has now been regularly "called off" by the various branches of the union, and is a thing of the sad past. The telegraphers have flocked back to get their jobs, on terms of unconditional surrender, but in most instances have found no employment, the companies being well supplied with operators. There seems to have been a good deal of suffering toward the end among those who went out so suddenly at the call of a whistle in a strike that had not been authorized.

TELEPHONY IN CHICAGO.—The Chicago Telephone Company's existing franchise expires in 1909, and the aldermen of that city have just granted to the company an extension for 20 years, so that the company can plan for extensions and improvements. A business telephone will cost $120 a year, a residence instrument $72, and a private exchange $368 per annum. A subscriber to a two-party line can get his service for $48 a year. Five cents is the rate for a message sent from a pay station, and the company is required to pay to the city, semi-annually, 3 per cent of the gross receipts of all its business inside and outside of the city. In 1929 there will be another readjustment. Chicago should soon enjoy to the full the measured-rate system which has been such a boon in New York, and has enabled the New York Telephone Company to give a service of unequaled efficiency. The Chicago Telephone Company gained 3016 subscribers in October and since January has added 28,098.

COLOR VALUES OF ARTIFICIAL LIGHTS.—Mr. H. V. Allen, of the General Electric Company, addressed the electrical section of the Western Society of Engineers, at Chicago, Nov. 8, on "The Color Values of Artificial Lights." Mr. Allen, who is associated with Mr. W. D'A. Ryan, showed a number of experiments presented by Mr. Ryan and associates at similar lectures elsewhere. The effect of fog and cloud in modifying white light was shown by projecting a light upon the screen which passed through a fog medium, the fog being produced artificially in the experiment. To show the effect of different artificial lights on common colors or goods, four booths were arranged, containing respectively an inverted gas mantle burner, a Nernst lamp, an enclosed arc lamp and incandescent lamps. These experiments served to demonstrate admirably the different color values given by common, every-day illuminants.

JOHNSON'S MUNICIPAL MACHINE.—With regard to the reelection of Mayor Tom Johnson, at Cleveland, his opponent, Congressman Burton, says: "No one can appreciate the strength of Mayor Johnson's machine. The work of thousands of men, their positions at stake, trained to political service and many of them with friends and relatives equally interested, is a factor strong enough to determine any election under ordinary circumstances. This machine manifested its power. No volunteer organization could equal it in efficiency. It was like a contest between regular troops and raw recruits. Another factor was the almost united support given Mayor Johnson by the liquor interests of the city. One great advantage which lay with Mayor Johnson in this campaign as compared with others was the operation of lines carrying passengers at a 3-cent fare, and the impression that a system would be established on which a 3-cent fare would be charged, and which would include the whole city."

TELEPHONE ELECTION RETURNS were more a feature than ever of the elections in New York City on Nov. 5. By permission of Commissioner Bingham telephones were installed in police stations at 25 strategic points, and here were stationed men who have been regularly employed for some years past in the transmission of returns. In the main office 10 receiving telephones were placed. Each was attended by an operator from the telephone company. There were also 7 sending telephones, over which the news was distributed to groups of three newspapers. When the telegraph system was in use one man would place the 21 newspapers upon a single loop and flash the returns to all at once. With the telephone this was deemed impracticable, three newspapers upon one line being regarded as a better plan. The receiving operators would take upon small bulletin sheets the count from the men in the various police stations as it was handed in, for instance: "Ten districts out of a total of 55 in the Thirty-first Election District give Foley 5000, Ihmsen 4000," and so on. The next returns received from this district would be added to the total already known, the number of districts still to be heard from reduced, and the results sent out by the sending operators. In this way the returns were handled without a hitch at the rate of 56 bulletins an hour, a record that compares favorably with the telegraph system.

RAILROAD REBATES.—Before one member of the Interstate Commerce Commission, Mr. Harlan, an argument was presented in New York last week on behalf of the General Electric Company in connection with its claim that it should receive an allowance of about $100,000 annually from the New York Central & Hudson River Railroad and the Delaware & Hudson Railroad for the work of shifting cars from the railway tracks to various parts of the electric plant. Previous to an indictment of the two roads for rebating, they had made payments to the General Electric at the rate of about $50,000. The case against the New York Central, tried before Judge Ray in Syracuse, resulted in a disagreement as to whether the sums paid constituted a rebate or a proper allowance. The General Electric Company has an elaborate switching system of its own, started more than 10 years ago with one small engine. The Delaware & Hudson has no yard in Schenectady, while that of the Central is inadequate. At times, according to Mr. Adelbert Moot, the electric company's lawyer, the Central has as many as 700 cars in the yards of the company. Demurrage on them to the extent of more than $30,000, it has already paid. The General Electric was forced to install its own switching system on account of the delays of the railroads. It now demands the allowance mentioned for the work so done.

DINNER TO CARROLL D. WRIGHT.—At the Engineers' Club, on Nov. 9, a dinner was given to Dr. Carroll D. Wright, former U. S. Commissioner of Labor, when the cross of the Legion of Honor was bestowed on him by the French Government in recognition of his services in the betterment of industrial conditions. The host of the evening was Mr. Charles Kirchoff, chairman of the advisory council of the Museum of Safety Devices and Industrial Hygiene, to whose work Dr. Wright has given hearty support. The decoration was conferred by Mr. Bonzom, acting consul general, and letters of congratulation were read from President Roosevelt, Hon. S. N. D. North, director of the U. S. Census, and Hon. Andrew D. White, former minister to Germany. Dr. Josiah Strong presided, and speeches were made by Dr. W. H. Tolman, of the Institute of Social Service; Dr. F. R. Hutton, president, American Society of Mechanical Engineers; T. C. Martin, president of the Engineers' Club, and Dr. Wright. Among those present were Charles R. Flint, Rev. Dr. Percy S. Grant, David Williams, C. Whiting Baker, Prof. F. R. Hooper, F. A. Halsey, Dr. E. F. Roeber, Albert Spies, George Gilmour, Wallace P. Groom, C. C. Cluff, of the Carnegie Steel Company; W. E. Howland, of the *Outlook;* Dr. L. L. Seaman, etc. After the dinner a visit was made to the new museum on West Thirty-Ninth Street, to see the preparations for its early opening to the public. It was announced during the evening that Dr. Hutton had consented to take the chairmanship of the jury of award for the *Scientific American* gold medal just founded in the Institute.

AMERICANS HONORED.—The Royal Society, with the approval of King Edward, has awarded the Copley Medal to Prof. Albert A. Michaelson, of the University of Chicago, for optical investigation. It has awarded the Davy Medal to Prof. Edward Williams Morley, of Cleveland, Ohio, for his investigations in physics and chemistry, and especially for his determination of the relative atomic weights of hydrogen and oxygen.

HUGE COPPER PURCHASES.—Advices from London state that a pool, in which the largest copper consumers of Europe are represented, was recently formed in that city, and has purchased 50,000 tons of copper. The price paid is slightly above the prevailing price in the market. The copper is to be delivered in November and December. The amount involved is approximately $15,000,000, which is to be paid in London on delivery.

WAR BALLOONS.—A special cable dispatch from Berlin announces that the Siemens-Halske-Schuckert Electric Company has decided to make a business of building military airships and selling them, just as the Krupps supply cannon to various countries of the world. The company has begun the construction of an airship designed to outstrip in speed and power all the dirigibles so far built. It has also been experimenting with flying machines.

MELTING POINT OF TUNGSTEN.—In some recent careful determinations made by Wartenberg, the melting point of pure metallic tungsten was found to be at least 2800 deg. C. and probably not over 2850 deg. C. The determination was made by heating the metal electrically in a vacuous bulb and employing a carefully calibrated optical pyrometer. For comparison the same experimenter measured the temperature of the positive crater of the arc lamp, which varies somewhat with the kind of carbon used, and determined this to be 3350 deg., while Reich had found 3430 deg. with the same kind of pyrometer.

THE BIDWELL SWINDLE.—For some time past the Bidwell Electric Company of Chicago has been advertising the sale of stock in its "cold motor," making most absurd statements and claims. Any number of inquiries about it have been addressed to this office. A federal warrant charging the use of the mails for fraudulent purposes has now been issued, and on Nov. 1, Charles F. Bidwell, the secretary, was taken into custody after a fight and, failing bail in $3,000, went to jail. A warrant is also out for Benson H. Bidwell, president of the company. It is said that 4300 investors have bought at least $200,000 of the stock.

MUSEUM OF SAFETY APPLIANCES.—Word has just been received that the international jury in the section of social economy at the International Book, Paper and Publicity Exposition, which closed in Paris last month, made an award of the grand prix to the American Museum of Safety Devices and Industrial Hygiene. A diploma of honor, the second highest award, was made to Messrs. Charles Kirchhoff and T. C. Martin, respectively chairman and vice-chairman of the museum's advisory council, also to Dr. L. L. Seaman and Rudolph Lenz for their active interest in promoting this work. The museum is now occupying the entire fifth floor at 231 to 241 West Thirty-Ninth Street, New York City, and all inquiries for space, exhibits and other information should be sent to Dr. W. H. Tolman, director of the museum.

LIGHTING AT MINNEAPOLIS.—We are informed by Mr. L. A. Lydiard, city clerk of Minneapolis, Minn., that a few months ago the City Council passed an ordinance providing that the city should establish an electric lighting plant, with an output sufficient to take care of all the lamps on the streets, about 1100 in number. The ordinance provides that the city engineer shall submit to the Council an estimate of the cost of constructing the plant. This estimate, we learn, has not yet been submitted. As there are no funds available for the work, it is hardly likely that under the most favorable circumstances any construction work can be begun this year, as it would be necessary for the board of tax levy to make provision for the expenditure. Moreover, money market conditions are now highly unfavorable to such municipal enterprises.

WHAT NEW YORK SPENDS.—Last Sunday Comptroller Metz, of New York City, addressed the "New Yorkers," a woman's club founded last year for social purposes. His speech was entitled on the program, "Financial Greeting." He said: "The city budget is enormous. Each month $1,000,000 is paid out in cash for salaries, and the salaries altogether, for the whole year, come to $71,000,000. The city spends annually $400,000,000—that is, more than London, Paris, and Berlin all put together. This means that we are doing in one year what they did in centuries. The city is growing tremendously, and we are rebuilding it from end to end. At present $50,000,000 is pledged to the city for parks and bridges, which we must have." He might have added that the city cannot show one well-paved street, and that its municipal supply of drinking water is vile. The only public services at all well run are those under private or corporate management.

NEW YORK POLICE TELEGRAPHS.—Police Commissioner Bingham has made some radical changes in the police telegraph system, suspending Superintendent Brennan, who has held the position for thirty years. He has had some fifty men under him. Early in the summer Commissioner Bingham engaged Prof. George F. Sever, of Columbia University, to investigate the police telephone system. Prof. Sever has just made a preliminary report, saying the present system is totally inadequate to handle police business. Mr. Henry F. Blackwell, who has succeeded Supt. Brennan for the time being, assisted Prof. Sever in his work. Commissioner Bingham had the Commissioners of Accounts investigate the bureau's method of issuing electrical supplies. Their report showed, he said yesterday, that no records had been kept of the supplies issued. Moreover, it is charged that the bureau has kept no maps whatever of the police cables, and that the department owns miles and miles of unused and unlocated cables. Detectives who have shadowed patrolmen detailed as linemen, have reported that they never went near any electric lines except the trolley lines leading to places of entertainment.

AMERICAN RAILROADS.—A pamphlet issued recently by Slason Thompson gives some interesting comparisons as to railroad values. The document is a spirited denial of the many charges which have been made by the critics of railroaods as at present managed. Where the net capitalization in 1906 has been officially declared to be only $11,671,940,649, the cost of the railroads, reached through several processes, is approximately $13,000,000,000. In comparing these figures with the cost of railroads in other countries Mr. Thompson shows that the some roads would cost: On Canadian basis, $13,384,240,000; on German basis, $21,969,000,000; on French basis, $28,712,000,000; on Belgium basis, $34,795,000,000, and on English basis, $58,644,000,000. On the ratio of assessed value to the true value of all property in the United States, as reported by the federal bureau, the assessment of American railways for the purpose of taxation is a certificate of value for $12,890,000,000, or more than $1,000,000,000 above their net capitalization. Although looking at the question strictly from the point of view of the railway officials, Mr. Thompson is a strong advocate of the popular demand for a governmental valuation of the railways. He denies, however, that the question of capitalization has any bearing on the question of rates. The prevalence of popular hallucinations as to values and rates, he says, emphasizes the necessity for an intelligent attempt by the government to ascertain and publish to the world a "reasonable, trustworthy estimate of the cost and true valuation of the railways of the United States."

Electrical Pumping Installation of the Lindal Moor Mines, England.

THE electrical pumping installation which has just been completed for the Lindal Moor Mines, of Messrs. Harrison, Ainslie & Co., is particularly interesting to engineers and the mining world in general, not only on account of the special features involved, but also because it is stated to be the largest and most comprehensive plant of its kind yet

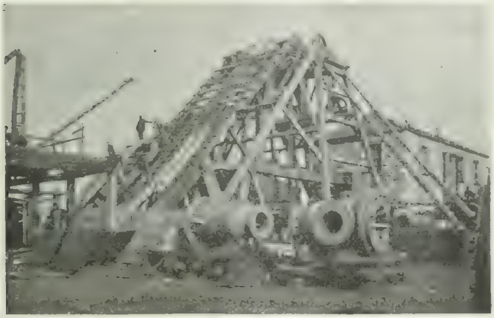


FIG. 1.—VIEW SHOWING INCLINATION OF PUMPS AT LOWFIELD PIT.

put down in Great Britain. The causes which led up to the adoption of the present scheme may be briefly summarized as follows:

The Lindal Moor Mines, which are located near Ulverston, Lancashire, England, contain rich iron ore, and in several of the pits pumping operations ceased in December, 1903, owing to breakdowns and also because the then-existing pumping plant was not capable of coping with the inrush of water. The four pits affected are connected together either artificially or by natural drainage. At the time the pumping operations ceased, the maximum inrush of water reached nearly 7000 gals. per minute, though the normal flow in dry weather only amounted to about 4000 gals. per minute. About 3300 gals. per minute were pumped out by the old plant from two of the pits between which an artificial connection existed. As much water was pumped out of the two other pits. For the above-mentioned reasons and owing to the then-existing business conditions, pumping operations were abandoned in the four pits until the matter came up again for serious reconsideration in the beginning of 1906.

All the mines at which the new pumps are fitted contain large quantities of ore, much of which was in sight when the work was stopped by the overpowering inrush of water. It is confidently expected that an immediate result of the installation will be a gradual but great increase of the output of the mines, which at the present time is 250 tons per working day. A great feature of the installation is the mobility of the pumps and motors. With the electrical energy generated at one central station and transmitted to the pits, it is obvious that very little work will be involved in removing one or more of the pumps to other areas when the mines now being dealt with are pumped dry. It is already intended to adopt this course at an early date, when one or more of the pumps will be transferred to the large new shaft now in process of sinking on the Buccleuch area, to control the water on that portion of the company's estate. This, the Grievson shaft, in addition to being a pumping station and relieving the company of the present expensive system whereby eight pumps are employed, will give a greater working depth to the Lindal Cote mines. As the work of exploration is continuously carried on simultaneously with the working of the existing mines, it will be seen that there is every prospect of the new installation being fully used. The prospecting work is of very great importance, and with this work kept abreast of mining operations it is evident that with electrical energy readily applicable at any portion of the property, the development of the latter must inevitably be greatly facilitated and the output increased enormously.

In the four pits in question, three shafts were available for pumping plants; but the great initial difficulty to be overcome was the designing of a plant which could be efficiently handled in the very small pump ways, and it was only after five or six schemes had been proposed and rejected that a satisfactory solution was evolved. It was, further, a very difficult matter to design a plant of the required dimensions which would be capable of making any impression upon the inrush of water, and it was only the possibility of using electricity and high-velocity pumps which induced the owners to seriously reconsider the project for pumping the mines dry.

PUMPING PLANT.

In the Lowfield pit, Fig. 1, which is inclined at an angle of 43 degrees to the vertical, two centrifugal pumping sets have been provided, each of which is capable of delivering 4000 gals. of water per minute against a total head, including friction, of 395 ft. On reaching a depth of 378 ft., where the two shafts join, the two pumps will be connected in series, and the design is such that when working in series the pumps can together deliver the full 4000 gals. of water per minute against a total head of 780 ft. These two pumps are of the one-stage type and rest upon a special carriage running on rails, as shown in Fig. 2.

Each pump has two wrought-iron delivery pipes, which are connected at the top by means of a Y-pipe, which supports a rising main 14 ins. in diameter. The check valve has an internal diameter of 375 mm. (14.76 ins) and a foot valve with an internal diameter of 450 mm. (17.71 ins.) is fitted with a strainer. Each pump has a rope sheave 4 ft. in diameter mounted on brackets. Each of the motors direct-coupled to

FIG. 2.—[illegible] THE PUMPS AT LOWFIELD PIT.

the pumps is capable of a continuous output of 750 brake horsepower when working on a circuit having a potential of 3000 volts and a frequency of 50 cycles. The speed of the combined set is 1485 r. p. m.

In the Diamond shafts, two vertical sinking pumps are provided, each of which is capable of raising 1000 gals. of water per minute against a total head, including suction, delivery and pipe resistance, of 680 ft. These pumps are also fitted with

[illegible]
speed of 1480 r. p. m. The pumps in this shaft are of the three-stage type, and are fitted with elastic couplings and cast-iron intermediate piece for connecting and centering the pumps [illegible]

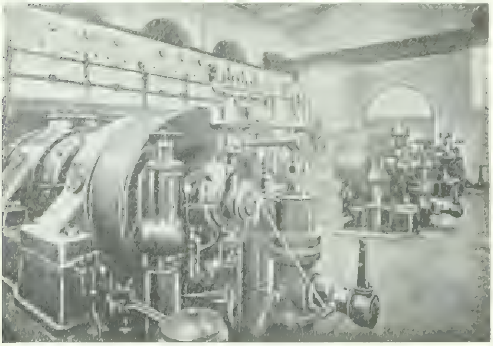


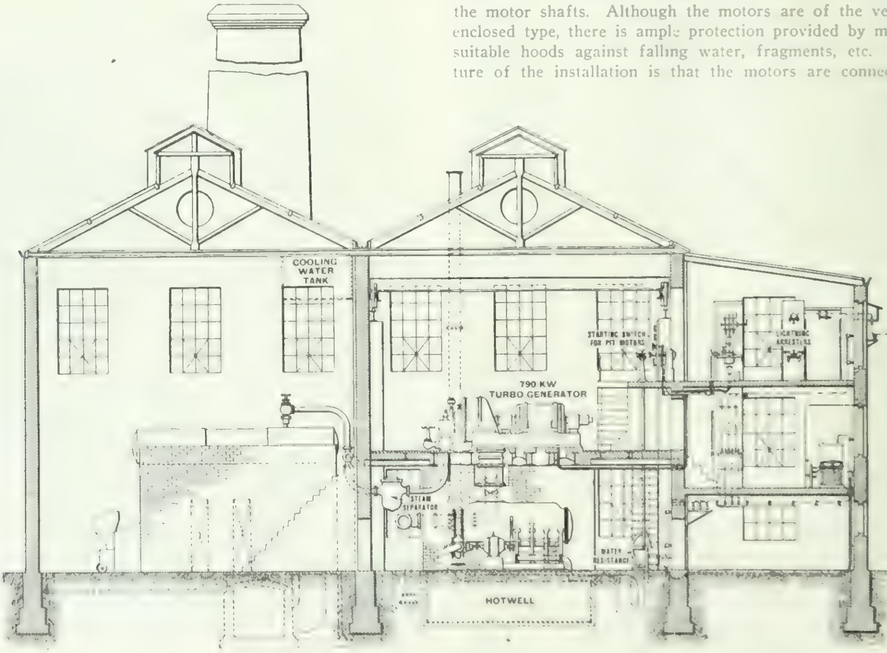
FIG. 3.—VIEW OF POWER PLANT SHOWING TURBO-GENERATORS.

wrought-iron suction pipe, foot valve and strainer. There are also wrought-iron delivery pipes connected at the top by a Y-pipe, which supports the rising main. Each pumping set is entirely enclosed in a framing of structural iron and a suitable rope sheave is provided for carrying the weight of the entire pump with its motor, cable and delivery pipe when filled with water under normal working conditions. On the side of each set is a service ladder with a wooden platform at the top and bottom.

In the two Berkune pits, two pumping plants of similar construction to those in the Diamond shafts are provided, but in this case each pump is designed for delivering 1000 gals. of water per minute against a total head of 540 ft.; the motor being rated at 250 horse-power and the speed of each set being 250 r. p. m. These pumps are of the five-stage type, and the arrangement of valves and pipes is the same as for the pumps in the Diamond shafts. The steel cables by which the pumps are lowered into the pits are fastened at the pit heads, from which point they go down their respective shafts, round the rope sheave of each pump, and up again to the top of the shafts, where they are wound round the winches provided for the purpose of raising and lowering. The delivery pipes for the vertical pumps are each stayed in position by means of the steel-wire ropes which pass up and down either side, stay rods being provided at various points with suitable guides through which the cables pass. The weight of each of the Lowfield pumps complete with its motor, suction and delivery pipe, suspension cable, electric cable and its own column of water, is about 75 tons. With a view to affording rapid sinking operations the Diamond and Berkune pumps have been designed so that during the first half of the operations of draining only a few of their impellers will be in use. When the halfway stages are reached the full number of impellers will be brought into action.

From the above it will be evident that the total initial quantity of water with which the whole plant will be able to deal is about 15,000 gals. per minute, this being reduced to 8000 gals. per minute as the pumps reach the lower levels. The centrifugal pumps were built by Sulzer Bros.

The motors are of special design for working under abnormal conditions, and are constructed with particularly narrow dimensions to admit of their passing down the existing pumpways. They are fitted with short-circuited rotors, and the motor cases are arranged with ample ventilation, a forced circulation of air being maintained by means of fans fitted on the motor shafts. Although the motors are of the ventilated enclosed type, there is ample protection provided by means of suitable hoods against falling water, fragments, etc. A feature of the installation is that the motors are connected directly to the 3000-volt lines without intervening transformers, all terminals and live parts being protected so that there is no risk of danger to the operators.



[illegible]NAL ELEVATION OF [illegible]

The cables used for conducting the electricity to the motors in the pits are of special flexible pattern. Pure and vulcanized rubber is used for insulation, the rubber being selected so as to render the cables safe for a constant working pressure of 3000

volts between phases, a wire armoring being also used for a protection to the rubber. The cable for each motor is wound on its respective cable drum, one end being connected to the slip rings on its shaft, the other end being connected through a watertight junction box, fitted on the side of the motor, direct

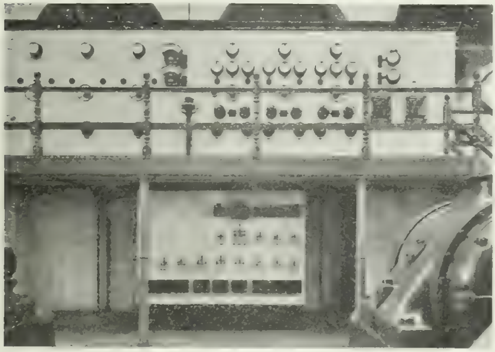


FIG. 5.—SWITCHBOARD, LINDAL POWER STATION.

to the motor terminals. By means of this arrangement the cable is paid out as the motor is lowered down in the pit and the whole of the live cables and terminals are effectually sealed and protected.

GENERATING STATION.

In order to provide electricity, a generating station has been built a short distance from Lindal Station, on the Furness Railway. The distance from the generating station to the three pits is: Lowfield, 980 yards; Berkune, 800 yards, and Diamond, 1720 yards. A three-phase system was adopted, and in order to transmit the required energy without undue loss and at the same time have a working pressure which could be applied directly to the motors, an e. m. f. of 3300 volts, with a frequency of 50 cycles, was chosen. The arrangement of the generating station is shown in Figs. 3 and 4.

Electricity is generated in three turbo-generators of the horizontal type, each set being capable of a continuous output of 1140 kilowatts when running at 3000 r. p. m. and supplied with steam at 200 lbs. pressure and superheated to a temperature of about 600 deg. F. Each turbine exhausts into a surface condenser. It may be mentioned here that the turbine used is of

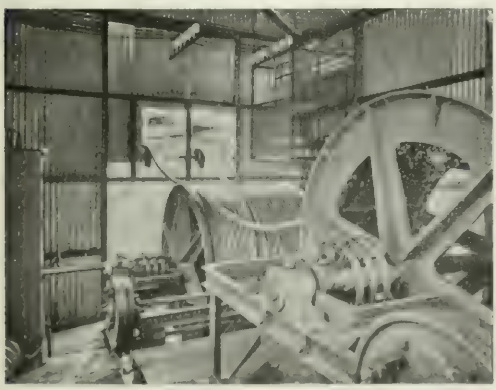


FIG. 6.—[illegible]

the velocity type, steam being expanded and its pressure energy transformed into velocity energy in two stages, each pressure stage having two velocity stages. Steam is expanded from boiler [illegible] from which it passes through the first set of blades and guides. It is then further expanded in the second set of nozzles, whence it passes through the second set of blades and guides directly into the condenser.

The generators are of solid construction, the rotating field magnet structure possessing the characteristic of a solid cylinder. By a system of ventilation and by water circulation in a double casing round the stator and bearings, the generator is kept quite cool. The circulating water flows by gravity from a tank situated above the engine room. Eleven gallons of water is circulated per minute. The generator also runs with very little noise, owing to the construction of the stator. Each generator has its exciting unit direct-coupled to the main shaft and by means of a Tirrill regulator the terminal voltage is kept constant irrespective of load fluctuations. The guaranteed steam consumption is 18.2 lbs. per kw-hour.

The boiler plant consists of three B. & W. water-tube boilers, each of which is fitted with a superheater. The furnaces are equipped with automatic stokers driven by a three-phase motor. Feed-water is passed through a Green economizer.

The generator and feeder circuits are controlled from a main

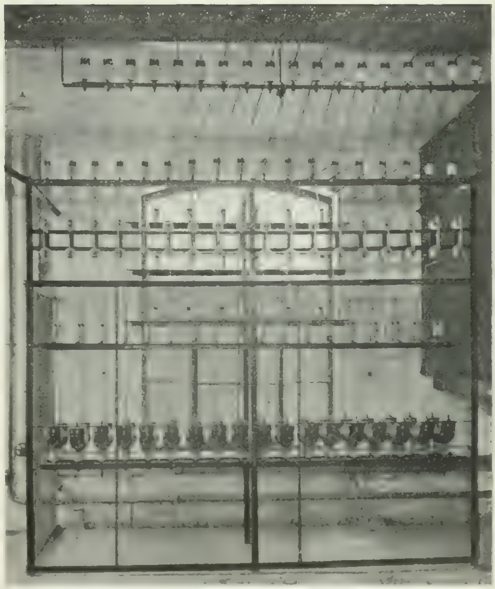


FIG. 7.—LIGHTNING ARRESTERS AT POWER STATION.

switchboard, Fig. 5, of special cellular design. The front of the board is constructed of tiled masonry, upon which the instruments are mounted, the switches being operated by handwheels. The connections are made to the switchgear by means of spindles passing through the wall. A feature of the control arrangements is that each of the six pit motors is under the control of the power-station engineer, the starting and stopping operations being carried out at the main switchboard.

Two sets of bus-bars are provided, one set for feeding the motors under full pressure, and the other set for gradually raising the pressure at starting. The starting is effected by two transformers connected in series. One of these is an auto-transformer, which gives a voltage half as large as the working e. m. f.; the second transformer has its primary winding connected in series with the auto-transformer and its secondary winding connected to a water rheostat, which is gradually short-circuited on starting the motors. By this means the e. m. f. applied to the motors at starting is gradually increased and all large rushes of current which might affect the voltage [illegible] speed, they are switched from the auxiliary bus to the main bus by

means of change-over switches of the oil-break type. To protect the motors against overload, each line is provided with automatic maximum-current circuit breakers. The handwheels operating the oil switches are connected to these circuit-breakers by means of trip gear, the latter being operated by solenoids fed direct from the busses. The relays controlling the circuit breakers are fed through series transformers, and as soon as the current exceeds a predetermined maximum, the solenoid circuit on the oil switch is closed and the switch is thereby opened by means of powerful springs. The relays can be fitted either for instantaneous operation or with a time element.

The switching arrangement, it will be seen, is centralized, the only apparatus at the pit heads consisting of an isolating switch in each case, with a voltmeter to indicate when the line is alive or dead. To permit the motors to be controlled from the power house, a separate transmission line of bare copper is run to each motor, the conductors being carried on porcelain insulators fitted on channel-iron cross-arms fastened to wooden poles. Fig. 7 shows the arrangement of the lightning arresters at the power house.

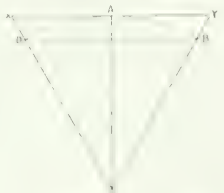
At the point where each transmission line terminates at the pit-head sub-station, the bare copper wires are connected to vulcanized rubber cables through a junction box mounted on the transmission line pole. The cables are in turn connected through the isolating switch and collecting brushes to the slip-rings of a specially devised cable drum, Fig. 6. The isolating switches are, in addition, arranged with mechanical devices by means of which the men in the pits in charge of the pumps can, in case of emergency, immediately disconnect the motors from the mains.

A complete telephone system has been installed between the power house and the various pits, whereby the necessary communications can rapidly pass between the engineer in the power house and his staff at the various stations.

The Lindal Moor Mines property covers about 3000 acres, which may now be developed on a scale hitherto impossible. Electrically-driven pumps have given results in mine working unattainable by any other method, and while direct-current motors have been employed to a great extent in British practice, polyphase motors have been extensively employed elsewhere, especially in connection with centrifugal pumps. The Electrical Company, Ltd., were the contractors for the entire installation.

Combined Two-Phase and Three-Phase Transformation.

The accompanying illustration indicates graphically a scheme for obtaining two-phase and three-phase electromotive forces simultaneously from only four wires, for which a patent was issued to Mr. W. T. Taylor on Oct. 29. In this illustration C, x and y are the terminal e. m. f. points of three delta-



TAYLOR TRANSFORMATION SCHEME.

connected transformers. Instead of obtaining three-phase e. m. f.'s from these three points, e. m. f.'s of less value in true three-phase relation are obtained from points C, D and B. The locations of B and D are so selected along the respective transformer windings that the e. m. f. CD or CB, is equal to the e. m. f. AC. Therefore, the e. m. f. DB is equal to the e. m. f. AC, and since it is in time-quadrature therewith the four points A, B, C and D give e. m. f.'s suitable for use with two-phase (independent windings) apparatus.

A Phenomenon of Revolving-Field Generators.

By F. Punga and W. Hess.

The treatment below deals with a phenomenon found in single-phase and polyphase generators, whose unpleasant consequences have been felt in many instances, but whose exact nature has not previously been investigated. The phenomenon relates to the small e. m. f. that is sometimes produced between the ends of the shaft of a high-speed machine; the layer of

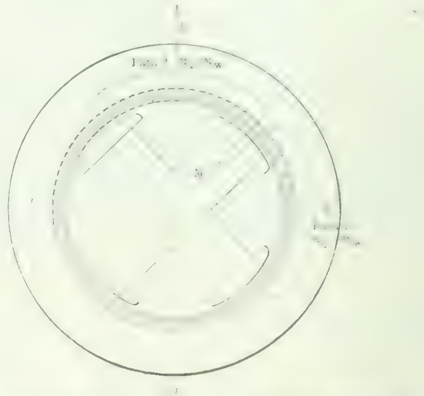


FIG. 1.—POSITION OF ROTOR GIVING [illegible]

oil in the bearings forms a good insulator for the low e. m. f. so that no opposing current is produced by the e. m. f. The e. m. f. corresponds in frequency to the normal frequency of the generator, and in large high-speed machines its value is such that the bearings must be completely insulated from the bed plate of the machine. The cause for this e. m. f. is discussed below.

Figs. 1 and 2 show a four-pole generator, in which the stationary armature core is built in two parts. Magnetically there exists two small slits (air-gaps) at a and a in the arma-

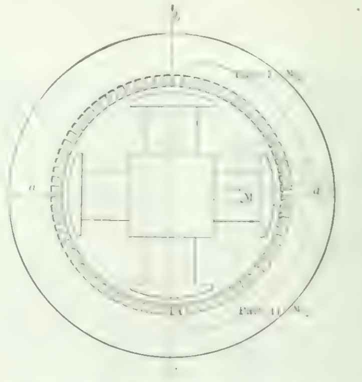


FIG. 2.—POSITION OF ROTOR GIVING UNIFORM RELUCTANCE.

ture ring. In Fig. 1 the rotor field core has such a position that there exists a maximum magnetic density through the slits a and a. However, the actual flux will be less through path II than that through path I, because the reluctance of the latter path is less than that of the former. Assuming that M is the value of the flux from each pole, expressed in megalines, then the flux in path I will be $(M \div 2) + m$ and that in path II will be $(M \div 2) - m$, m depending in value upon the reluctance of the slits.

In Fig. 2 the field core has such a position that the slits a and a have no effect on the distribution of magnetism, and the magnetism in each path is $(M \div 2)$. Evidently the effect is the same as though a flux of m megalines passed perpendicularly to the armature shaft, and alternated at the frequency of the terminal voltage. Assuming a sinusoidal time rate of change of the flux the actual value of the e. m. f. between the ends

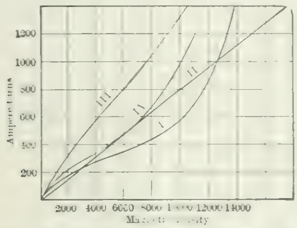


FIG. 3.—MAGNETOMOTIVE FORCES FOR VARIOUS SLIT-WIDTHS.

of the shaft will be, in volts, $E_s = 4.4 fm\, 10^{-2}$, where f is the frequency in cycles per second.

An actual example may be used to show the true magnitude of the e. m. f., E_s. In the accompanying table values are given for a certain four-pole generator in which the width of the slit

Excit. Current	Megalines Per Pole	Lines per sq. c.m. Mean	Max.	Min.	Volts Calculated	Observed
[illegible]	14.5	[illegible]	3,800	[illegible]	5.00	5.3
40	27.3	4,870	7,300	2,490	10.00	10.5
[illegible]	39.7	7,100	10,200	4,000	[illegible]	12.0
80	[illegible]	8,400	11,300	5,500	12.00	12.0
[illegible]	52.0	9,300	12,000	6,600	11.00	12.0
[illegible]	56.0	10,000	12,500	[illegible]	10.30	12.0

(a of Fig. 1) was 1 mm. Column 1 gives the exciting current; column 2, the magnetic flux per pole by test; column 3, the magnetic density in the armature on the assumption of uniform distribution of the flux.

In Fig. 3 the abscisssæ represent magnetic density and the ordinates the required ampere-turns of m. m. f. Curve I is for the path of the flux in the armature from one pole to another; a length of 113 cm through the iron sheets is obtained from the design sketch of the machine. Curve II shows the ampere-turns for a slit-width of 1 mm. Curve III, the ordinates of which are the sum of the ordinates of curves I and II, gives the ampere-turns for the total path when there is an added slit of 1 mm. Curve IV shows the mean flux for each value of excitation. By use of the above table and curve IV one can readily determine the maximum and minimum density in the field core. Finally, the density of the flux m has a value of $(B_{max} - B_{min}) \div 2$. The cross-section is 2750 sq. cm; the

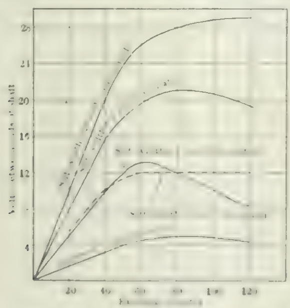


FIG. 4.—EXCITATION CHARACTERISTICS FOR VARIOUS SLIT-WIDTHS.

frequency f is 33.3; so that all values are available for the determination of the e. m. f. between the ends of the shaft by means of the formula above. In Fig. 4 this e. m. f. is plotted as a function of the exciting current. Values are given for slit [illegible] e. m. f. for an air-gap of 1 mm. As previously noted, the determinations were based on a normal magnetization curve for iron, and the deviation at the higher density indicates that the permeability of the iron was actually somewhat better than assumed. The e. m. f. was also measured when the two halves of the stator were placed directly in contact with each other. As is well known, even when the halves are placed upon each other as closely as possible the slit-width (air-gap) does not reduce to zero. The tests seem to indicate that the unavoidable contact reluctance corresponds to an air-gap of ¼ mm. A comparison of the two curves shows that the maximum e. m. f. of 4.6 volts with a .25-mm gap increases to 12. volts with a 1-mm gap. For a 4-mm gap the maximum e. m. f. is 20.5 volts, and with a 20-mm gap the e. m. f. reaches 29 volts. In Fig. 5 the maximum e. m. f. is plotted as a function of the slit-width (air-gap) in mm; it is seen that with the chosen

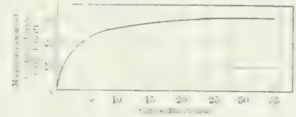


FIG. 5.—VARIATION OF E. M. F. WITH THE WIDTH OF THE SLIT.

machine the e. m. f. between the ends of the shaft (at 33.3 cycles) may reach 30 volts.

Fig. 6 gives an oscillograph record of the e. m. f. between the ends of the shaft when the slit-width in the magnetic ring had its minimum value.

It is interesting to determine what the results will be with a machine having a different number of poles than four. If there are two slits in the magnetic path then there can be no e. m. f. between the ends of the shaft of a two-pole machine; in case an e. m. f. does appear, it may be attributed to the irregular magnetic reluctance of the laminations. On the other hand, an e. m. f. will be produced between the ends of the shaft on any machine whose number of poles is divisible by four when there are two parts to the magnetic ring. It can be shown also that a machine having $2p$-poles in which the magnetic ring is divided into n equal parts will possess an e. m. f. between the ends of its shaft if $2p \div n$ is an even number. The question naturally arises as to the method by which the disadvantageous e. m. f. between the ends of the shaft may be overcome. An obvious remedy is to make the magnetic reluctance of the slit (air-gap) in the ring as small as possible; it is impossible, however, to decrease the reluctance to zero. An effective cure is found in making the number of slits in the ring such that $2p \div n$ is not an even number, and thereby insuring that the various flux paths will have equal reluctances. For example, a four-pole machine could have two horizontal and two vertical slits in the magnetic ring.

It is possible to make use of the e. m. f. between the ends of the shaft to obtain a special form of high-speed, low-voltage, alternating-current generator. This machine has no armature winding, and need not have slots; the stator discs are arranged in p sections, separated from each other by a slit (air-gap) or any non-magnetic material. The shaft itself serves as an armature winding, a large number of copper brushes being used for collecting the current. The bearings, or the bearing stands, are thoroughly insulated from the ground.

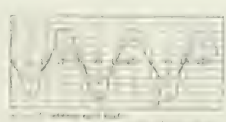


FIG. 6.—OBSERVED E. M. F. BETWEEN ENDS OF SHAFT AND NORMAL E. M. F.

Although the machine would hardly be considered for practical operation, yet it may prove of interest to compare its performance with that of a normal machine. The no-load excitation characteristic is sufficiently well shown in Fig. 4. It will be noted from Fig. 5 that the width of the slit in the stator ring after reaching a certain value is almost without [illegible] to the armature

reaction, as will be seen below, it is absolutely necessary to take a very large value for the gap.

The armature reaction exhibits itself at three different points: (1) in the yoke, (2) in the stator proper, and (3) through the stator and the pole faces; the various paths are indicated in

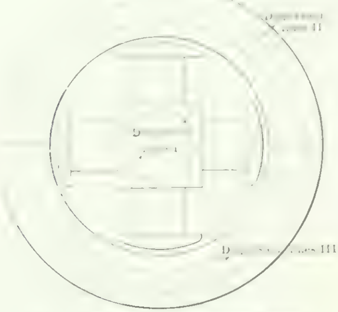


FIG. 7.—PATHS OF [illegible]

Fig. 7. It is to be noted that with a load current of I amperes, the armature m. m. f. is I ampere-turns, the armature winding consisting of a single turn.

The first path, in the case of a massive yoke, would permit the formation of considerable eddy currents; on the other hand, if the path is laminated the magnetic reactance will be large. There are two methods of overcoming these difficulties: either the yoke can be provided with copper damping devices in which the loss will be small, or the poles and the yoke can be frequently subdivided as shown in Fig. 8.

The second path (Fig. 7) follows the periphery of the stator, and encounters only the reluctance of the joints; it is desirable to ascertain its effect upon the operation of the machine. Consider, therefore, a two-pole, 50-cycle machine having a flux of 30 megalines per pole and an e. m. f. between the ends of the shaft of 30 volts. It is required to determine the width of the stator-slit when the reactive e. m. f. caused by the flux following path II will be 5 volts at a load of 8000 amperes. From the familiar transformer e. m. f. formula, $E = (4.4 f n \phi_m) \div 10^8$. $5 = 4.4 \times 50 \times 1 \times M \times 10^{-8}$, hence $M = 2.2 \times 10^6$; 2.2 megalines must follow path II. The total

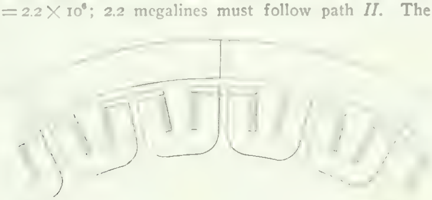


FIG. 8.—ARRANGEMENT OF POLES TO MINIMIZE REACTANCE.

reluctance of the periphery may be considered as merely that of the slit whose width is l cm. Let the cross-section of the path be q sq. cm.

Then, approximately,

[illegible]

Assuming a cross-section, q, of 1770 sq. cm, l becomes 11.5 cm. That is to say, the slit should have a width not less than 11.5 cm to obtain the desired performance.

The third path (Fig. 7) is along the leakage route formed by the pole face when it is adjacent to the stator slit. The leakage field through this path can be reduced by using a larger air-gap, a change that will necessitate an increase in the main exciting m. m. f.

The determination of the characteristics of a multipolar machine is made exactly as has just been done for a two-pole machine, except that the current strength should be divided by the number of pairs of poles—that is, by the number of stator slits.

It is noteworthy in this connection that in a machine with a rotating armature, an e. m. f. will be generated between the

FIG. 9.—[illegible]

ends of the shaft if a radial slit is cut in the armature discs, as indicated in Fig. 9. The flux will vary with the position of the armature and will swing across the shaft and generate an e. m. f. therein. The authors have as yet not made a test on such a generator.

Direct-Current Turbo-Generators.

By H. I. C. BEYER.

The direct-current turbo-generator differs in many respects from machines of the low-speed type. In fact, it is of all machines the most difficult to construct. The following outline of the constructive features of such machines may prove of interest to designing and constructing engineers. Only those machines which possess commutating poles and compensating windings will be considered, because for large ratings no other types of generators are satisfactory.

In designing the armature the problem arises as to the proper number of coils to use per slot. The investigation of this problem shows that in high-speed generators there should be not more than two conductors per slot. The facts upon which this conclusion is based were discussed by the writer in the issue of *Elek. U. Masch.* (Vienna), for Oct. 6, 1907.

Experience shows that the e. m. f. between adjacent commutator segments should not be greater than 25 volts; it is preferable to keep the e. m. f. below 20 volts. By the use of compensating windings or slotted poles with highly saturated pole-teeth the e. m. f. between segments will remain constant at all loads.

On account of the fact that the cooling surface of the armature in most cases will be large enough to prevent the temperature elevation from reaching an excessive value even when the iron loss per cubic inch is high, the actual frequency of reversal of magnetism and the loss occasioned thereby is not a determining factor in selecting the number of poles. The choice of the number of poles depends largely upon the maximum permissible e. m. f. between the commutator segments and maximum permissible peripheral speed of the armature.

Assume, for example, a 250-kw, 550-volt, 3000-r. p. m. machine having a pole arc equal to six-tenths of the pole-pitch. The minimum number of segments between neutral points would be $(550 \div 25)(1 \div 0.6) = 36$. If the machine be constructed with four poles, the total number of segments will be $4 \times 36 = 144$. With two bars per slot there would be 144 slots in the armature. The armature conductor should have a section of 3×10 mm. By calculation the slot pitch is found to be about 14 mm so that the circumference is $.014 \times 144 = 2.02$ m and the peripheral velocity $(2.02 \times 3000) =$ [illegible] m per

second, which velocity is much too high. The machine must, therefore, be constructed with two poles, in which event the peripheral velocity can be lowered to about 70 m per second, and the maximum e. m. f. between segments may be lowered to about 20 volts. It is seen, therefore, that the machine will be improved by employing two rather than four poles, although the cost will be higher.

From the foregoing example it is evident that a disadvantageous limiting condition is imposed by the requirement of not more than two bars per slot. For machines rated at 1000 kw or more the two-pole construction results in a mônstrosity. In such a case the limitation may be removed by employing "intermediate segments," as shown in Figs. 1 and 2, connected to the rear ends of the armature bars. By this construction the e. m. f. between segments decreases to one-half of the former value, and the machine can advantageously be built with four poles. The distance between brushes will be adequate on account of the required large diameter of the commutator of large machines. In order to make the reactance of the connecting wire as small as possible, the armature spider should be constructed of non-magnetic material. It will seldom be possible to use more than four poles. However, when the speed is low enough or the e. m. f. is low, a six-pole machine can be operated with satisfactory results.

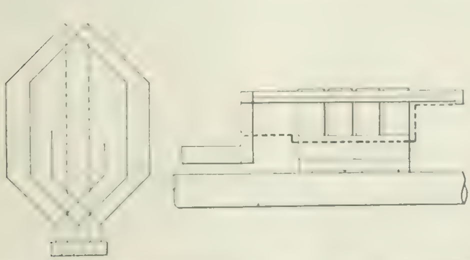
As a substitute for the "back-connecting wires" use may be made of interposed armature coils formed of wire of small diameter. One end of each coil is connected to one of the main segments, while the other end is connected to an intermediate segment.

The determination of the reactance e. m. f. is made as simply as possible, because the commutating field can be adjusted experimentally. It is necessary merely to make the commutating field equal to twice the reactance field at each load current, because during commutation the reactance field changes from a certain positive value to an equal negative value.

The fact should not be overlooked that during the commutation period the armature teeth are opposite a pole face. It is advantageous to use solid pole shoes, and also to place a plate of copper over the pole face so that the eddy currents produced therein reduce the reactance field and improve the commutation.

The problem as to the maximum permissible value for the amperes per armature conductor for high-speed machines has not yet been definitely solved. Experience indicates that a current of 750 amperes per conductor at normal load may be employed in a machine revolving at 3000 r. p. m. and using simple metal brushes and yet the commutation will be satisfactory.

The selection of the form of the slots depends upon the same factors encountered in the ordinary direct-current dynamos. Special efforts must be made to render the wedges strong. The wedges may advantageously be constructed of hard-fiber fish-paper or wood. For narrow slots, the form shown at I in Fig. 3 may be used; when the slots are wide form II may be used. The strongest construction is shown in form III. Moreover, with the last form the advantage of a small slot opening is obtained. Each armature conductor should be made up of two separate parts with their individual insulation, the two parts being insulated as a unit after being dropped into place.



FIGS. 1 AND 2.—ARRANGEMENT OF INTERMEDIATE COMMUTATOR SEGMENTS.

Fig. 4 will serve for illustrating the variation of flux in the armature iron and thereby ascertaining the iron loss. The magnetic density in the armature core varies from a positive maximum at cross-section IX to a negative maximum at XI. The periodicity of the flux variation is determined from the number of main poles and the rotative speed, just as is true with machines without commutating poles. In the teeth, however, the magnetic cycle is not so simple. The magnetic density

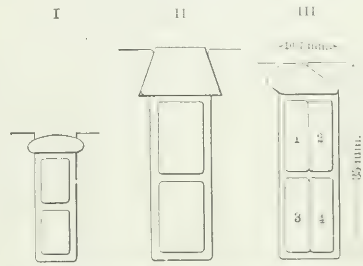


FIG. 3.—ARRANGEMENT OF SLOTS AND RETAINING WEDGES.

in the teeth varies from a positive maximum under a main pole through zero to a negative maximum under an auxiliary pole; the density then decreases to a certain minimum between the auxiliary pole and the next main pole of the same polarity, and then increases again to the maximum under the main pole. The action is, therefore, somewhat complicated. It is possible to determine the losses in the teeth approximately by finding the value of the loss which would be caused if the auxiliary poles alone were active and then finding the value of the loss attributable to the main poles alone, and adding these two losses.

The mechanical details of the machine must be designed and constructed with great care. For small and medium-sized machines the armature laminations may be mounted directly upon the shaft. In this event the discs must be mounted with extreme accuracy. Ventilating ducts should be provided near the shaft. Large armatures should be built with bronze or steel spiders. Air ducts about 8 mm in width should be placed along the armature at intervals of from 30 to 50 mm. The armature end-discs should be constructed of bronze. These discs can simultaneously serve as supports for the windings.

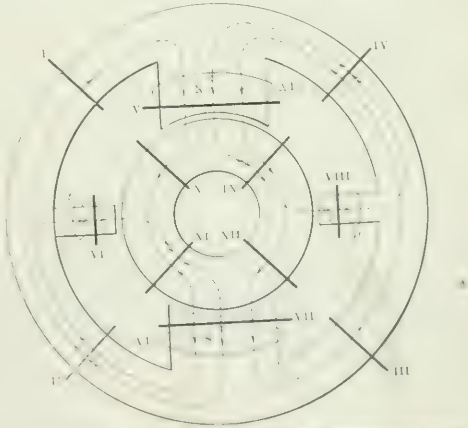


FIG. 4.—DISTRIBUTION OF MAIN POLE AND COMMUTATING POLE FLUX.

Fig. 5 shows a longitudinal-section of an armature for a four-pole 220-kw machine designed for 2600 r. p. m. and 110 volts. It will be noted that the armature conductors are

soldered at the rear; this arrangement prevents the lower conductors from being bent by the centrifugal force.

The insulating material should be flawless and of high mechanical strength; it should possess a minimum compressibility.

The shape of the armature conductors should be such that they fit the cylinder perfectly before the binding wires are applied. The conductors should first be held securely by temporary bands, before the final binding wires are applied. When temporarily banded the whole should act as a solid mass when struck a hammer blow.

A good form of binding material is found in American bronze wire. Each band should be made from a single length of wire without joint. Steel wire should never be used on account of the heat produced in it by the leakage magnetism.

One of the most important features of the process of applying the binding wires is the tension used. A special machine is employed by the A. E. G. of Berlin. An indicator which makes a record on a strip of paper shows the exact tension used. The binding wires should be so designed that at a speed 25 per cent above normal the "factor of safety" will be about 5. When the binding wires have been properly applied, no trouble is to be feared from "creeping." The diameter of the wire should be at least 2 mm. The ends should be soldered in place with the aid of numerous sheets of copper, exactly as is done with low-speed machines.

Between the commutator necks and the bronze end-cylinder, the distance should be at least 50 mm for a 250-volt machine and 80 mm for a 500-volt machine.

Extra care must be used in the design and construction of

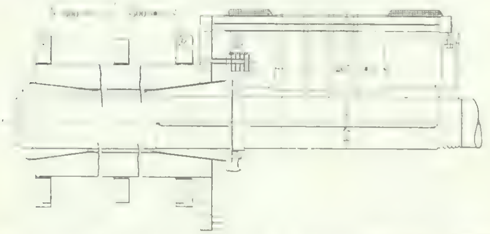


FIG. 5.—LONGITUDINAL SECTION OF A [illegible] K.W., [illegible] R. P. M. [illegible] GENERATOR.

the commutator. With an e. m. f. of 25 volts between segments the mica should be 1.5 mm thick; with 20 volts the thickness should be 0.8 mm. The insulation under the shrink-rings should be of mica; its thickness should be 8 mm for 500-volt machines, and 5 mm for 250-volt machines.

The peripheral speed of the commutator should not exceed 40 meters per second. The segments should be given such a height that when they have become worn for a radial depth of 20 mm they will not bend outward. The shrink-rings must therefore be given such a strength and be so disposed that at a speed of 25 per cent in excess of normal the segments will not bend. It has been found that with segments from 50 to 60 mm in height on a commutator about 300 mm in diameter there may be a clear distance of 300 mm between the shrink-rings. The segments should be made of hard-drawn copper.

The life of the commutator depends to a large extent upon the material of which the brushes are made. Carbon brushes should not be used upon a cylindrical commutator at very high peripheral speeds, because the commutator is sure to vibrate, and the springing of the brushes will cause sparking. Of the several metallic brushes, the copper-graphite brush and the straight-wire brush have proved satisfactory. The former brush keeps the commutator in better condition than does the latter. However, it requires a more nearly perfect commutator because the brush is not so pliable as the wire brush. Moreover, when the straight-wire brush is used the commutating field need not be so closely correct as when the copper-graphite brush is used.

[illegible]

carbon and metallic brushes in combination. An arrangement of this kind is shown in Fig. 6. The carbon is placed practically at right-angles to the metallic brush. A disadvantage of this arrangement is found in the fact that the springs *a* and *b* act in opposite directions, and the distribution of the pressure is indefinite. An improvement is indicated in Fig. 7, where the holder for the carbon is rigidly attached to the brush spindle. The clamp for the carbon brush is built as a hinge so that each holder is independent of the other. The carbon brushes serve

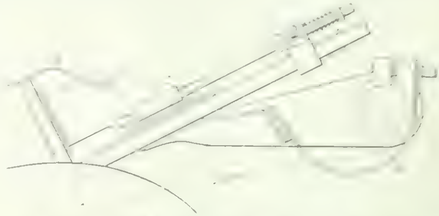


FIG. 6.—[illegible]

merely for improving the commutation, and not for conveying the main-line current. In order, however, to prevent the spring *c* from being heated by current, it is desirable to connect the carbon directly to the metal part of the holder. Faultless commutation can be obtained when the current density is 25 amp. per sq. cm of the contact of the metallic brushes. It is advisable, however, not to exceed 20 amp. The cross-section of each metallic brush should be at least 50 x 8 mm. The carbon brush should have approximately the same cross-section.

The distance between the outer holder and the shrink-ring for a 500-volt machine should be at least 30 mm. The tendency to "flash over" from brush to brush is especially pronounced when a 500-volt machine without compensating winding or highly saturated pole tips is subjected to a suddenly applied overload, on account of the high e. m. f. between segments due to the cross flux. For the purpose of preventing the "flash over," Parsons arranges the brushes in two groups, the negative brushes being placed on one side of the commutator and the positive on the other. This arrangement is disadvantageous in that it requires a commutator of double the normal length. Moreover, it does not entirely eliminate the "flash over," because it can form between one brush and a shrink-ring and from this ring to the opposite brush. It is possible to place a stationary insulating ring between the brushes and the shrink-rings, and a separate shield between the brushes of opposite polarity; it is possible, also, to isolate each brush thoroughly in its own insulating compartment.

The brush rigging should be especially rigid. It is advantageous, particularly with large machines, to mount the rigging separate from the machine body and bed plate. The brush spindles should be fastened at both ends to massive iron rings. The insulation used should have very large surface on account of the unavoidable collection of carbon and copper dust which may form a conducting path between the iron rings and the brushes. The two rings should be mounted in their own sup-

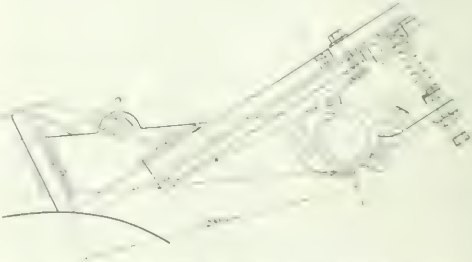
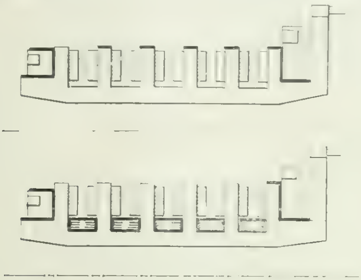


FIG. 7.—[illegible]

ports and be arranged to be rotated by means of worm-gearing.

It has been suggested to arrange the commutator upon its own shaft with separate bearings and bed-plate. By this arrangement the vibrations of the armature do not reach the commutator, and it is permissible to use carbon brushes. If the commutator could be built without leads, this solution would be a good one. Moreover, in case nothing prevents, the diameter can be made smaller, because the shaft need not be large.

It has been shown by Seidener that a large part of the loss at the brushes may be attributed to the vibrations occasioned by the eccentricity of the surface of the commutator. The vibrations of the brushes may be minimized by placing them sidewise against a radial commutator, as has been done by the British Westinghouse Company with good results. This arrangement is shown in Fig. 8, where shrink-rings are used on the outer circumference of the segments, and in Fig. 9, where steel bands are placed in the grooves. In order to obtain the advantages of shrink-rings with the form shown in Fig. 9,



FIGS. 8 AND 9.—ARRANGEMENT OF DISC COMMUTATOR AND RADIAL BRUSHES.

Miles Walker devised the ingenious scheme shown in Fig. 10. Each band was wound in a four-part U-shaped ring. After the rings were wound as solidly as possible, transformer-core material was built up around them. Alternating current being sent through a conveniently located solenoid, a large secondary current was produced in the bands. In this way the temperature of the bands was raised until they were red-hot, when they were moved over to the extreme right (Fig. 10). When the bands were allowed to cool off, the commutator possessed great solidity. A difficulty of this kind of commutator is found in the necessity for insulation around each steel ring. Moreover, the peripheral speed of the outer part of the discs is somewhat high.

Tests have shown that at high speeds, the current density may be 10 amp. per sq. cm with soft Morganite carbon brushes; with hard carbon brushes the density should be somewhat less. The radial-disc commutator is considerably more costly than

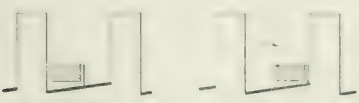


FIG. 10.—METHOD OF [illegible] SHRINK BANDS.

a cylindrical one, but a compensating advantage is found in the ability to use carbon brushes. A generator using a commutator of this type is now being built by the British Westinghouse Company. This machine is rated at 1000 kw, 600 volts, 1500 r. p. m. and has four poles.

The stationary and revolving members of a 375-kw, 2500-r. p. m. machine built by the above-mentioned company are shown in Figs. 11 and 12, respectively. The machine is a four-pole generator provided with a shunt winding for 230 volts at no load, and a series winding for compounding to 240 volts at full load. The inner diameter of the armature core is 298 mm, the outer diameter is 560 mm and the bore of the field core is 580 mm. The total net axial length of the armature is 305 mm; there being six 8-mm air ducts, the real length is 257 mm; allowing 10 per cent for insulation, the effective iron length is 230 mm.

The armature has 72 slots, each 10.7 x 35 mm in section (see III of Fig. 3). There are two conductors per slot, each

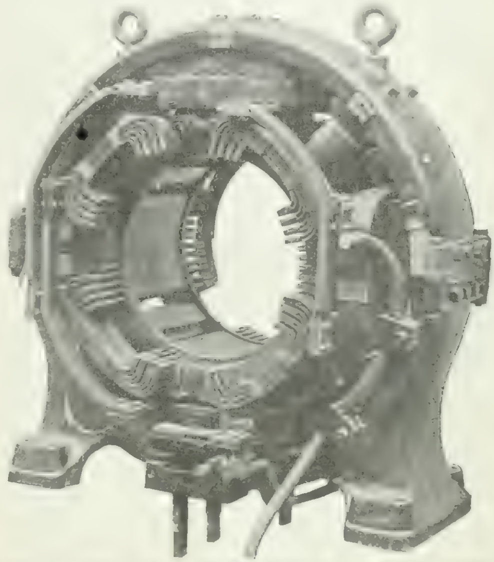


FIG. 11.—STATOR OF A 375-KW, 2500-[illegible] GENERATOR.

consisting of two bars in parallel, the cross section of each being $4 \times 12.7 = 50$ sq. mm; thus the copper area per conductor is 100 sq. mm. The total number of conductors is 144. The winding is connected in "lap," the rear "throw" being slots 1 and 19, the front 19 and 2.

The commutator has 72 segments. Its diameter is 305 mm. The total length of the segments is 880 mm. Four shrink-rings, each about 40 x 70 mm, serve to hold the segments together. There are nine metallic brushes per holder, each having a cross-section of 35 x 8 mm. These brushes are combined with nine carbon brushes 35 x 8 mm, as shown in Fig. 7.

The peripheral speed of the armature is 73 meters per second, and that of the commutator 40 meters.

The machine shows a total e. m. f. drop at the brushes (including the drop in the brushes themselves) of 4.6 volts. The [illegible] There are

FIG. 12.—[illegible] CURRENT GENERATOR.

[illegible] The pole face factor is .61. Under each pole there are 11 teeth the total cross-section of which is 270 sq. cm. Therefore, the flux density is 15,200 lines per sq. cm. In the armature body, the cross-section of which 2 x 220 sq. cm. the flux density is 9300.

[illegible] The current density in each armature conductor is 4 amp. per sq. mm. The current per slot is 800 amp. The ampere-conductors per centimeter of circumference = 328. The current density in the metal brushes is 17 amp. per sq. cm.

[illegible]

21 volts. There are four bronze balancing rings connected respectively between segments 1 and 37, 10 and 46, 19 and 55, 28 and 64.

The shaft is 165 mm in diameter at the center. The armature discs are mounted directly upon the shaft as shown in [illegible]

The effective air-gap area is 730 sq. cm so that the air-gap flux density is 5600; the ampere-turns per pole is 4500 for the air gap. An approximate calculation of the leakage gives 15 per cent; the magnetic density in the pole core is 10,400 lines per sq. cm; the density in the yoke is 8000. Thus the ampere-turns for the pole iron is 150; for the yoke, 250, and for the armature iron 50. The total m. m. f. for the iron part of the path is 450 ampere turns, or 4950 ampere turns for the whole machine.

By taking into account the total flux which cuts across the conductor locally during the commutating period, it is found that the effective reactance field is 127,000 lines. In order to produce a speed e. m. f. equal and opposite to the reactance e. m. f. the conductor must cut across 254,000 lines of the commutating field during the same period. Assuming initially that the machine is to operate with metal brushes having an arc on the commutator of 1.5 cm, the pole arc at the air gap would be 2.8 cm, and within this arc the armature conductor must cut across 254,000 lines. The cross section of the air gap at the commutating pole being 76 sq. cm, the density of the commutating field at the air gap would be 3350. The depth of the air gap being 1 cm, the m. m. f. to produce the commutating field would be 2700 ampere-turns. The total pole

FIG. 13.—DIAGRAM OF GENERATOR WINDINGS.

arc has been made 6.3 cm and the total flux of each commutating pole is 600,000 lines.

The armature m. m. f. per pole is $(144 \times 400) \div 8 = 7200$ ampere turns. The main compensating winding should have $(328 \times 56 \times \pi \times 0.61) \div 4 = 8800$ ampere conductors. Since this winding carries 1600 amperes, there should be 5.5 conductors. The machine is built with 6 conductors per pole, each consisting of 2 rods 8 x 50 mm in cross-section; the current density is 2 amp. per sq. mm. In each pole face there are 9600 ampere-conductors. In order to compensate for the armature m. m. f., each pole must provide $7200 - (9600 \div 2) = 2400$ ampere-turns; that is, 1.5 turns at 1600 amperes. In order to produce the commutating field there must be additional m. m. f. of $(2700 \div 1600) = 1.7$ ampere-turns. Thus the total m. m. f. should be 3.2 ampere-turns, for perfect commutation with metal brushes. The machine as actually built contains only three turns. Under test the generator sparked somewhat and the air gap at the commutating poles had to be decreased to obtain sparkless commutation with metal brushes. In commercial service the machine is used with combined carbon and metal brushes, which cover a larger arc on the commutator than did the metal brushes, and thus the period of commutation is increased considerably. In fact it has been necessary to shunt 140 amperes from the commutating-pole circuit in order to obtain sparkless commutation at full load. The total flux per commutating pole is thus reduced from 600,000 to 422,000 lines, and the magnetic density to 2360.

A calculation of the leakage flux at the commutating poles gives 363,000 lines. The useful field is 422,000 lines, so that with a pole cross section of 70 sq. cm, the magnetic density in the pole body is 11,200 lines. The density in the yoke between a commutating pole and a main pole of opposite polarity is 10,000. In the armature core the density reaches a maximum of 11,200 lines

The losses in watts are distributed as follows:—See the diagram of connections, Fig. 13.

Armature iron loss	4,240
Brush friction loss	3,170
Brush I^2R loss	1,630
Armature I^2R loss	3,830
Compensating winding I^2R loss	1,425
Commutating pole winding I^2R loss (with shunting resistance)	404
Compound winding I^2R loss (with shunting resistance)	101
Shunt excitation winding I^2R loss	540
Regulating rheostat I^2R loss	228
Total loss	15,568
Output	[illegible]
Input	390.568

(Excluding windage and bearing friction.)
Net efficiency, per cent, 96.

The following temperature rises were observed by thermometer, the room temperature being 25 deg. C.

Surface of the armature iron	30 deg. C.
Surface of the armature end turns	33 "
Commutator	38 "
Commutating pole winding	22 "
Compensating winding	16 "
Shunt excitation winding	28 "

The above values were obtained when the machine was not enclosed.

If certain of the above values are inserted in the formula for the temperature rise, in degrees C.

$$T = \frac{[illegible]}{[illegible]}$$

where W is loss in watts, A is the cooling surface in sq. cm and s is the peripheral velocity in meters per second, then the constant K has a value of 310 for the iron part of the armature when the outer surface of the armature cylinder is counted in full, and the air ducts and the inner surface are counted at one-half of their value. For the end turns of the armature windings K has a value of 375 when the outer surface is counted in full and the inner at half value.

When the temperature rise in deg. C. and the exposed surface in sq. cm and the watt loss of the shunt excitation windings are inserted in the formula,

[illegible]

K is found to have a value of 600 when the surface adjacent to the iron is neglected.

The design in all of its details cannot be considered as ideal, yet there have arisen no causes for complaint and it has fulfilled every expectation. It could be improved somewhat by increasing the magnetic density in the body of the main poles to 16,000 lines per sq. cm—thereby obtaining a machine whose e. m. f. would be less sensitive to changes in speed and excitation—and by decreasing the pole-arc of the commutating poles from 63 mm to about 45 mm, thereby decreasing the magnetic density in the armature, the yoke and the commutating pole, and lessening the leakage.

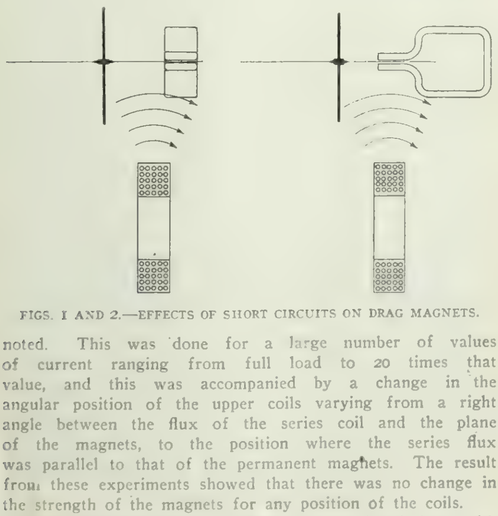
Effects of Short Circuits on the Drag Magnets of Watt-hour Meters.

By A. A. Radtke.

It is generally held to be true by meter men that the permanent magnets of meters are protected by the right-angle arrangement between the plane of the magnets and the flux emanating from the series coil of a direct-current watt-hour meter. That is, if a short-circuit occurs on the circuit to which the meter is connected, the magnetic blow on the permanent magnets will have a minimum effect. Referring to Figs. 1 and 2, the former is believed to be the arrangement that gives the most complete protection. It was upon this point that Duncan took out a patent claiming that the right-angle arrangement gave complete protection.

Recently it was my opportunity to be able to investigate the truth of this statement. The method employed was as follows: A watt-hour meter of 10 amperes rating was connected to a storage-battery circuit capable of maintaining a constant condition of operation with a load of several incandescent lamps. Above the retarding system there was mounted a set of coils duplicating the series coils of the meter, and connected in series with them was a fuse gap and a source of energy of large capacity.

In order to study the effect of various influences, a steady current was first sent through the upper coils and then removed, and any decrease or increase of rotative speed



FIGS. 1 AND 2.—EFFECTS OF SHORT CIRCUITS ON DRAG MAGNETS.

noted. This was done for a large number of values of current ranging from full load to 20 times that value, and this was accompanied by a change in the angular position of the upper coils varying from a right angle between the flux of the series coil and the plane of the magnets, to the position where the series flux was parallel to that of the permanent magnets. The result from these experiments showed that there was no change in the strength of the magnets for any position of the coils.

Fuses were then inserted in the gap provided and blown with the coil again in the various angular positions. This series of trials covered fuses up to 50 amperes in rating, and gave very definite results.

The conclusions drawn were the following: When a magnet of the form usually used in meter construction is subjected to a sudden impulse or blown from an intense field at right angles to the lines along which the molecules have arranged themselves when magnetized, the result is always a demagnetization of the permanent magnets; and that when the magnetic blow emanates from a field which is parallel to the flux of permanent magnets, there is always an increase in the strength of the magnets.

In the first case there is a flux passing through the magnet at right angles to the direction of the molecular alignment. Therefore, only forces are exerted which tend to destroy the arrangement of the molecules and with a resulting reduction in the strength of the magnet.

In the other case each of the two limbs of the magnet is traversed by flux from the blow, but the direction of this latter is different in the two portions of the magnet, as compared with the sense of the molecular alignments. In one limb the tendency is to strengthen the grouping of the molecules and in the other to destroy it; or, in other words, we have the two limbs subjected to separate magnetizing and demagnetizing forces. Inasmuch, however, as steel exhibits unequal changes in magnetic strength for equal and opposite magnetizing forces, the larger change being in the direction of the initial set, there is accordingly a gain in the strength of the magnet in every such case. Ewing in his "Magnetic Induction in Iron and Other Metals," 1892, page 331, refers to this phenomenon.

This point is supported by the experience of Ferranti, who found that the permanent magnets of his type of mercury meter registered too low after a short circuit had occurred. In his meter the axis of the permanent magnets is parallel to that of the series coil.

These conclusions, which are at variance with those reached by Duncan, lead at once to the inference that between the two limiting positions there must be one where complete protection can be found, namely where there is neither demagnetizing nor magnetizing action.

This point it would be well for central-station companies to investigate farther, in order to find at what angle the permanent magnets do receive the most effective protection; for it is apparent that since a meter on which a short-circuit has occurred always favors the consumer, it is quite likely that many cases exist in which the central-station company is supplying energy gratis, while if the protecting angle were once determined for a particular type of meter, the occurrence of short circuits would not be of any particular moment. Lost energy so common to all large central-station systems and often reaching a considerable value, may possibly be partly explained upon the above basis.

The Naval Wireless Telegraph Station at Sitka, Alaska.

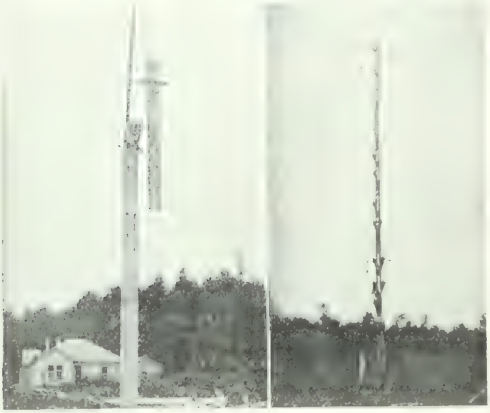
By H. C. Gearing, U. S. Navy.

Following the demonstration by Marconi, in 1896, of the practicability of wireless telegraphy the Admiralties of European nations and of the United States were quick to see the adaptability of this new method of transmission of intelligence to marine operations. This included the installation of wireless apparatus on war-ships and the establishment of stations on shore with which the ships might communicate. At the same time other branches of the Federal Government saw possibilities in the new art; the Army, for service in the field and for peace purposes; the Light House Board, under the Department of Commerce and Labor, for bringing its light-ships into touch with the mainland, and the Weather Bureau, under the Department of Agriculture, for use at its isolated stations, such as that at the Farallon Islands, for transmission of its weather reports. Four great departments thus became interested, causing duplication of experiment and promising confusion. To end this President Roosevelt convened representatives of these departments into an interdepartmental board to consider the whole subject.

One of the recommendations of this board, all approved by the President, assigned to the Navy Department the control of all the coast-wise Government wireless telegraph stations, including the island possessions and the canal zone. This naturally includes the coast of Alaska, and, also, such stations as may be installed on outlying light-ships.

Consequent upon this the Bureau of Equipment, under the Navy Department, actively began the installation of the coastal stations, including three, on the east coast, on exposed light-ships, the scheme being to have all these stations dotting the coasts in touch with each other and in communication with Washington by land wire wherever possible. At present there are 30 such stations in operation on the Atlantic Coast, probably

placed nearer together than the latest experience and extension of range show to have been necessary. The stations on the Pacific Coast being installed later than those on the Atlantic, were placed wider apart than on the east coast. The Pacific stations run in geographical order: Pt. Loma, near San Diego; Pt. Arguello; Farallon Islands; Table Bluff, near Eureka; Cape Blanco, Oregon; North Head, mouth of the Columbia River, and Tatoosh Island, off Cape Flattery. In addition to these there are stations at Mare Island and Puget Sound Navy Yards and at Yerba Buena Training Station, San Francisco Harbor; with a station designed for Smith Island, at the



FIGS. 1 AND 2.—MAST IN PROCESS OF ERECTION, AND COMPLETE WITH STRAIN INSULATORS AND AERIAL.

entrance to Puget Sound, but not yet begun. In addition there are stations, one each, at Honolulu, Guam and Cavite in the Philippine Islands; other stations in the Philippines are contemplated.

To extend this chain of coast stations last spring Mare Island Navy Yard was directed to erect stations at Sitka and Valdez, in Alaska, the instruction being modified later to include only the station at Sitka, on account of lack of funds; it is expected that a station will be installed at Valdez next summer. The expedition was to start north by July 1. This gave short time, but happily the contract for the erection of the two masts, buildings, water-tanks, etc., was awarded to the contractor who had so successfully erected all the other stations on the coast. The experience gained in the work was an asset to him and a guarantee to the Government of expeditious work. His party, with all material, sailed from Seattle July 6, and on Aug. 6 his work was completed. A site for the station had been found on Japouski Island, which is separated from the town of Sitka by a narrow strait. This island is under the control of the Navy Department, which has a coaling station already established there.

The next-nearest United States wireless station is at Cape Flattery, 646 miles distant. Immediately inland of the site is high land and on the direct line to Cape Flattery there is high and wooded land. High land, if near by, is obstructive, and wooded land seems to be very absorbent of the waves sent out. These considerations suggested high power for the Sitka station—20 kilowatts, as compared with 15 kilowatts at Tatoosh. Accordingly, specifications for duplicate gas engines driving alternating-current generators, with wireless apparatus filling desired requirements were prepared, and bids were invited for the whole. Hitherto, for other stations, gas engines had been separately provided, built on the Pacific Coast, and only the wireless apparatus was secured in the East. The result of the change of procedure is that engines, generators and wireless are all to be built in the East.

Correctly foreseeing great delay in filling the contract and being loathe to have the summer pass without anything being done, it was determined to provide an improvised installation from what could be found at the Navy Yard. Accordingly a second expedition left Seattle Aug. 4, made up of Navy Yard employees and three wireless operators. The machinery, apparatus and station outfit went with this second party. On Sept. 30 the station was reported as working, and by Oct. 4 the station had had communication with the steamer *President*, distance 650 miles, and had heard North Head Station, distance 767 miles. North Head, for several nights previously had been sending out V-signals, and it may be remarked, incidentally, that it was these signals that the flagship *West Virginia* had heard at 1860 miles, longer than any distance previously achieved in the Pacific. Both expeditions did remarkably well considering their distance from base, the lack of facilities at Sitka, and the almost incessant rain that fell while the work was in progress.

The station has two sectional masts, each 182 ft. high, spaced 400 ft. apart. The masts are made in sections of 26 ft. length for handiness in transportation. Each mast is supported by four sets of guys securely anchored and carefully insulated. The strain insulators are made of chestnut wood boiled in paraffin. The security of this style of mast has been tested by many heavy gales along the coast from Pt. Arguello north.

The operating room, containing the wireless apparatus and dwelling for the three operators combined in one, is midway between the two masts. The style of dwelling, a single-storied bungalow, originated in the East, but has been modified to meet the exposed situations of the Pacific Coast stations, as at Tatoosh, Cape Blanco and North Head, where gales of over 100 miles an hour are not uncommon. The dwelling at Sitka was additionally modified to meet a cold climate, but a closer investigation of climatic records shows that under the influence of the Japan Current, the climate of Sitka is very mild, considering its latitude. It has the same climate as Port Angeles, Wash., or Glasgow, Scotland.

The power house, containing the engine, generator, etc., is near the dwelling to eliminate long electric leads. The oil houses, water-tanks, cistern, etc., are all similar to those at other stations, standardization having been reached. The aerial

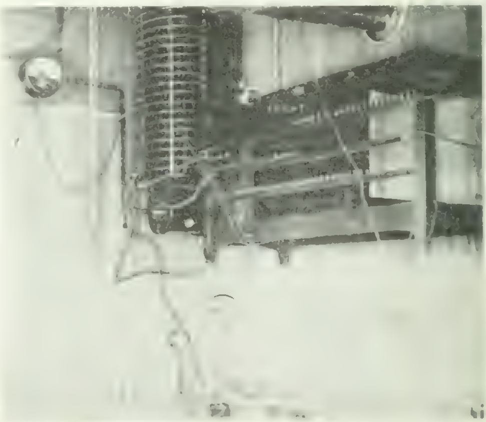


FIG. 3.—OPERATING ROOM AT THE SITKA WIRELESS STATION.

is of four wires, of the form called "flat-top," 370 ft. in length, stretched between the two masts. The result is a natural wave length of 650 meters.

The temporary apparatus is a 25-hp gas engine, driving an alternator generating at 1100 volts and 125 cycles, and a 10-kw Massie wireless set, the induction coil raising the e. m. f. to 40,000 volts. The apparatus eventually to be installed will be duplicate gas engines, silent chain drive, with 20-kw, single-phase, 120-cycle, 500-volt, alternating-current generators. The induction coil will be rated at 20-kw. The set will be capable

of sending any wave length between 300 and 1600 meters, and of receiving any wave length between 200 and 2000 meters. The closed and open circuits, both sending and receiving, will be capable of adjustment to resonance for any wave length within the range of the apparatus, and there will be means for easily and quickly changing the transmitting wave lengths. A contract has been placed with the Massachusetts Wireless Equipment Company, who will supply the Pierce type of apparatus.

The station being on an island, it was necessary to lay a cable across the narrow strait separating it from Baranoff Island, on which Sitka stands. This cable was laid by the Army signal corps and connects the wireless station both by telephone and wire telegraph with the cable office in Sitka. This gives a vessel hundreds of miles at sea in Alaskan waters immediate connection with the various naval stations on the coast and with the seat of government at Washington, and will permit the transmission seaward of the daily noon-time signals sent out from the naval observatory on Mare Island.

There is no doubt that the Navy Department will continue the extension of its line of stations westward from Sitka. The

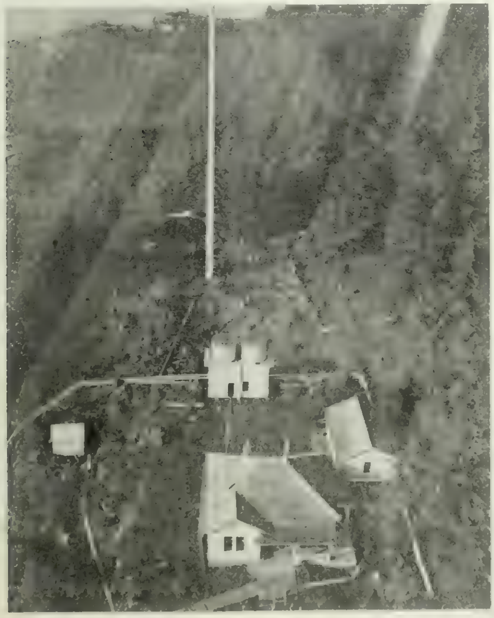


FIG. 3.—STATION AS SEEN FROM THE TOP OF ONE OF THE MASTS.

signal corps of the Army has two stations operating in Alaska, one at St. Michaels and one at Safety Harbor (Nome) working in connection with its Alaska cable system. It was found impossible to keep in order a cable crossing Katzebue Sound on account of the ice. Wireless telegraphy was resorted to with success. According to press reports the signal corps contemplates a number of inland stations to connect points where the difficulties of the country and great cost make land wires prohibitive. The Canadian Government has begun the establishment of stations along the British Columbia and inner Vancouver Island coasts. These are to be located at the following points: Victoria, B. C.; Pt. Grey, B. C.; Pachena Pt., Estavan Pt. and Cape Lazo, and will have a normal range of 100 miles. Cape Lazo, the one farthest north, is 570 miles from Sitka. They are very near each other; none is on the seaward side of Vancouver Island. They have been located, apparently, not for strategic naval purposes, as are ours, but for commercial intercommunication in a thinly settled and difficult region that could hardly support a land-wire service.

Sitka is closely surrounded on nearly all sides by high land. This will militate against any success in communicating with any inland wireless stations that the Army might establish. But this limitation is not very material since the naval strategic purpose of coastal stations is communication with ships at sea, and the range seaward is practically clear. It was feared, too, that the high and heavily wooded land on the line to the southern stations would prove obstructive, but signals from the station have been heard by all the stations from Tatoosh south to the Mare Island Navy Yard. The distance of the latter is 1253 miles. When the more powerful apparatus designed for the station will have replaced that temporarily installed, it is believed that the chain of wireless stations on the coast, from San Diego to Sitka, will be securely established.

Since the above was written the station at Sitka has reported signals from the Army transport *Sherman* at a distance of 2200 miles, which result is the best yet obtained by any of the Pacific stations.

Comparative Performance of Steam and Electric Locomotives.

At the November meeting of the American Institute of Electrical Engineers, Mr. A. H. Armstrong presented a paper outlining some of the fundamental reasons for the substitution of electric for steam locomotives. The author discussed briefly certain steam locomotive improvements, compound versus the simple, and the comparative advantages of different types of electric locomotives. Although the compound locomotive consumes about 20 per cent less steam per hp-hour than does the simple locomotive, yet the latter continues in general use on mountain divisions. The largest steam locomotive yet built is a Mallet compound, which weighs about 300 tons, and gives a sustained output of 2180 horse-power. An electric locomotive of the New York Central type giving the same output would weigh only 100 tons. On account of the limited output from a steam locomotive, it may be stated that for a certain gross annual ton-mileage, the cost of steam locomotives may be even greater than the cost of the electric units replacing them.

As against the reduction in fuel expenses promised by the use of compound locomotives fitted with superheaters and feed-water heaters, the electrical equipment provides the possibility of regeneration of energy while electrically braking on mountain-grade divisions. The chief advantage of regeneration lies in the assurance it offers of greater safety in operating on heavy grades. The present method of braking, by friction between wheel and shoe, results in overheated parts, breakages resulting therefrom and consequent danger of derailment. The descent of a long, heavy mountain grade is accompanied by the shoes and wheel rims becoming heated to a dull red, while the introduction of the electric locomotive offers an opportunity of holding the train in whole or in part by means of the same motors used to haul it up grade, and thus eliminating one of the greatest sources of danger in mountain railroading.

As to the relative costs of using electric and steam locomotives, the author showed that for operation up and down grade, with simple locomotives and without electric energy regeneration, the operating expenses per ton-mile would be from about 23 per cent to 36 per cent greater with steam than with electric locomotives.

The writer stated his belief that the time is not ripe for the substitution of electricity for steam on all roads. There are, however, certain divisions of steam railroads which, either on account of their broken profile or heavy traffic, offer an opportunity to introduce a superior type of locomotive which will effect economies in operation sufficient to provide adequate return on the investment required for the substitution. There are still other divisions where a much desired increase in the track-tonnage can be effected only by double tracking so long as the steam locomotive is adhered to. Double tracking a mountain-grade division is often a matter of enormous expense, and the use of electric locomotives on the single track may relieve the present traffic congestion at a moderate cost.

On mountain-grade divisions the subject of regeneration with electric locomotives should receive very careful consideration, not so much on account of the saving in energy which it may effect, but rather on account of the greater safety of operation which it guarantees by eliminating the serious defects of holding trains on heavy grades by wheel and shoe friction. Finally, there are the many incidental advantages to be gained which cannot be predicted with any accuracy, as they result from changes in operating methods sure to follow the introduction of a type of locomotive not subject to the service limitations of the steam locomotive.

The freight-car shortage problem itself is a very serious one at certain times of the year on some roads, and as the total freight-car mileage can be increased with the higher speeds provided with electric locomotives, it should result in the saving of a considerable expense now incurred for rental of foreign cars, or even increase the gross receipts by the movement of tonnage which a larger number of available cars would make possible.

New Telephone Patents.

SWITCHBOARD CIRCUITS.

As a means for reducing the responsibility and labor of the telephone operator, automatic ringing has been long since suggested. With such an arrangement the period of ringing begins automatically at the instant of plugging in and without any special act of the operator. It then continues either steadily or intermittently until the response of the called party. Mr. W. W. Dean has patented such an arrangement, adapted to the Dunbar two-wire system. The ringing is controlled by a double-wound self-locking relay, through one winding of which the ringing current is led. The relay will not respond to the current as long as the bell is in circuit, but it does respond as the transmitter shunts the bell. Mr. Dean has assigned his patent to the Kellogg Company.

H. G. Webster, of Chicago, has also obtained a circuit system patent, assigned to the Kellogg Company. His invention relates to the arrangement of line relays in a two-wire system. Two relays are provided which must co-operate to effect a signal. When a plug is in the line jack, however, one of these relays becomes shunted out by a low resistance supervisory relay in the cord circuit.

AUTOMATIC SYSTEM.

With automatic systems there must always be provided some means to prevent a third party from switching himself onto a busy line, and thereby interfering with the conversation. Mr. F. A. Lindquist, of Chicago, has obtained a patent for a system in which a special circuit and relay takes care of this. The relay fails to operate except when connected to a busy line. Under this latter condition it does operate to sever the talking connection between the interloper and the existing connection.

Letters to the Editors.

Long-Distance Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—The observations of Mr. Ernest F. Smith, in your issue of Nov. 9, regarding the maximum electromagnetic effort at a point antipodal to the source of the waves are interesting. The same idea has been advanced previously, I believe, by Mr. Tesla.

Mr. Smith, however, fails to take into consideration the "losses" which these waves continually suffer as they travel from their source. It would be a powerful station, indeed, which could be heard on the opposite side of the earth, and it seems rather a waste of time to speculate as to the physical explanation of an alleged wireless message anent the arrival in Philippine waters of a ship which has been lying out of commission at Seattle for three years. I should opine that the real explanation of this phenomenon lies more properly in the realm of psychology.

Not only should the location of Port Morien, approximately 180 deg. from Manila, be considered, but also the time of receipt of this message, a time properly defined as the psychological moment.

NEW YORK. [illegible]

Turbine Tests.

To the Editors of Electrical World:

SIRS:—I would like to correct an error in a statement made under the head of "New York Turbo-Generators" appearing in your Nov. 2 issue, in which, referring to the Sept. 1 test of one of the Westinghouse-Parsons 7500-kw turbines which showed a water rate of 14.9 lbs. per kilowatt, it is stated: "It is said to have developed results hitherto unattained by any steam prime mover in this country."

The above is undoubtedly a correct quotation of the statement, but the statement is not borne out by facts. One of the 5000-kw Curtis steam turbines in operation in the station of the Boston Edison Electric Illuminating Company, as tested by the Edison Company's engineers, developed a water rate of 13.5 lbs. per kw-hour; and an 8000-kw Curtis turbine in operation in the station of the Commonwealth Electric Company, of Chicago, as tested by its engineers, developed a water rate of 12.5 lbs. per kw-hour, or a water rate over 16 per cent better than the one to which the statement referred. This last-mentioned result, namely, 12.5 lbs. of water per kw-hour, is, I believe, the best water rate which has ever been developed by any steam prime mover of any form, either in this country or abroad.

BOSTON, MASS. CHAS. [illegible]

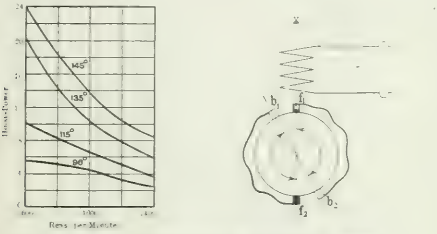
DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-phase Repulsion Motor.—An illustrated description of the construction and method of operation of the Deri single-phase commutator motor developed by Brown-Boveri Company which has already been noticed briefly in the Digest. The motor is a pure repulsion motor and its principle is shown in Fig. 1. The stator winding alone is connected to the external circuit. The rotor winding has no external connections whatsoever, either directly or through transformers. The brushes bearing on the commutator are short-circuited amongst themselves. The essential novelty in the Deri motor which distinguishes it from the ordinary repulsion motor relates to the arrangement of these brushes. There are two sets of brushes of which the [illegible]

[illegible] method of regulation. Vector diagrams are given to explain the principle. Fig. 2 gives the curves between the speed and output of a 6-pole, 10-hp, 50-cycle motor. The four curves relate to four different positions of the set of brushes b_1b_2, namely when the angle between b_1b_2 and f_1f_2 is 96°, 115°, 135° and 145° respectively. The trend of the curves shows the series character of the motor. So far it has been assumed that there is no connection between the two sets of brushes. By arranging, however, to connect these with one another through an adjustable resistance, as shown in Fig. 3, the curve of torque and speed, which without this connection would have the form [illegible]

become W_1, W_2, W_3 and W_4. In the operation of cranes, a frequent requirement is that when lowering the load an automatic braking action shall be exerted. One way of attaining this with the motor described is as follows: The movable brushes are separated from the fixed brushes and are connected with one another, and the stator winding is connected to the



FIGS. 1 AND 2.—SINGLE-PHASE REPULSION MOTOR.

supply circuit as shown in the left-hand diagram of Fig. 4. In the brush position and for the direction of rotation there shown, the motor acting as an ordinary repulsion motor, exerts a strong torque in opposition to the direction of rotation. This torque may be regulated either by adjusting a resistance interpolated between the brushes, or by moving the brushes in a direction opposite to the direction of rotation of the rotor. When the movable brushes, moved in opposition to the direction of rotation, approach an angle of 90° behind the fixed brushes,

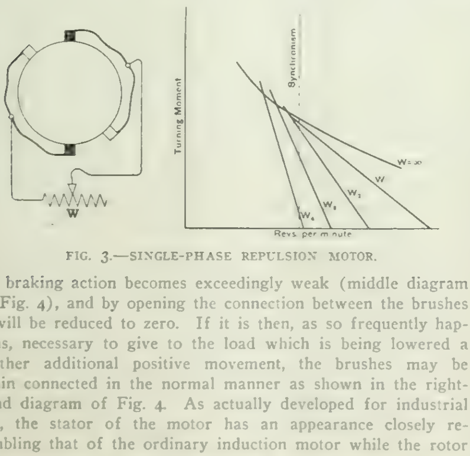


FIG. 3.—SINGLE-PHASE REPULSION MOTOR.

the braking action becomes exceedingly weak (middle diagram of Fig. 4), and by opening the connection between the brushes it will be reduced to zero. If it is then, as so frequently happens, necessary to give to the load which is being lowered a further additional positive movement, the brushes may be again connected in the normal manner as shown in the right-hand diagram of Fig. 4. As actually developed for industrial use, the stator of the motor has an appearance closely resembling that of the ordinary induction motor while the rotor

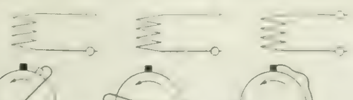


FIG. 4.—DIAGRAM OF POSITIONS OF BRUSHES.

is generally built just like an ordinary direct-current armature. It seems that the motor is used chiefly for small ratings, or from 2 to 10 horse-power, but it is stated that a traction motor for 40 horse-power at 80 volts and 33 cycles and with a rated speed of some 700 r. p. m. has also been developed.—*Lond. Elec. Eng'ing*, Oct. 24.

Glass Brushes for Cleaning Commutators.—A note stating that a European Company has placed on the market brushes made of glass which are to replace emery cloth for cleaning and polishing the commutators of dynamos and motors. These brushes are said to clean the commutators without scoring the metal, and their use avoids the inconveniences and dangers of [illegible].—*Lond. Electrician*, [illegible].

Lamps and Lighting.

Electric Arc Between Metallic Electrodes.—W. G. Cady and H. D. Arnold.—Up to the present, most investigations on the electric discharge between metals have been confined either to the glow discharge chiefly at low gas pressures, or to the arc discharge at relatively high current densities, where a pronounced volatilization of both electrodes takes place. The present authors have studied systematically the transition from one form of discharge to the other, paying particular attention to the phenomena with small currents. The chief results are as follows: There exist between iron terminals in free air two types of arc, distinct from each other in appearance and in characteristic curves. To these types the terms first stage and second stage are applied for the sake of brevity. The transition from one stage to the other is somewhat similar to the hissing point of the carbon arc, but the cause is not the same. Evidence from loss in mass of the electrodes, spectrum of the arc, and temperature of the anode, shows that the first stage is characterized by the absence of vaporization of the positive terminal. Experiments are described on the change from the glow discharge to the arc in free air between terminals of iron, platinum and copper. Attempts were made at identifying the two stages for arcs between several different metals in air. Both stages could be maintained steadily only in the cases of copper and of iron. In nitrogen at reduced pressures the glow and both stages of the arc were observed between a carbon cathode and anodes of lead, silver and carbon. There is reason to believe that similar results can be obtained with most other metals. Platinum, and iron free from traces of oxide, did not show a stable first stage under any conditions. The diminution in potential difference between the arc terminals in passing through the critical point from the first to the second stage is attributed partly to a decrease in the thermal e. m. f. at the anode, partly to increased conductivity of the arc vapor. There is some evidence of a connection between the critical point and the melting temperature of the material of the anode, but it is not well marked, and is likely to be masked by effects due to the physical condition of the surface of the anode. The characteristic curves of the iron arc are discussed, together with the probable form of the equation connecting voltage, current and length. A series of experiments was carried out on electrical oscillations in arcs with iron, copper, and silver anodes. At a current a little below two amperes, on the second stage, the iron arc rotates and emits a whistling sound. This is often attended by spasmodic changes back to the first stage. The application of Lecher's test for continuity led to observations on the "singing" iron and copper arcs, the energy expended in the oscillations in both stages of the arc being observed by means of a bolometer. To test the continuity of arcs between various metals by a method more free from error, a new manner of connecting the bolometer was devised. A general agreement with Lecher's results for large currents was found. But the iron arc became continuous on the first stage, while in the case of arcs with silver or copper anodes, marked oscillations were detected as the current decreased.—*American Jour. of Science*, November.

Comparative Cost of Gas and Electric Lighting.—E. G. Kennard.—A comparison of the cost of lighting by gas or electricity. Three groups of sources of light are distinguished, representing weak, medium and strong sources. In the first group there are sources of between 40 and 60 candle-power, and the author finds that for the cost of 2.36 cents per cubic meter of gas and 8.4 cents per kw-hour, the cost of lighting by the osram lamp is twice that of gas lighting with an incandescent mantle, while the cost of the tungsten lamp is about 50 per cent higher than that of the gas mantle. For lower sources of light, such as 10 candle-power, the situation becomes more favorable to electric light. In the second group, which comprises sources of light between 200 and 400 candle-power, he finds that under the same conditions of cost of gas and electrical energy as given above, the electric flame arc and the Cooper-Hewitt lamp are cheaper than the "gas arc," but the latter is cheaper than the [illegible]

group, which comprises sources of light of 600 candle-power and more, he compares the Blondel arc with gas lamps of 670 candle-power in favor of electric lighting. The ideal electric system for lighting would be the direct-current system at 60 volts, since arc lamps could be operated at this e. m. f., without waste of energy and metallic-filament lamps could also be used at this voltage. Direct-current lamps at 60 volts are hardly available. Alternating current is in all cases preferable to direct current at 100 volts for private lighting since it is possible to obtain any desired e. m. f. by the simple use of a transformer.—*L'Eclairage Electrique*, Sept. 14, 21.

Tungsten Lamp.—A note on a British patent of the British Thomson-Houston Company. Metallic tungsten for the manufacture of lamp filaments is prepared in the form of rods by the usual processes. These rods are then drawn while in a heated condition by means of die plates. The heating is produced electrically, and to prevent oxidation of the tungsten during treatment it is electroplated with silver, copper or gold. The protecting metal coating is finally removed by heating in a vacuum.—Lond. *Elec. Eng'ing*, Oct. 24.

Flame Arc Lamp.—H. E. ANGOLD.—A description of an arrangement for flame arc lamps with converging electrodes feeding through tubes, whereby, when the feed mechanism reaches a certain critical point, a contact is closed which short-circuits the lamp through a suitable resistance and so causes a very definite feed to take place.—Lond. *Elec. Eng'ing*, Oct. 24.

Power.

Combined Gas-engine and Steam-turbine Plant.—L. ANDREWS.—Some data on the comparative first cost and cost of operation of steam-turbine and gas-engine plants. The first data given refer to a 16,000-kw plant working at unity power factor. The capital cost per kilowatt installed is given as $65.50 for steam turbines and $94.40 for gas engines. On the other hand the total cost per kw-hour (including interest and depreciation at 10 per cent) is 0.408 cent for the steam-turbine plant and 0.270 cent for the gas-engine plant. With decreasing load factor the advantage of the gas-engine plant over the steam-turbine plant becomes less and less and from the values given by the author for a 15-per cent load factor it appears that for a 16,000-kw plant the total cost per kw-hour is 1.090 cents for the steam-turbine plant and 1.132 for the gas-engine plant. With such a low load factor there would be no advantage in putting down a gas-engine installation. The dominating item of the running charges on a low load factor is the item of interest and depreciation, whereas on a high load factor the dominating charge is the cost of fuel. The two curves in Fig. 5 show the total running costs per kw-hour, as depending on the load factor when the latter varies from 10 to 100 per cent; a 16,000-kw plant being assumed and 10 per cent being charged for interest and depreciation. The author recommends installing

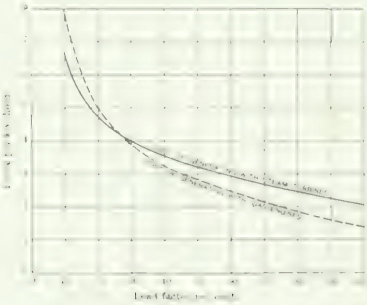


FIG. 5.—CURVES OF COSTS OF GENERATING.

a combined gas-engine and steam-turbine plant to suit the load diagram in Fig. 6 which relates to a total plant equipment of 16,000 kilowatts and a maximum demand of 13,000 kilowatts. It is suggested that 25 per cent of the total plant should be gas engines and the remaining 75 per cent steam turbines. The average load on the gas-driven generators will then correspond to a 62-per cent load factor, whereas the steam-turbine plant will be running on a load factor of 7.5 per cent. The combined average load factor is 25 per cent of the maximum demand or 19.5 per cent of the plant installed. It is estimated that the running cost, including interest and depreciation, would be 0.82 cent per kw-hour. If only gas engines or only

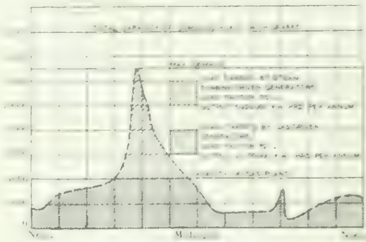


FIG. 6.—LOAD DIAGRAM.

steam turbines would be used the cost would be higher.—Lond. *Elec. Eng'ing*, Oct. 24.

Electricity in Mines.—H. R. SPEYER.—The conclusion of the illustrated article on the electric equipment of the Mansfeld copper mines. Particulars are given of a sub-station which is supplied with energy both from a gas-engine station at 3000 volts and from a new 10,000-volt steam station. Descriptions are given of the electric pumping plant at one mine and of the very complete equipment at another mine, including examples of electric underground haulage, ventilation, pumping, etc.—Lond. *Elec. Eng'ing*, Oct. 24.

Electric Energy for Farming.—E. W. LEHMANN-RICHTER.—An illustrated description of the use of electric motors and lamps on farms, with special reference to an installation on a farm on the island of Ruegen, in Germany. A gas-driven 20-kw direct-current shunt generator is employed there in connection with a storage battery of 270 ampere-hours when discharged in three hours. Electric motors are used for thrashing, for driving various cutting machines, pulverizing mills, cream separators, etc.—*Elek. Zeit.*, Oct. 24.

Electric Cranes.—H. H. BROUGHTON.—A continuation of his illustrated serial in which the author deals with the general arrangement and speed of electric cranes and then considers the electrical equipment in detail. The series-wound, continuous-current motor is naturally preferred, though the single-phase commutator motor is now available for alternating-current working. Three-phase motors are unsuitable for crane working.—Lond. *Electrician*, Oct. 25.

Ignition of Gas Engines.—J. G. CHARVET.—A note on the Lodge method of ignition for gas engines.—*L'Eclairage Electrique*, Sept. 28.

Traction.

2000-volt Direct-current Railway.—A full illustrated description of a small railway in Germany, connecting an iron mine with a blast furnace and being operated at a direct e. m. f. of 2000 volts, as has already been briefly noticed in the Digest. This narrow-gage (one meter) railway is 8.7 miles long and carries at present about 2600 tons of ore per day, two trains being required, which pass one another at a turn-off about in the middle of the line. Each return journey takes about 2 hours. The weight of a train ranges from 200 to 300 tons, and there are gradients ranging up to 3 per cent. The loads were too severe for steam locomotives, and in order to enable 4000 tons to be dealt with per day, the steam locomotives had to be replaced by electric locomotives. Three-phase traction was unsuitable on account of the number of trolley wires required, and the choice was therefore between the high-voltage, direct-current and the single-phase system. Estimates were made for both systems, the direct e. m. f. being assumed to be 2000 volts and the single-phase e. m. f. 6000 volts, the rails being used as return in each case. The high-tension, continuous-current motors have short commutators and a proportion-

ately large effective core length, while the single-phase motors, designed for a low pressure, have long commutators and consequently a shorter effective core length. A continuous-current motor of 160 horse-power could be built within the space allowed by the narrow gage, but 60 horse-power was the maximum output of a single-phase motor under the same conditions. It must be remarked, however, that the diameter of the armature was not limited by the height of the floor of the locomotive or the diameter of the wheels, and that this circumstance was only taken advantage of in the case of the continuous-current motor. Four continuous-current motors were found to be sufficient for the power required, while six or more single-phase motors would have had to be provided. Comparing the two systems with regard to the current distribution, the single-phase system with its high line voltage was superior to the continuous current system, notwithstanding the greater losses in the return circuit and the inductive losses. A disadvantage of the single-phase system, which had to be considered, was that the stray currents might seriously effect signal and telephone circuits, even at considerable distances from the line. It was found, however, that the railway could be economically worked with continuous current at 2000 volts without using an excessive amount of copper, and this fact, together with the superiority of the continuous-current motors, decided the issue. Had the line been of much greater length the single-phase system would have shown to greater advantage. The direct e. m. f. of 2000 volts is obtained from two motor-generators. Each of the four axles of the locomotive is driven through gearing by a 160-hp motor. The motors are permanently connected in two groups of two in series. The motor-armatures have 61 slots, each of which has 12 coils of flat copper. The commutator is large in diameter and is built with 83 segments. There are two sets of three brushes. In order to ensure sparkless running, the motors are provided with commutating poles. This is a matter of great importance in high-tension motors, where very little sparking may cause flashing over or start an arc to the earthed frame. As a further safeguard all the space round the commutator is lined with insulating material.—Lond. *Elec. Eng'ing*, Oct. 24.

Electric Traction in Switzerland.—The report presented by Prof. Wyssling, on the work which has been done by committee for studying electric traction in Switzerland. The sub-committee has finished the investigation of 22 typical electrical systems. While it is too early to give the complete results, some general points are already evident. The recuperation of energy on grades is found to be practically too difficult, and not sufficiently economical to be taken into consideration. With respect to the variations of load, the different systems of storing energy have been considered and the conclusion has been reached that hydraulic storage is not as economical as it is often thought to be. As to the question of the supply of electric energy to trains, the third-rail seems to find the greatest sympathies with railway engineers. Its disadvantages are the high first cost and the fact that it is impossible to go beyond a certain e. m. f. At the safety limits of e. m. f. the following values are given for different systems: direct current with third-rail, 800 volts; direct current with overhead wire, 3000 volts; three-phase system, 5000 volts; single-phase system, 15,000 volts; "with a direct e. m. f. of 3000 volts is meant that 1500 volts are safe per commutator of a motor." As to the disturbances which are caused by electric railways on telephone and telegraph lines much has been learned from the line from Seebach to Wettingen, where the endeavor to avoid all such disturbances has been finally successful. The committee has not yet agreed on a single system of traction as universally suitable. Among the many details which have been investigated, is the ratio of weight to output. This will be somewhat unfavorable to the single-phase system, but it has yet to be determined how far this will be the case. On the Swiss railways the starting torque is 2½ times the normal torque. This ratio can be obtained with single-phase motors, but the question of weight must also be taken into consideration. The members of the committee cannot agree on a certain frequency, although the latter will be between 15 and 25. Some want 25 because this has been taken over from the United States; others want a lower frequency. The cost is of great importance and it has been decided to make exact calculations for 25 and 15 cycles per second. Very complete calculations of the cost of electric operation on the St. Gotthard railway and on a certain net-work of railways will be made, first for the present traffic and second for a hypothetical increased traffic. The committee hopes to conclude its investigations during the next year.—*Elek. Zeit.*, Oct. 24.

Electrical Equipment of Prussion State Railways.—A summary of an estimate of Pforr of the cost of converting the Prussian State Railways from steam to single-phase traction. Costs of Erection: The energy would be transmitted at 50,000 volts to sub-stations placed 25 miles apart along the line. It would there be decreased to the trolley e. m. f. of 15,000 volts. Each sub-station would have an output of 5000 kilowatts on double lines, or 3000 kilowatts on single lines. It is estimated that these stations would cost $25,000,000 for the total 12,860 miles of double track and 8275 miles of single track. Line equipment would cost $4,000 a mile, while from $1,600 to $2,600 would be expended on the feeders. The total cost of the feeding and distributing system would be $235,000,000. Locomotives: Only 64 per cent of the present number of steam locomotives would be required. A 600-hp electric locomotive weighs 42 tons, while a steam locomotive weighs 57 tons unloaded. The cost of the electric locomotives may be taken as $133,750,000, as against $167,000,000 for the steam locomotives. Generating stations: These would also supply energy to the surrounding districts, otherwise the load factor would only be 20 per cent, and reckoning the cost of the station at $87.50 per kilowatt, the interest, etc., would work out at 0.4 cent per unit. But by connecting up private consumers it is hoped this may be decreased to 0.32 cent per unit. Fuel would cost 0.2 cent and attendance, etc., 0.1 cent, or a total of 0.7 cent per unit. Working costs: The working expenses by steam for the year 1904 amounted to $241,800,000, but it is hoped that a great saving would be effected by the adoption of electric traction. The decrease in wages is estimated at $10,750,000, and in cleaning at $1,000,000. The up-keep expenses with electrical working would show a decrease of $45,000,000, from which $4,250,000 must be taken for line upkeep.—Lond. *Electrician*, Oct. 25.

British Tramway Plant.—An account of the last annual report of the municipal tramways of Wolverhampton. This system is of special interest since it is the only place in the United Kingdom where the Lorain surface-contact system of electric traction is used. "The undertaking still feels the bad results of the first few years of working, but it is satisfactory to note that the corner seems to have been turned—it is to be hoped, permanently." The total expenses, including capital charges, were 20,722 cents per car-mile, while the corresponding income from all sources was 22.074 cents.—Lond. *Electrician*, Oct. 25.

Railway Signals.—The first part of a fully illustrated description of the electric signal installations at the Euston & Crewe stations of the London & Northwestern Railway. At each station the Webb-Thompson system of signalling and point operation is in use. Electric power directly applied is employed, by means of motors in the case of points and solenoids in the case of signals, so that the operating parts are of the simplest possible character.—Lond. *Electrician*, Oct. 25.

Railway Signals.—W. E. FOSTER.—In a continuation of the long illustrated serial on railway signalling, the "language of fixed signals" is explained.—*Electric Journal*, November

Installations, Systems and Appliances.

Combined Gas and Electricity Works.—An illustrated description of the new station at Ascot. This is the only instance in Great Britain of an electricity supply station running in connection with a gas works. It is the only case in which a gas company succeeded in obtaining parliamentary power to supply electricity and at the same time secured the rejection of a competing application. The electric generating station has been erected in close proximity to the gas works. Electric motors are being installed in the gas works for a number of purposes. The electric generating plant consists at present of

two gas engines, each capable of working continuously at 90 horse-power, and coupled to a direct-current generator capable of giving normally 110 amperes at 460 volts, with a speed of 210 r. p. m. Gas is supplied from a suction producer, the fuel being coke from the gas works. Only a very small space is taken up by the producer plant and the convenience of a stand-by gas supply is evident. The price of energy has been fixed for the present at 14 cents per kw-hour for lamps and 8 cents per kw-hour for motors, the e. m. f. of supply being 220 volts on either side of the three-wire system. The price of gas is $1.12 per 1000 cu. ft.—Lond. *Electrician*, Oct. 25.

Choice of System for Cities of Medium Size.—F. Ross.—The author refers to an article by Niethammer in an Austrian daily paper in which the direct-current system is considered to be the most suitable one. for cities of less than 100,000 inhabitants. Reference is made to the city of Goerlitz, in Germany, which is a city of 85,000 inhabitants, and in which in the year 1895 a 2000-volt, single-phase plant was installed, but was later changed to a direct-current, three-wire system at 2 x 220 volts to make the operation more economical. The present author denies that the economy of this plant has been improved at all by this change. He thinks that in erecting new plants it is now important to think of the installation of low-voltage, high-efficiency metallic-filament lamps. For this purpose the alternating-current system appears to be preferable.—*Elek. u. Masch.*, Oct. 13.

Effect of Sea Water on Pipes on Board Ships.—M. Lussac.—An account of the effects of stray currents on the condenser pipes on board ship. The pipes referred to are of copper, and are connected together by galvanized elbows and bronze collars, and are supported on hangers fixed to the bulkheads. It has been noticed that the most corroded parts are those where the metal has been worked, and in these places the metal is deeply pitted. The stray current seems to increase with the circulation of the water. This effect cannot be explained by the acidity of the lubricating oil, as pipes into which the oil never penetrates are affected in the same way. As the usual e. m. f. on board ship is 80 volts, while the insulation resistance is about 16,000 ohms, it may be supposed that there are stray currents whose total intensity is 0.005 ampere flowing in the hull of the ship. As the hull is made up of riveted places whose joints are oxidized, it is not very conducting, and the path of the stray currents is generally through the copper pipes which are connected to it. When the path reaches a more or less insulating joint, it passes into the liquid and a sea-water voltameter is thus formed. One pipe forms the anode and is eaten away, while the same effect will be noticed on the other pipe if the current is reversed. The effect is best prevented by bonding the joints across, and thus providing a low-resistance path for the current. It has been found that this action is not confined to pipes carrying sea water, but that it also appears on fresh water systems, and increases with a rise in voltage.—Lond. *Electrician*, Oct. 25.

Power-Factor Improvement.—C. I. Young.—The author refers to a former article of W. Nesbit on synchronous motors for improving the power-factor in which a method was described for determining the characteristics of a synchronous motor required to raise the power-factor of a given kv-amp load from its original value to a higher value. The author has worked out a "graphic calculator," that is, a chart by which it is possible to find the power-factor improvement. The method of using this chart is described.—*Electric Journal*, November.

Electrophysics and Magnetism.

[illegible] J. Zenneck.—[illegible] waves over plane surfaces and of the absorption of such waves by the atmosphere. Marconi has shown that the distance one can reach by wireless telegraphy is two and one-half times as great by night as by day, and he attributes this phenomenon to the increased absorption of the waves due to ionization of the air by daylight. Zenneck's calculation shows that the layers of air less than 6000 meters from the earth's surface cannot change their conductivity by daylight sufficiently to account for the absorption of the waves, and he believes that this absorption is due to the loss of energy from the antennæ due to daylight. It is probable also that the good effect of clouds and fog is due to the protection of the antennæ from this loss of energy due to light. The waves employed in wireless telegraphy in passing from water to land and in the reverse direction must suffer partial deflection. The amplitude, therefore, of the wave depends not only upon the distance the waves have traversed over sea and land, but also upon the shore form, or barrier between land and sea. On this partial reflection depends the fact that less distorted waves are received at a distance from the sender than at a station near the sender.—*Ann. d. Physik.*, No. 10, p. 846; abstracted in *Am. Journal of Science*, November.

Pinch Phenomenon.—P. Bary.—Some notes on the "pinch phenomenon" and on Northrup's paper on this subject.—*L'Eclairage Electrique*, Sept. 28.

Units, Measurements and Instruments.

Resistor Coils and Comparisons.—C. B. Drysdale.—The conclusion of his long serial in which the author gives the general theory of the slide-wire bridge, and then describes in detail a slide-wire bridge for standardizing devised by him, and in which he has combined in a single bridge the possibility of testing, either by the Reichsanstalt or Cary-Foster methods, coils of high or low resistance and of any gauge.—Lond. *Electrician*, Oct. 25.

Telegraphy, Telephony and Signals.

Generator for Spark Telegraphy.—P. Villard.—The sparks used in wireless telegraphy are usually produced either by an induction coil or by an alternating-current transformer. The former equipment is of very limited power output, and the second has the inconvenience of giving too many sparks and thus wasting energy. A method for reducing the sparks in number from, say, 80 or 100 per second to 10 or less per ceond, has recently been described by Blondel. It consists in having the secondary circuit of the transformer slightly out of resonance with the alternating current, so that beats are produced; and thus the sparks may be reduced in number till there is, say, only one every ten alternations. In this method the regulation must be very precise. A simple method consists in the use of a special alternator. The armature is fixed and carries two bobbins, and the field magnet rotates inside it. This field-magnet is shaped somewhat like the letter H, and presents four poles of alternate sign arranged in two close pairs, one pair diametrically opposite the other. During nearly a half turn these poles do not pass in front of either bobbin and the losses reduce to those in the sheet iron of the stator. All the driving power is spent in a small fraction of a turn. First one pole passes before a bobbin and produces therein an e. m. f. of, say, $+E$, then a second pole, replacing the first, produces an e. m. f. of $-2E$, and finally this latter pole in leaving the coil induces $+E$. Thus each period is composed of three alternations, of which one is double either of the others. By aid of a transformer it is easy to arrange that each period gives one spark, and each spark is always in the same sense.—From *Comptes Rendue;* abstracted in Lond. *Elec.*, Oct. 11.

BOOK REVIEW.

[illegible] U. S. Navy. By Commander Burns T. Walling, U. S. N., and Julius Martin, E. E. Annapolis, Md.: U. S. Naval Institute. 648 pages, 300 illustrations. Price, $6.00.

In the absence of a preface, it may be assumed that the object of this voluminous compilation is to furnish a manual for the instruction of those persons in the Navy who have to do with the installation and operation of electrical plants aboard war ships, or are charged with the purchase and inspection of naval electrical material. As such, the volume should prove [illegible]

value to those outside having a practical interest in the application of electricity to marine purposes. Moreover, much information of general value is scattered throughout the pages relating to the construction, operation and care of apparatus, operation of storage batteries, inspection and testing of material, etc. It is true that war-ship conditions demand a maximum of reliability entirely regardless of the expense involved, thus conflicting with commercial principles, which include the factor of cost in the formula of maximum economy. Nevertheless, the requirements for naval apparatus and material have an interest in that they presumably represent the highest standards that have been attained. To students the descriptions of apparatus and appliances should prove useful, as in general they are in fuller detail than can be found outside of manufacturers' catalogues, and do not assume on the part of the reader any special knowledge of electrical engineering. While the book does not possess the character of a connected treatise, but appears rather to be mainly a compilation from naval technical files, manufacturing companies' bulletins and note-books of the authors, yet from it an excellent idea may be obtained of the remarkable extent to which in recent years electricity has found application on shipboard, and particularly on war vessels.

The book opens with a chapter on incandescent lamps, from which we learn that in the navy, aside from 16 and 32-cp lamps for general purposes, special lamps are used as follows: 1, 2 and 5-cp for instruments; 6-cp for torpedoes; 10-cp for signaling, and 150-cp for diving purposes. The standard voltage in the navy is now 125, but some of the older vessels employ 80 volts—the former standard voltage—while the vessels purchased during the late war have 110-volt plants. The greater part of the chapter is devoted to a description of the method of inspecting and testing incandescent lamps in use at the New York Navy Yard. Chapter II has for its subjects arc lamps and search lanterns, the types used in the navy being described in detail and instructions included for their operation. Standard wire is the subject of Chapter III, which includes the specifications and tests of the various types of conductors used in the navy. The next chapter, entitled "Wiring Appliances," deals with circuit installation and fittings. Chapters V and VI describe in detail the naval types of generating sets, the greater amount of space being devoted to the steam end. Three chapters have for their subject motors, in which their numerous applications on shipboard are detailed. Chapter X is devoted entirely to instructions for the preliminary inspection, preliminary test and final test of generating sets and motors. Chapter XI is on auxiliary apparatus and instruments used in generating sets and motors, such as measuring instruments, circuit breakers, etc. Chapter XII consists of practical notes on the operation and care of generating sets and motors. Chapter XIII has for its subject electric fixtures and lanterns of the special types employed on war ships; and the following chapter is devoted to the electrical devices used for interior and exterior communication, including night signaling. In view of the general use in the navy of wireless telegraphy, it is somewhat surprising to find that this subject receives no mention in the book. The final and longest chapter is entitled "Notes on Installation," and consists of practical instructions on the laying out of war-ship electrical plants and their installation.

Sturtevant Steam Turbine.

Recent performances have demonstrated that the reciprocating engine has a strong rival in the modern steam turbine. Although the relative steam economy of the turbine and the reciprocating engine is still a question, it must be remembered that the piston engine has been developed uninterruptedly for nearly two centuries, and when the same activity of research and design has been directed to the steam turbine, its economy will doubtless equal, if not surpass, the older form of prime mover. Assuming that there is not an appreciable difference in economy as regards cost of fuel, such advantages as simplicity, durability, freedom from oil in the exhaust steam, absence of valve adjustments, etc., must find favor in many installations.

Several years ago it became apparent to the B. F. Sturtevant Company that the steam turbine was particularly adapted for direct-connection to their blowers and small generators. The experimental work was conducted by Mr. William E.

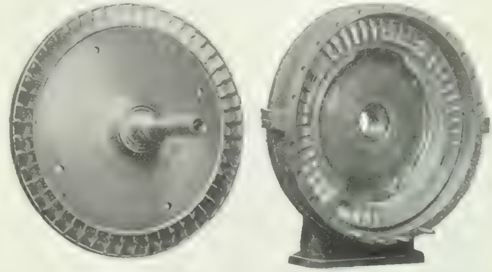


FIG. 1.—BUCKET-WHEEL, CASING AND REVERSE GUIDE RINGS.

Snow, of the engineering staff, and the turbine is now built under his patents. The resulting machine, which is a modification of the Riedler-Stumpf type, admirably fulfills the requirements of this work. Steam enters at the sides of the bucket wheel through nozzles of Tobin bronze and acts upon the buckets cut in the wheel. Similar buckets in the steel stationary guide plates form closed spaces in which the steam reacts, and the steam is returned again and again to the moving buckets, each time at reduced velocity. The steam finally escapes from the open-ended guide plates into the interior of the turbine case.

FIG. 2.—STEAM NOZZLES OF TURBINE.

The bucket-wheel, or moving part, is made of a single forging with the buckets worked out of the solid metal on a special automatic bucket-cutting machine. This process insures a wheel of great strength, and as it runs between the two guide plates there is said to be no tendency to end thrust. A clearance of 1/16 in. all round the revolving wheel greatly re-

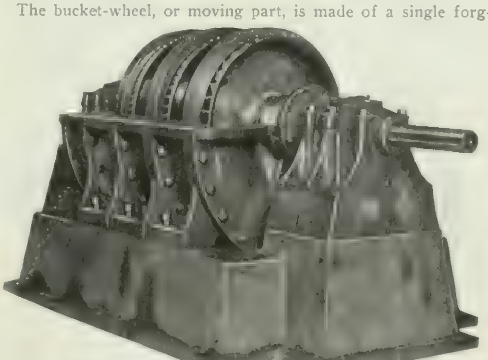


FIG. 3.—TURBINE WITH UPPER HALF OF CASING REMOVED.

duces the liability of contact from lack of alignment, due to heating or wear of the bearings. The bucket-wheel is also made with buckets milled into the edges of the disc. In the latter form the steam acts tangentially.

The turbine is made of the single-stage type in ratings ranging from 10 to 200 horse-power, and adjustment of the nozzles and buckets permits a wide range of power and speed for a turbine of given outside dimensions. Sizes above 200 horse-power are usually made from two to four bucket wheels. The areas of the nozzles and buckets increase successively on

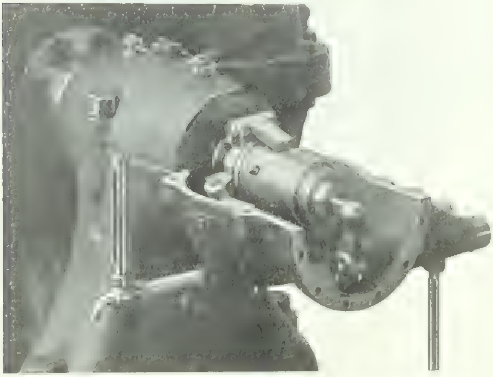


FIG. 4.—GOVERNOR AND BEARING OF SINGLE-STAGE TURBINE.

these wheels to take care of the larger volume of the expanded steam.

The speed of the turbine is controlled by a direct-connected throttle governor, consisting of four parts and one spring, located upon the end of the outboard bearing. The governor is enclosed in a dust-proof case, and is direct-connected to the regulating valve, which is placed upon the inlent beneath the governor.

The pressure upon the main bearings, which are of the self-aligning ring-oiling type with solid linings of phosphor bronze, is said to be but 14 lbs. per square inch, therefore, the wear is not appreciable.

The casing is made in halves so that the upper part can be removed easily for inspection of the bucket wheels; an annular

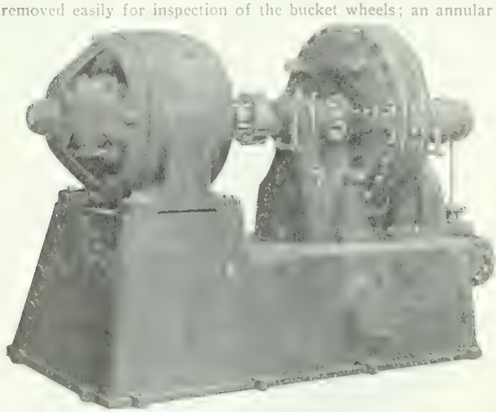


FIG. 5.—TURBO-GENERATOR SET.

passage supplies steam to the nozzles, and each nozzle can be shut off separately by means of a small valve. The deep base is utilized for carrying the steam and the exhaust, the respective pipes being connected directly to the base. The live steam passages in the base are also arranged to act as a surfaces. These locomotives are built in weights from 10 to 30 essential to the efficiency and the long life of the nozzles.

The turbine has the advantage of low speed ranging from 1600 to 300 r. p. m. In many turbines the speed is reduced by gears, or several bucket-wheels are mounted on the same shaft.

For installations in which the turbine is to be run non-condensing, no stuffing boxes are used on the shaft, steam tightness being secured by a water packing. Since there is no contact between the rotary and the stationary rings of this packing, no adjustments are necessary and the life of the packing is long.

Jamestown Exposition Awards.

Mr. James L. Farmer, secretary of the jury of awards, Jamestown Exposition, has notified the General Electric Company that it has been awarded two gold medals and a bronze medal on account of its exhibit at the exposition. The classification by which the jury was governed in granting the awards limited them to one in each department, while previous expositions have allowed separate awards for each class of material exhibited. The General Electric Company's exhibits are grouped in three departments, the Machinery, the Manufactures and Liberal Arts, and Mining.

A collection of motors applied to various machine tools and other devices was awarded a gold medal. The arc and incandescent lamps and electric cooking applications exhibited in the Departments of Manufactures and Liberal Arts were also awarded a gold medal. The company exhibited a special motor designed particularly for use with an Ingersoll-Temple pneumatic rock drill, and this motor, because of its peculiar adaptation to the special service, was awarded a bronze medal. The company was also awarded a silver medal for installation of exhibit.

Electric Switching Locomotive.

The accompanying illustration shows a 25-ton switching locomotive built by the Jeffrey Manufacturing Company, Columbus, Ohio, for use in handling freight cars for the Cerveceria Cuauhtenoc Brewery, of Monterey, Mexico. This locomotive takes the same electrical equipment as the mine type, the only changes being in the side and end frames and the addition of a platform and cab to meet the conditions incident to surface

SWITCHING LOCOMOTIVE.

work. The motors are of the waterproof steel-frame type, having drum-wound armatures, laminated pole pieces, oil lubrication with auxiliary grease boxes, and liberal wearing surfaces. These locomotives are built in weights from 10 to 30 tons with two motors, and in larger sizes with three and four motors, arranged with rigid frame, or with trucks having flexible wheel base.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The country has made good progress in accommodating itself to the changed financial conditions wherein credit instruments are substituted for cash. At the same time, wholesale and jobbing trade was some quieter and there was an evident disposition in industrial lines to curtail production wherever possible. There was a more optimistic tone in business than during the previous week, which was the outgrowth of a better feeling at the East, the large receipts of gold from Europe and the belief that basic conditions are better than in some preceding years of stress. From the Northwest and the South numerous complaints are made of the difficulty of getting wheat and cotton to market on account of the scarcity of cash; but the general issuance of bank and corporation checks in small denominations has eased the currency situation very perceptibly. Collections were slower, but retail trade was stimulated by the cooler weather. In jobbing lines some reorder business is noted, and in wholesale lines a quieting down in purchases for future deliveries is reported. Business in iron and steel trade is practically at a standstill, pending the clearing of the financial situation. Wage reductions from 5 to 10 per cent have been announced. Steel bars, plates and bar iron are weaker, and in some instances buyers of wire products are requesting the postponement of deliveries. Copper reacted on realiz'ng in London, and Lake and electrolytic brands declined to 14 cents and 13¾ cents. Business failures in October, as reported by *Bradstreet's*, number 964, with aggregate liabilities of $139,180,481. This is the largest number of failures reported since January, 1907; the heaviest total in October for ten years past and the largest liabilities ever reported in any month. Four-fifths of the liabilities were furnished by New York City and three-fifths were accounted for by suspending trust companies. The number of failures for the week ending Nov. 7 was 226, against 223 in the preceding week, and 146 in the corresponding week last year.

DELTA POWER PLANT DAM.—The Ambursen Hydraulic Construction Company, of Boston, Mass., has closed a contract with the Delta Electric Power Company, of Delta, Pa., for a reinforced concrete dam in southeastern Pennsylvania for supplying power to the quarries and other industries in that district. A similar contract has been closed by the same company with the Big Horn Power Company, of Chicago, Ill., for a dam on the Big Horn River in Wyoming. These two dams are almost exactly similar in dimensions and characteristics. Each dam is situated in a narrow gorge where there is no possibility of a detached or independent power house. The Wyoming dam will create a head of 60 ft. and the Pennsylvania dam a head of 65 ft., and both structures are about 70 ft. high above the foundations. The power houses in both cases will be under the rollway of the dam and protected by an inner shell. The great height of the dam allows ample space for a power house, together with traveling crane, switchboard, office, etc. Both dams will be of the half apron type. Work has been begun and will be carried on throughout the winter. It is expected to complete both dams before the spring freshets.

WESTINGHOUSE IN SAN FRANCISCO.—Despite the recent financial troubles of the home company, the San Francisco branch (controlling the Pacific Coast) of the Westinghouse Electric & Manufacturing Company is holding its own in the matter of sales. It reports that the three months ending Oct. 1, 1907, were the largest in its history. The orders for large types of machines were more numerous than ever, with some falling off in the trade in small motors. The lamp department showed satisfactory increase of business. The Westinghouse Machine Company is represented on the Pacific Coast by Hunt, Mirk & Company, of San Francisco, who report that they are not affected by the recent troubles. Their business continues to be satisfactory, and they have recently made some large sales of power machinery, including the installation of the new plant of the City Electric Company.

POWER FOR CENTRAL TEXAS.—It is stated by J. J. Henry and T. B. Burbridge, of Denver, Col., that they are making good progress with their preliminary plants for installing a great electric power plant near Austin, Tex., for the purpose of supplying a large number of towns of Central Texas with light and power. They will use lignite for fuel. They have secured options on extensive lignite fields in that section. More than $3,500,000 will be expended in installing the plant and in building the transmission lines. Some of these lines will be 200 miles long, and will extend to several of the larger cities of the state. Mr. Henry installed the Consolidated Power & Lighting plant at Deadwood, S. D., and the Northern Colorado Power Company's plant. Mr. Henry says that the latter plant is an exact parallel undertaking to what is contemplated in Texas. The Colorado plant is located on the lignite beds north of Denver. It supplies 25 cities and towns in Northern Colorado, besides furnishing electrical energy to the Colorado & Southern Railroad for its Northern Division.

POWER ENTERPRISES SUSPENDED.—Work has been suspended temporarily on the McCall's Ferry, Pennsylvania, power project and that of the Stanislaus River, California, on account of the tying up of funds in the embarrassed Knickerbocker Trust Company of New York. Early resumption of work is expected. When the McCall's Ferry project was started nearly two years ago the Knickerbocker Trust Company of New York became the trustee of the $10,000,000 mortgage put on the work. Bonds were issued immediately and the proceeds were deposited in the trust company as soon as they were sold According to a report, the McCall's Ferry Dam Company had $800,000 to its credit when the institution closed its doors. It is stated that some $3,000,000 has already been expended on the Stanislaus Power & Water Company's plant.

COLORADO RIVER POWER.—Charles H. Alexander, of Dallas, and associates, have acquired the falls in the Colorado River and Marble Falls and are arranging to install a large electric power plant there for the purpose of supplying Austin, Tex., and a number of other towns of the central part of the state with electrical energy. A 10-ft. cap will be built across the natural dam.

PUMPS FOR MANILA.—The Municipal Board, Manila, P. I., will receive bids until Jan. 15 for electrically driven pumps and motors for the new sewerage systems in that city. There will be one main station and five sub-stations, each equipped with two pumps and corresponding motors. Specifications may be obtained from either the Municipal Board or from the Bureau of Insular Affairs, Washington, D. C.

MANUFACTURE OF TYPEWRITERS.—The Oliver Typewriter Company has recently purchased new power [illegible] electrical units for the plant at Woodstock, Ill., comprising a 22 in. x 42 in. Allis-Chalmers horizontal heavy-duty Corliss engine direct connected to a 300-kw, 240-volt, direct-current generator of the same build for carrying the power and lighting load.

POWER FOR LAREDO.—Samuel Kahn, of San Antonio, is at the head of a company which is being organized to install a large electric power plant at the coal mines, 25 miles from Laredo, Tex. The energy will be transmitted to Laredo and used also for operating irrigating plants in the valley of the Rio Grande.

CRANES IN PRESS FACTORY.—The new foundry of R. Hoe & Co., printing press manufacturers, of New York, has been equipped with three 10-ton electric traveling cranes, each of about 65-ft. span, furnished by the Northern Engineering Works, Detroit, Mich.

TELEPHONES FOR AUSTRALIA.—The Postmaster-General's Department, Adelaide, South Australia, will receive bids until March 11, 1908, for the supplying of one common battery switchboard, 400 subscribers' telephones and 400 protectors.

WIRELESS.—The steamship "Joseph Vaccaro," of the Vaccaro Brothers Steamship Company, trading from New Orleans [illegible]

BARTOW, FLA., MUNICIPAL PLANT.—The electric light and water plant of the city of Bartow, Fla., under the superintendency of Mr. Eugene Bivins has, it is claimed, experienced a prosperous growth. Within the past two years, it is stated, the number of patrons has more than doubled and at the present time the plant capacity is taxed to its utmost. The equipment in the municipal plant at Bartow includes an Allis-Chalmrse direct-connected generator. This unit was installed four years ago, and, according to the attendants, has never given a particle of trouble. The Bartow plant gives only a night service, of 14 hours' duration,, and there has been but a single shut down in two years chargeable to the engine. Practically no repairs have been required since installation, a single set of new brushes for the exciter covering everything chargeable to the electrical equipment. The population of Bartow is 2000.

COPPER CONDITIONS are steadily improving, from one point of view, on account of the restriction of output and the cleaning up of the metal now on the market. On the New York Metal Exchange this week, Lake has been quoted at 14 to 14¼ cents, electrolytic 13¾ to 14¼ cents, and castings 13¼ to 13¾ cents. There seems little doubt as to the sale of 112,000,000 lbs. by the United Metals Company to a foreign pool of consumers. This week the price of aluminum has been lowered by the manufacturers from 45 cents a pound to 40 cents.

Financial Intelligence.

THE WEEK IN WALL STREET.—On the stock market there was a better feeling, but speculative operations were discouraged by all conservative interests. There was, however, considerable investment buying, mainly in small lots. A better feeling in Wall Street resulted from the settlement whereby the Tennessee Coal pool was relieved of its burden and the property transferred to the control of the United States Steel Corporation. The announcement of this deal caused an exhibition of strength in Steel shares, but later in the week sales of the Steel bonds received in exchange for Tennessee Coal stock caused them to fall to 80. More strength was shown in electrics, with general advances. Westinghouse furnished the most prominent exception and declined from 54 to 49—a net loss of 5 points. General Electric made a net gain of 6⅝ points at the close of the week. The general market was then steady. The curb market was dull and irregular throughout the week, but the heavy liquidation appeared to be over. Following are the closing quotations of Nov. 12:

NEW YORK.

	Nov. 4	Nov. 11		Nov. 4	Nov. 11
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	[illegible]	[illegible]
Allis-Chalmers Co. pfd.	[illegible]	[illegible]	Hudson River Tel.	—	—
Am. Dist. Tel.	—	—	Interborough Met. com.	[illegible]	[illegible]
American Locomotive	[illegible]	[illegible]	Interborough Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	[illegible]	[illegible]	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable	65	60	Mackay Cos. pfd.	50	[illegible]
American Tel. & Tel.	—	92	Marconi Tel.	—	[illegible]
Brooklyn Rapid Transit	30¼	31½	Metropolitan St. Ry.	—	[illegible]
Electric Boat	[illegible]	—	N. Y. & N. J. Tel.	[illegible]	[illegible]
Electric Boat pfd.	[illegible]	—	Western Union Tel.	[illegible]	[illegible]
Electric Vehicle	—	—	Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd.	—	—	Westinghouse pfd.	[illegible]	[illegible]

BOSTON.

	Nov. 4	Nov. 11		Nov. 4	Nov. 11
American Tel. & Tel.	[illegible]	92	Mass. Elec. Ry. pfd.	[illegible]	[illegible]
Cumberland Telephone	96¼	—	Mexican Telephone	—	[illegible]
Edison Elec. Illum.	[illegible]	195	New England Telep.	[illegible]	[illegible]
General Electric	—	—	Western Tel. & Tel.	—	[illegible]
Mass. Elec. Ry.	[illegible]	[illegible]	West. Tel. & Tel. pfd.	[illegible]	[illegible]

PHILADELPHIA.

	Nov. 4	Nov. 11		Nov. 4	Nov. 11
American Railways	[illegible]	[illegible]	Phila. Electric	[illegible]	[illegible]
Elec. Co. of America	8	8	Phila. Rapid Transit	15⅞	16
Elec. Storage Battery	31	30	Phila. Traction	—	[illegible]
Elec. Storage Battery pfd.	[illegible]	—			

CHICAGO.

	Nov. 4	Nov. 11		Nov. 4	Nov. 11
Chicago City Ry.	[illegible]	[illegible]	National Carbon	[illegible]	—
Commonwealth-Edison	—	80	National Carbon pfd.	—	99
Chicago Subway	[illegible]	[illegible]	Union Traction	[illegible]	[illegible]
Chicago Tel. Co.	—	110	Union Traction pfd.	—	—
Metropolitan Elec. com.	19*	19*			

* [illegible]

DIVIDENDS.—Directors of the Georgia Railway & Electric Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable on Nov. 20. Niles-Bement-Pond Company has declared the regular quarterly dividend of 1½ per cent on the preferred stock of the company, payable Nov. 15. Pratt & Whitney Company has declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Nov. 15. The directors of the Chestnut Hill Railroad Company declared a quarterly dividend of 1½ per cent, payable Dec. 4, to stock of record Nov. 20. Directors of the American Telegraph & Cable Company have declared the regular quarterly dividend of 1¼ per cent, payable Dec. 2. The directors of the Pittsburg & Butler Telephone Company have declared a dividend of 16 per cent from the past year's earnings. The company is a subsidiary of the Pittsburg & Allegheny Telephone Company. The dividend in 1906 was 6 per cent. Directors of the Consolidated Gas Company, of New York, have declared a regular quarterly dividend of 1 per cent, payable Dec. 16.

GENERAL ELECTRIC SALES.—A comparative statement of General Electric orders received from and sales billed to customers for the first nine months of each of the past five years is as follows:

ORDERS RECEIVED.

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

On Oct. 30 the General Electric completed the first three-quarters of the current fiscal year to end Jan. 31 next. Gross sales billed in this nine months will exceed $55,000,000, as compared with a little less than $42,000,000 in the corresponding period of 1906. In the three months ended Oct. 30 the General Electric broke all previous records in the total amount of goods billed out, the aggregate being nearly $20,000,000 or $4,000,000 greater than for the same three months of 1906. The comparison of the goods billed in the first three-quarters of the current and 1906 fiscal year shows as follows:

	[illegible]	[illegible]	[illegible]
First six months	[illegible]	[illegible]	[illegible]
August	6,100,000	5,200,000	900,000
September	[illegible]	[illegible]	[illegible]
October	7,100,000	5,900,000	1,200,000
Total	[illegible]	[illegible]	[illegible]

In the twelve months ended Jan. 31 last the General Electric billed a total of $60,071,883 of electrical apparatus. In the next three months, therefore, the company will have to ship but $5,000,000 of goods in order to equal the record of the previous year. As a matter of fact, it now seems likely that the total sales billed for the year will not fall far short of $70.000.000.

NORTH AMERICAN REPORT.—The North American Company has issued a statement in which it says: "In view of the disturbed financial conditions now prevailing, the directors have decided to defer the declaration of the dividend for the present." The income account of the company for the 10 months ending Oct. 31, 1907, is as follows:

RECEIPTS.

Interest received and accrued	[illegible]	
Dividends received	1,179,328	
Compensation for services	[illegible]	
		[illegible]

EXPENSES.

Salaries, legal expenses, rent and other expenses of administration	$74,576	
Interest paid and accrued	66,193	
Taxes	5,260	
Losses	[illegible]	
		[illegible]
Net profit		[illegible]
Three quarterly dividends paid		[illegible]
Surplus for the ten months		$161,408
Undivided profits, as of Oct. 31, 1907		4,160,956

The loans which the company has made to the various companies in which it is principally interested, for extensions and additions chargeable to its capital account, amount as of Nov. 7, 1907, to $3,612,938. Repayment on account of these advances has been depended upon by the North American Company as required to pay its own dividends. At the moment these companies are unable to comply with this requirement. because of their inability to sell, except at great sacrifice, their own mortgage bonds, which have been issued and are available to reimburse their treasuries for capital expenditures heretofore made, or to make loans on reasonable terms. In order to pay a dividend on Dec. 1, the North American Company would either be obliged to require these companies to make payment to it on account of their loans (which, as stated above could only be done at great sacrifice) or would itself be obliged to borrow money for the purpose.

WESTERN ELECTRIC BONDS.—At the special meeting of the Western Electric stockholders, held in Chicago, when a vote was carried to issue $15,000,000 bonds, President Barton made a statement calling attention to the fact that the accounts receivable, plus cash and merchandise combined, is over three times the amount of bills payable. Inventory of finished merchandise, work in process and new material Oct. 1, is estimated at $22,000,000. He says that the rate of production of telephone apparatus at factories is still somewhat in excess of orders, although the number of employees has been reduced 39.9 per cent. "We know, however, that our telephone customers are using up their own stock to such an extent that we believe they will soon be placing more orders than at present. We expect that additional business from present telephone customers, together with sales to independent telephone companies, to whom we are now prepared to sell apparatus freely, will require the present rate of production to be increased, and consequently additional hands to be employed." President Barton preferred a stock issue, but it was impracticable to put out stock sufficient to make any inroads into indebtedness. The determining question with the board, he said, was that the larger number of stockholders are not in a position to take their proportion of new stock. The question of interest is not paramount. At present rates the company is paying, the interest on this $15,000,000 would equal a shade over 6 per cent. Bonds cannot be sold in the immediate future except below par "Our collections have been excellent all this year and still are excellent. Our customers are not behind ordinary normal conditions, but we have about $15,000,000 indebtedness, or amount of our capital, and if we took out our cash balance it would still be between $11,000,000 and $12,000,000. Our quick assets are over three times our indebtedness, but we can't realize on merchandise or receivables all at once." The company has in its business practically $35,000,000. Its capital last year was turned over twice. The surplus is now between 19 and 20 millions. Bills payable on Oct. 1 were $15,347,000, a decrease of $7,534,000; cash $3,733,000, an increase of $2,106,000. Total bills payable, less cash, $11,615,000, a decrease of $9,640,000. Accounts receivable and undiscounted bills receivable on hand Oct. 1 were $12,838,000, a decrease of $7,484,000, compared with Dec. 1, last year. The Western Electric annual report shows sales for the first six months of 1907 equal to $29,614,000, or 1 3/10 per cent more than for the previous year. Sales for four months ending Sept. 30 were $15,745,000, or 35 1/10 per cent less than previous year. Total number of employees Oct. 1 was 16,183, a decrease of 39.9 per cent compared with Dec. 1, 1906.

LAKE SUPERIOR CORPORATION.—It would appear that there is a fight on for the control of the Lake Superior Corporation, a $40,000,000 company, which arose three years ago from the wreck of the old Consolidated Lake Superior Company, that collapsed in 1903. Strong Philadelphia interests are at work to overthrow Charles E. Orvis and Francis H. Clergue, who have been on the board since the reorganization. Before the organization of the present company a syndicate of New Yorkers, headed by Speyer & Company, lent the Consolidated Lake Superior Company $5,050,000. Upon the company's failure to pay this money the company's assets were sold under foreclosure, and the syndicate bought them in. A number of the syndicate members were interested in the Canadian Improvement Company, and it was this company which largely liquidated the debt. The entire $5,050,000 has been paid. The directors of the Lake Superior corporation announced a month ago that the company would not make a payment this year on the $3,000,000 issue of income 5 per cent bonds, which were put up at the time of the reorganization of the old company. This decision, it was said, was not the result of earnings, but was due to the desire of the directors to use all of the company's funds in its business.

NATCHEZ RECEIVERSHIP.—W. A. Pollock, of Vicksburg, has been appointed receiver for the Southern Light & Traction Company, of Natchez, Miss., the local property of the Southern Electric Securities Company, the latter company having been adjudged a trust by Chancellor Hicks in a case before him at the last term of the Warren County Chancery Court. The company is conducting an electric light and gas plant and electric street railway system in Natchez, and has similar property in Vicksburg, Jennings, La., and Beaumont, Tex. There is little local capital in the property, though the Natchez end was organized by Natchezians. The property will be operated by the receiver, with W. B. Moorman continuing as superintendent. The application for a receiver was made by Harry K. Johnson, of Vicksburg. The receivership grew out of the late litigation, culminating in the recent decision of the Supreme Court in the case of S. S. Bullis vs. the Southern Electric Securities Company, in which the Supreme Court held the company to be a trust and combine, and operating in violation of the laws of the State.

WESTINGHOUSE BONDS.—Kuhn, Loeb & Company, who acted as bankers for the Westinghouse Electric & Manufacturing Company, have requested the holders of the convertible sinking fund 5-per cent bonds and of the 3-year 6-per cent collateral trust notes of that company to communicate with them. At the company's office last week it was said that the request had been issued merely for the purpose of bringing the holders of these securities into touch with Kuhn, Loeb & Company to watch any developments in plans for the rehabilitation of the Westinghouse Company. It was said that the bankers had no knowledge of any proposed plans of readjustment or whether a general reorganization of the Westinghouse Company would take place. The three-year collateral trust notes were issued only a few months ago to take the place of a previous issue. The present issue has nearly three years to run. Kuhn, Loeb & Company already represent a large amount of the Westinghouse notes and bonds.

ISSUES AUTHORIZED.—The New York Public Service Commission, Second District, has authorized the Newport Electric Light & Power Company to construct lines in the town of Newport and in the village of Poland, Herkimer County, and to issue a mortgage to secure the payment of thirty-year bonds amounting to $75,000, the proceeds to be used for retiring $15,000 of bonds outstanding and the balance for construction and equipment. The Commission has given permission to the Dutchess Light, Heat & Power Company, of Rhinebeck, N. Y., to construct extensions of its lines in the towns of Red Hook and Hyde Park, Dutchess County, and for authority to issue $20,000 capital stock, to be devoted to the acquisition of land and construction and extension of its plant.

IDAHO POWER CONSOLIDATION.—Advices from Pocatello, Idaho, state that the Idaho Consolidated Power Company, with a capital of $2,000,000, has absorbed the American Falls Power, Light & Water Company, the Pocatello Electric Light & Power Company and the Blackfoot Power & Water Company. The formal transfer of these holdings to James H. Brady, of Pocatello, will be made at once. Mr. Brady retains the presidency of the consolidated company. The plans include the development of the Consolidated's 50,000 horse-power at American Falls and transmission of electrical energy to the surrounding towns. Twenty-five hundred horse-power is now being generated at American Falls, and an additional 4000 can be delivered inside of sixty days.

SHAWINIGAN POWER.—Directors of the Shawinigan Water & Power Company recently declared an initial dividend of 1 per cent on the common stock. About $7,000,000 of cash has gone into the enterprise and this cash is represented by $5,000,000 of bonds which have been selling on the London Stock Exchange around par, $1,000,000 of debenture stock, also listed in London, selling around 90, and $6,500,000 of common stock which has been selling in the neighborhood of 50. The company is now generating about 72,000 hp and is delivering 14,000 hp daily to the city of Montreal. It has 300 miles of transmission line, including two cables under the St. Lawrence River.

UTAH INDEPENDENT TELEPHONE.—The United States Independent Telephone Company of Rochester, N. Y., has sold the Utah Independent Telephone Company, one of its subsidiary corporations, to R. L. Day & Company, investment bond dealers of New York City. The price paid was $910,000, which, with $50,000 forfeited by Elmer R. Jones, representing Salt Lake City capitalists who took options some time ago on this property makes the sum realized for the Utah holdings $960,000.

CANADIAN GENERAL ELECTRIC.—The stockholders of the Canadian General Electric Company have voted in favor of the issuance of $2,000,000 of preferred stock, carrying with it a preference as to assets as well as dividends. The new issue was entirely underwritten, but stockholders could subscribe in proportion to their holdings.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Greater Birmingham Electric Light & [illegible] Creek for the purpose of supplying electricity for lighting purposes. The company plans to build a power plant of 1000 horse-power on the creek in North Birmingham. It is capitalized at $196,000 and will apply for franchises in the various municipalities in the Birmingham district. J. M. Bradley, formerly with the Birmingham Railway, Light & Power Company, is president of the company.

HEADLAND, ALA.—An election will be held Dec. 1 to vote on the proposition of issuing $23,500 in bonds for the construction of an electric light plant and water works system. The city previously authorized an issue of $20,000 in bonds for this purpose, but the amount is claimed to be insufficient.

PRESCOTT, ARIZ.—C. E. Miesse, president of the Octave Mining Company, states that a plant will be installed to furnish power for the various mining companies in the district near Wickenburg on the [illegible].

YUMA, ARIZ.—The Board of Supervisors has granted Thomas Drennan a permit to maintain and operate a telephone system on the county roads for a term of 25 years.

ALAMEDA, CAL.—The electric light commissioners have awarded the contract for the construction of the power house for the municipal electric light plant for $25,495. The building is to be of reinforced concrete and will be erected on Park Street.

AZUSA, CAL.—The San Gabriel River Dock Company is planning to install a 50-hp electric motor at its stone crushing plant. A second crusher will be built on the Pacific electric line about Jan. 1.

BISHOP, CAL.—The Bishop Light & Power Company is contemplating making additions and increasing the capacity of its plant. E. Robinson is president.

GRASS VALLEY, CAL.—Arrangements are being made by the California Gas & Electric Corporation to resume work on the Deer Creek power plant. It is expected that the plant will furnish 8000 horse-power within two months. John A. Britton, of San Francisco, is president of the company.

HERMOSA BEACH, CAL.—The Hermosa Beach Improvement Association has pledged itself to secure a municipal electric lighting plant for this town. A committee consisting of G. Scoles, A. C. Moore and Theodore Haneman has been appointed to work for the project. The cost of the plant is estimated at $15,000.

LOS ANGELES, CAL.—Arrangements have been made whereby the Los Angeles Railway Company agrees to extend the Eagle Rock line west into Glendale, a distance of two miles.

LOS ANGELES, CAL.—The Union Home Telephone Company, controlling the independent systems of ten Southern California cities, has made public an arrangement whereby its interests have been combined with those of the United States Long Distance Telephone Company. J. M. C. Marble, president of the Union Home Company, has resigned, and Frank W. Wachter has assumed the management of both corporations. The amalgamation, it is expected, will be ratified by the stockholders of the two companies at the annual meetings in January.

OAKLAND, CAL.—The Bay Counties Power Company has announced its plan of stringing a double transmission line into Oakland from its Yuba County power plant, and of generating electricity at the power plant of the Oakland Gas, Light & Heat Company at First and Grove streets. The Bay Counties Power Company is planning to furnish electricity in the towns along the route of the transmission line, but the greater portion of the supply will be distributed in Oakland.

SAN BERNARDINO, CAL.—Bids will be received by the Board of County Commissioners until Nov. 25 for a franchise to erect poles and wires for the transmission of electricity for heat and power on certain streets. Charles Post is clerk of the board.

SANTA ANA, CAL.—The Orange County Coal Mining Company is contemplating the installation of a power plant to use at its mine. Dr. J. A. Kronkhite, of Los Angeles, is president of the company.

STOCKTON, CAL.—Manager Buck, of the Union Construction Company, which has been building the reservoirs, mills, pipe line, plant and wire lines of the Stanislaus Power & Water Company in Tuolumne and Calaveras counties, but was compelled to cease operation recently owing to the failure of the Knickerbocker Trust Company, of New York, N. Y., has announced that the corporation expects to resume work on the power system inside of thirty days.

WILLOWS, CAL.—The plant and holdings of the Willows Water & Light Company has been purchased by the Northern California Power Company, of Redding. This gives the latter company control of the water and light systems in Redding, Red Bluff, Corning, Orland and Willows. The Northern California Power Company has furnished electricity for operating the Willows plant for several years. Samuel Boyd, of Corning, will have charge of the plant.

DENVER, COL.—The Denver & Intermountain Railway has been purchased by a syndicate headed by Daniel Chase, which has secured a right of way for the new electric line from Englewood to Roxborough Park. The Intermountain road will be operated by electricity. The new company will expend $2,000,000 for improvements to the line.

LAS ANIMAS, COL.—Bids will be received until Nov. 23 at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for power plant, building and machinery at U. S. Naval Hospital, New Fort Lyon, Col. William M. Smith is acting chief of bureau.

TRINIDAD, COL.—The Trinidad Electric Railroad Company is contemplating building an extension from Sparis to Cokedale.

BRANFORD, CONN.—The Connecticut Company is planning to install an alternating current day service about June 1, 1908. E. T. Gilbert is superintendent.

NEW HAVEN, CONN.—Surveys are being made by the Connecticut Company for an extension of its line from Lighthouse Point along the shore to South End and then connecting with the Branford electric line at some further point not yet decided upon.

WILMINGTON, DEL.—The Wilmington Light, Power & Telephone Company has been granted permission to build an additional conduit on Eighth and Shipley streets.

ATLANTA, GA.—Upon petition of the American Circular Loom Company, Judge Pendleton on Oct. 25 appointed T. A. Burke co-receiver with F. M. Laxton, of the Southern States Electric Company. The petitioning company requested that the additional receiver be appointed to represent its interest and the interest of other creditors.

COLUMBUS, GA.—Charles E. Main and John E. Porter, consulting engineers of the Stone & Webster syndicate, of Boston, Mass., have been in the city recently and made an inspection of the power house of the City Mills, with a view of making improvements to increase the capacity of the plant, which is leased by the Columbus Railroad Company. They also inspected the water power of the Eagle and Phoenix mills, which is to be greatly improved.

MONROE, GA.—The city is contemplating holding an election to vote on the proposition of issuing $30,000 electric light and sewer bonds.

SPARKS, GA.—The citizens on Nov. 5 voted in favor of issuing $20,000 in bonds to provide for funds for an electric light plant and water works system.

MOSCOW, IDAHO.—H. H. Robinson, city clerk, writes that the question of constructing a municipal electric power and lighting plant has been discussed by the City Council, but nothing definite has yet been done.

NAMPA, IDAHO.—A new electric pump is being installed at the water pumping station by the Baker City Iron & Supply Company. The cost of pumping water with electric power will be $160 a month, which is about $75 less per month than the cost by steam power.

CENTRALIA, ILL.—The Centralia Gas & Electric Company is planning extensive improvements to its plant, and will change its system from the two to the three wire and increase the boiler capacity. G. E. Fish is superintendent.

CHICAGO, ILL.—The Dearborn Street Improvement Association has decided to install 78 luminous arc lamps on Dearborn Street. Plans for lighting the street have been approved by William Carroll, city electrician.

CHICAGO, ILL.—The Drainage Board expects to begin on Dec. 1 to supply electricity generated at Lockport to the city of Chicago and the other municipalities with which contracts for power have been made. The municipalities which, it is expected, will be ready to take electrical energy, are: City of Chicago, 6000 kw; West Park Board, 900 kw; township of Cicero, 15 kw, and the village of Morgan Park, 112 kw. The Sanitary District, which is to receive $15 per horse power per year for the sale of electric power, expects to be able to supply 11,000 kw at the outset. About 4500 kw will be furnished to the Union stockyards firms.

DANVILLE, ILL.—Sealed proposals will be received until Dec. 4 at the office of the treasurer, Danville Branch, N. H. D. V. S., Danville, Ill., for furnishing materials, labor, etc., for installing a telephone system at the Danville Branch, N. H. D. V. S., in accordance with instructions and specifications, copies of which, with blank proposals and other information, can be secured upon application to M. J. Barger, treasurer.

CRAWFORDSVILLE, IND.—The Chicago & Western Indiana Traction Company has been granted a franchise by the Commissioners of Montgomery County to construct and operate an electric railway through the county. This grant completes the right of way for the entire route, and it is said that work on the construction of the road will soon commence.

FORT WAYNE, IND.—It is reported that the Fort Wayne Power Company, recently incorporated, will take over the plant and holdings of the old Fort Wayne Water Power Company.

GOSPORT, IND.—The Gosport Electric Light & Power Company, which was recently incorporated to build and equip an electric light plant in this town, informs us that contracts have been placed for the plant. W. A. Montgomery and J. S. Davis are among the directors.

NEW ALBANY, IND.—The United Gas & Electric Company, through its general manager, Martin Insull, has asked for permission to install 50 lamps of a new and improved system on Elm and other streets in the city as a test. The company proposes to operate these lamps for 90 days, and if not satisfactory, they are to be removed and replaced by the lamps now in use.

NEW ALBANY, IND.—The United Gas & Electric Company has announced a reduction in its prices for incandescent lighting, taking effect from Nov. 1. The reduction to smaller consumers will be about 20 per cent.

PLYMOUTH, IND.—The Indianapolis, Logansport & South Bend Railroad Company has been granted a franchise by the Commissioners of Marshall County to construct and operate an electric railway on the Michigan road through the county. The franchise is for a term of 99 years and the road must be completed within a year. The City Council recently granted the company a franchise within the city limits.

WILKINSON, IND.—The Wilkinson Switchboard & Telephone Company, recently incorporated, is in the market for material, equipment and labor for the construction and installation of a new telephone plant.

TULSA, I. T.—The Tulsa Interurban Railway Company has applied to the City Council for a franchise to operate an electric railway on certain streets in the city. The company proposes to build an electric railway from Sapulpa to Tulsa by the way of Red Fork and the Glen Pool, and thence to Broken Arrow. John O. Mitchell, L. D. Marr, H. R. Cline, G. N. Wright are interested in the enterprise.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Railway & Light Company is contemplating enlarging its boiler room and equipment, including coal and ash-handling apparatus, chain grates, conveyers, etc., and possibly economizers. W. J. Greene is manager.

ELKADER, IA.—The Turkey River Power & Improvement Company is contemplating the construction of three dams, and also proposes to build an interurban line from Elkader to Oelwein and Dubuque.

KEOTA, IA.—Robert Morris, who recently purchased the local electric light plant, is planning to install new machinery.

VALLEY JUNCTION, IA.—The Valley Junction Water & Light Company is contemplating increasing the equipment of its plant, and will install new boilers and engine. R. M. Lewis is superintendent.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company is contemplating making extensive improvements to the Penn Street substation. P. O. Keilboltz is consulting engineer.

FITCHBURG, MASS.—The Fitchburg Gas & Electric Light Company is making arrangements to place its wires underground in the business section of the city. The company recently placed a large order with the General Electric Company for underground cable.

MERRIMAC, MASS.—At a special town meeting held recently the citizens voted to make additions to the municipal electric light plant to cost $6,000. It is proposed to increase the equipment of the plant to furnish electricity for motors, for which the demand is increasing.

OXFORD, MASS.—The Webster Electric Company has commenced work on the extension of its line from Texas village, North Oxford to Cominsville, for the purpose of furnishing the village of Cominsville with electric light.

STOCKBRIDGE, MASS.—The Stockbridge Lighting Company has completed the construction of its lines. Electricity for operating its system is purchased from the Glendale power station, which is operated by the Monument Mills Company, of Housatonic. The company has not made any contract for lighting the streets of the town as yet. Charles E. Hull is treasurer and general manager.

TURNERS FALLS, MASS.—The Selectmen have granted the Franklin Electric Light Company a franchise to maintain a pole line to Millers Falls for the purpose of supplying that village with electricity. The Millers Falls fire district has made a contract with the company to furnish electricity for a term of ten years, and will abandon the municipal power plant.

WINCHENDON, MASS.—The Winchendon Electric Light & Power Company is contemplating the installation of an auxiliary plant in connection with its present water power plant. Frank W. [illegible] is manager.

WORCESTER, MASS.—The Worcester & Holden Street Railway Company has been granted permission by the Railroad Commissioners to issue $40,000 additonal capital stock at par.

ADRIAN, MICH.—The [illegible] Electric Company has increased its capital stock from $25,000 to $[illegible].

BERRIEN SPRINGS, MICH.—We are informed that the C. L. Olds Construction Company, of Fort Wayne, Ind., on Nov. 7, was awarded the contract for [illegible] miles of [illegible] transformer and erection of poles, wire, etc., for the municipal electric lighting system for $[illegible].

LUPTON, MICH.—The capital stock of the Ogemaw Telephone Company has been increased from $[illegible] to $[illegible].

ONAWAY, MICH.—The Onaway Light & Power Company is contemplating the construction of a new dam next year to meet the increased demands made on its plant. W. W. Vaughn is president.

ANOKA, MINN.—Application has been made by the American Trust & Saving Bank, of Chicago, Ill., for a receiver for the Anoka Water Works, Electric Light & Power Company. The application is made on the ground that the plant has not been kept up and extensive repairs are necessary. The plaintiffs ask that in case the motion is granted, Frank H. Philbrick, the present manager, be appointed receiver.

FERGUS FALLS, MINN.—The farmers of Leaf Lake will form the Otter Tail Telephone Company. H. H. Brutlag is secretary.

MONTICELLO, MINN.—Two rural telephone companies have been organized here recently known as the Pelican Lake Telephone Company and the Prairie Rural Telephone Company, which makes five telephone companies operating in Monticello.

NASHWAUK, MINN.—The Village Trustees are contemplating increasing the equipment of the municipal electric light plant by the installation of an 80-kw alternator with engine and other necessary apparatus, and also the extension of lines to two mines. G. A. Lindsay is superintendent.

STEWARTVILLE, MINN.—The Stewartville Electric Light Company is contemplating making improvements and increasing the equipment of its plant. A new dynamo and other machinery will be installed.

VIRGINIA, MINN.—The Virginia Light & Water Company is contemplating the installation of a 100-kw alternating-current, 2300-volt direct connected unit in its plant. O. H. Griggs is manager.

CANTON, MISS.—The citizens are contemplating the purchase of a 50-lamp transformer for the municipal arc lighting system, and the extension of fire main to the corporate limits. John T. Sharp, Jr., is manager.

HUNTSVILLE, MO.—C. F. Roberts, manager of the Huntsville Light & Power Company, will soon apply for a franchise in the city of Moberly to operate an electric lighting system and street railway. Mr. Roberts was recently granted a right of way for an electric railway over the public highway between Huntsville and Moberly.

MARYSVILLE, MO.—Preliminary plans and estimates have been prepared by Burns & McDonald, of Kansas City, for the construction of an electric light plant for this city, to cost about $10,000. Bonds have not yet been sold.

MEMPHIS, MO.—The Iowa-Missouri Traction & Power Company is contemplating the construction of two dams across the Des Moines at Keesauqua, Ia., to develop water power for an electrical plant of 9000 horse-power. The plant will furnish electricity for lighting and operating a railway system. D. Fitzgerald, of 80 Wall Street, New York, N. Y., will finance the enterprise. A. W. Carpenter, of Memphis, can give further information.

STEELVILLE, MO.—A franchise has been granted to Janus Bright to furnish electricity in this town for a term of twenty years. The power house wil be located one mile east of the city. Water power will be used.

NORTH PLATTE, NEB.—The North Platte Electric Light & Power Company is contemplating making extensive improvements to its plant. The company was recently granted a 20-year franchise by the City Council.

PAPILLION, NEB.—At a town meeting held recently the citizens voted in favor of establishing an electric light plant.

PLATTSMOUTH, NEB.—The City Council has awarded a contract and franchise for operating an electric lighting system and for furnishing street lighting to Earl C. Wescott, of Plattsmouth. Electricity for operating the system will be furnished by the Omaha Electric Light & Power Company, which will construct a transmission line from Omaha to Plattsmouth River, opposite Plattsmouth. Arc lamps will be used in the business section of the city, and tungsten incandescent lamps will be placed in the residence districts. No contracts have been placed for any of the material needed for the plant.

STELLA, NEB.—The Stella Electric Light Company has closed a contract with the city for street lighting for a term of years, and will begin work at once installing a plant. Power for operating the plant will be furnished by the meal mills. John Brenner, of Humboldt, will be the electrician.

WOOD RIVER, NEB.—The City Council has voted to issue $18,000 in bonds for the construction of a combined electric light and water plant.

ALPHA, N. J.—The Alpha Cement Company is making arrangements to construct a power plant along the Pennsylvania side of the Delaware River, near Foulrift, next spring. The plans call for the construction of a canal 40 or 50 feet wide and three miles in length for the generation of electricity to operate its mills.

BRANCHVILLE, N. J.—The new electric lighting plant has been completed and was put into operation for the first time Oct. 26. The plant has an output equivalent to 40,000 candle power and is operated by water power. The old plant has been discarded and is for sale. The new plant was constructed by Charles H. Crisman, who has installed lighting systems in Sussex, Stanhope, Andover, Blairstown and Branchville.

NEWARK, N. J.—Work has commenced on the installation of the municipal electric lighting plant, which will be installed in the basement [illegible]

[illegible] three generators, and the plant will have an output of 300 kw. The cost [illegible]

SANTE FE, N. M.—M. H. Fisher has made application for water rights on Fresnal Creek, a tributary of La Luz Creek, for the purpose [illegible]

SOCORRO, N. M.—It is reported that plans and estimates are being considered for the construction of an electric light plant in this place. If the present plans are carried out the plant will be owned by the city.

ATTICA, N. Y.—Notice has been served upon the Attica Water, Gas & Electric Company by the clerk of Board of Trustees that unless the company makes arrangements by which sufficient fire protection can be afforded the village, the board will not renew its contract with the company under the present terms.

BINGHAMTON, N. Y.—[illegible] board of managers are considering plans for extensive improvements to the Binghamton State Hospital, among which is included the complete reconstruction of the light, heat and power plants and system, for which an appropriation of $60,000 is now available.

CORNWALL-ON-HUDSON, N. Y.—Edward Wiltgen, superintendent of the Hudson Counties Gas & Electric Company, writes that the company is changing the transmission e. m. f. from Newburg from 2000 volts, two-phase to 6000 volts, three-phase. The company is abandoning its old steam station, which was used as a sub-station, for its new sub-station, which is more centrally located.

HORNELL, N. Y.—The Hornellsville & Canisteo Railway Company is planning to purchase considerable equipment and cars. G. T. Rehn is general manager.

LIMA, N. Y.—The Lima-Honeoye Electric Light & Railroad Company is planning to place contracts within the next six months for the construction of about 26 miles of track, and is also contemplating the erection of a new power station to be located in the gas fields, four miles south of the city, where the company can produce gas at a cost of not exceeding five cents per 1000 cu. ft.

LOCKPORT, N. Y.—The Public Service Commission in the Second District, on Nov. 10, made public its decision in connection with the merger of the lighting companies in Lockport. The decision permits the new corporation, the Lockport Light, Heat & Power Company, to purchase the Lockport Gas & Electric Company and the Economy Light, Fuel & Power Company, of Lockport. It forbids the new company, however, to issue securities for a capitalization above $700,000, equivalent to the total issues of the two old companies. The new company desired to issue stock and bonds to a total of $1,200,000.

NEWPORT, N. Y.—The Newport Electric Light & Power Company has been granted permission by the Public Service Commission, second district, to construct transmission lines in the town of Newport and the village of Poland, and to exercise its rights and privileges in those places. The Commission also authorizes the company to issue a mortgage to secure the payment of bonds amounting to $75,000, the proceeds to be used for retiring $15,000 in bonds outstanding and the balance for construction and equipment.

RHINEBECK, N. Y.—The Public Service Commission, second district, has granted the Dutchess Light, Heat & Power Company authority to extend its transmission lines to the towns of Red Hook and Hyde Park, and also permission to issue $20,000 in capital stock to be used in the acquisition of land and construction and extension of its plant.

RHINEBECK, N. Y.—R. Raymond Rikert, secretary of the Dutchess Light, Heat & Power Company, writes that plans for the proposed extension are not yet complete.

ROCHESTER, N. Y.—The United States Independent Telephone Company has sold the Utah Independent Telephone Company, one of its subsidiary corporations, to R. L. Day & Company, of New York City. The price paid was $910,000.

UTICA, N. Y.—The Public Service Commission has granted the Utica Gas & Electric Company permission to operate the franchises granted by the village of Frankfort and the towns of Frankfort, German Flats and Little Falls, and to commence construction under them.

SMITHFIELD, N. C.—The Holmboe Company, of Louisville, Ky., has been engaged to prepare plans and specifications for water works, electric light plant and sewerage system for this town. As soon as an estimate of the cost is prepared an election will be held to vote to issue bonds for the work, and if bonds are voted, work will be started soon.

ASHBORO, N. C.—The Genton Lumber Company, recently incorporated, proposes to furnish electricity for lamps and motors in connection with its lumber plant. W. C. Hammer is interested in the enterprise.

CINCINNATI, OHIO.—W. Kelsey Schoepf, president of the Cincinnati Northern Traction Company, has petitioned for a lease on the bank of the Miami & Erie Canal, between Dayton and Miamisburg, for a pole line. It is said that he is planning to furnish electricity for lamps and motors to towns along the line.

COLUMBUS, OHIO.—Bids will be received until Nov. 25 by the Board of Public Service (E. F. McGuire, secretary) for furnishing material and making the following improvements at the municipal electric light plant, Dublin Avenue: Boiler blow-off tunnel, foundation for additional boilers, continuation of ash-pit tunnel, retaining wall and driveway, foundation for 1000-kw steam turbine and exciter and foundation for water tight pit around foundations for turbine, etc.

McCONNELLSVILLE, OHIO.—The McConellsville-Malta Electric [illegible] be used in case of emergencies. A. Durbin is superintendent.

MILFORD CENTER, OHIO.—The light and water plant, which was recently sold by the village to Dr. John L. Boylan, has passed into the hands of Edward Schambs, of Richwood, Ohio.

NEWCOMERSTOWN, OHIO.—The Newcomerstown Light, Heat & Power Company has increased its capital stock from $25,000 to $100,000.

[illegible] water works will be completed in about two months. H. H. Alexander is superintendent.

OKLAHOMA CITY, OKLA.—General Manager J. W. Shartel, of the Oklahoma City Street Railway Company, has announced that plans have been made for extensive improvements and extensions to the street railway in this city, which will involve an expenditure of about $1,000,000. Work has commenced on the construction of the interurban line to Edmond, 14 miles north of the city. It is the intention of the company later to extend the interurban line to Guthrie.

GRANT'S PASS, ORE.—The Gold Hill Canal Company is said to be carrying on negotiations to acquire the properties of the Gold Ray Water & Power Company, the Golden Drift Mining Company, the Savage Rapids water power, and the Hell Gate water power. The Gold Ray Water & Power Company owns a large electric plant at Gold Ray on the Rogue River, which supplies electricity to Grant's Pass, Gold Hill, Central Point, Medford, Jacksonville and Ashland, and also to a number of large mines in Southern Oregon, the longest of its lines being that to the Greenback mine, 42 miles in length. The Gold Drift Mining Company has a dam in the Rogue River near Grant's Pass and supplies power to operate two large pumps, the water being used for hydraulic mining. The Savage Rapids and Hell Gate power properties have not been developed, though among the most available on the Rogue River. Savage Rapids is five miles above Grant's Pass, and Hell Gate is 14 miles below. The Gold Hill Canal Company has its headquarters at Indianapolis, Ind. The company has a small electric power station at Gold Hill.

NEW PINE CREEK, ORE.—F. E. Russell, chief engineer of the California-Oregon Light, Heat & Power Company, writes that the power plant of the company was destroyed by fire on Oct. 11, and that the company has decided to install an entire new plant. E. Keller is president and manager.

ALTOONA, PA.—The Juniata Water Power Company has entered into a contract with the Citizens' Electric Light Company to supply the latter company with electricity for a term of ten years.

DELTA, PA.—The Delta Electric Power Company has closed a contract with the Ambursen Hydraulic Construction Company, of Boston, Mass., for the construction of a reinforced concrete dam in southeastern Pennsylvania to supply power to the slate quarries and other industries in that district. The dam will have a head of 65 feet, and the power house will be under the rollway of the dam and protected by an inner shell. Work has already commenced on the dam and it is expected to have it completed early in the spring.

HUNTINGDON, PA.—The dam of the Juniata Hydro-Electric Company has been completed and the plant will soon be started. Besides the dam, which will furnish 4000 horse-power, a large steam plant has been erected for generating electricity. The plant will furnish electricity for lighting Huntingdon and Altoona, and will also furnish the Wilson Electric Company with electrical power. The cost of the plant is estimated at about $2,000,000.

NORRISTOWN, PA.—The citizens, on Nov. 5, voted to issue $300,000 in bonds for the construction of sewers and roadways and for enlargement and extension of the municipal electric light plant and other purposes.

PITTSBURG, PA.—A permit has been granted St. Francis Hospital to construct a power house to cost $100,000 to furnish light, heat and power for the hospital.

PITTSBURG, PA.—The special committee of the Select Council, appointed to consider the ordinance requiring the placing of all public service wires underground, adopted a resolution requesting the Director of Public Works to furnish the Council with an estimate of the cost of building a conduit system covering the entire city, also plans and specifications of the same.

POTTSVILLE, PA.—At a recent meeting of the directors of the Edison Electric Illuminating Company and the Minersville Electric Light Company Heber S. Thompson was elected president of both companies. The Edison Electric Illuminating Company has greatly improved its system, and has made long-term contracts with various municipalities. The company has just completed its system for lighting in Orwigsburg and is now lighting the streets of the town in accordance with the contract recently made. Port Carbon will receive electricity for private and public consumption within a short time.

YORK, PA.—The McCall Ferry Power Company, which is building a large dam at McCall Ferry on the Susquehanna River, suspended operations Nov. 2, when the last of the force of 2000 men were laid off. The suspension is due to the closing of the Knickerbocker Trust Company. Charles T. Barney, former president of the Knickerbocker Trust Company, was the chief promoter of the McCall Ferry Power Company, and the trust company is trustee of the bond issue.

GANN VALLEY, S. D.—A telephone company is being organized to install a local exchange and build rural lines.

COVINGTON, TENN.—The Memphis, Covington & Northern Electric Railway Company has applied for a charter for the purpose of constructing an electric railway between Memphis and Covington. The company will be capitalized at $14,000, and the incorporators are C. B. Gillespie and John T. Garner.

LEBANON, TENN.—The Board of Mayor and Aldermen has granted the City of Cedar Mills a franchise to furnish electrical energy to all the manufacturing plants in the city. The company agrees to furnish electricity at the rate of four cents per kw-hour or less, and the city is to receive two per cent of the gross earnings of the company on all such contracts. The city recently contracted with the company to furnish electricity for operating the municipal electric lighting system for the next ten years. It is expected to have the plant in operation within 30 days.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company is contemplating the complete rearrangement of its system and doubling the capacity of its plant. Frank W. White is secretary and manager.

DENTON, TEX.—H. M. Griffin, president of the Denton Interurban Railway & Power Company, has announced that the finances for the construction of the proposed interurban electric line have been arranged for.

FORT WORTH, TEX.—The telephone company is contemplating the construction of additional telephone exchanges in North Fort Worth and the south side to supplement the main building in Fort Worth.

GOLIAD, TEX.—Work has commenced on the construction of an electric light plant in Goliad. Dr. W. L. Chilton is interested in the enterprise.

NEW BRAUNFELS, TEX.—The Landa Electric Light & Power Company is installing a 35-hp motor to operate the Landa elevator. C. C. Platz is superintendent.

SAN ANTONIO, TEX.—The City Council has granted a franchise to the San Antonio Traction Company to extend its Tobin Hill line to one of the suburbs. W. B. Tuttle is vice-president and general manager.

SAN ANTONIO, TEX.—Charles Smith, of San Antonio, is interested in the construction of an electric interurban railway between New Braunfels and Seguin, a distance of fifteen miles. Water power rights have been secured on the Guadalupe River for operating the proposed water plant.

BETHEL, VT.—The Woodbury Granite Company has commenced the construction work on an extensive addition to its cutting plant. The new plant will be equipped throughout with the latest machinery, which will be operated by electricity. The cost of the improvements is estimated at from $75,000 to $100,000.

MORETOWN, VT.—This town will soon be lighted by electricity. The main line of the Moody & Almon system running to Northfield has been tapped about two miles from the village and many of the stores and residences have been wired. R. F. Britain, of Montpelier, who has had charge of the construction of the system, is to be resident engineer.

RANDOLPH, VT.—The White River Electric Company has entered into an arrangement with the Gaysville Power Company whereby the latter company will furnish power for operating the electric lighting system in this village. The Gaysville Power Company has a power plant on the White River which has a capacity of 500 hp. The company furnishes power for the Woodbury Granite Company and the Woodbury stone sheds, where the steam plant will be located, which will be used as an auxiliary in times of low water.

BUENA VISTA, VA.—The Buena Vista Light & Power Company is contemplating installing a new switchboard in its plant and making other improvements.

LYNCHBURG, VA.—C. W. Hancock & Sons, of this city, have secured the contract for the construction of a concrete dam across Cedar Creek on the Natural Bridge property. The dam will be located a half mile below the bridge and will furnish power for an electric plant of 1000 hp. The plant will turnish electricity for lighting the grounds and charging automobiles, which will be used to convey visitors around the grounds. C. I. Johnson is president of the company owning the grounds.

FRIDAY HARBOR, WASH.—Arrangements have been made whereby the streets of the town will soon be lighted again by electricity. The mill [illegible] Brothers, and the machine is now being placed in the mill. The dynamo was removed from the mill the day before the local bank foreclosed on the mill property, and since that time the citizens have been forced to [illegible]

PORT TOWNSEND, WASH.—The Pacific Electric Company is making preparations to install electric lighting plants in the Fairmount shingle mill, owned by Lundstrom & Fischer, and in the Diamond shingle mill at Center.

PROSSER, WASH.—The Prosser Traction Company, recently organized to construct an electric railway in this section, is preparing to file an application for a power right on the Yakima River. Frederick [illegible] selected a site seven miles below Prosser, which if secured the company [illegible] Prosser. The traction company now holds two franchises, one from this [illegible]

[illegible] utilize the water power of the Upper Cascade Rapids for manufacturing and other purposes.

BLUEFIELD, W. VA.—The Bluestone Traction Company will soon commence construction work on its South Bluefield extension to Ghent. The rails, poles, wires, etc., have already been purchased. Surveys have also been completed for the Princeton extension, which will be twelve miles in length. P. M. Wallizer is general manager of the company.

ELKINS, W. VA.—The Elkins Electric Railway Company has been granted a franchise by the county court to construct and maintain an electric railway on the county roads in Leadsville, Roaring Creek and Beverly districts.

WHEELING, W. VA.—It is understood that the National Telephone Company will soon make application to the county courts for permission to place its wires underground along the county road through the Narrows through Glendale.

MADISON, WIS.—The Wisconsin Capitol Commission will receive separate proposals until Nov. 22 for furnishing the equipment for the heating and power plant for the capitol building now under construction at Madison, as follows: Boilers, engines, electrical generators and motors, mechanical stokers, feed pumps, building supply pumps, storage tanks, conveying machinery, hoisting crane and open heaters. Specifications and blank forms may be obtained from Lew F. Porter, secretary of the Capitol Commission.

MARINETTE, WIS.—A. W. Wilson, of Marinette, and A. L. Gillette, of Oconto, have applied to the City Council for a franchise to establish a new lighting system for the city of Marinette. The petitioners offer to furnish electricity for lighting purposes for one-half of the present rate, and also state that they intend to start an interurban railway from Marinette to Peshtigo. Electricity for operating the system will be secured from the water power of the Perley Lowe Company on the Peshtigo River.

NORTH MILWAUKEE, WIS.—The North Milwaukee Light & Power Company is contemplating changing part of its system to alternating current. Theodore Waech is manager.

WAUWATOSA, WIS.—The citizens are considering the question of establishing a municipal electric light plant.

CHEYENNE, WYO.—The Big Horn Power Company, which was recently incorporated with a capital stock of $700,000, proposes to supply central Wyoming with electricity for lighting and power purposes. The company is planning to construct a dam on the Big Horn River, fourteen miles from Shoshoni. The plant will have a capacity of 10,000 horse-power, and will furnish the Boysen Mining Company with 500 horse-power, and the remainder will be distributed among the towns within a radius of 100 miles. Among the towns to be supplied are Lander, Shoshoni, Thermopolis, Riverton and Arapahoe. Ultimately the company intends to connect these towns with an electric railway.

OKOTOKS, ALB.—The Okotoks Electric Light & Power Company closed its plant on Nov. 1, and has notified the Town Council that it will be sold to the first purchaser, as it has been run at a loss since its inception.

STRATHCONA, ALB.—The ratepayers voted in favor of granting a franchise to the Strathcona Radial Tramway Company, which was organized for the purpose of building an electric street railway system here. The company has already made application to lay tracks on several of the streets in the city of Edmonton.

BRANDON, MAN.—An electric lighting plant installed at the water works has proved so successful that the Council is considering the installation of a plant to do all the municipal lighting. Address Superintendent Shaw.

MINNEDOSA, MAN.—Surveys have been completed for the development of a municipal power plant here, and arrangements are now being made for the calling of tenders. Address E. O. Dennison.

SOURIS, MAN.—At a meeting of the Town Council the clerk was instructed to write D. A. Keiser, Winnipeg, Man., regarding the construction of a dam in the Souris River for the ultimate development of electrical power. Address Alderman Stirling, Souris.

LONDON, ONT.—The City Council has decided to adopt the report of the special power committee recommending the submitting of a by-law to the people on Jan. 6, 1908, calling for $235,000 for the construction of a distributing plant for the city for Niagara power, and providing for new street lamps and equipment. Engineer Richards submitted an estimate on the lighting end of the proposition which has not been included in the previous report, which will require an additional sum of [illegible]

STAMFORD, ONT.—The township of Stamford has completed arrangements for lighting its main highways by a private corporation allied with the Ontario Power Company. The municipality will pay the company $500 a year for lighting the roads from Niagara Falls to a point [illegible] Stamford for two miles along the Lundy's Lane Road. Incandescent lamps will be used on these highways. Many residents along the road [illegible]

TORONTO, ONT.—Surveys have been completed which the Hydro-Electric Power Commission has been making with a view of obtaining routes for transmission lines from Niagara Falls. Surveys have been made from Niagara Falls to Toronto, Niagara Falls to Hamilton, to London, via Woodstock, and to London via Berlin, Stratford and St. Mary's branches; also to St. Thomas, to Preston and Galt. The routes which have been laid out would practically give a double line of wires [illegible]

[illegible] Electric Light & Power Company to J. T. Kissack, who, together with his brother, is proprietor of the Paisley Electric Light Company, Paisley, Ont.

[illegible] the electric plant owned by Hiram Walker & Sons, Ltd. The company is now installing a 150-kw, 2200-volt, 2-phase Westinghouse generator direct connected to McEwen engine, made by the Waterous Engine Company, of Brantford, Ont.

New Industrial Companies.

THE WESTERN MULTIPHONE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000,000.

THE ASUNCION CITY IMPROVEMENTS, ELECTRIC LIGHT, POWER & TRAMWAYS COMPANY, of Portland, Me., has been incorporated with a capital stock of $3,000,000, for the purpose of conducting a general construction business. James E. Manter is president of the company and Clarence E. Eaton is treasurer, both of Portland.

Legal.

POWER OF CITY TO REGULATE TELEPHONE RATES.—A city authorized to fix and regulate telephone rates granted a franchise under the statutes of California, providing for the sale of franchises, under which a telephone company was given the right for a period of fifty years to construct, maintain and operate a telephone line. The ordinance fixed the charge not to exceed $60 per annum for private telephones until the exchange comprised more than 10,000 telephones, after which the rate should not be increased by more than a sum equal to $6 per annum for each 1000 telephones connected in excess of the 10,000. In consideration for this franchise, the telephone company furnished thirty telephones to the city gratis, and also provided fifty pairs of wires in its conduits and the upper arms of its poles for the use of the city's police and fire-alarm telegraph system, and agreed to pay a 2 per cent gross earnings tax. It was held that the city by such ordinance did not surrender its right to regulate rates for the 50-year term of the franchise, but that the city was entitled to reduce the rates below the maximum charge so fixed during the term of the franchise. It was contended by the telephone company, in an action to restrain the enforcement of an ordinance which lowered the rate, that the power conferred was only a power to fix and determine charges once for all; that is, permanently, by contract, but the contention was not sustained and its was held that the words themselves, "fix" and "determine," when applied to rates, fairly import a continuing power of regulation. Home Telephone & Telegraph Company vs. City of Los Angeles, United States Circuit Court, Fed. Rep. 554.

LIABILITY OF TELEPHONE COMPANY FOR DEATH OF EMPLOYEE.—A lineman in the service of the Cumberland Telephone & Telegraph Company went out with others to push back into a perpendicular position a pole on the line of the company which had leaned over from a heavy sleet. The pole carried a large number of wires and was about 45 feet high. The telephone wires were up near the top; and down about 30 feet from the ground there ran a high-voltage circuit of an electric light plant. When they had dug the earth out around the foot of the pole and attempted to push it back to a vertical position it was found that it came in contact with the electric light wire. As it was raining, the pole and the electric light wire were wet, and when the pole came in contact with the wire the pole began to smoke. The foreman determined to place an insulator on the pole and fasten the electric wire to it, and the lineman was directed to do the work. While he was working he received a shock from which he died. It was held that the company was liable in damages, and a verdict of $10,000 was awarded. The lineman had not assumed the risk incident to insulating the wire. The servant assumes the risk ordinarily incidental to his work, conducted with ordinary care; but he does not assume risks due to the negligence of the master, of which he has no knowledge, and which are not so obvious that by ordinary care in the discharge of his duties he should know them. It is the duty of the master to furnish the servant a reasonably safe place to work, and reasonably safe appliances for performing his work; and the servant, in performing his duties, where inspection is not in the line of his duty, has the right to assume that the place and the appliances are reasonably free from danger, and to act upon the assumption, unless he knows of the danger, or by ordinary care in the discharge of his duty he should know of it. In cases like this the burden is on the defendant to show that the employee took the risk with the knowledge of the danger, or that he failed to use ordinary care for his own safety, but for which he would not have been injured. Cumberland Telephone & Telegraph Company vs. Graves, Court of Appeals of Kentucky, 104 S. W. Rep. 357.

Obituary.

MR. H. F. BENDER.—Mr. Harry F. Bender, treasurer of the Gamewell Fire Alarm Telegraph Company, of New York City, was taken suddenly ill last week when he was leaving a Mount Vernon train at the Grand Central station. He was removed to the station master's office and died shortly afterward.

MR. C. D. WYMAN.—The sudden death is announced of Mr. C. D. Wyman, of Boston, in a railway train in Montana while on his way from Boston to Seattle. He was looking after the interests of the Stone & Webster Corporation in that region. Mr. Wyman was widely known in the electric railway field, having been connected with enterprises in New York City, Milwaukee and New Orleans, and taking an active part in [illegible] a wife and [illegible]

Personal.

MR. W. EDGAR [illegible]

MR. W. EDGAR REED, electrical engineer, formerly with the Westinghouse interests in Paris for some time, and also for a considerable time at East Pittsburg, has opened an office for general consulting work in the Machesney Building, Pittsburg, Pa. Mr. Reed entered the employ of the Westinghouse Electric & Manu- [illegible] as an engineering apprentice. Upon finishing his apprenticeship course in the Westinghouse works he took a course in the Massachusetts Institute of Technology, from which he was graduated in 1897. Later he took a post-graduate course in Paris at the laboratory of the late Prof. Henri Moissan, the well-known chemist and metallurgist. Following this Mr. Reed became connected with the French Westinghouse Company at Havre, France, filling the position of chief designing engineer of that company from 1898 to 1903. In 1903 Mr. Reed went to Pittsburg, filling the position of designing engineer for the French and American Westinghouse companies. This position he has filled up to this time. He has had a long experience in designing both continuous and alternating current machinery, and has had direct charge of induction motor designing for several years. He has also had much experience in the practical application of direct and alternating current motors and generators, and is thoroughly familiar with their characteristics and applications. Mr. Reed is a member of the American Institute of Electrical Engineers, and also of the Engineers' Society of Western Pennsylvania. He is a nephew of Mr. Albert Schmid, so long associated with the Westinghouse engineering and manufacturing departments.

MR. JOHN E. BRADY has associated himself with Alfred W. Varian, Esq., in the general practice of law, with offices at 44 Pine Street, New York.

MR. GUY P. WRIGHT, formerly of South Framingham, Mass., has accepted the position of chief engineer of the municipal electric light plant in Holyoke, Mass.

MR. W. E. HASELTINE, superintendent of the Dexter Electric Light Company, Dexter, Me., has resigned, and will leave for Raleigh, N. C., where he has accepted a similar position.

MR. ALEX. HENDERSON, of the American Circular Loom Company, is on a long Western trip and reported recently from Billings, Mont. He finds good conditions and prospects in that section of the country.

MR. EDWARD E. SCRIBNER has joined the staff of the Holophane Company, with headquarters in New York. Mr. Scribner's work will lie in interesting architects in modern methods of illumination.

COL. M. E. THORNTON, of Hickory, N. C., the president of the Thornton Light & Power Co., president of the Water-Power Electric Co., which is just ready to be developed, and also the contemplated street railway, desires the services of a competent man to manage the entire business for him, and one who can assist him in the financing of the water-power electric enterprise at once.

DR. C. P. STEINMETZ is delivering at the Polytechnic Institute, Brooklyn, a series of eight lectures on light, radiation and illumination. The term is from Nov. 7 to March 12, and the fee for the course is ten dollars.

MR. HUGH C. MACLEAN, of Toronto, Canada, well known as a technical and trade publisher, has purchased the *Canadian Electrical News*, which he proposes to bring up to the level of his other enterprises in modernity and efficiency.

MR. C. O. BAKER, JR., has been on a visit to Kansas and was last heard of at Wichita. While there he posed as the "Platinum King," and was rated by the papers as "many times over a millionaire." The impecunious East is awaiting his return eagerly.

MR. THOMAS NEWHALL, West End Trust Building, Philadelphia, has sold his interest in the firm of J. L. Blackwell & Company, and the construction company, Newhall & Company, has been dissolved. He is now devoting his attention to the purchase and sale of the securities of well-established electric railways.

MR. [illegible] MARCONI [illegible] fection of his newly inaugurated service of transatlantic wireless telegraphy, Mr. Marconi announces he is giving considerable thought to the employment of Hertzian waves for the transmission of power as well as a means of communication."

MR. H. W. CONNELL, of the firm of Connell, Sykes & Connell, engineers, 40 West Street, New York, has recently been retained as consulting engineer to the Hannawa Falls Power Co., of Potsdam, N. Y. Under his supervision the company is making large additions to its equipment and extending its transmission lines. Mr. Connell will spend a large part of the coming winter at Potsdam, giving this work his personal attention.

PROF. ROBERT SIBLEY, professor of mechanical and electrical engineering at the University of Montana, has resigned his chair in the university in order to devote himself exclusively to engineering consulting practice, with offices in Missoula. Electrical and hydraulic work will be made specialties. Mr. Nathaniel P. Craighill, formerly with the Mechanical Appliance Company, Milwaukee, and a graduate of Massachusetts Institute of Technology of the class of '93 has, as recently announced in these columns, been elected to the chair of mechanical and electrical engineering.

MR. M. J. BUDLONG.—Two important annual meetings of two of the largest automobile trade associations were held last week, the Association of Licensed Automobile Manufacturers, under whose auspices the Madison Square Garden show was held, and the National Association of Automobile Manufacturers. The Licensed Association met at its offices, and the most important act was the retirement of E. H. Cutler as general manager and the election of Milton J. Budlong to the position. Mr. Cutler will hereafter devote his entire attention to the Knox automobile concern, with which he has been identified for several years. Mr. Budlong was formerly president of the Electric Vehicle Company, of Hartford, but resigned a short time ago. He is one of the best known men in the automobile world.

MR. H. L. HIBBARD, electrical expert to the Bureau of Construction and Repair, U. S. Navy Department, has resigned that position to enter the employ of the Cutler-Hammer Manufacturing Company, of Milwaukee, makers of electric controlling devices. Mr. Hibbard's experience in navy yard and shipboard work extends over a period of eight years, four of which were spent in the office of the superintending naval constructor at Newport News, in supervising installations of electrical apparatus on ships built and equipped at that yard. More recently Mr. Hibbard has been stationed at Washington where, as electrical expert to the Bureau of Construction and Repair, he has had supervision of all electrical work coming under the cognizance of that bureau. In his new position with the Cutler-Hammer Company, his thorough knowledge of navy requirements and methods will undoubtedly be of great value in the further extension of that company's line of electric controlling panels for navy yard and shipboard use.

Trade Publications.

DEAN ELECTRIC COMPANY, of Elyria, Ohio, has issued a neat pamphlet entitled, "An Independent Telephone Plant," and descriptive of its fine new factory and its equipment. The company has increased its plant three times in three years. The power plant includes two Stirling boilers, two Ball cross-compound engines and two Crocker-Wheeler direct-current generators of 200 kw each. The various shops are driven electrically.

THE CENTRAL ELECTRIC COMPANY, Chicago, is sending out a number of attractive circulars calling attention to the various types of Columbia lamps. The company reports a very much increased business this year in Columbia lamps as compared with any previous year in its history, and confidently asserts that this increased business is due entirely to the many superior qualities of the Columbia. The Central Electric Company asks that those who contemplate buying incandescent lamps in the near future should communicate with it.

LIFTING MAGNETS.—The Cutler-Hammer Clutch Company in a handsome 32-page catalogue describes and illustrates its line of lifting magnets for handling pig iron, steel stampings, castings, scrap and other material. Several full-page illustrations show magnets lifting great burdens, and diagrams are given showing the principles of construction. A new cable take-up device is illustrated and described, by which the strong inductive reaction which occurs when the circuit is suddenly opened on a magnet coil is automatically shunted to discharge resistance, thus protecting the lifting coil.

Business Notes.

THE FERRACUTE MACHINE COMPANY, of Bridgeton, N. J., manufacturer of presses and dies for sheet metal work, made shipments of its presses last month to India, Austria, France and England, besides several carloads of large presses to manufacturers of electrical goods in this country. Its shops are provided with electric cranes and installed with modern machinery, placing the company in a position to handle large orders.

THE NORTH SHORE ELECTRIC COMPANY, of Beverly, Mass., has taken over the business of the Greenlaw Electric Company, of Beverly, Mass. Joseph W. Lee retires from the company and Joseph M. Greenlaw will manage the Beverly store, and his district will cover Beverly, Salem, Wenham and Hamilton. The North Shore Company has also taken over the business of Charles C. Phillips, in Lynn. John Andrews, of Gloucester, is treasurer and general manager.

J. L. SCHUREMAN COMPANY, manufacturer of electric motor controlling devices, whose main office is at 70 to 86 West Jackson Boulevard, Chicago, Ill., has recently moved its New York office to 114 Liberty Street, where its interests will be looked after by Mr. W. R. Harvey. This move increases the facilities which this company has enjoyed in New York, and places it in an excellent position to bid on all work without regard to location of the project.

THE WIRE & TELEPHONE COMPANY OF AMERICA recently purchased the entire equipment and stock of the Reed Electric Cordage Company, of Syracuse, N. Y. This additional equipment gives the Wire & Telephone Company a manufacturing capacity which enables it to take care of its rapidly growing demand, not only for bare copper wire, magnet wire and rubber covered wire, but all grades of weatherproof, office, fixture and annunciator wire. The well-established trademark "Romeoid" is a guarantee of quality and has given this progressive company an excellent standing in the trade. The fact that it draws the wire for its insulating departments insures a conductor in the insulated product perfect in every respect.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 5, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

869,873. INSULATOR; Duncan M. Bass, Fackler, Ala. App. filed June 17, 1907. An insulator comprising a vertically slotted casing having an insulating block therein transversely recessed to receive a conductor opposite said slotted portion of the casing.

869,885. SIGNAL BELL; George F. Drew, Brunswick, Me. App. filed Oct. 13, 1906. The bell is specially formed with laterally extending portions between which the clapper can vibrate.

869,914. ELECTRIC ARC LAMP; George M. Lane, Lanoka, N. J. App. filed March 24, 1905. Details of gravity-feed controlling mechanism for an arc lamp including a compound lever arrangement connected to the clutch.

869,934. DYNAMO ELECTRIC MACHINERY; Charles A. Parsons and John H. Armstrong, Newcastle-upon-Tyne, England. App. filed Feb. [illegible] 1906. A [illegible] winding for field magnets [illegible] pole pieces with grooves in their face parallel to the axis of the machine and adapted to contain flanged elements of magnetic material.

869,943. ALTERNATING-CURRENT MOTOR CONTROLLER; August Sundh, Yonkers, N. Y. App. filed Dec. 18, 1905. Motor-controlling apparatus for elevator hoists including features by which the contacts are successively operated through a pilot circuit by pneumatic operation.

869,955. SWITCH FOR TROLLEY WIRES; Frank M. Zimmerman, Aurora, Ill. App. filed Oct. 23, 1905. At a trolley turn-out patentee provides a movable double-conductor element which swings into alignment either for the direct track or the turn-out.

869,970. RAILWAY SIGNAL AND SAFETY APPLIANCE; Charles J. Kintner, New York, N. Y. App. filed Aug. 10, 1905. Includes mechanical features and electrical circuits of a signal system having among other features a train stop lever on the roof of the car, which is engaged by an arm from the [illegible] signal.

870,002. CABLE SUSPENSION DEVICE; Malcolm C. Williams, Kansas City, Mo. App. filed Oct. 3, 1906. A wire is bent into special form so as to [illegible] wire and support a cable so as to be removable without the use of special tools.

870,015. STORAGE BATTERY; Joseph C. Cook and Edward Sokal, Buffalo, N. Y. App. filed May 10, 1905. Storage battery plate in which the lead has a multitude of very slender cones which serve to hold the active material in place.

870,029. SYSTEM OF MOTOR CONTROL; Jay H. Hall, Cleveland, Ohio. App. filed March 19, 1906. System for controlling one or more electric motors from a distant point. A motor has a magnetically operated switch and an auxiliary switch mechanically opened by the closure of the main switch.

870,035. DYNAMO ELECTRIC MACHINE; Dugald C. Jackson, Madison, Wis. App. filed Dec. 22, 1902. Provides a single-phase, alternating-current generator adapted to be self-starting. Form of a series commutator motor with a starting resistance in the circuit.

870,042. RESISTANCE ADJUSTING DEVICE; Hector P. MacLagan, Chicago, Ill. App. filed Oct. 11, 1905. Has a resistance winding circularly disposed in the path of a pivoted arm which makes contact with the windings throughout its arc of movement.

870,068. FIRE ALARM; Robert M. Whipple, Mayfield, Idaho. App. filed June 19, 1907. A thermostatic alarm in which an electric signal circuit is closed by the expansion of metal under the action of heat.

870,078. ELECTRIC SWITCHING APPARATUS AND CONTROLLING APPARATUS THEREFOR; Alfred Blackmore, Kensington, London, England. App. filed April 2, 1906. Provides a magnetic switching apparatus working with low voltage currents for controlling high-voltage switch at a distance. Has a ratchet mechanism to obtain the successive alterations in opposite directions.

870,080. TROLLEY WHEEL; Charles P. and Homer C. Bostian, Milton, Pa. App. filed July 15, 1907. The peripheral groove of the trolley wheel is inset with V-shaped spurs for breaking up ice on the conductor.

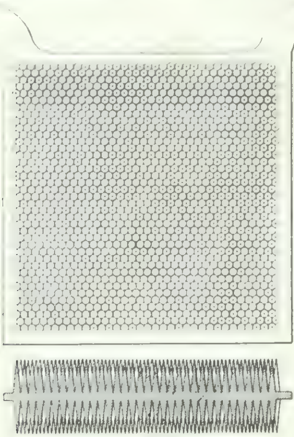
870,102. ELECTRIC SIGNALING APPARATUS; Felix B. Herzog, New York, N. Y. App. filed July 12, 1889. Form of circuit closure which will produce changes in the normal circuit conditions at its station which will continue until some act is performed at a distant point.

870,139. TRACK RELAY; John D. Taylor, Swissvale, Pa. App. filed April 18, 1907. An alternating-current relay in form of a wattmeter [illegible] frequency. The rotation makes contact [illegible].

[illegible]

two.

870,145. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS; Harry [illegible] Apr. filed Jan. 18, 1907. Among



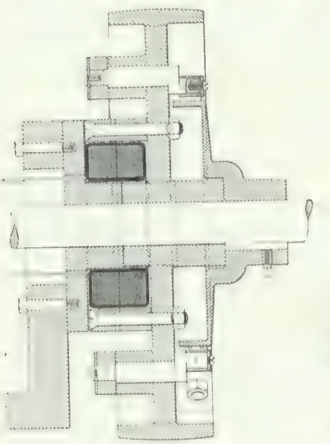
[illegible] Storage Battery

other features of a signal system, patentee has a specially constructed contact shoe in the form of a downwardly spring-impelled pivoted arm.

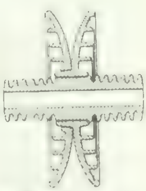
870,147. MULTIPLE UNIT CONTROLLING SYSTEM FOR ELECTRIC LOCOMOTIVES OR MOTOR CARS; Ragnar Wikander, Westeras, Sweden. App. filed Jan. 5, 1907. System for controlling the speed of trains having two or more electric locomotives. Has means whereby the respective voltages supplied to the motors of each unit may be independently regulated.

870,149. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph L. Woodbridge, Philadelphia, Pa. App. filed April 19, 1905. Relates to systems in which use is made of a battery and its booster in connection with both alternating-current and direct-current lines.

870,150. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph L. Woodbridge, Philadelphia, Pa. App. filed May [illegible], 1905. Relates to systems of distribution in which there is an alternating-current and [illegible]



870,166.—Electric Clutch



[illegible]—Wall Insulator

a direct-current circuit, with means for transmitting energy in either direction between the two. Designed to provide more sensitive means for automatically effecting such transmission, and for controlling the power effect on the alternating-current circuit.

870,166. ELECTRIC CLUTCH; Noah S. Harter, Waukegan, Ill. App. filed June 25, 1907. Clutch having a driving and a driven member connected by friction straps, and electromagnetic means carried by a third stationary member and adapted to tighten said straps.

[illegible]. INTERCOMMUNICATING TELEPHONE; W. W. [illegible], Wollaston, Mass. App. filed Sept. 17, 1906. A formed metal telephone box comprising a base, a body rigidly secured to said base and a two-part cover removably secured to said body and adapted to support the transmitter; in combination with a bell movement, induction coil, receiver switch, signaling switch and necessary connectors, all removably secured within said body.

870,169. APPARATUS FOR MAKING RAIL BONDS; Albert B. Her[illegible] An apparatus for [illegible] which a conductor is [illegible] such surface into a plurality of parts through which the conductor is cut to make two separate bonds.

870,187. WALL INSULATOR; Fred M. Locke, Victor, N. Y. App. filed July 18, 1907. Wall insulator for high-potential currents having ribbed cylindrical portions projecting on either side of the wall and separated therefrom by flaring petticoats.

870,198. ELECTRICAL HORN; William E. Russell, Danbury, Conn. [illegible] vibrating diaphragm.

[illegible]. EVAPORATOR; [illegible] March 12, 1906. An apparatus for evaporating corrosive liquors [illegible]prising a receptacle having a refractory lining and non-corrodable electrodes which extend below the liquid level. Has conductors connected to said electrodes and supported entirely above the liquid level.

870,232. SIGNALING DEVICE FOR RAILWAYS; George S. Getschell, Los Angeles, Cal. App. filed Jan. 24, 1907. Railway signal having a plurality of features including depressible tappets adjacent to the track rail which are impelled to close the signal circuits by the wheels of a passing train.

870,233. PROCESS OF MANUFACTURING REFLECTOR INCANDESCENT LAMPS; Howard Gilmore, Brookline, Mass. App. filed Aug. 16, 1905. The lamp is manufactured with a reflector permanently embodied within the globe.

870,253. ELECTRIC COMPENSATOR; Edmund O. Schweitzer, Chicago, Ill. App. filed Nov. 2, 1904. Means for automatically correcting the errors caused in electric instruments by internal and external variations of temperature. Includes a compensating element acted on equally by the temperature of the room or instrument.

870,262. THERAPEUTIC LAMP; Julius E. Wantz, Chicago, Ill. App. filed March 9, 1907. A concave casing has a plurality of separate lamps with individual parabolic reflectors and having their circuits separately controllable by plugs and jacks.

870,313. DYNAMO ELECTRIC MACHINE; Mathias Pfatischer, Philadelphia, Pa. App. filed July 23, 1906. Features of construction and arrangement of a magnetic circuit of a commutating field for alternating-current motors.

870,326. ELECTRIC FURNACE; Frank J. Tone, Niagara Falls, N. Y. App. filed March 7, 1905. An electric resistance furnace having a self-sustaining resistance conductor composed of shaped pieces of resistance material assembled to form a continuous electrical conductor.

870,328. ELECTRIC SIGNALING MECHANISM; Jean F. Webb, Jr., Chicago, Ill. App. filed May 31, 1907. Has a step-by-step unidirectional rotatable shaft carrying an escapement wheel and a ratchet disc and constituting a selecting mechanism whereby a particular signal of a line may be operated.

870,341. INCANDESCENT LAMP; Herman Boehm, Youngstown, Ohio. App. filed Nov. 21, 1906. An incandescent lamp bulb of cylindrical formation throughout the remaining portion of its length flattened at opposite points, the flattened portions extending from one end of the bulb to and terminating at the cylindrical portion, and leading-in wires flattened against the flat sides of the bulb.

870,353. CIRCUIT CLOSER; Theodore M. Foote, Allston, Mass. App. filed Nov. 3, 1906. Has two substantially similar toothed wheels secured together and having their teeth slightly displaced from one another. One is of insulating material whereby a contact engages the other only after a slight angular interval corresponding to the displacement.

870,376. CONTACT GALVANOMETER; John W. Manley, New Barnet, England. App. filed Sept. 29, 1906. Electric indicating apparatus having a pair of conductors belonging to two distinct circuits and twisted on each other, said twisted conductors being coiled around the field of play of a magnetized needle.

870,423. ELECTRICAL THERMOSTATIC ALARM; Joda Finch, Lyndhurst, N. J. App. filed Feb. 26, 1907. A thermostat adjustable to operate at any predetermined temperature; has a form of mechanical thermometer with an adjustable contact in the path of the pointer.

870,4[illegible]. CONNECTING DEVICE; George A. Schnaufer and Harry G. Smuck, Denver, Col. App. filed July 7, 1906. Relates to electrical connections and more particularly to a connecting device for telephone and electric lighting wires by which tapped connections are quickly made with the usual service lines.

870,486. CONDUCTING WIRE SUPPORT AND INSULATOR; Harvey W. Wistner, Ogden, Utah. App. filed June 13, 1906. A two-part insulator in the form of a split sleeve which can be placed upon a wire so as to surround the same. It is exteriorally threaded so as to enter openings in the telegraph pole cross-arms.

870,490. COMBINED ELECTRIC CONNECTOR AND SWITCH; Stephen F. Burbank, Wilmington, N. C. App. filed Jan. 24, 1906. A revoluble contact device comprising two sets of insulated conductors, the conductors of one set having sockets receiving projecting portions of the conductors of the other set, said sets of conductors being relatively revoluble to each other through 360 degs.

870,495. AUTOMATIC RESOLDERING DEVICE FOR ELECTRICAL PROTECTIVE APPARATUS; Frank B. Cook, Chicago, Ill. App. filed May 11, 1907. A repairing device for thermal protectors of the character described, comprising two pairs of normally separated spring members, means for normally holding the pairs of spring members in this separated relation, and a thumb-piece adapted to be depressed whereby the contact between each pair of spring members is closed.

[illegible]. APPARATUS FOR SYNCHRONIZING MOTORS; W[illegible] P. [illegible], Cambridge, Mass. [illegible] An apparatus for synchronizing motors for the driving mechanisms of telescopes at remotely situated points.

[illegible]. PROCESS OF PRODUCING CARBON TETRACHLORID; [illegible] J. [illegible], New York, N. Y. [illegible] The process of forming a chlorid of carbon which consists in contacting incandescent carbonaceous material with a stream of chlorin, removing the products of reaction from the point of formation and condensing the same.

[illegible]. INDIVIDUAL PROTECTOR UNIT; [illegible] Ill. App. filed [illegible] a sheet-metal base, insulating portions secured to one side [illegible] base, spring members carried by the said insulating portions and inserted through holes therein, and suitable fuses and lightning arresters held in place by the said spring members.

[illegible]. ELECTRIC[illegible] ATTACHMENT FOR MOLDBOARD [illegible]; John R. Dawkins, Dallas, Tex. App. filed Sept. 30, 1907. Patentee connects the blade of his plow in an electric circuit for the stated purpose of preventing the soil from adhering thereto.

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CONTENTS.

THE FINANCIAL RECOVERY.

Slowly but surely the financial situation is righting, and one of the best signs of this is the dwindling premium on currency. If there be hoarding, there can be no trade but the primitive and barbaric kind called barter; and reduced to that civilization itself disappears. Money that was hidden away under the impulse of panic is again emerging freely from holes in the ground, and the use of it to settle debts and make purchases of goods or securities is vitally helpful.

The worst hoarders of all at the present juncture are the banks themselves, many of which are as criminal in their denial of proper credit as others are in the looseness of their management. If, instead of denying credits to manufacture and industry and piling up huge, abnormal reserves that are no earthly good to anybody, the banks would see to it that no good commercial paper was refused discount and that the hands and wheels of industry could thus be kept going, the banks would be discharging the function for which they were created. As Mr. J. J. Hill said truly this week: "Credit is the atmosphere which inflates the lungs of business, and when it is greatly lessened, business must be reduced in proportion or be quietly smothered." It is now for the banks to forget there was a panic and to live up to their opportunity.

Business, for example, has been and is good in the electrical field, but denied the ordinary, legitimate facilities it would fade away; while on the other hand, the regular demands for electrical apparatus and energy cannot be satisfied through a long series of years to come. Last year the consumption of that character was $12 per capita in this country. During the past month we have published nearly 300 separate items of new construction, and have noted that since the middle of October operations have been proposed by 57 new electric companies with a capital of $28,000,000. This does not include all the previous work laid out since January. Discreetly financed, that development can but add to the wealth, resources and comfort of the whole population, but it must have for that very purpose some of the millions salted away with pessimistic cowardice a few weeks ago, and now being held in worse than idleness. There are times when courage is a much higher virtue than conservatism, and this is one of them

ABNORMAL CONDITIONS IN TRANSFORMER OPERATION.

An article in this issue by Mr. J. Murray Weed again directs attention to the investigation of the abnormal primary current and secondary voltage on placing a transformer in circuit, as reported by Mr. Tyrvge Jensen in our issue for Sept. 14. The author of the present article agrees with the investigators in attributing the abnormal phenomena observed to the increase in the reluctance of the transformer core with the higher magnetic densities. It seems well to mention in this connection an additional cause which contributed somewhat to the results, namely the electrostatic capacity of the transformer windings. If the capacity effect were the predominating one, then an enormous rush of charge would take place upon closing the

primary circuit at the instant when the supply e. m. f. has its maximum value. The fact that no such rush was observed proves either that the capacity effect was insignificant or that the oscillograph was not sufficiently sensitive to record the rush on account of the brevity of its existence. It is probable both that the capacity was small and that the instruments were unable to detect the current representing the rush of charge. In view of the results actually recorded by the instruments used, the explanation offered by Mr. Weed covers in a clear manner the phenomena known to exist.

Two-Candle Power Sign Lamps.

Some central-station companies have discouraged the use of 2-cp lamps for electric signs, because they have feared that the use of such small lamps would reduce the revenue from sign lighting. It has also been urged that the 2-cp lamp is very inefficient, taking about 12 watts, as compared with 19 or 20 watts, for the 4-cp lamp. While it is true that the efficiency of the 2-cp lamp is much lower than that of the 4-cp lamp, yet for the same amount of power the larger number of lamps that can be operated in a sign should more than compensate for this. While it would cut down the revenue from existing sign users to substitute 2-cp for 4-cp lamps, the general use of 2-cp lamps means in the long run larger revenue because of a much more general use of electric signs. If, for example, a small merchant can obtain an electric sign with 2-cp lamps, at a cost of two-thirds what he would pay for 4-cp, many more small merchants will invest in signs. We have in mind one city where the electric sign business has had a wonderful growth without any special effort on the part of the central-station company, except to give free renewals of 2-cp lamps. The signs in this city are numerous, and in many cases more legible than the same signs would be with 4-cp lamps. The larger the lamps, unless the sign is a great distance away, the greater is the blurring effect. In a sign where 2-cp is ample, the greater efficiency obtained by 4-cp lamps is worse than useless. The low operating cost of 2-cp lamp signs is undoubtedly a great stimulus to the sign business in the city referred to, and the example might well be followed elsewhere.

The Leakage Coefficient of Induction Motors.

Of all of the calculations relating to dynamo-electric machines that dealing with the "stray" flux in the air gap is the one most subject to error, by reason of the fact that no method has ever been devised for the exact determination of such flux. The importance of obtaining a method of calculation that gives results in reasonable agreement with actual conditions will be appreciated when one considers that the performance of alternating-current machinery varies largely with the value of the local magnetic reactance of the windings. In fact, it may truly be stated that no calculation connected with the predetermination of the performance of an induction motor is of greater importance than that of the magnetic leakage. It is not correct to infer from the statement just made that it is essential for the value of the leakage to be known with absolute accuracy. Indeed, a formula based on absolutely accurate theory for representing the leakage, in addition to being impracticable for use on account of its complication, would lead to absurd fineness, because experience shows that induction motors built according to the same patterns and by the same tools in the hands of the same workmen differ as much as 15 per cent in their "leakage coefficients." Thus, a simple practical working formula which gives results differing by less than 15 per cent from actual test results on motors of various types is entirely satisfactory for all purposes for which the formula can be used. A formula that seems to possess the requisite degree of accuracy is given by Mr. R. E. Hellmund on page 1004 of this issue. In its final shape, especially when expressed in "safe" terms, the formula is extremely simple and convenient, all of the factors being reduced to machine dimensions.

Rubber Insulation for Electrical Conductors.

There used to be a standing subject of disputation among electrical engineers over which an animated discussion could ordinarily be invoked upon the smallest opportunity—namely, the utility of storage batteries to central stations. That subject has lost most of its charm from the standpoint of a controversialist, because so much more is now known about storage batteries, both from practical experience and from laboratory study. A fairly good substitute for controversy in recent times has appeared in the matter of specifications for hard-rubber cables. There are some persons who are to be envied for the enthusiasm they can develop on this topic at short notice. Engineers have been using rubber-covered wires of one kind or another for more than half a century, yet the physics and the chemistry and the practical applications of rubber-covered wires are so complex that we are still compelled to employ empirical rules in many important details. What are required are more information, analysis, generalization and experience in the direction of high-tension cables.

The article on this subject by Mr. Fred J. Hall, of which the first section appears on page 1009 in this issue, contains a number of useful facts and practical deductions. It is pointed out that the acetone test is often misinterpreted, and that the extractive matter in rubber is more likely to interfere with the success of the vulcanization process than with the durability of the material. It is recommended that 7 or 8 per cent of extractive matter in gum, as obtained by acetone test, including free sulphur, should be regarded as permissible. It is claimed in regard to the stretching test for mechanical elasticity, that specifying a stretch test for high-tension rubber insulation invariably means reducing the electrical factor of safety. If this statement can be substantiated by relative observations, it should certainly be widely distributed. It is in contravention to views that have been published by persons trained in the rubber-cable industry. The paper recommends, however, that in small sizes of wire a stretch test, with the very moderate extension ratio of three, should be adopted.

In regard to the high-voltage test, it is recommended that either twice the maximum working voltage should be applied to the cable for 30 minutes or that 2½ times the maximum working voltage should be applied for 5 minutes. If these two aplications are intended to be considered in the light of experience as equally severe, the figures would indicate that between these limits the time of applying the voltage should be inversely as the eighth power of the voltage. A half-hour test is, we believe, altogether too long for practical use. Even a five-minute test is a long test in factory practice, where many samples have to be tried. A two-minute test would be greatly preferable, or even a one-minute test. We think the author is entirely justified in taking the position that excessive voltage should not be applied to a cable during tests. One might as well endeavor to determine the breaking stress of the Brookyln

Bridge by loading it until it broke. All we can hope to accomplish in the way of tests after manufacture is to make sure that there is no incipient fault in the insulation, by applying a moderately high voltage for a suitably short period, well within the electric elastic limit. This testing voltage should not ordinarily be less than twice the working voltage that the cable must withstand. At the same time, break-down tests on short separate samples of the cable are very valuable, and not one only, but a number of such short samples must be tested, if the purchaser is to know what factor of safety his cable possesses. The civil engineer breaks down test-pieces of the material from which a bridge is built, and from a number of such tests he arrives at a warrantable estimate of the factor of safety of the completed structure. The electrical engineer should follow this example, and determine the braking-down voltage of short samples of his cable under different conditions of age, temperature and duration of test-voltage.

A good word is given as to the meaninglessness of the "30-per cent rule" for pure para rubber in cable coverings. This 30-per cent rule may be reliable under certain empirical conditions, but it has been made a fetish. It resembles the old rule that a pump would not raise water above 30 ft. because, as Galileo humorously remarked when he investigated the phenomena, Nature ceased to abhor a vacuum beyond 30 ft. It is reasonable to expect that as we get to know more about rubber insulation, engineering specifications will cease to abhor a dielectric containing less than 30 per cent pure para gum. If reclaimed rubber can be utilized in cables all the better; and the manufacturer should be encouraged in his attempts, provided that he does not conceal or misrepresent the facts. No purchaser can be blamed, on the other hand, for suspecting the durability of a cable insulated with material containing an unduly large proportion of reclaimed rubber.

TRANSMISSION IN THE ANTIPODES.

We are fortunate in being able to present this week a very full account of the first high-tension power transmission plant in New Zealand—indeed the first in Australia. New Zealand in many respects an ancient land of wonders, is in no wise more remarkable than in the amount of hydraulic power available for development. With about the same area as the State of Colorado, the horse-power suitable for hydro-electric utilization rises to 3,700,000, or nearly 37 horse-power per square mile. This is a tremendous allotment which should bespeak an immense industrial growth in due season in conjunction with the development of near-by Australia. One cannot help, in considering water-power, an instinctive casting forward to days in which the lessening fuel supply shall have shifted the world's centers of activity. If recent forecasts be true, those days are drawing near enough to be seen by the grandchildren or great-grandchildren of men even now living. The Waipori plant, which we here describe, is only the beginning then of the utilization of New Zealand's resources. It is a typical example of high-head working, carried out along the lines already familiar on our Pacific Coast, and in very thorough and workmanlike fashion. The water of the Waipori River, taken out by means of a short ballasted crib dam, is led for nearly two miles through a system of timber flumes and tunnels, and is then plunged through a pipe line down to the power house.

In the construction of the flume attention should be called to the preparation of material on the spot by means of a temporary hydraulic installation. An impulse wheel worked under 120 ft. head was installed at a convenient spot, operating a saw mill, and then a cable tramway about five-eights of a mile long carried the timber to the scene of action. In addition, a four-mile wooden tramway system was laid for bringing the logs to the mill, in which some 1,400,000 ft. of lumber were prepared for use. This sort of preliminary engineering is coming to be an important economic feature of not a few large enterprises, and should be regularly taken into account as one of the factors in cheap construction. The Waipori pipe line is somewhat out of the ordinary in that it is constructed of open-hearth steel. The latest practice is followed in the omission of any receiver back of the wheels, but an unusual feature is introduced in the form of an air chamber kept filled automatically by a motor-driven compressor at the pipe-line pressure and serving as a cushion to protect against "water-hammer." Its space is about 210 cu. ft., and the working pressure is 288 lbs. per sq. in. The branches at the lower end of the pipe line are of gray cast iron. The water is received on a pair of Pelton wheels for each generator, regulated by Lombard governors. The form of regulation presents some peculiarities, the nozzles being provided with needle valves, but the regulation proper being by deflecting the nozzles. The considerable amount of suspended matter carried by the stream has doubtless influenced this construction. It is worth noting that the efficiency of the wheels at full load proved under test to be 83 per cent, while there is a 50-per cent overload range for which also the duplex regulation serves an important purpose.

Electrically the plant is upon familiar lines. There are at present two 1000-kw, 50-cycle generators working at 2400 volts. These feed a bank of transformers arranged in two groups of three with a seventh as a spare unit. The connection is mesh on the low-tension side and star on the high-tension side, bringing the working e. m. f. to 34,700 volts. The station has hydraulic power back of it sufficient for three times the present equipment when extensions become necessary. From the station, proceed two 35,000-volt lines. The station wiring is mostly of bare copper and the switching apparatus is, as in many recent stations, elaborate to the point of excess. It occupies nearly as much space as all the rest of the station, and must have been correspondingly costly. The station, however, is simple in operation and seems to have given most excellent results. It is handled by a staff of but seven men. One curious fact noted is the extreme noisiness of the plant, which compels the use of megaphones in the operating room if conversation is desired. High-head impulse wheel plants are never exactly soothing in their quietude, but it would seem that in this case some extra care devoted to silencing the racket would have been well worth the while. Altogether, the Waipori plant is a very good example of its class, and should prove a substantial and profitable enterprise, and the forerunner of many others. It would be exceedingly interesting to know the cost of construction of this plant in detail, and the economies that were effected by the adroit use of local resources in material and labor-saving opportunities. Engineers, even the best of them, tend to get into ruts, and nothing helps them out more effectively than the study of what other engineers, working perforce under very different conditions, have been able to accomplish in the way of economical special construction.

Meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers.

The eighth annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held in the assembly room of the Hollenden Hotel, Cleveland, Ohio., on Friday and Saturday of last week. President W. T. Magruder occupied the chair and took part in the deliberations. A portion of the forenoon on Friday was taken up with business meetings and a meeting of the council. The secretary's report showed the organization to be in a healthy condition financially. The membership is now 249.

The first paper was prepared by Mr. W. L. Morris on the subject, "Some Suggestions Concerning the Management of Engineering Societies," but as he was prevented from being present, it was read by Secretary F. W. Ballard, of Cleveland. Mr. Morris contended that an organization of this kind should be conducted differently from a school and that all school studies should be eliminated. All papers should furnish the society with something that can not be gotten from books. They should contain experiences, with figures representing the actual tests and results. If formulae are used, then the books from which they are taken should be named and filed with the society for examination. They should not advise, but tell what was done.

Every society should have instruments with which its members may conduct experiments and endeavor to arrive at valuable results for the good of themselves and the entire body. These instruments could be used by members in conducting the work of their employers, and in such other ways as might be suggested in return for a reasonable charge. A committee should have charge of the instruments and experiments.

The discussion brought out the fact that all the members are ready for as much new information as they can get, and a number of them commended the paper on this point. They thought new experiences especially should be made the subject of papers, in order that discussion might bring out information to the fullest extent. However, President W. T. Magruder objected to the statement that nothing included in the school books and other books should be taken up in the papers. He said that it is practically impossible for any man to write a paper that is original in every way and contains all new matter. In fact, it would be difficult to write a paper that contains any ideas that are entirely new. Even in his own paper, Prof. Magruder said the writer had done just what he advises against.

Some of the members objected to the plan of purchasing instruments for the use of the society. They said that instruments used indiscriminately would soon go to pieces and to purchase and keep them in repair would become a heavy burden. The paper was considered idealistic and the plan a good one if it could be carried out, but men have not reached that stage where they can fall in love with that which is really ideal in engineering or anything else.

MANUFACTURE OF INCANDESCENT LAMPS.

The second paper was read by George Loring, of Cleveland, the subject being "Manufacture of Incandescent Lamps."

In his paper, Mr. Loring considered the manufacturing details relating to the filament, the stem and its mounting, the bulb, sealing the mount into the bulb, exhausting the lamp and attaching the base. He then discussed the manufacturing differences between plain and graphitized carbon filaments, tantalum and tungsten lamps.

The chief difference in the manufacturing [illegible] graphitized carbon filament lamp compared to a plain carbon is that the thread of the former is baked in an electric furnace before and after being treated. The tantalum lamp varies from a carbon in the process of manufacture chiefly in the methods used in mounting. The tantalum filament, on account of its extreme length, is wound upon trees connected to the ordinary stem of the lamp where the anchor is generally found. The platinum does not protrude from the end of the stem, but is joined to a small copper wire with a tubed end. This extends from the stem for an inch or so, and into it is inserted the end of the tantalum filament, a connection and contact being made by crushing the copper together. No paste is used. The filament of a tantalum lamp is entirely different from the cellulose or carbon, inasmuch as it is a wire drawn from the metal from which it is named.

The method of mounting a tungsten filament differs from that employed with a carbon. The platinum at the end of the leading-in wires is entirely embedded within the sealed portion of the stem. The ends, which generally protrude, are connected with copper wires which extend through the stem into the lamp and are welded to the filament. The filament is also produced in an entirely different way, the result being a thread made out of practically pure tungsten.

The lowest commercial specific power consumption of an ordinary 50-watt carbon filament lamp is 3.1 watts with a life of approximately 500 hours; of a 50-watt graphitized filament lamp 2.5 watts, with an equal life; of a 40-watt tantalum lamp 2 watts, with a life of 800 hours on direct current, 600 hours, 25-cycle, and 400 hours 60 cycle; of a tungsten 40-watt lamp 1.25 watts with a life of 1000 hours. Only the useful life is considered in giving the above figures, and the specific consumption is based upon the mean horizontal measurements of the illumination.

The highest practical e. m. f. that can be used with the tantalum lamp, Mr. Loring said, is 130 volts. With regard to copper leading-in wires, the speaker said that he had had no experience, but that he had no doubt that Edison had tried this out thoroughly in his experiments, and that if copper could be used successfully it would have been taken up some time ago. The 3.8-watt lamp is best adapted to commercial use at an e. m. f. of 250 volts.

In answer to a question regarding the use of alternating current with the tantalum lamp, the speaker said that the lamp was intended originally for direct current. Alternating current causes the filament to become rough and it gives way sooner than when used with direct current.

Regarding the graphitized carbon-filament lamps, the speaker said that the first cost is greater, but that the cost of energy would be about the same as of the plain carbon lamp. It makes up in greater brilliancy and life for the additional original cost. It is cheaper to use a Gem 2.5-watt lamp than a 3.5-watt carbon lamp. Of all the lamps in use Mr. Loring said he favors the tantalum lamp, as it has proved a good one and the demand for it is now showing its popularity. The tungsten lamp will probably come in later on.

The afternoon was spent in an inspection of the factory of the Sherwin-Williams Company, where every department of interest to engineers was given attention.

The first exercise at the evening session was an address by President W. T. Magruder on "Some Suggestions on Industrial Education in Ohio."

[illegible]

Prof. Magruder stated that the higher technical education, as given at the State University at Columbus, at the Municipal University at Cincinnati, and by the Case School of Applied Science in Cleveland, continues to be in increasing demand; that manual training has been introduced into the grade schools of Columbus and a number of other cities, that it is flourishing in Cleveland and in the new high school manual training annex at Akron, and that a new manual training high school is being built at Dayton; that the various branches of the Y. M. C. A. throughout the state are busier than ever in their industrial departments, offering to men and boys the technical education that they have not been able to obtain previously; and finally, that one or more manufacturing establishments have entered the field of education and are operating shop-schools for their apprentices. The one distressing part of the whole outlook is that very little is being done for the industrial education of the masses. Prof. Magruder stated his

belief that the establishing of trade schools is greatly to be desired for the benefit of a large number of younger citizens. He asked the society to instruct the council to memorialize the next session of the General Assembly, asking for the appointment of a commission on industrial education and industrial conditions to collect facts and disseminate information on the subject of industrial schools, to advise municipalities, manufacturing corporations and public-spirited citizens on the subject, and to report at as early a date as possible on the advisability of establishing one or more industrial schools in each manufacturing district of Ohio.

H. M. Lane, at the close of the address, made a motion that a committee be appointed to memorialize the general assembly, asking that a commission be appointed to take up the question of establishing industrial schools in the principal manufacturing cities and districts of the state. Messrs. Magruder, Miller and Ballard were named as members of the committee.

Most of the members agreed so thoroughly with all that Prof. Magruder said that there was not much room for the discussion of the address. A general need for industrial schools is recognized in the state, and a number of engineering organizations have taken the matter up. Without doubt the movement will result in something of advantage to the industry.

A paper read by W. A. Rowe on "Air Washing and Humidifying and Some of Its Industrial Applications" was interesting to those who have to do with large building operations where ventilation and pure air are desired. As the subject was somewhat removed from the work of most of the engineers, however, but little discussion followed. The idea of dehumidifying air for use in blast furnaces attracted attention, however, and the members will look forward to the results of the experiments that are now under way in that direction. Mr. Rowe made use of illustrations in the printed copy of his paper to make the various points clear.

B. F. Houghton, of the Cleveland Electric Illuminating Company, in his paper on "Power, Heat and Light from Central Stations," opened up a topic of interest to all who are engaged in the lighting business.

CENTRAL STATION VS. ISOLATED PLANT SERVICE.

The paper by Mr. Houghton gave the following outline of the disadvantages of isolated plants: Vibration of building from power plant, which has a weakening effect upon the structure; very often fires are started in the coal storage by spontaneous combustion, thus endangering the building; handling coal and ashes around the building; excessive heat in summer in stores or offices over engine rooms; higher insurance rates; probability of higher prices for supplies; losses due to the destruction of property and materials by dust and moisture from plant; risk of damages to employees and public through accidents, such as explosion of flywheel or boiler.

The advantages derived from purchasing electrical energy from a central station were given as: Continuous service for 24 hours per day, 365 days per year; all night lighting service; all night elevator service; dispenses with a large percentage of the dirt of building; eliminates trouble with smoke inspector and neighboring buildings.

The discussion was opened by a reply written by A. M. Allen and, in his absence, read by Secretary Ballard. Mr. Allen took exceptions to a statement that central stations are taking the place of isolated plants, and said that the details of many manufacturing establishments make it both cheaper and more convenient to operate their own electrical plants. The chief trouble with isolated plants is that manufacturing concerns do not give them the attention they deserve and allow them to operate as they will as long as they drive the machinery. The cost of operation is included in the expense account of the establishment, and no trouble is taken to ascertain whether they are really paying propositions or not. All this will be remedied when the manufacturer learns to keep a record of the cost of his energy and compares it with the cost of energy from the central station. Mr. Allen says that the rejected heat from the exhaust steam may be used throughout a part of the year for heating the building, and that other economies may be practiced that are usually not availed of at the present time.

Mr. Allen took as an example two small generating plants, one of them operated by steam and the other by gas engines, each to cost complete $10,000, with liberal operating expense and depreciation, and showed that energy may be produced at 2 cents per kw-hour from a steam plant and slightly more than that from a gas plant. This is taking into consideration the use of heat from the exhaust steam for four months in the year. He said that the hot water used in the gas plant may also be employed for heating, as the heat may be augmented by making use of the hot air from the engine. The cost of production increases as the size of the plant decreases, he said, from the ideal that he had taken. On the other hand, the energy could probably be made to cost less with the use of larger plants.

It is true that the shafting and belts are more economical than individual motors, where it is necessary to group machines in certain ways to secure proper service from them. Where motors cannot be used to advantage, the only means is the shafting and belts.

George C. Bennett contended that there are isolated plants in operation in Cleveland that are producing energy at less than 1 cent per kw-hour at the switchboard. The central station charges, he said, are three times that much. He referred to plants operated by gas engines.

Mr. Adams said that more attention is now being given to the energy question than ever before, but he thought the most important feature of the subject is in the delivery. To that end he asked Mr. Houghton the cost for delivering energy per kw-hour at a point one mile away from the central station. The reply was to the effect that almost every station has a sliding scale to suit the conditions found in the various shops and factories and the number of hours per day that the motors are in use. Where motors are operated ten hours a day every day in the week, energy may be furnished more cheaply than where operated half time.

E. E. Miller said that in Canton a flat rate is used. In some comparatively small plants the energy is furnished at less than 2 cents per kw-hour. In one factory a gas plant, costing $16 per month to operate, was replaced by motors which are costing about $22 per month. Mr. Miller said he could not say whether the company can afford to furnish energy at 2 cents per kw-hour, but it is doing so. Bad engineering, another speaker said, is the worst feature of isolated plants. If plants are put in as they should be, energy could be produced cheaper than it can be purchased from a central station. A large stand-by service is usually maintained, in order that energy may be obtained in case of a break-down and this is a costly feature also.

In the case of some kinds of plants, as ore docks, it will not pay to have a special plant, as it would be in operation only about half of each year. However, Pickands, Mather & Company, of Cleveland, are using a small plant to operate ore docks. It remains to be seen whether it will really pay to use it. It was asserted that the small plants are abused by poor attendance or they would show much better results.

Prof. Fernald spoke interestingly of the use of gas producer gas engines in the operation of generating plants. The installation, he said, will run from 15 to 30 per cent higher than steam up to 1000 horse-power and about 10 per cent higher from 1000 horse-power to 5000 horse-power. In larger plants the cost will be about the same, as has been shown with a plant at St. Louis The gain in the cost of operation will make up for the additional initial cost in from one and a half to two and a half years, he said, depending upon the size of the plant. One ton of coal will produce as much energy in a gas producer plant as two and a half tons in a condensing steam plant.

Prof. Fernald asserted that a plant can be operated with refuse coal, which is piled up by the hundreds of tons in the mining districts, at a negligible cost. Tests have been made along this line, and the manufacturers of gas producer gas plants are now getting ready to take them to the mines as a further test of what they will do He also said that within two

years producer plants will be in operation on lake freighters. Much thought is now being given to their application to marine work, and one company has offered to fit out a vessel in order to test the machine for this purpose.

The use of gas producer gas engines for central-station service, he said, will greatly reduce the cost of producing energy. They may also be used to advantage for private plants. There are now over 300 installations in generating stations, largely among the coal plants of the country.

Dr. Bemis, superintendent of the waterworks at Cleveland, told of a visit to the large central station at Newcastle, England, where turbines have been put in. Energy is being furnished to several large factories at an exceedingly moderate rate. Here, it is believed, the energy is being purchased at a lower figure than it can be produced in private plants. In most cases in England, he said, small plants are holding their own. He believes that some time in the future central stations will take the business of the country, but they will have to do it at a much lower figure than is being demanded at present.

On Saturday forenoon the members visited the factories of the White Steam Automobile Company and of the Warner & Swasey Company, makers of telescopes, optical instruments and machine tools; Allyne Brass Foundry, large bronze and aluminum castings, and the Brown Hoisting Machinery Company, builders of hoisting and conveying machinery.

In the afternoon, after a meeting of the council, a business meeting was held. Ten new members were elected; it was decided to hold the next meeting at Columbus in May, the day to be fixed by the council. The following officers were chosen:

President, F. W. Ballard, Cleveland; second vice-president, W. C. McCracken, Columbus; treasurer, Mason Chilcote, Canton; members of the board of managers, Louis Kiser, of Cincinnati, and Mr. Haswell, of Bucyrus.

Following the business meeting, G. A. Jacobs read a paper on "Coil Insulation in Electrical Apparatus."

INSULATION OF COILS.

Mr. Jacobs treated the subject under three sub-divisions: First, the insulation on the wire; second, what might be termed the internal insulation of the coil, that is, the insulation which fills in between the turns of the insulated wire, usually after the coil has been wound; third, the external insulation which is placed on the outside of the coil and insulates it from the metal of the machine.

Mr. Jacobs illustrated his paper with a number of sketches and samples of insulation with the compound, which he described. The wires in all these samples, he said, are covered with plain cotton, and the compound forced in between them saturates the cotton, which really serves merely to separate the wires. Experiments show that cotton begins to break down at 125 deg. C. in the air, but in a vacuum the compound will not injure the cotton at 300 deg. Answering a question, Mr. Jacobs said that the compound may soften a little at 200 deg., but it strengthens the cotton insulation and will not break down at that temperature. The principal use of the insulating compound is to keep out the moisture, and under ordinary operating conditions treated coils are perfectly hard. For perfect insulation, however, the cotton must not be charred, but must remain intact. The speaker said that attempts are being made to secure a wire covering that will withstand a much higher temperature—something that may be heated to a red heat and yet remain perfect—but that such a substance has not yet been found.

Replying to a question, Mr. Jacobs said that he would advise the use of baking varnish wherever possible, instead of air-drying varnishes or preparations, since most of them will absorb moisture. An armature may be baked in a night and the cost of a baking oven is small. To further questions, he replied that almost all asbestos-covered wire is treated with varnish in the course of manufacture, but if not it should be so treated in using.

An address of H. M. Lane on "A Volumetric Study of Cast Iron" was delivered extemporaneously, and accompanied by lantern illustrations. The speaker went into the subject in detail and followed the chemical and mechanical changes from the pig to the cast, outlining the percentages of substances other than iron that enter into the composition.

Mr. Lane said that a Pittsburg concern has produced non-magnetic iron by combining tungsten and some other materials with the iron up to 8 per cent. He also talked of the cause of weakness in certain irons, which he said are often found in cupolo practice. Oxygen is the greatest enemy of the foundryman, he said, and if air is admitted in certain quantities the product may be porous and weak.

Court Criticism of Patent Office Procedure.

The U. S. Circuit Court of Appeals, sitting in New York, rendered a decision Nov. 15, reversing a decision of the Circuit Court of Appeals of the same district, in a case involving patents on the wireless cluster type of fixture. The litigants were the Benjamin Electric Manufacturing Company and the Dale Company. The decision of the lower court was rendered by Justice Holt, who had held that the Dale fixture did not infringe the patents at issue. Justices Lacombe, Coxe and Ward were on the bench when the case was brought up on appeal.

It appears that two patents were issued to Benjamin on the same date, having respectively the numbers 721,774 and 721,777. Three claims of the earlier patent were at issue and two claims of the later patent. The lower court held it to be very doubtful whether the second patent should not be regarded as invalid because anticipated by the first patent, under the rule that the patent numbered first takes precedence of the other, and rendered its decision on this rule. The comment of the higher court on this application of the rule is given below. The court stated that it concurred with the lower court as to the validity of the Benjamin invention only because by a combination of parts he was able to dispense with individual lamp wires and thus made the so-called wireless cluster a commercial success; but that three of the five claims at issue might be fairly construed to cover clusters which are not wireless and therefore these cannot be sustained. Then taking up the question of infringement, the court decided that two valid claims of the earlier patent were infringed, while the bill was dismissed as to infringement of the claims cited from the second patent.

The opinion is severe in its criticism of the lower court in adhering under the circumstances to the rule that the patent numbered first took precedence of the second patent, and drastic in its comment on Patent Office procedure. Quoting from a previous decision of the same bench, it said, "It would be a failure of justice if the patentee of a meritorious invention should be deprived of the fruit of his labors because an arbitrary rule of the Patent Office has brought about complications not contemplated." The opinion then proceeds as follows: "This case is a striking example of the unfortunate result of too close adherence to a rule. Benjamin came to the Patent Office with a meritorious invention—a simple one which was quite sufficiently described in a brief specification. The specification and the drawings showed his cluster-unit, by itself and also made a practical commercial article by the use of a cover and a switch, varieties of covers with and without bushing being shown. He asked for seven claims. The logical way would have been to include the genus and its varieties in the same patent, and half a dozen claims would have covered every possible combination which he was entitled to hold. But by the time that the Patent Office got through with him, Benjamin was the holder of four separate patents granted upon divisional applications split off from his original one, the four patents containing together 98 claims. It does not seem just that the patentee, who was powerless to obtain any modification of the rule for dividing application, should be made to suffer from such misdirected energy. There seems sufficient authority to warrant a construction, which will hold that these two patents, based on a single original application, isued on the same day, are to be treated as a single one, containing the five claims above quoted."

November Meeting of the New York Section of the I. E. S.

At the meeting of the New York Section of the Illuminating Engineering Society, held Nov. 14, Mr. W. S. Andrews presented an illustrated lecture on the early work of Mr. Edison on the incandescent lamp. The lecture was rendered particularly interesting by reason of the fact that Mr. Andrews spoke not only from personal knowledge, but from personal experience, because he had worked with Mr. Edison in the early days. Views were shown of the laboratory of Mr. Edison where there were developed many methods and devices that subsequently became standard in the electric lighting industry. Among the most interesting illustrations were those showing the development of the Edison bipolar generator from the long two-coil dynamo, through the shorter six-coil type, to the latest short two-coil machine, many of which have remained in continuous service up to the present time. In fact, so far as reliability is concerned, the old Edison bipolar machines proved equal to any modern generators. The first incandescent electric lighting system was the one installed on the steamer *Columbia*, which was used continuously for 15 years. Mr. Andrews related in an interesting manner the various difficulties that had to be surmounted before the lighting system was successful. Thus the first attempt to place the conductors underground failed because of the unjustifiable assumption that the electricity would prefer to follow the low resistance of the copper rather than the high resistance of the soil. When the bare conductors were placed in sand, a fair amount of success was obtained, but the insulation disappeared when moisture reached the sand. The third attempt, when the conductors were covered with tarred rope, brought complete success. It was stated that the early patents issued to Mr. Edison described in every essential detail the type of carbon-filament lamp that is yet in common use, although more than a quarter of a century has been spent in the introduction of minor improvements.

After the lecture, interesting talks were given by the following gentlemen, all of whom related instances of Edison's almost infallible "common sense," gathered from personal contact with the man, and most of whom had been associated professionally with Mr. Edison in his development work here and abroad: Messrs. T. C. Martin, C. L. Clark, J. W. Lieb, W. N. Stewart, W. S. Howell, F. J. Sprague, W. J. Jenks, J. D. Flack, R. W. Pope and Prof. W. D. Marks.

It was announced that the next meeting of the New York Section of the Illuminating Engineering Society will be held on Thursday, Dec. 12, at which time Mr. Bassett Jones, Jr., will present a paper dealing with architectural principles in illuminating engineering practice.

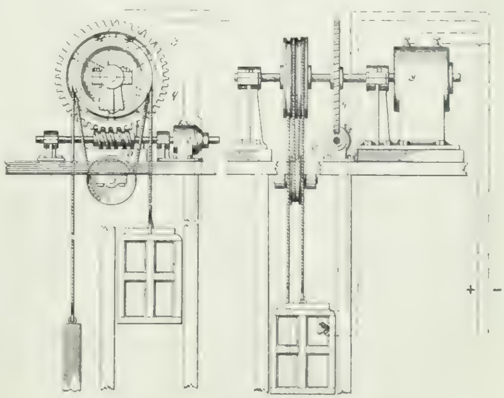
High-Speed, Electrically-Driven Elevators.

At the regular monthly meeting of the American Society of Mechanical Engineers, held on Nov. 12, in the Engineering Societies Building, New York, Mr. Charles R. Pratt presented a paper entitled "A High-Speed Elevator," which aroused no little interest. In it he described the gearless, 1-to-1, traction, electric elevator which is to be installed in the two highest office buildings in New York, pointing out its advantages over other types and also its defects.

The driving mechanism is located over the hoistway with a traction sheave and a brake pulley on the motor's armature shaft. The ropes from the car pass over this traction sheave, down under an idler sheave and again over the traction sheave and down to the counter-balance, giving two half traction turns over the traction sheave to drive the difference in weight between the car and the counter-balance. This traction has been found to be sufficient in ordinary passenger elevator service, especially in high-rise elevators, on account of the weight of the ropes and variable counter-balance chains or ropes, the latter leading from the bottom of the car to the bottom of the counter-balance, thus adding to the constant load on the ropes leading to each face of the traction sheave, thereby reducing the variable difference in traction load caused by the variable passenger load. The car speed of 600 ft. per minute requires a speed in the hoisting motor of 57 r. p. m. The loss of motor efficiency at this low speed is compensated for by the saving in friction loss due to the elimination of all transmission gearing between the motor and the ropes.

The brake pulley being about the same in diameter as the traction sheave, requires a frictional resistance of the brake shoe equal to the net load, or the same that is required by a safety device on the car to stop the car by gripping the steel guide rails. The usual reduction in speed is made by the dynamic action of the motor nearly to a stop; the brake, however, must be able to do this alone if required.

The elevator eliminates friction of worm, spur, screw, or rope and sheave gearing; excessive size of winding drums; dependance upon automatic limit stops and the inertia of a moving mass of metal and water in hydraulic elevators. The two distinct advantages that the traction elevator has over all others are unlimited rise and safe, normal limit stops. This type of elevator has been used for high-class passenger service but a few years, and although the author knows of no troubles in its operation or of accidents to suggest danger, he feels that the omission of positive speed control and holding power is too important a safety factor to be ignored in elevator service. He



DIAGRAMS OF ELECTRIC ELEVATOR MECHANISM.

suggests that this can be easily restored without detriment by replacing the brake pulley with a worm gear having its worm driven by an electric motor, called the controlling motor. Other changes necessitated would be as follows: The worm gear ratio should be such as to obtain the greatest efficiency in the controlling motor at the greatest range of speed by its field regulation. The construction of the worm should be such that it cannot be driven by its worm gear by making its angle of thread below 5 deg. and by using larger diameter thrust washers. The controlling motor should be connected in circuit with the hoisting motor so that the motors will synchronize with each other in starting, stopping and speed regulation.

The following advantages are claimed for this system: With both motors on open circuit, the car gradually and positively stops, because it cannot drive the worm gear. With the hoisting motor on open circuit and driving against gravity, with a heavy load, the fuse of the controlling motor blows and the motor stops; when driving in the direction of gravity or with a light load against gravity, the controlling motor drives the traction sheave under the control of the operator in the car and brings the car to its floor. With the controlling motor on open circuit, the fuse of the hoisting motor blows, and the car gradually stops. The controlling motor governs acceleration by its field regulation and the hoisting motor requires no finely

graduated starting resistance. The controlling motor governs the speed when driving with gravity and the hoisting motor requires no armature shunt. These advantages are obtained with the two motors connected in parallel; the same or possibly better results may be obtained if they are connected in series with slightly different action.

The action of the worm gear may be easily followed by reference to the accompanying illustration. On the shaft of the hoisting motor, 3, is a worm gear, 9, the teeth of which engage in the worm, 10, driven by motor, 12. The thread of worm 10, has such a small pitch that no amount of pressure against the threads of the worm could cause it to revolve. The hoisting drum is thus locked and no motion is possible until motor 12 revolves the gear 9 through the worm 10.

Motor 12 is compound wound and is connected in parallel with motor 3. The latter motor has a rating 10 times as large as that of motor 12, and the latter revolves 20 times as fast as motor 3. This high speed gives it a flywheel action that insures perfect acceleration in starting and stopping the car. In hoisting one switch closes the circuits of both motors simultaneously and both motors start together to hoist the load. At each change of speed one switch closes a circuit that makes the two motors synchronize with each other in speed. In stopping, a small friction brake can be used on motor 12 to bring it to a full stop promptly; but no brake is required to hold the car at rest or to keep it from exceeding its normal speed. In lowering, motor 3 is driven as a generator by the weight of the car and counterweight and motor 12 tends to drive the gear faster than the hoisting motor would allow it to be driven. This adds slightly to the load that drives the motor as a generator, but permits motor 3 to return energy to the line.

Failure of the circuit to either or both motors when lowering would not permit the car to increase its speed, and as oil buffers are provided to stop the car at full speed, safety is assured. The positive safety obtained by this method of control would compensate for some slight loss in efficiency. The synchronous operation of the two motors is simple. In hoisting, the smaller motor follows the larger motor and does its share of useful work. In lowering, the motors act as a booster set. The larger motor, therefore, retains the same functions as at present. It is assisted in hoisting and driven in lowering by the smaller motor, which has a slightly greater relative speed.

Meeting of the Chicago Section of the Illuminating Engineering Society.

A meeting of the Chicago section of the Illuminating Engineering Society was held Nov. 14, to listen to the paper by Messrs. V. R. Lansingh and C. W. Heck on "Fixture Design from the Standpoint of an Illuminating Engineer." Mr. Lansingh presented this paper in person. Among the suggestions made in the paper are the following: A reflector should be used over lamps placed in hemispheres. This may be of white asbestos, but preferably something with better reflecting surface. Several forms of hemisphere fixtures were shown. The same thing applies to art glass box fixtures. Curves were displayed to show the great increase in candle-power at all useful angles by the use of reflectors in ceiling fixtures of the bowl type. A suggestion was taken from the U. S. government specifications that small reflectors be placed over lamps used inside large enclosing globes. The use of reflectors inside of art glass brackets was recommended. He strongly recommended the use of fixtures with sockets pointing straight down, rather than at the common angle of 45 degrees, because of the difficulty of efficiently shading the lamp and covering the lamp filament if the lamp is placed at an angle.

Mr. Walter D. Steele, in discussion, expressed the opinion that the design of electric fixtures had been in the past too much in conformity with gas fixtures, as the electric fixtures did not have the limitations of gas as to location. He advised placing them higher and in fixtures not in conformity with the conventional gas designs.

Mr. S. M. Bushnell endorsed the neat appearance, good diffusion and good illumination secured with the ceiling hemisphere when installed with a single lamp and reflector, as recommended in the paper. He also emphasized the necessity of pointing sockets straight down, in order that the lamp filament may be easily hidden. As the efficiency and light intensity of incandescent filaments get higher year by year, this becomes more important.

Mr. Peirce Anderson, of D. H. Burnham & Company, speaking from an architect's standpoint, thought it desirable to eliminate the fixture entirely if possible, as a lot of protruding fixtures interfered with the effect. He described at length the provision made in the new Union Station at Washington for lighting the large waiting-room, and also the concourse, with but few exposed sources of light.

Mr. E. W. Lloyd thought that while it was a good plan to get away from the conventional gas-fixture idea, nevertheless, for reasons of cost and convenience, such fixtures must necessarily be common for a number of years to come, and the study of efficient arrangements for use with such fixtures was important. He thought the society should have more papers of this kind, taking up practical details.

Mr. J. R. Cravath emphasized one practical detail frequently forgotten and by many unknown, of the importance of an asbestos disc used at the neck of all enclosing globes to keep out dirt. Such discs are seldom seen, but are very important, both on account of looks and service. He also told a number of stories to illustrate how important it is that anyone planning a job of lighting should watch carefully to see that specifications are carried out in detail; otherwise, by slight changes which are very likely to be made by the fixture dealer or fixture hanger, many of the results aimed at may be defeated.

It was voted to devote the Dec. 12 meeting to the subject of "Special Lighting of Downtown Streets," as the business men of several streets in Chicago are contemplating special spectacular lighting, and there is general interest in the subject at the present time in Chicago.

CURRENT NEWS AND NOTES.

THE UNIVERSITY OF MONTANA Branch of the A. I. E. E. at its last meeting elected the following-named officers: Prof. Robert Sibley, president; Mr. James Slack, vice-president; Mr. Sidney R. Tuch, secretary, and Mr. Chas. Barret, treasurer. The branch has a large active membership and many interesting meetings are being planned for the winter.

DAM IN NIAGARA RIVER.—It is stated that plans for a submerged dam across Niagara River, just above the Falls, are being considered by the International Waterways Commission, and a favorable report will probably be submitted to Congress. Members of the commission believe this scheme will restore the lake levels, and it is said that the dam will not affect the falls.

PITTSFIELD SECTION, A. I. E. E.—The second meeting of the Pittsfield section was held Nov. 14, in the large dining room of the Hotel Wendell. One hundred and ten members were present and listened to a very clear and interesting address by Mr. H. H. Barnes, Jr., on "The Practical Side of the Curtis Steam Turbine." The lecture was illustrated with a large number of lantern slides, showing details of construction. Mr. Barnes brought out the great economies which have been effected by the use of these machines both in the matter of space and steam consumption. The remarkable growth of this business was shown by figures giving the total kilowatt capacity installed at the various periods during the four and one-half years in which these machines have been developed. The Pittsfield section has adopted the plan of admitting to its membership "local" and "student" members. The membership has been increased from about 20 at the beginning of the season to about 200, and great interest is being manifested in next meeting will be held on Dec. 6.

PLATINUM DEPOSITS.—According to a recent consular report extensive plantinum deposits have been located in the province of Lloro, Colombia. The government has assumed a monopoly of the utilization of these deposits.

INDUSTRIAL FREEDOM.—At Norfolk, Va., on Nov. 16, the American Federation of Labor by a vote of 154 to 50 refused to place itself on record as favoring the government ownership of railways and mines, the question having come up on a resolution offered by Herbert Crampton, of the Amalgamated Carpenters, to amend the economic platform adopted at Minneapolis last year so as to include railroads and mines in the favorable action taken at that time on the "nationalization" of telegraph and telephone properties. The opponents took the ground that government ownership of mines and railways would prevent all strikes, no matter how peaceably they might be conducted, and that with a federal government opposed to labor it might prove a death blow.

MARCONI STATION BURNED.—Special advices from Nantucket, Mass., state that the Marconi wireless station at Siasconset was destroyed by fire on Nov. 15. This station was the first to be established on this side of the ocean for commercial purposes, principally for reporting vessels. The fire destroyed the engine and engine house, a large amount of wireless apparatus, the lodging house of the operators and several smaller buildings. The big mast escaped and can easily be connected with the new instruments. The loss is between $6,000 and $7,000. The Marconi Company has begun prompt measures to restore its wireless station at Siasconset, Mass. A new equipment has been ordered and early restoration of the plant is expected. Meantime, the service will be carried on through South Wellfleet.

CHASING CORPORATIONS.—Before the National Grange at Hartford, on Nov. 13, President Mellen, of the New York, New Haven & Hartford Railroad, which has lately been applying electricity to its system, made a very vigorous address in which he characterized the late attacks on corporations to a drunken debauch, and said: "The country has been having the time of its life. We have been chasing the corporations until it has got on our nerves; we are tired of the life we have been leading; we have got to rest. When we awake it will appear to have been a costly dream. When we have mended the smashed furniture, the broken crockery, we will lay by for a time and accumulate the wherewithal to repair the waste of our debauch. We may not think quite so well of ourselves for some time, our leaders will not look quite so large in our eyes again, but we forget quickly and we can only forget the whole miserable business after we have paid the bill and have well learned our lesson. There will be a measure of compensation, not without its value."

AGAINST ELECTROCUTION.—It is announced from Berlin, Germany, that Prof. Freudenthal, the distinguished German criminologist who went to New York to study the use of electricity in carrying out death sentences with a view to the adoption of the system in Germany, advises against its substitution for hanging and decapitation now in vogue here. Prof. Freudenthal witnessed an execution by electricity at Auburn Prison, New York. He says that the chair is preferable to the gallows or the block from one standpoint of the spectators, because the human agency whereby death is caused is not so apparent, but that this advantage does not compensate for the torture the spectators suffer in the uncertainty as to just what moment death occurred, or if it has occurred at all. On the occasion on which Prof. Freudenthal was present the spectators had a distinct impression that the heart of the condemned man continued to beat after the first application of the voltage, which was followed by a second application. Prof. Freudenthal also finds that the length of the torture suffered by the condemned makes the adoption of electricity undesirable in Germany

NIGHT IN LONDON.—We should alter two of our impressions of England, according to Mr. Thomas A. Janvier—our idea that London is dark or gloomy at night, except in a few neighborhoods, and our "belief in English phlegm." "Eagerness—to get somewhere or to do something, and to get it or do it in a desperate hurry—is what one sees by night (and by day, too) in London streets," writes Mr. Janvier in the December number of *Harper's Magazine*. As to the lights o' London, Piccadilly Circus is the heart of them—"an all-pervading electric glare." Even London Bridge is brightly lighted. The photographs of London by night accompanying the article, show quite wonderful effects from the camera. They were made by Arthur Hewitt, and are reproduced in tint. Paris is often spoken of as "La Ville Lumiere," but is a hollow mockery in that respect, for only one or two thoroughfares are brilliantly lighted. The rest are sunken in Cimmerian gloom, and the same might be said of the London suburbs.

AMERICAN TRACTION PROGRESS.—A special cable dispatch from Berlin, of Nov. 16, says: "Herr Wittfield, privy councillor and the electrical expert of the Prussian railway ministry, who took a commission of experts to the United States recently for the purpose of studying electrical transportation problems, said to-day: 'America's progress in electrical rapid transit since my previous visit there is astonishing—amazing. Not only have the roads for municipal rapid transit been greatly increased, developed and perfected, but electricity is applied more and more to standard gage roads. It interested me especially to see that the practical Americans are now using almost exclusively the single-phase alternating current. The continuous-current roads which predominated in my previous visit are dropping further and further into the background. The American roads are built excellently. It is astonishing to see with what simple means the Americans get splendid results, even where money is lacking. We were astonished at the gigantic development of electrical roads in Indiana and the thinly settled states, like Oregon.' Herr Wittfeld added that the visit of the German experts will have practical results. Their observations in the United States will be utilized in electrifying the Berlin and suburban roads. Work on the plans of these improvements has been begun, but it will require several years to finish them."

INTEREST IN STOCKS.—One of the hopeful outcomes of the recent financial depression has been the increase in the number of stockholders in all the great corporations, even where probably least expected. For example, Western Union, which has for many years been regarded as one of the best investment securities on the market, and is generally held on to very tightly has shown almost an increase in the face of a slump in price during the year from 86 to 63. The number of new accounts opened during the quarter previous to Oct. 1 was 434, or a gain in number of stockholders of 118. For the first month of the new quarter since Oct. 1 the number of new accounts opened has been 407, or a gain of 175. This makes the gain for one month larger than that for the whole preceding quarter. This is particularly significant in view of the fact that the total number of persons holding Western Union stock is approximately 14,200. The exact figures for the American Telegraph & Telephone Company, another standard industrial, could not be obtained, but the representatives of the company in New York stated that their gain in stockholders taking small blocks of shares was running up into big figures. He said: "This is something that we have been trying to bring about for a long time. It has so happened with us as we have issued new stock we have taken over new properties that we have found the principal stockholders loaded up with about all that they could hold, and we have had to canvass to get other holdings. But once we can get the people in and get them interested in buying a solid interest-paying security as an investment everybody will be pleased." [illegible] has just published a couple of interesting articles on the promise of telephone investments

PORTRAIT.—A very [illegible] portrait medallion of Benjamin Franklin, modelled by John Flaxman, R.A., and reproduced in "jasperware" by Josiah Wedgwood, will be the frontispiece of the Christmas *Scribner*.

CARELESSNESS WITH FIRE.—It is stated that the United States fire bill for crime and mischief is far less than the bill for carelessness in handling heating and lighting apparatus, matches, cigarettes and firecrackers. For their carelessness in playing with fire in the 21 years people of the United States have paid $266,340,058, or 12 per cent of the total loss, if the itemized percentages for the years given hold for the entire period. This source of fires is more than double the total fire bill for electric wires, lightning, cyclones and earthquakes prior to the San Francisco disaster. Even forest and prairie fires can be added without equalling the loss from carelessness.

ARGUMENT OF DESPAIR.—Governor Guild, of Massachusetts, speaking before the Cleveland Chamber of Commerce last week said: "The one danger that most business men view with horror is socialism, the idol that has wrecked one republic after another and that crouches to-day like an incubus upon the neck of Australia. The strongest argument for government ownership, the argument of despair, is that State ownership is the only relief from graft. The man who is doing more for socialism, communism and anarchy to-day than any other is the highly respected business man who for any reason buys legislation. Graft could never exist but for the man behind the grafter."

MUNICIPAL FIRE ALARMS.—The Philadelphia *Ledger* says of local conditions in its city, under municipal ownership: "Philadelphia's fire-alarm apparatus is a quarter of a century behind the times; it is impossible to send an alarm from many of the boxes, while the 3300 cells on the ninth floor of the City Hall that form the storage battery for the operation of the police and fire calls will be thrown upon the junk heap within a month as worthless rubbish. So antiquated is the method of carrying the cables into the City Hall that a slight accident could throw out the entire system and not one fire alarm or police call box in the city could be used. There is no emergency main into the building, such as every large business house provides, and in case of accident to the power plant in the basement of the City Hall, every fire house in Philadelphia would be cut off from communication with the boxes." Exactly similar conditions prevail in New York's fire and police telegraphs under municipal management, as revealed by recent investigations.

NEW TRAINING SCHOOL.—At Albany, N. Y., an appropriation of $10,000 has been made to start a boys' manual training and grammar school, the first of its kind in the country. In this school, mathematics, as a special study, will be entirely omitted, and in its place brass and iron working and casting will be taught. The measurements and planning necessary for the initial work will teach the boys all the principles of arithmetic and elementary algebra. At the end of the course of study in the manual training school the graduates will have mastered sufficient mathematics to enter the high schools with those who have attended the regular grammar schools, in addition to having learned a handicraft. The sponsor for the scheme is Mr. James M. McElroy, the well-known inventor of the electric car-heating and train-lighting systems. Mr. McElroy claims that working with brass and iron holds the interest of the boys, so that they learn more mathematics in connection with the manual training than is possible in a regular grammar course. The details of the plan have been worked out from the methods used in the technical schools of Sweden and Germany.

PLATINUM PRODUCTION.—In 1906, 1439 ounces of platinum were produced in this country as against 318 ounces in 1905 and 200 ounces in 1904. The imports of platinum during the year 1906 were valued at $3,788,759, as against $2,173,-[illegible] in 1905, [illegible] as follows: Unmanufactured, [illegible] lbs., valued at $390,989; ingots, bars, sheets and wire, 10,227 lbs., valued at $3,210,131; vases, retorts and other apparatus, vessels and parts thereof for chemical uses, $186,398; manufactures of, not specially provided for, $1,241. The price of platinum rose from $20.50 per troy ounce on Jan. 6, 1906, to $38 on Nov. 17, remaining at this figure until the end of the year, after which there was another slight rise in price. In February, 1907, for the first time, a distinction was made between ordinary platinum and hard platinum; that is, platinum rich in iridium and osmium, considerable iridium being allowed to remain alloyed in the platinum of the ingots. Such hard platinum was quoted at $41 per ounce on Feb. 23, and this price held until April 6, 1907, when the placing on the market of more than 100 lbs. of platinum by a new producer interested in American developments checked the advance, and on May 4, 1907, ordinary platinum was quoted at $32 and hard platinum at $35. Then a gradual decline set in, and the present price (October, 1907) is $23 for ordinary and $25 for hard platinum.

TELEGRAPH TRANSMITTER.—A patent was recently issued to Mr. J. C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, for a keyboard telegraph transmitter designed primarily for use in connection with his page printing telegraph system, which has been referred to in these columns. The transmitter, however, is not limited to use in connection with any particular system of printing telegraph, nor to any particular code of transmission, but is applicable to telegraphic transmission in general, and may transmit according to any code desired. It comprises a number of adjustable stops or circuit-controlling devices adjustably mounted on a rotatable drum, and arranged to be adjusted in position according to the character to be transmitted. It also comprises contact mechanism to be operated variably according to the variable adjustment of the circuit-controlling devices, so as to transmit the different signals. Mr. Barclay's invention consists in novel and improved means for operating the transmitting contact mechanism variably, according to the character to be transmitted, besides several other features, and the objects of the invention are to improve and simplify keyboard telegraph transmitters, to render them certain and rapid in operation; to adapt them for the employment of approved types of transmitting contact mechanism; to avoid unnecessary delay between characters transmitted and to make the machine easy to operate, easy to inspect and keep in order, simple, rapid in operation and relatively inexpensive.

MORE LIGHTING INQUIRY.—Although the electric lighting situation was thoroughly investigated only three years ago by public authorities, with a record of several bulky volumes, some members of the Public Service Commission are anxious to go through this expensive performance again. The lighting inquiry, if undertaken, will be in charge of Commissioner Maltbie, who is understood to be anxious for this opportunity. The first company called upon to produce its books and submit to the examination of its officials will be the Edison. Following that, each of the subsidiary concerns of that company will be taken up and the situation in Manhattan, in its entirety, made a matter of record. The question of rates will receive special attention. After the Manhattan situation has been disposed of the commission will take up the service in Brooklyn and Richmond. The rates will also be considered, and it is declared that there is a strong probability of the commission seeking to have the rates in all the boroughs lowered by legislative enactment. It is said that the commission has received a number of complaints that the electric lighting companies insisted on yearly contracts. It is the aim of the commission to do away with this practice entirely. Another matter that it will give particular attention to is the "break down" service to business buildings which have their own plants but which have to depend on the Edison or some other company in case of a mishap to their own plants. The lighting companies obviously could not afford to put in plants worth millions of dollars in the hope of doing chance business for one hour.

Hydro-Electric Generating Station on the Waipori River in New Zealand.

THE amount of power available for hydro-electric development in the rivers of New Zealand is stated to b e approximately 3,700,000 horse-power. While there are several small streams being utilized for generating electrical energy, the most important hydro-electric station is that of the Dunedin City Corporation, on the Waipori River, in the province of Otago. This station besides being the largest, has the distinction of being the only high-tension transmission plant in Australasia.

INTAKE.

At the point where the Waipori River leaves its last elevated plateau and begins its final rush toward the sea, is the intake, the height of this above sea level being 1125 ft. From this point the river rushes in numerous cascades through a vertical height of 700 ft. in less than 2 miles. The length of the river above the intake is 22 miles and the catchment area of the watershed is about 95 sq. miles. The discharge at the point of intake has varied from a maximum of 50 cu. ft. per square mile to a minimum of 0.4 cu. ft. per square mile.

The location of the intake was well chosen and advantage was taken of a projecting spur of rock through which a tunnel 22 ft. in length was cut. This tunnel leads into a wooden flume. On the opposite side of the river a similar spur forms an excellent key to the dam. The rocks also provide an easy method of handling the head-gates. The tunnel is rectangular in section, being 8 ft. by 4 ft. at the intake and tapering to 6 ft. by 4 ft. at the junction with the flume. Each head-gate is 4 ft. by 4 ft. in size and is operated by rack, pinion and pawl with ratchet levers. The dam is constructed of rock-filled crib work, 76 ft. long at the crest, 15 ft. in depth, with a top width of 10 ft., and a bottom width of 32 ft. The timber used was obtained in the vicinity, and none of the logs are less than 8 ins. in diameter at the small end. The first bay of logs was run longitudinally with the stream, and fastened to the bedrock by iron dowels run in with neat cement. The next tier was run at right angles to the first, the logs being finished with an adz to present a neat seat at each intersection. The space was then filled with hand-packed rubble as large as could be conveniently placed in the structure. A spillway has been constructed on the opposite side to the intake, which tends to divert the water clear of the head-works during heavy floods, and an 18-in. scour pipe has been provided in order to draw off silt accumulations. The object of the dam was to cause the deposit of material carried in suspension, the material thus deposited to form a water-tight structure, and to reduce the pressure on the crib-work to a minimum.

FLUME.

The conduit for the water embraces all the features usually met with in an undertaking of this class, viz., earthworks, tunnels and pipes, and the total length from intake to water wheels is 11,484 ft.

The conduit from the intake to the penstock is wooden rectangular fluming, except where it passes through the tunnels, built upon a bench 10 ft. wide, mostly excavated out of solid rock. Where the flume crosses creeks and gullies it is carried on masonry piers. It is 6 ft. by 4 ft. in the clear, and has a uniform gradient of 8 ft. to the mile. The joints in the longitudinals are butted and covered by battens 3 ins. by ½ in., under which is placed a 3-in. strip of tarred felt, the joint having received a coat of tar applied hot, and all butt joints were run in with boiling pitch. The length of wooden fluming is 8976 ft., and the six tunnels aggregate 726 ft., total 9702 ft. Four spillways are provided in this distance; these are for the purpose of facilitating repairs to the flume. The flume is constructed of mountain birch, an abundance of which exists in the locality. A saw-mill was erected in the vicinity and worked by an impulse wheel, under a head of 120 ft., located on the bank of the river, and the sawn timber was hauled 3170 ft. by cable

FIG. 1.—VIEW OF INTERIOR OF WAIPORI POWER HOUSE.

[illegible] four miles of [illegible] tramway were laid through the bush, on which the logs were hauled by horses to the mill. Nearly 1,000,000 ft. of timber was used in the flume construction, and 400,000 ft. of sapwood was cut into suitable sizes for building purposes. The life of the flume is estimated at from 10 to 12 years, but before the expiration of that time, no doubt, a tunnel about 5000 ft. long will be constructed through the hill to conduct the water to the penstock.

TUNNELS.

The tunnels, which are cut through the various spurs, vary in length from 295 ft. to 20 ft., and they are made slightly larger than the flume. One novel feature in the construction of the tunnels consists in increasing their capacity by dropping the invert level 7½ ins. at the inlet and rising correspondingly at the outlet. It was found that owing to the decrease of frictional resistance the discharge was increased by this means nearly 15 per cent.

Three spillways are operated by rack, pinion and pawl, while the fourth, from which all water discharged into the pipeline is regulated, is operated by a revolving screw, the nut being firmly fixed in a yoke piece which has two long arms with a cast-iron ball weighing 30 lbs. at each end. As the plane of the gates is at right angles, one leading to the spillway and the other leading to the penstock, the race-man is able to stand in a position so as to operate both gates simultaneously with the assistance of the centrifugal force obtained by the cast-iron balls.

In order to free the water of all materials carried in suspension two catchment basins, to intercept stones, etc., have been constructed, each having a capacity of 53 cu. yds. of silt. The flume terminates at the penstock, which is constructed of concrete, and is 13 ft. long by 9 ft. wide and 10 ft. deep below the sill of the flume. Two pipes are built into the penstock, each 42 ins. in diameter and provided with 6-in. air vent pipes, located on the pipe side of the main gates. Before the water enters the penstock it passes through two gratings, 20 ft. apart, one formed by wrought-iron bars, 1½ ins. apart, lying at an angle of 45 deg., and the other of galvanized wire netting, 1½-in. mesh, at an angle of 60 deg.

PIPE LINES.

The pipe line presents some features of interest, on account of the deviation from the usual practice. The steel pipes vary from 42 ins. to 30 ins. internal diameter and vary in thickness from ⅛ in. at the penstock to ½ in. at the power station end. The length of the pipe line is 1776 ft. The pipes are manufactured from "soft open hearth" steel plates with a tensile strength of between 52,000 and 56,000 lbs. per sq. in. The rivets are of similar quality with a tensile strength of between 44,000 and 50,000 lbs. per sq. in., all materials being submitted to the usual bending, punching and cold hammering tests.

FIG. 2.—DAM ACROSS THE WAIPORI RIVER

The pipes were made in 20-ft. lengths in the shop and were subjected to a test 25 per cent in excess of that given, after which they were cleaned by sand-blast, then heated to a temperature of 300 deg. F. and dipped for 15 minutes in a bath of asphaltum mixture, containing 1½ per cent of pure linseed oil.

The building of the pipe line entailed a large amount of labor and risk to men and horses, owing to the inaccessibility of the country. After being placed in position in the trenches the pipes were jointed and hand riveted, afterward being caulked both inside and out; they were then covered with soil to a depth of 2 ft. 6 ins. to dispense with expansion joints. The variation in temperature of the water between summer and winter is not more than 15 deg. F., and the expansion due to this difference will not be more than 2 ins., which will be taken care of by the vertical angles in the pipe line. Six anchorages, four of which are of solid concrete blocks, 6 ft. x 4 ft. x 6 ft., prevent the line from creeping. Five air valves of the triple cluster type are provided with shut-off gate and extension pieces to allow the influx and efflux of air, the balls being of hard wood with rubber seats. Five manholes are placed in the line to facilitate field riveting and inspection.

[illegible]

Owing to the physical features of the country it was found impossible to select a line wholly below the mean hydraulic gradient, and recourse had to be made to a tunnel at the lower end. This tunnel is 187 ft. in length, with a gradient of 1 in 3½, and large enough for three pipe lines, thus providing for future extension. At the mouth of the lower end of the tunnel the last section of ½-in. plate pipe is attached to a cast-iron "Y" branch piece, dividing the water into two 22-in. cast-iron pipes, each to carry 20 cu. ft. of water per second, one branch for each unit. On each end of the branch of the "Y" a main 22-in. gate is placed with a 4-in. by-pass. The valves are enclosed in a tower, as they are operated by fine thread spindles, which require 2500 turns of the hand wheel to open or close them; a motor is installed to operate these. The rest of the pipe line is of cast iron, each leg of the 22-in. branch being 80 ft. long, bifurcating by a cast-iron "Y" piece into two 14-in. branches, each leading to the nozzle of the impulse wheel. Each 14-in. branch is controlled by a 14-in. gate valve with by-pass. The cast-iron pipes were made of best gray iron, having a tensile strength of not less than 18,000 lbs., and were cast vertically in 6 ft. 6 in. lengths, weighing 2800 lbs.

It was, of course, necessary to erect the foundations for the engine beds before the pipes were laid, and considerable difficulty was met with in having to connect rigidly with two fixed points in the pipe line. The closures were made ¼ in. short and the final joints were run in with lead caulked against a wrought steel band shrunk over the flanges. In the terminal pipe two extension pipes were placed, one being a 6-in. branch to operate the exciter units, and the other a 4-in. branch leading to the air receiver. The exciter pipe line is so arranged that

any two of the three exciters may be operated in parallel with the same hydraulic head.

All cast-iron pipes were tested hydrostatically to a pressure of 450 lbs. per sq. in., and the valves to 500 lbs. per sq. in. The joints are made with round rubber high-pressure gaskets, the flanges being recessed for that purpose.

Generally the whole layout of the pipe system is a departure from that usually adopted, more particularly in respect to the entire absence of receivers at the back of the power house. The deviation of water is made by the "Y" branches. The weight of the column of water in the pipes is about 470 tons, which at full bore moves with a velocity of 5.66 feet per second; and in order to provide against accident due to shock from water hammer, an air receiver has been installed which consists of a shell 30 ft. long by 36 in. in diameter. The air pressure is maintained equal to that in the pipe line by an air compressor operated by a 10-hp motor, and the water is covered with a layer of oil to prevent aeration of the former. The capacity of the receiver was calculated to absorb the shock of a sudden stoppage of flow from one jet of the four main pipes in six seconds at full bore; the standard working pressure being 288 lbs. per sq. in. The receiver reclines at an angle of 26 deg. from the horizontal, and is provided with an automatic float which operates the controller of the compressor motor.

The receiver was placed at the end of the malleable line because it was impossible to place it nearer the nozzles; the cast-iron pipes had, therefore, to be made sufficiently strong to resist the shock arising from water hammer.

As previously mentioned, the main supply of water carries a large amount of sludge in suspension, which renders it unsuitable for the operation of the hydraulic governors. A supply of clear water was obtained from a small creek giving a hydraulic head of 400 ft. at the power station. A small concrete dam 8 ft. high to the sill of the spillway was constructed across the bed of the creek, and the water conveyed by a 4-in. pipe line, 1807 ft. in length, to the governor. This pipe line is provided with the necessary air valves, gate valves and stopcocks, and is buried and securely anchored. It is tapped at a height of 250 ft. above the power station to supply the engineers' residences and fire hydrants, and in addition to supplying the governors the water is also used for cooling the transformers.

The maintenance and operation of the flume are looked after by one man, who has been provided with a small cottage lo-

FIG. 4.—SWITCH ROOM, SHOWING [illegible] OIL SWITCHES AND [illegible]

cated near the penstock. It is this man's duty to record the water passing through the flume and over the dam and to patrol the whole length of the flume twice per diem. His residence is connected by telephone to the power station, and there are also telephone stations along the flume at each spillway and one at the intake, and the [illegible] to the power station from each point.

When making the efficiency test the water was measured by passing it through a square orifice. The head and aperture were accurately measured and the coefficient of discharge used was 0.619, and the results agreed with the measurements of the water over a weir. The amount of water used during the experiments was 25 cubic feet per second, and allowing for frictional losses, etc., the total theoretical horse-power at the power house was 2185. This included the water for the main unit and exciter. The spouting velocity at the nozzles was

FIG. 5.—SWITCH ROOM, SHOWING 2400-VOLT OIL SWITCHES AND BUS-BARS.

12,360 ft. per minute; the peripheral speed of the water wheels being 5945 ft. per minute.

POWER HOUSE.

An ideal site for the power station was selected on the bank of the Waipori River. The building is constructed of concrete reinforced with steel rods; the metal, gravel and sand for the concrete were obtained from the opposite bank of the river and consequently only the cement and reinforcing rods had to be transported from Dunedin.

The power station building is 100 ft. long by 64 ft. in width (internal dimensions), and a temporary wall has been constructed at the down stream end to allow of future extension. Before commencing the work of clearing the site for the foundations it was deemed advisable to clear the bed of the river in front of the power station of the large rocks and boulders so as to provide a clear channel for the water in flood time. This dangerous and arduous work took several months to complete, and the bed of the river was cleared for a length of 528 ft., the result being that the normal level of the water was reduced 6 ft., thereby considerably reducing the cost of the power station foundations, as the floor level would have been 6 ft. higher if this work had not been carried out.

Concurrently with the work of clearing the river bed the construction of a training wall at the up-stream end of the power station was proceeded with to divert the flood waters from the power station site and to form a permanent protection to the foundations from erosion during time of floods.

The foundation for the wall of the building on the river front was taken down to the rock bottom 16 ft. below the bed of the river, and is 8 ft. wide at the base, tapering to 4 ft. wide at the engine room floor level, which is 6 ft. above the highest known flood level.

The power station is divided into two portions: the front portion forms the engine room and is 100 ft. long by 30 ft. wide: the back portion is [illegible] long by [illegible] ft. wide and has two floors. On the ground floor adjacent to the engine room is the low-tension bus-bar corridor, which runs the whole length of the building and is 7 ft. 6 in. in width. At the rear of this is the transformer room, which is [illegible] ft. long by [illegible] ft. wide and at the

rear of the transformer room is the high-tension bus-bar corridor, which runs the whole length of the building and is 9 ft. wide. These compartments are divided from each other by concrete walls, which also form the support for the floor of the oil switch room above, which contains the high-tension and the low-tension remote control oil switches, the low-tension in this case being 2400 volts. The walls and floor of the oil switch room are constructed of reinforced concrete, the floor being calculated to carry a distributed load of 40 tons. At the down-stream end of the building, in the rear of the high-tension bus-bar corridor, is the lightning arrester annex, which is 29 ft. long by 5 ft. 6 in. wide.

The main walls of the engine room carry a 15-ton traveling crane, which runs on concrete girders reinforced with steel rods and partly supported on concrete corbels. The roof is constructed with framed iron principals at 12 ft. 6 in. centers and is sheathed with thin boards, felted and covered with galvanized iron. The engine room and the oil switch room are lighted by means of skylights which run the full length of the building, and there are also large windows at the up-stream end. The foundations for the machinery are carried down to bed rock; they are constructed of solid concrete and are entirely independent of the main building. The cast-iron pipes conveying the water to the engines are carried through the building on independent foundations.

There are two main generating units, each unit consisting of one General Electric, 1000-kw, 2400-volt, 50-cycle, three-phase generator, running at 429 r. p. m. The regulation at full load and unity power-factor is 7 per cent, and with 1000 kva and a power-factor of .75 the regulation is 15 per cent. The efficiency is 95.25 per cent at full load. The

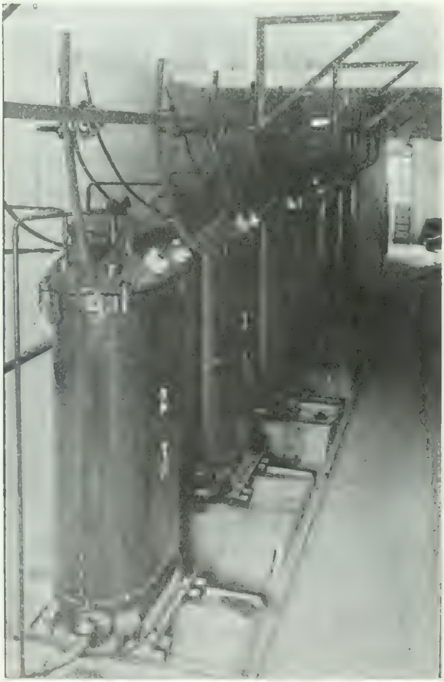


FIG. 6.—TRANSFORMER ROOM, SHOWING STEP-UP TRANSFORMERS.

generator is driven by two Pelton wheels, each 4½ ft. in diameter, one at each end of the shaft. Leading to each water-wheel is the 14-in. pipe, so designed as to increase the velocity at the nozzles. The flow of water is controlled by the main 14-in. gate valves on each branch, which, under operating conditions, are left wide open, and the regulation is adjusted by means of movable needles within the nozzles. The needles are of bronze and operated by worm gear and hand wheels, so that the quantity of water flowing through the nozzles varies according to the area of the concentric aperture between the needle and nozzle tip, the latter being 5½ in. internal diameter.

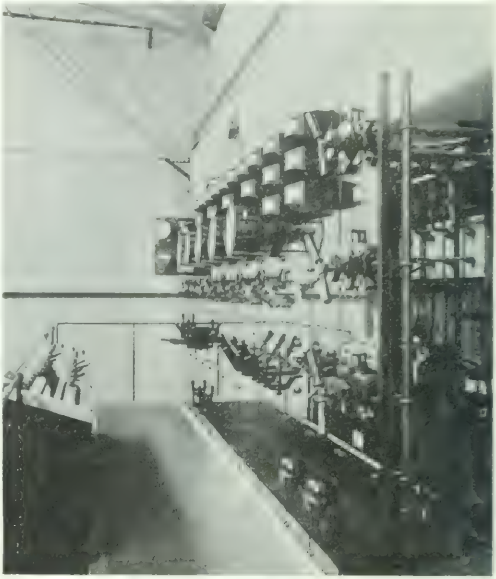


FIG. 7.—MAIN SWITCHBOARD IN POWER HOUSE.

When operating at full load the radial space is ⅞ in. The needles are provided with heavy reaction springs to ease the effort required to increase the annular opening.

Under full-load conditions the nozzles are at the top position and the jet impinges on the center of the buckets. At no load the jet is quite clear of the buckets and impinges against a heavy iron baffle plate which deflects the water into the bottom of the tail race. The jets discharge across the river and strike the opposite bank. They act as an ejector and special ducts are led into the discharge to admit air. The whole of the solid casting forming the nozzles is attached to the main pipe by a ball and socket joint, and is free to move in a vertical plane through an angle of 4 degrees. The nozzles are raised and deflected by means of a system of levers, cut gearing, and rack shaft operated by the hydraulic governors, which are of the Lombard type. The deflecting portion of the nozzles is counterbalanced by hydraulic pressure, so that quick action can be secured from the governor on account of the absence of inertia in heavy counterbalanced weights.

The governors are provided with electric-control motors operated from the table switchboard, which admit of instantaneous control of the speed of the water-wheels. This control is of great advantage when synchronizing. The regulation of the governors is sensitive and does not vary more than 4 per cent from no load to full load and from full load to no load. When the load is thrown off, the jets are deflected clear of the buckets.

The Pelton wheels are capable of driving the generators at 50 per cent overload, but they are designed to give the best efficiency at full load. The buckets are made of the highest grade cast semi-steel, and the wheels are guaranteed to safely withstand the highest run-away speed attainable under the effective head of 665 ft. without damage with the nozzle adjusted to give the maximum stream. The nozzles are pivoted on heavy trunnion pins and the ball joints are leather packed with oak-tanned leather laid in tallow. A reaction strut is provided for

relieving the fulcrum bolts from thrusts which are taken up on an independent journal in line with the axis of the joints. The wheels are guaranteed to develop an efficiency of 80 per cent of the theoretical energy in the water delivered to each wheel at full rated load, 75 per cent at three-quarters load and 70 per cent at half load. In tests made, the efficiency obtained at full load was 83 per cent. The main generating units are spaced 24 ft. 4 ins. apart, center to center.

At the down-stream end of the engine room are located two exciter units, foundations being provided for a third. Each unit consists of a 40-kw, 125-volt generator coupled to a 60-hp Pelton wheel; coupled at the other end of the Pelton wheel is a 60-hp induction motor, the object of the latter being to act as a speed regulator for the exciter, the position of the adjustable needles in the deflecting nozzles being fixed to take care of the normal load on the exciters.

At the rear of the exciter units is the switchboard gallery, the floor of which is 8 ft. above the engine-room floor level. The center of the gallery will be the ultimate center of the power station when the plant is duplicated. On the switchboard gallery is located the main controlling switchboard, consisting of four generator panels, two exciter panels, one motor panel, one transformer panel, one regulating switch panel, and two line panels. In front of the gallery is a table switchboard inclined to a slight angle, on which are distributed the switches for controlling the oil switches and water-wheel governors. These switches are provided with red and green lamps, which indicate whether the oil switches are open or closed and the connections are engraved on the marble so that the attendant can see at a glance which line or bank of transformers he is operating.

In the low-tension bus-bar corridor are located the 2400-volt bus bars which lead from the hand-operated oil switches and bus bars on the switchboard to the remote control oil switches controlling the low-tension side of the transformers.

In the transformer room there are 7 G. E. transformers, each having a rated capacity of 350 kilowatts and arranged in two banks of three each, with the seventh as a spare. The transformer ratio is 2400 to 20,000, and they are connected in "delta" on the low-tension side and in "star" on the high-tension side, with neutral earthed giving a potential of 34,700 volts between phases. The primary full-load current is 146 amperes and the secondary full-load current 17.5 amperes. The transformers are oil insulated, water cooled, and each tank contains 350 gallons of oil. They are guaranteed not to exceed a temperature rise of 35 deg. C., after 24 hours' run at full load and 50 deg. C., after two hours' run at 25 per cent overload, and the tests prove that these guarantees were fully conservative. The efficiency of the transformers at full load is 97 per cent, the regulation with non-inductive load 1.4 per cent, and at 90 per cent power-factor 2.8 per cent. Each transformer is 11 ft. high by 4 ft. by 3 ft., weighing 5.7 tons, and is connected to a system of oil piping by means of which the oil can be drained from the transformer to a well, and a small electrically-driven rotary pump lifts the oil to tanks overhead, from where it gravitates back to the transformers; the transformers are also connected to a circulating water supply. Each transformer is mounted on wheels and can be shifted off its bed on to a car and wheeled into the engine room so that it can be taken apart with the aid of the overhead traveling crane.

There are several small transformers in the power station for various purposes. Three 40-kw transformers are connected to motor and lamp circuits, the potential being regulated by taps connecting to the dial switches on switchboard. Series transformers are connected in transmission lines for operating the overload relays and line ammeters.

In the high-tension bus-bar corridor at rear of transformer room are the bus-bars connecting the oil switches on the high-tension side of the transformers to the oil switches controlling the line bus bars. This bus-bar corridor is constructed on the cellular principle with concrete partitions, and all high-tension wires are kept a minimum distance of 12 in. from earth.

In the oil switch room are located the remote control oil switches, which are of two types. There are four of the Westinghouse solenoid operated type which connect 2400 volt bus bars to the low-tension side of the transformers, four G. E. motor-operated type which connect the high-tension side of the transformers to the bus bars, four of the Westinghouse solenoid type which connect the high-tension bus bars to the 35,000 volt line bus bars and two G. E. motor-operated type which control the two transmission lines. The switch compartments are built up with concrete walls separating each chamber, and the doors are hung from the top, so that they are free to fly outwards in the event of explosion in the oil cells.

The controlling circuits for motors, solenoids and signal lamps, are taken off the 125-volt exciter circuits. The switches can be opened or closed with hand levers in case of necessity, and both types of oil switches are entirely satisfactory in operation. All oil switches throughout the system have disconnecting knife switches on either side of each leg, and the greatest care has been exercised with the station wiring, exposed bare conductors being used; the only insulated cables being those which connect the generators to the switchboard bus bars and those which connect both sides of the transformers to the disconnecting switches.

The leads from the transformers are connected to double-throw knife switches on the low-tension side and to plug switches on the high-tension side, in order to admit of the spare transformer being cut in to replace any one in service that may give out in either of the two banks. The connections to the plug switches on the high-tension side are made by means of heavily insulated flexible cable to admit of safe handling with a potential of 20,000 volts to earth. The double-throw switches and plug switches are all supported on an angle iron framework. On this framework are also carried the interconnecting bus bars between the transformers and the oil switches on both sides.

The wiring of the power station is on the duplex system throughout and admits of either generator being connected to either transmission line through either bank of transformers, independently or in parallel.

In the lightning arrester annex are six Westinghouse low-equivalent, lightning arresters, one set on each leg of the two transmission lines. Each arrester is of the standard type with a series of spark gaps in series with a resistance between them and the ground. Oil-insulated, choke coils are connected between the lightning arresters and the line oil switches to protect the transformers from damage due to surges.

The hissing of the brush discharge from the high-tension conductors is very marked and the discharge is visible at night. It was found advisable to have all insulators carefully cleaned with dry cloths at regular intervals. The operation of the plant is extremely simple, and the only electrical troubles encountered was a puncture of an insulator on one of the selector switches and a burn out in one transformer, the latter due to a heavy surge on the line.

The generators were put into operation on Nov. 3, 1906. and have been running almost continuously ever since.

Electrical energy was first sent through to Dunedin on March 19, and after the necessary preliminary experiments the whole scheme was put into permanent operation on April 7.

The power station staff consists of three engineers, three switchboard attendants and one spare man, who divide the shifts between them.

A gravitation tramway had to be constructed on the hillside to convey the material from a receiving shed at the foot of the practicable wagon road to the power station. The full truck descending hauls up the empty one. The horizontal length of the line is 1980 ft. and the total fall 720 ft. at an average grade of 36 in 100, the steepest pinch being 1 in 1.43. The tramway is constructed of birch rails laid on transverse sleepers.

The power station being at the bottom of a deep gorge does not receive any of the sun's rays for about three months of the year, and in order that the residences for the attendants should not be subjected to this condition, a site was selected on a spur about 250 ft. above the power station. It is also necessary that the houses be built away from the noise caused by the impact of the water on the impulse wheels, which is so deafen-

[illegible] means of a megaphone. There are three residences, Voltaire Villa, for the chief engineer and family; Ampere Cottage, for the second engineer and family; and Faraday House, for the third engineer, three switchboard attendants and the spare man. These residences are all substantially built and furnished by the Council and the barracks is provided with a billiard-room and library for the benefit of those who have to live in this isolated part of the country; there is not another residence within eight miles, and on one occasion they received no communication for nearly a fortnight, on account of snow. A description of the transmission line and sub-stations will be published in a subsequent issue.

Leakage Coefficient of Induction Motors.

By R. E. Hellmund.

In the following a formula for the "leakage coefficient"—the ratio of the total stationary reactance to the synchronous no-load reactance—of induction motors of the squirrel-cage type will be given, which, although not theoretically exact in every detail, yet takes all factors influencing the value of the leakage coefficient into consideration and produces good practical results;

l = total width of iron cores (excl. air ducts).

The following are the values which should be known for the determination of the leakage coefficient:

a_1 = number of slots per pole in the primary.

a_2 = number of slots in the secondary per pole.

$\triangle$ = length of air-gap.

λ = pole pitch in air-gap.

L_1 = the length of the conductor outside of the iron core in the stator.

L_2 = the length of the conductor outside of iron core in the rotor.

l = total width of iron cores (excl. air ducts).

AT_t = total ampere turns required for the magnetization of the motor.

AT_1 = ampere turns required for the air-gap.

Moreover, the slot dimensions as given in Fig. 1 must be known for both the primary and the secondary members. From

FIG. 1.—DIMENSIONS OF SLOT.

these dimensions the following factor may be determined for each member:

$$S = \frac{d_1}{3b} + \frac{d}{b_1} + \frac{2d}{b_1 + b_2} + \frac{d_1}{b_1} \quad [illegible] \tag{1}$$

Also the following factor may be determined:

$$\psi = \lambda - a_1(b_1\ stator - \triangle) - a_2(b_1\ rotor - \triangle) \tag{2}$$

The various parts of the leakage may be expressed as follows:

Primary zig-zag leakage $= \frac{k_1}{a_2^2}$ (3)

k_1 being a constant.

Secondary zig-zag leakage $= \frac{k_1}{a_1^2}$ (4)

Primary slot leakage $= \frac{3.0 \times \triangle}{a_1 \times [illegible]} S_1$ (5)

S_1 being the factor S determined for the primary.

Secondary slot leakage $= \frac{3.0 \times \triangle}{a_2 \times [illegible]} S_2$ (6)

S_2 being the factor S determined for the secondary.

Primary end-connection leakage: [illegible] (7)

[illegible] being a constant.

Secondary end-connection leakage: [illegible] (8)

c_2 being a constant.

The total leakage coefficient is, therefore:

$$[illegible] \tag{9}$$

This formula applies for motors of the squirrel-cage type with partially closed slots in both the primary and the secondary members, and for motors with open slots in one member and partially closed slots in the other member. If both members have wide open slots, the value of ψ must be de-

FIG. 2.—PRIMARY WINDING OF CASES 1 AND 2.

termined by a somewhat different method; such motors are, however, hardly of practical importance.

The coefficient k_1 has a value of about .8 for the blocked rotor condition, while it is .47 for the running motor. For practical calculations it will be advisable to use the former value, since then the calculation of the motor based upon the coefficient will be safe for all load cases.

The coefficient c_2 may be assumed to be .50 for the customary construction of squirrel-cage rotors with a short-circuiting ring at each end of the rotor. It may be assumed to be .80 for a rotor constructed with end plates riveted directly against the iron core.

The coefficient c_1 varies largely with the style of winding used and with the arrangement of the end-connections relative to the iron of the core, to the iron of the bearing brackets, to other metal parts and to each other. It is, therefore, ad-

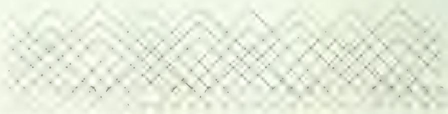


FIG. 3.—PRIMARY WINDING OF CASE 3.

visable to find this value from tests for each particular winding arrangement. This is comparatively simple, since all other factors of the leakage coefficient may be determined from the formula, while the total value of the leakage coefficient may be easily determined by tests on any motor. It has been found that c_1 has a value of from 1.00 to 1.50, and an average value of 1.25, for motors with a winding such as is shown in Fig. 2. (Case 1): It has a value of from 1.2 to 1.70, and an average value of 1.50, for the same style of winding, but wound with thinner wire and comparatively close to the bearing bracket. (Case 2): It has a value of from 1.00 to 1.50, and an average value of 1.20, for motors with such a winding as is shown in Fig. 3, the winding also being comparatively close to the bearing bracket and otherwise like case 2. (Case 3): It has a value of from .5 to 1.10, and an average value of .70, for motors with such a winding as is shown in Fig. 4. (Case

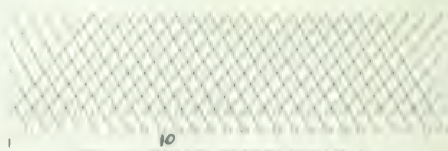


FIG. 4.—PRIMARY WINDING OF CASE 4.

4): The values for c_1, especially those of case 4, have not been checked on very many motors, therefore they may not be very exact, but they may serve as a guide in cases where tests on a certain motor type have not been made.

In determining c_1 from tests no very exact results should be expected; it will be seen that c_1 is found from the remainder

of the test value after five other values have been subtracted. It is, therefore, evident that an inexactness of a comparatively small percentage in the test will cause a comparatively large error in the remainder, and, therefore, in c_1.

The value L_1 also varies largely with the style of winding, and it can be determined only from practice; for full pitch windings it has been found that L_1 varies from 1.6λ to 2.3λ. The value L_2 may be assumed to be λ plus twice the distance of the short-circuiting rings from the iron core. Where air ducts are used their total width should be added to L_1 and L_2, respectively.

The above formula and constants have been based on full-pitch windings, and are not intended to apply to fractional-pitch windings, but the formula also fairly well applies for fractional pitch if it be assumed that L_1 has the value it would have for a full pitch winding. It is to be noted that the dimensions may be expressed in any convenient unit consistently used, that is, either the inch or the centimeter.

It is evident that the above formula for the leakage coefficient may be considerably simplified for any line of motors which is laid out fairly uniformly, because in this case some of the factors appearing in the formula are practically constant. For rough calculation one may make the following substitutions, and use the constants indicated

Constructive Details of Motors.					Comparison of Test Results With Calculations.				
			Style of winding.			Formula 17		Formula 18.	
H.P.	No. of poles	Average number of slots per pole.	Primary Case No.	Secondary Case No.	Tested values of σ	Calc. value.	Error in %	Calc. value.	Error in %
2	4	9.8	4	2	.0518	.0526	+ 1.5	.0524	+ 1.2
5	6	10.1	4	1	.0645	.0685	+ 6.2	.0768	+19.0
5	6	11.3	3	1	.0500	.0539	+ 7.8	.0568	+13.6
7.5	6	11.3	3	1	.0396	.0392	− 1.0	.0468	+18.2
10.0	6	11.3	3	1	.0480	.0450	− 6.2	.0550	+14.6
2	6	6.7	3	2	.0805	.0780	− 3.1	.0899	+11.7
3	4	10.1	3	2	.0450	.0485	+ 7.8	.0569	+26.5
5	4	12.7	3	2	.0610	.0550	− 9.9	.0643	+ 5.4
2	6	6.7	2	2	.0918	.0908	− 1.1	.1016	+11.9
3	4	10.1	2	2	.0580	.0547	− 5.7	.0584	+ 7.0
4	12	5.6	2	1	.1140	.1078	− 5.4	.1185	+ 4.0
10	6	9.8	2	1	.0529	.0538	+ 1.7	.0643	+19.4
5	6	11.3	2	1	.0527	.0572	+ 8.6	.0580	+12.2
16	8	9.6	1	1	.0545	.0589	− 8.1	.0707	+29.7
15	10	12.3	1	1	.0590	.0650	+10.0	.0833	+40.0
24	10	12.3	1	1	.0570	[illegible]	− 3.3	.0658	+15.4
50	10	12.3	1	1	.0480	.0450	− 6.3	.0492	+ 2.5
15	6	12.8	1	1	.0499	.0560	+12.2	.0636	+27.4
35	8	15.4	1	1	.0488	.0550	+12.7	.0643	+31.8
50	8	15.4	1	1	.0450	.0463	+ 2.9	.0530	+17.8
150	8	20.0	1	1	.0424	.0401	− 5.4	.0489	+15.3

$$a = \frac{a_1 + a_2}{2} \qquad (10)$$

$$[illegible] = k_{[illegible]}\lambda \qquad (11)$$

$$L_1 = k_{[illegible]}\lambda \qquad (12)$$

$$L_2 = k_4\lambda \qquad (13)$$

$$\frac{AT_{[illegible]}}{AT} = k \qquad (14)$$

In motors with moderate magnetic densities k_5 is approximately equal to 1.1.

$$[illegible] \qquad (15)$$

$$[illegible] \qquad (16)$$

The following very simple formula is thus obtained for the leakage coefficient:

$$[illegible] \qquad (17a)$$

or

$$\sigma = \frac{k}{a}[illegible]\left(\frac{k}{a \times \lambda} + \frac{k}{l}\right) \qquad (17b)$$

where $k_{[illegible]} = 2k_{[illegible]}$

This simplified formula should give fairly good results after the values for K_6, k_6 and k_7 have been determined for a certain line of motors.

When it is more desirable to obtain a safe value, than to obtain a very exact value, it may be assumed for motor with partially closed slots in both the primary and the secondary members and for stator case 1, 2 or 3, in combination with rotor case 1 or 2.

$$\sigma = \frac{1.75}{a}[illegible]\left(\frac{2}{a[illegible]} + \frac{[illegible]}{l}\right) \qquad (18a)$$

and

$$\sigma = \frac{1.75}{a}[illegible]\left(\frac{2[illegible]}{a \times \lambda} + \frac{4[illegible]}{l}\right) \qquad (18b)$$

for motor with partly closed slots in both members and for stator case 4, in combination with rotor case 1 or 2.

With these coefficients, the formula will, as a rule, give values which are too large.

All of the values given above for k_1, and the coefficients in formula 2 refer to three-phase motors. For two-phase motors they may be slightly different, since the end-connection leakage flux interlinking with all the phases is different in two-phase motors from what it is in three-phase motors. The difference will be comparatively small in case of the primary windings of case 1 and 2, while it will be larger for primary windings of case 3 and 4.

In the accompanying table a number of tested values for the leakage is given in comparison with the values derived from the formulas; for formula 17, use has been made of the average values given for k_1. In each case the length of the air-gap has been determined from the observed magnetizing current.

It will be seen that the errors of formula 17 are comparatively small, those of formula 18 are rather large in some cases, as is to be expected; it will be safe, however, to use formula 18, since all of the errors are on the safe side.

Abnormal Primary Current and Secondary Voltage on Placing a Transformer in Circuit.

By J. Murray Weed.

In the following there is offered an explanation of the results obtained by Messrs. Jensen and Andree, as recorded by Mr. Jensen in his article in the Electrical World for Sept. 14, on "Abnormal Primary Current and Secondary Voltage on Placing a Transformer in Circuit."

Assuming a constant alternating e. m. f. applied to the terminals of a transformer, with open secondary, the total counter e. m. f., which must be equal and opposite to the applied e. m. f., is the resultant of components due to the rate of change of magnetism in the iron, to the resistance of the winding and to the reactance attributable to magnetic lines at least part of whose circuit is outside the iron. The last two of these counter e. m. f.'s, which do not appear in the secondary circuit—not strictly true of the latter—but constitute the e. m. f. drop in the primary windings of the transformer, become negligible in normal operation, with open secondary. In this case the counter e. m. f. due to the magnetism in the iron is practically equal and opposite to the applied e. m. f., and the relative phase position and magnitude of applied e. m. f., magnetism and magnetizing current, may be represented somewhat as in Fig. 1. The current is in time-phase with the magnetism, with each instantaneous value depending upon the instantaneous value of magnetism and the corresponding reluctance of the iron. The component of the exciting current which is in time-phase with the applied e. m. f., supplying the losses, is not shown.

It should be noted, in Fig. 1, that the maximum point of the magnetic cycle, and of the magnetizing component of the exciting current, occur at the instant when the e. m. f. is passing through zero, and vice versa. Considering now the conditions from the instant when the e. m. f. passes through zero, it is seen that the magnetism passes through a half circle, beginning with its maximum value and ending with the maximum value in the reverse direction. The total number of lines cutting the trans-

former winding in the same sense, during the half cycle of e. m. f. beginning with a zero value, is, therefore, twice the maximum total magnetism in the core, since the total magnetism cuts out of the coil in one direction and into it again in the opposite direction.

Suppose, now, that the transformer is inactive with no residual magnetism in the core, and that the e. m. f. is suddenly applied at the instant when it is passing through zero.

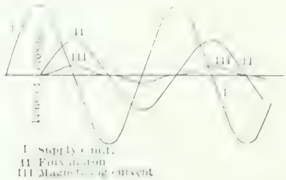


FIG. 1.—RESULTS OF CLOSING CIRCUIT AT MAXIMUM E. M. F.

If the counter e. m. f.'s due to resistance and to the flux in air are negligible here (this assumption will be made at first in this and the following cases), the cycle of magnetism in the iron will be the same as before, when the transformer was in normal operation, except that instead of starting from a maximum value and going to a maximum value in the opposite direction, it will start from zero, and must, therefore, pass to twice its normal maximum value. (See Fig. 2.) It is evident that even though the normal flux density in the core is fairly low, it will be high at double normal density, and the reluctance at this point will be high. The magnetizing current will, under these conditions, be large, having passed from zero, when the e. m. f. was first applied, to a large value at the end of the first half cycle. During the second half cycle both the magnetism and the magnetizing current will evidently return to their zero values, having passed through a complete cycle of change without reversing in direction. The magnetizing current is thus a pulsating current, with a maximum value which will be very large if the normal flux density in the core is high, since the maximum density reached may be far beyond saturation for the iron.

If a residual magnetism exists in the core and the e. m. f. is applied at the instant when it is passing through zero, as above described, the direction of the residual magnetism being

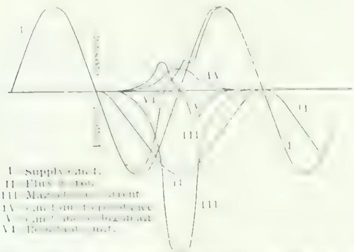


FIG. 2.—RESULTS OF CLOSING CIRCUIT AT ZERO E. M. F.

the same as that which will be produced, the maximum flux density reached will evidently be just that much greater than it otherwise would have been, so that the magnetizing current in this conjunction of circumstances may become exceedingly great. On the other hand, a residual magnetism in the reverse sense would make a corresponding reduction in the maximum value which will be reached by the flux and by the magnetizing current. During the second half cycle, the magnetism will in both cases return to the residual value at which it started, so that the cycle of change may be alternating, but with greater maximum value in one direction than in the other, or it may exist in the same direction throughout the cycle, and not reach zero value at all.

If the e. m. f. be suddenly applied to the transformer, at the instant of maximum value, instead of at its zero value as above, with no residual magnetism in the core, both the flux and the magnetizing current will have their normal value at the time of closing, and should enter their normal cycle without disturbance. Likewise, with the e. m. f. applied at any other point in the cycle, if there is a residual magnetism in the core of such a value as would be normal at the instant of closing, both the magnetism and the magnetizing current should follow their normal cycle, with only a slight disturbance, the latter being attributable to the fact that the magnetizing current must increase from zero at the first instant.

It is evident that any other conjunction of conditions as to residual magnetism and time of closing than those mentioned in the last paragraph will result in an abnormal cycle of magnetic change and magnetizing current at the start. Moreover, this abnormal state would continue indefinitely if the counter e. m. f. due to the flux in the iron were the only one to be considered, as assumed above. It is necessary, however, to consider the counter e. m. f.'s due to resistance and to the flux in air, which, though negligible when the current is small, as when the transformer is in normal operation with open secondary, yet must be considered when the magnetizing current is abnormally great, as in some of the above conditions of starting.

The instantaneous value of the counter e. m. f. due to the flux in air is directly proportional to the instantaneous rate of change in the value of the current, and in such a direction as to oppose that change. It depends upon the shape and amplitude of the current wave, but is independent of its position relative to the zero line. Thus, whether the current be an alternating one, or a pulsating one, the e. m. f. due to the flux in air will be an alternating e. m. f. It will differ in phase, however, from the e. m. f. due to the flux in iron by the same amount that the exciting current differs in phase from the magnetizing component. It will, therefore, change the phase relation and reduce the extreme unbalance which otherwise would exist at the start in the cycle of flux in iron and of magnetizing current, but it will not tend to change this cycle from that at first established.

Consider now the counter e. m. f. due to resistance. In the case where flux and magnetizing current exist in the same direction throughout the cycle, this e. m. f. will also exist in the same direction throughout the cycle. It will oppose the impressed e. m. f. during the half cycle in which the flux is increasing, but augment it during the half cycle in which the flux is decreasing. The total change in flux necessary to maintain a zero resultant between applied and counter e. m. f.'s is, therefore, considerably greater in one sense than in the other, the result being an approach toward normal conditions. The *IR* drop due to an unbalanced cycle of magnetizing current is thus the main factor in bringing about normal conditions in the cycle of flux and of magnetizing current.

The curves of Fig. 2 are a first approximation to what, in view of the above considerations, will occur when an e. m. f. is applied at the instant when it is passing through zero. The shape and phase relation of the curve for "Flux in Iron" is based upon the assumption that it must generate an e. m. f. which is equal and opposite to the applied e. m. f. The maximum flux density is assumed to be much above saturation for the iron, so that the magnetizing current is very large. The resulting e. m. f.'s due to resistance, and to flux in air, when combined with the applied e. m. f., produce a "resultant e. m. f." which, instead of the applied e. m. f., must actually be neutralized by the e. m. f. due to flux in iron. The result is that the curve of flux in iron, and therefore all the other curves indicated in Fig. 2, except the applied e. m. f., will be quite different from those actually shown. The loss element of the exciting current is neglected in the curves for the sake of simplicity.

The foregoing considerations explain the results recorded by Mr. Jensen as to the behavior of the primary current upon connecting a transformer in circuit, as shown in Fig. 5 of his

article, but do not explain why the secondary e. m. f. should behave as shown in Figs. 1, 2, 3 and 4. In fact, there appears to be no way of accounting for a secondary e. m. f. higher than normal except by a rise in the primary e. m. f. The writer has been unable to detect a rise of secondary e. m. f. in the oscillograms given, although his Fig. 8 shows a considerable rise in the primary e. m. f.

Beyond any doubt the results obtained by Mr. Jensen are very mild indeed as compared with what would have occurred if the tests had been made at the full rated voltage of the transformer. When the normal flux density is high, the magnetizing current required to produce a given percentage increase in this density will be much larger than if the normal density be lower.

When it is considered that many of the large transformers built at the present time are designed for a high normal flux density, and that a considerable reduction in the density would necessitate an increase in their cost, it would seem that some means of bringing these transformers into circuit without the instantaneous application of full voltage is not only desirable, but important. The use of a choke coil or inductance, as suggested by Mr. Jensen would, as demonstrated by him, be advantageous, but where the normal density in the transformer is high, this scheme might not suffice for decreasing the current rush to a satisfactory value. There could be used for this purpose a small auxiliary regulating transformer, of sufficient rating to supply exciting current to the main transformer while raising the e. m. f. on the low tension side, by steps, from a small value up to normal before connecting it to the circuit.

Characteristics of the Solenoid.

By Charles R. Underhill.

In order to calculate accurately the pull due to a plunger-electromagnet or an iron-clad solenoid at various points throughout the entire range, it is important to know the solenoid effect, or the pull due to the magnetizing force of the winding and the magnetic induction in the core or plunger for various relative positions. The pull due to a plunger-electromagnet may then be found for all points within the range of the magnet by adding the pulls due to the induction between the plunger and the stop, to the pulls due to the solenoid effect.

Data for determining the maximum pulls of solenoids of various dimensions and magnetizing forces were given in a previous article,* and from it Fig. 1 is reproduced herewith in a somewhat modified form [illegible] maximum pulls with variable ampere-turns and 1 sq. in. of plunger.

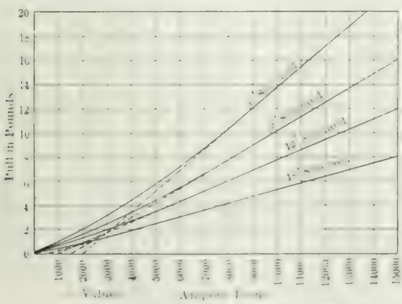


FIG. 1.—RATIO OF AMPERE-TURNS TO PULL WITH PLUNGER ONE SQUARE INCH IN CROSS-SECTION.

In Fig. 2 are shown the curves of several solenoids of various lengths, each winding being 3⅛ ins. diameter. The plunger used in the test was 36 ins. long and 1⅛ ins. diameter, making the cross-sectional area 1 sq. in. The magnetizing force in this test was 15,000 ampere-turns for each coil, which caused the iron plunger to be thoroughly saturated, as reference to Fig. 1 will show. This would make the ampere-turns per inch of length in the various solenoids as follows: 6-in., 2500; 9-in., 1560; 12-in., 1250, and 18-in., 830.

By grouping the curves in Fig. 2 on a common plane, so as to make the ampere-turns per unit length the same in all cases

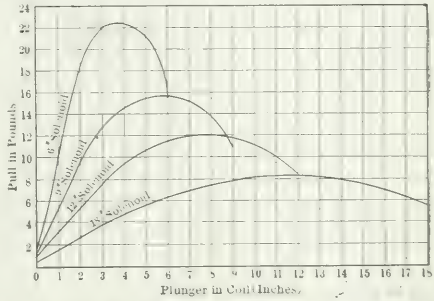


FIG. 2.—TEST OF SOLENOIDS WITH 15,000 AMPERE-TURNS

(see Fig. 3), we find that the curves are similar, with the exception that the peaks of the curves are proportionately higher for the longer solenoids. If, however, the pulls throughout the entire range of each curve in Fig. 3 are compared with the maximum pull for that solenoid, the curves are found to be

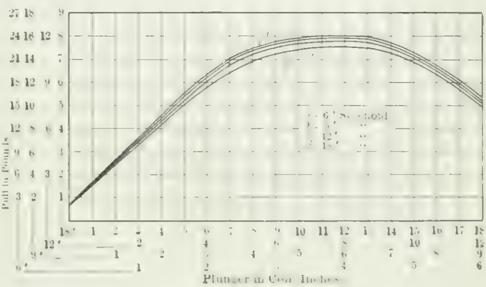


FIG. 3.—COMPARISON OF SOLENOID CURVES.

practically similar in all cases cited. This common curve is illustrated in Fig. 4.

It therefore remains to determine the locus of this curve, which is partly sinusoidal, and the equation

$$y = \sin 0.77x \qquad (1)$$

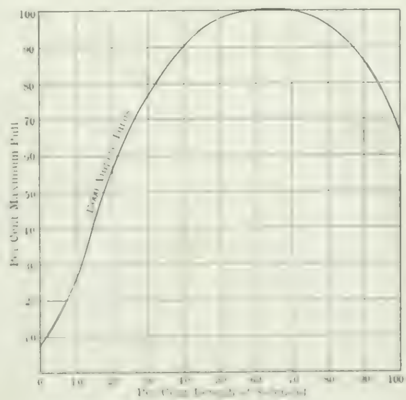


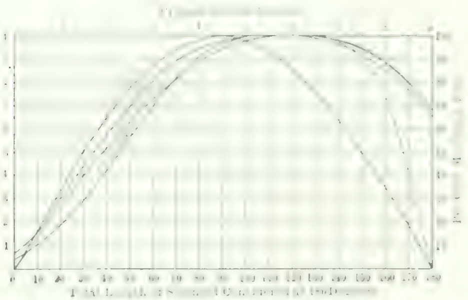
FIG. 4.—AVERAGE OF CURVES.

satisfies this condition for practical purposes, as reference to Fig. 5 will show. In this case the length of the solenoid is compared with 180 deg. In order to make a direct comparison

* "Calculation of Pull Due to Solenoids," [illegible], May [illegible], 1907.

the 9-in. solenoid is assumed in Fig. 5, although this curve is common to all the other solenoids as in Fig. 4.

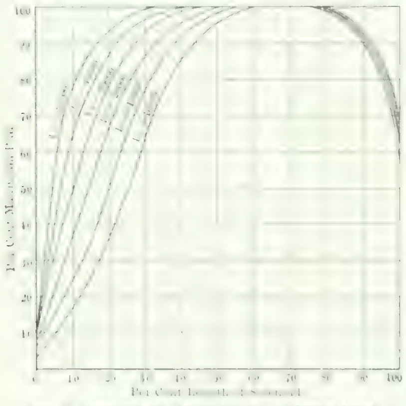
While the solenoid pull curve in Fig. 5 is slightly higher than the $y = sin\,0.77x$ curve from 25 deg. to 120 deg., it must be understood that the percentage of maximum pull throughout the first half of the solenoid is greater for higher than for lower magnetizing forces, owing to the fact that the plunger is



more quickly saturated under the former condition, thereby increasing the pull—or, to be exact, the percentage of maximum pull; and since this curve represents the pull due to 15,000 ampere-turns, the percentage maximum pull would be somewhat lower with a magnetizing force just sufficient to saturate the plunger at the position of maximum pull, and therefore the curve $y = sin\,0.77x$ represents a good average, as the curves beyond the point of maximum pull do not vary appreciably as the magnetizing force increases, after the plunger is saturated.

This effect is illustrated in Fig. 6, which is the result of a test of the 12-in. solenoid; the maximum pull being the same as indicated in Fig. 1. An inspection of Fig. 6 also shows that the range of the solenoid is much greater with high than with low magnetizing forces.

Again referring to Fig. 5, the dotted curve represents the effect of using a plunger of the same length as the solenoid



Referring to Fig. 1, it is evident that after the plunger is saturated each curve will be practically a straight line, and hence to calculate the ampere-turns for any solenoid from the data given, necessary to produce any other maximum pull P (pounds), the formula will be

$$IN = \frac{[illegible]}{P_c} \quad (2)$$

Where IN_c and P_c represent the ampere-turns and pull in pounds respectively (and above saturation) per 1 sq. in. of cross-section of plunger, upon which the calculation is based. The values of n are indicated in Fig. 1, where the dotted continuations of the straight portions of the curves touch the axis of abscissas.

Similarly to determine the maximum pull under these conditions, (2) may be written

$$P = \frac{[illegible]}{IN_c - n}$$

If we let

$$S = \frac{[illegible]}{P_c}$$

[illegible]

The values of n, P_c and S are expressed with a fair degree of accuracy by the formulae

[illegible]

within the limits of those discussed, and in which L is the length of the winding in inches.

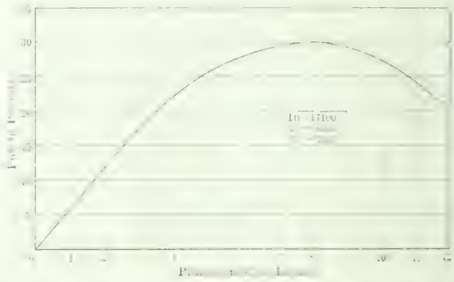
Substituting the values of (7) and (9) in (5),

$$P = \frac{IN - \frac{12{,}000}{L}}{[illegible]} \quad (10)$$

and

$$IN = 98LP + \frac{12{,}000}{L} \quad (11)$$

In everything thus far a plunger area (cross-sectional) of 1 sq. in. is assumed. In order to determine the cross-sectional



area A of a plunger to give the proper value for IN_c with any total ampere-turns IN_t use may be made of the formula

$$A = \sqrt{\frac{IN_t}{IN_c}} \quad (12)$$

Values assumed for IN_c should always be taken above the saturation point, *i. e.*, on the straight portions of the curves in Fig. 1.

Applying this mode of calculation to a specific case, assume a solenoid 12 ins. long to have a maximum pull of 30 lbs.

Using (11) and assuming $IN_c = 8000$,

[illegible]

$$[illegible] \sqrt{\frac{36{,}280}{8000}} [illegible]$$

and instead of using 36,280 ampere-turns and a plunger 1 sq. in. in cross-section, only $2.13 \times 8000 = 17{,}100$ ampere-turns will be required for the same pull, but with a plunger 2.13 sq. ins. in cross-section. This may be expressed as follows:

$$IN = IN_cA \quad (13)$$

Now, from these data a curve may be plotted showing the approximate pull at all points throughout the range of the solenoid. It will be [illegible]

pull to the maximum (y) is equal to $\sin 0.77x$, and if we let l represent the distance in inches the plunger is in the coil, and compare the linear ratios with those represented by degrees, we have

$$x = \frac{180l}{L} \qquad (14)$$

Representing the pull by p, the ratio of actual to maximum pull is $\frac{p}{P} = \sin \frac{.77 \times 180l}{L}$, whence $p = P \sin \frac{138.6l}{L}$ (15)

Fig. 7 is plotted from (15), the values of P and L being 30 and 12, respectively, as in the example worked out.

Rubber Insulation for Conductors—I.

By Fred J. Hall.

INTRODUCTORY.

This article is limited to the consideration of rubber as insulation for electrical conductors. No attempt is made to treat the subject exhaustively; its object is to present a few general facts regarding rubber, and some special information, based on practical experience, as to its use for the insulation of electric wires and cables.

Theory and practice cannot always be made to harmonize. Knowledge acquired solely from text-books, laboratory experiments and office work, however, valuable, must be supplemented by practical experience before any theory can be evolved that will hold good when applied to the production of a manufactured article in commercial quantities. While this fact is self-evident, its neglect is the most prolific source of trouble to both the purchaser and the manufacturer of rubber insulated conductors. The writer will endeavor to treat the subject unprejudicedly. He realizes that want of practical experience in the manufacture of insulated wires and cables would naturally lead to impractical conclusions; also that the purchaser is entitled to the protection afforded by such test as will best prove the practical efficacy and life of the insulation.

PARA RUBBER.

A great deal of misconception exists regarding para rubber. The name is a geographical one, and it is applied to rubber coming from widely different localities, principally in Brazil, Bolivia and Peru. There are differences in the qualities of paras, depending not so much on locality as on methods of gathering and coagulation. For commercial purposes these have been divided into three grades:

Fine.—The clean, thoroughly smoked or cured biscuits.

Medium.—In the center of which there is more or less moisture or milk, due to imperfect curing.

Coarse.—The residue scraped from the collecting vessels.

As the growth of industries requiring the use of rubber has of late years been enormous, the price of para has steadily advanced. The supply was inadequate to the demand, and the use of rubbers other than para became absolutely necessary. Various grades of rubber are produced in all parts of the tropical world, Africa furnishing the larger part and the better qualities. The methods of gathering these rubbers were at first crude. They were dirty and improperly cured. These defects have been largely overcome, and to-day rubber compounds can be made, containing no para, that will have as long a life and give as good practical results as an all-para compound. Were all manufacturers of rubber goods to confine themselves to the use of para, prices would advance by leaps and bounds. The rubber insulating industry, and others dependent upon it, would be paralyzed. These are cold facts to which the purchaser can no longer remain oblivious.

PROPERTIES OF RUBBER.

The most important properties of rubber, considered only from the standpoint of insulation, may be grouped under the following heads: 1. Non-hydroscopic; 2, dielectric; 3, mechanical strength; 4, elasticity.

All these properties except the non-hydroscopic property are materially affected by the process of manufacture, and each one is developed more or less at the expense of the others. This will be shown later on.

COMPOUNDS.

In selecting a rubber compound for insulation the manufacturer carefully considers the following points: First, conditions of service; second, what quality will best meet these conditions with an ample factor of safety and the least cost to the purchaser; third, how, in the process of manufacture, can the most essential qualities of the rubber be developed, so that the compound in its final state will have the greatest practical efficacy.

As a rule, the manufacturer has no difficulty in determining the quality of the compound and the method of treating it so as to produce the best results at the lowest price. The stumbling block appears when he tries to harmonize his ideas, based on practical experience, with the theories of the purchaser as expressed in the specifications.

As a matter of fact, the purchaser has no real interest in the composition of the rubber compound, nor in the manufacturing methods of handling it. His sole interest is to secure an insulation possessing high practical efficiency for the conditions of service. In other words, to purchase cables that will work for a long time and give no trouble. Many a purchaser has become convinced that this result can only be obtained by the use of fine para rubber, and draws specifications in a way that he believes will preclude the use of anything but fine para. In doing so he often subjects himself to useless expense, and forces the manufacturer to produce an article which he knows is higher in price and no more effective for the conditions of service—perhaps, less so—than could be produced if the manufacturer was allowed to exercise some discretion in the matter.

Let us now consider the various tests by which the purchaser endeavors to secure what he considers the best insulation. When a specific compound is called for, it is usually one containing 30 per cent para, and in considering the following tests the writer has such a compound in mind.

ACETONE TEST.

Para being the first rubber to become well known, it was made the standard. Its chemical and physical properties were carefully determined, and the insulating value of other rubbers was erroneously fixed by the extent to which they were shown to possess these identical properties. In all rubbers there is a percentage of oily or resinous matter soluble in heated acetone. The percentage of this resinous or extractive matter varies widely in different brands of rubber, "*nor is the quantity constant in the same brand.*" (Weber, "Chemistry of Rubber," pages 3 and 4). Unvulcanized fine para rubber varies in the amount of its extractive matter from 1 per cent to 2 per cent. It has been assumed that unvulcanized rubber containing a higher percentage of extractive matter than that determined for para are of less value as insulators: an erroneous assumption.

Weber, page 4, says, "*The presence of these resins in crude rubber does not appear to affect its stability in an appreciable degree.*" In the same paragraph he explains that the presence of the extractive matter *does* affect vulcanization, when it exists in larger quantities than is generally found in fine para. In such cases, more sulphur as well as an increase in the factors of time and heat is necessary to prevent the under-vulcanization of the compound in which form it is "*highly perishable.*" It is evident, therefore, that a rubber containing a higher percentage of extractive matter than para may be quite as effective an insulator, *if properly vulcanized.*

It is often assumed that the extractive matter in rubber is highly volatile, and that when this extractive matter disappears the rubber is left lifeless and brittle. As a matter of fact, the extractive matter is not volatile; the hardening of the rubber is due to the drying out of moisture and to oxidation—principally the latter. Dr. Werner Esch, of Hamburg, in a pamphlet entitled "Observations Concerning the Best Method of Vulcanizing India Rubber," makes a statement bearing directly on this subject. He says, "*It is erroneous to believe that the best rubber articles are made from pure caoutchouc*" (rub

ber), and calls attention to the increase *"as to elasticity and resistance to tearing asunder"* in inner tubes for pneumatic tires when 0.5 per cent of pitch is added to the rubber. Now there is probably no article into which rubber enters where it is more important to increase the strength of the rubber and prevent hardening than inner tubes, and it has been proved that this is best done by the addition of an ingredient possessing a high percentage of extractive matter of the same general character as that obtained from the rubber. Furthermore, if the hardening of a rubber compound by age was due to the dissipation of the extractive matter, less of it would be found in an old and brittle compound than in the same when new and elastic. Such, however, is not the case; in many instances it will be found that aging has increased the extractive matter, especially if it has taken place under conditions when the temperature was at times above normal.

In accepting 1 per cent to 2 per cent as the standard for extractive matter in fine unvulcanized para, it should be borne in mind that this result was obtained from specially selected samples, and that the tests were made by eminent chemists, who brought to their task unusual skill and experience. The manufacturer cannot purchase rubber in commercial quantities that will average in fineness selected samples for laboratory use, and it is not likely that the conditions under which the acetone test is generally made by a purchaser or his employee will be productive of as accurate results as when made by a Weber or a Henriques. The writer knows of a representative of a large purchaser of rubber insulated conductors who makes acetone tests upon which the acceptance or rejection of thousands of dollars' worth of goods may depend, who admitted he had never seen a Weber improved soxhlet, and that he determined the amount of extractive matter by the discoloration of the acetone. The worthlessness of such tests and the injustice that may be done to a manufacturer by them are obvious.

Vulcanized rubber always shows an increase in extractive matter over the pure unvulcanized gum. This is due to chemical changes, the exact nature of which is not known, though they are probably caused by the heat necessary for mixing and vulcanizing. In all vegetable matter heat produces chemical changes—decomposition or oxidation—the extent of these changes depending upon the degree of heat and time of exposure to it.

Sulphur is also soluble in acetone, and the free sulphur will appear in the acetone extract. As this free sulphur may vary from 2 per cent to a fraction of 1 per cent, it is obvious that when it is included in the extractive matter, widely different results may be obtained from compounds in which nothing but fine para is used. It is safe to say that a compound giving approximately 6 per cent of extractive matter and free sulphur has little or no organic matter other than fine para; also that a smaller percentage of extractive matter would be no proof that a better quality of rubber was used. The removal of the free sulphur from the extractive matter is a somewhat complicated process and is not always done, though it should be if strictly accurate results are desired. The question as to what percentage of free sulphur should exist in a rubber insulating compound is treated under a separate heading.

The addition of organic matter other than para has been shown to be highly desirable, and when this is done an increase in extractive matter takes place. The point to be determined in fixing the percentage allowable under the acetone test is not the minimum amount obtainable from a pure para compound, but the maximum amount that can safely be allowed while precluding the too free use of less expensive organic matter. The writer would consider that if other tests were satisfactory, there would be no danger of over-adulteration in a compound showing 8 per cent of extractive matter, including free sulphur.

The writer's attention was recently called to the fact that the wax used for weatherproofing the braid increased the percentage of extractive matter in the rubber compound. The inference was that the rubber absorbed a small quantity of the oily and resinous matter always largely present in all cable waxes and weatherproofing compounds.

In order to get reliable data on this matter the following experiment was made:

Four sample lengths of No. 14 B & S were insulated with four grades of rubber compound and vulcanized. An acetone test was made of the compounds on these samples before braiding and waxing. Samples were then braided and waxed. The braid carefully removed, the rubber wiped with a clean rag to remove any small particles of wax that might cling to the surface, and the acetone test was repeated.

The following table shows the results of this experiment. The column headed "After" gives the percentage of extractive matter after braiding and waxing. Column headed "Before" gives percentage of extractive matter before braiding and waxing. The difference shows the increase in extractive matter apparently due to the weatherproofing of the braid.

Sample.	Per Cent After.	Per Cent Before.	Per Cent Difference.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	44
3	[illegible]	[illegible]	36
4	[illegible]	[illegible]	69

The above includes free sulphur. While this increase would not lessen in the slightest degree the dielectric value of the rubber compound, the fact that it takes place should be borne in mind. In some case—especially if the surface wax is not carefully removed—this increase might be sufficient to make the result of an acetone test come just outside the specification requirements.

ASH TEST.

This is simply the burning up of the organic matter in a compound, leaving as ash the inorganic or mineral matter. Perfect combustion and accurate weighing are necessary in making this test. The writer has seen variations of 6 per cent in the ash obtained from the same compound, due entirely to inaccuracies in weighing and carelessness in burning. The amount of rubber in a compound varies with the conditions to be met; it is seldom less than 30 per cent nor more than 40 per cent. The percentage of ash required should be made to cover such variations. A minimum of approximately 56 per cent, and a maximum of approximately 68 per cent, would accomplish this. The sample to be burned should be cut into very small pieces, so as to have as large a surface exposed to air as possible. This helps materially to produce perfect combustion.

If a purchaser is not equipped to properly make an acetone and ash test, there are laboratories in all our large cities where he can have these tests made accurately and at a small cost.

In a subsequent article, the stretch test, the tensile strength test, the tests for the insulation resistance, temperature coefficient, etc., will be discussed, and suggestions made as to specifications.

New Telephone Patents.

PARTY LINE SERVICE METERS.

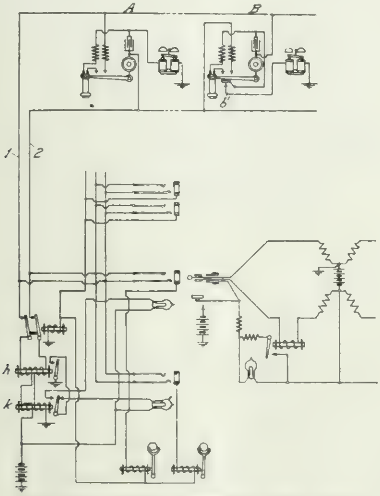
Where telephone service is sold upon the message basis there must always be some way of recording each sale, i. e., message. For a long time regular tickets were written by the operator for each call, but of recent years an effort has been made to do this work mechanically. The successful system has provided a key associated with each pair of cords, which key so manipulates the electrical circuits as to operate a meter associated with the line into which the cord happens to be plugged.

This system will, however, not work where there is more than one station connected to the line unless there be some added means of differentiating between the different stations. Mr. J. L. McQuarrie, of Chicago, has obtained patents for two different applications of this system to party lines, his patents being assigned to the Western Electric Company.

In one arrangement, a meter control relay is included in series with the line relay. This relay is a limit relay, adjusted to fail on certain current values to which the line relay will respond. One of the stations on the line is wired, normally, so that upon a call being originated, the normal current flows and the control relay responds with the line relay, and the proper

meter becomes associated with the line. At the second station, a high resistance polarized relay is included in the normal transmitter circuit, and while the line relay operates, the control relay fails and leaves the second station meter connected in. When the line is plugged into, a reversed current is sent out upon the line and the result is an operation of the station polarized relay. The contact of it thereupon shunts out of circuit such a large part of its winding that, while it remains operated, the effect upon transmission is negligible.

In the second arrangement two answering jacks are used, the one for each station. One meter and one line signal is associated with each, as shown in Fig. 1. The control of line



MC QUARRIE SERVICE METER FOR PARTY LINES.

signals lies in the relay *k*, which is differentially wound, together with the contact *b* at station *B*. By tracing the circuits, considering the hook elevated at station *A*, it will be seen that at that station the bell coils are in parallel with a circuit composed of line *I*, the two induction coil windings and the receiver, and one winding of each of the two line relays. It will thus be seen that the current in the two windings of the differential relay are not the same and this relay operates. For station *B*, the bell circuit is opened, and its unbalancing effect is lost and the control relay fails.

RECEIVER SUPPORT.

A receiver support, adaptable to either desk stands or wall sets, forms the invention of R. Higgins, of Canfield, Ohio. In both cases the receiver is supported upon a bar. This bar carries a pin so adjusted that when the receiver is pushed back out of the way the pin engages and depresses the hook switch.

TESTING PLUGS FOR PROTECTORS.

Frank B. Cook, of Chicago, has patented two different test plugs for two different types of his self-soldering heat coils. These plugs are adapted to be inserted in the arrester springs and to register with them and the heat coil contacts, so that at will an abnormal current may be put upon the coil to operate it. The current source is then disconnected and the plug withdrawn, which acts leave the protective apparatus automatically reset for further use.

LETTER TO THE EDITORS.

Color of Illuminants.

To the Editors of Electrical World:

SIRS:—To the onlooker, the present war—waged principally by salesmen—over the color of illuminants is not without its amusing features. A prospective customer for ilumination is one day solemnly assured that the common enclosed arc gives daylight color values; on another day the same quality is claimed as distinctive of the Nernst glower, and then along comes one of our gas friends with claims as to the absolutely white light given by a specially treated mantle. The incandescent-lamp salesman, knowing that his product is too yellow to carry any claims whatever to being a rival to daylight, asks why people want a white light anyway, and so the controversy goes on. The amusing part of the whole situation, both from the practical commercial and the scientific standpoint, is that every day of our lives we work under such a great variety of colors of light, both natural and artificial, that the task of prescribing the ideal color which artificial iluminants should have is practically hopeless. If daylight itself, as we receive it, were perfectly constant as regards its color, it might be reasonable to set it up as the standard toward which we should work. As a matter of fact, daylight varies considerably in color according to the amount of air, cloud and smoke the sun's rays must pass through before reaching us, so that even assuming daylight as the ideal color of light, we have a rather uncertain standard to work to. Add to this the fact that the majority of people pass their evenings contentedly under a light which is radically different from daylight, being either the yellow of the incandescent electric lamp, the kerosene flame or the open gas jet, or the greenish light of the gas-mantle burner. When one leaves aside the question of the value of different lights for color matching there seems to be little left upon which to base arguments in favor of one color of light as against another, save the general effect produced. Here again we find a lack of any definite ideal because one person will show a preference for a much whiter light than another. What seems to one to be a "soft, mellow" light is to another a "sickly yellow" light. The person who calls the common incandescent lamp a sickly luminary feels much more cheerful under a whiter light; while to his friend who likes the "soft mellow" light, a nearly white light may seem cold and lacking in cheerfulness. In the meantime the world goes on making its selections of colors of artificial illuminants mainly on the ground of economy, convenience and expediency, and probably will continue to do so for some time.

CHICAGO, ILL. JNO. L. BERTRAM.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Compounding Alternators.—J. REZELMAN AND J. PERRET.—An illustrated description of a method of compounding alternators in which the armature m. m. f. is directly made use of for obtaining a required compounding effect, without the assistance of any special compound winding or rectifier. The m. m. f. of the armature may be regarded as split up in two components, a demagnetizing and a cross-magnetizing one. The first component tends to reduce the e. m. f. of the armature, while the second produces a lateral shifting of the resultant flux. By a suitable design of the magnetic circuit it is arranged so that as the resultant flux is shifted the reluctance decreases, the flux will increase and so raise the e. m. f. of the machines. The effect of an increase in the demagnetizing ampere-turns is thus balanced by a decrease of reluctance. The compounding effect is obtained, however, only for a specific power-factor. The article is illustrated by diagrams and a numerical example is given.—Lond. *Electrician*, Nov. 1.

[illegible] illustrated discussion of the conditions which must be fulfilled for the successful operation of transformers in parallel, especially in the case of three-phase transformers. The latter, even if of equal ratio of transformation, cannot be connected in parallel in many cases. The condition which must be fulfilled for parallel connection, besides equal ratio of transformation, is that the windings should be so arranged that the secondary voltages have always the same phase difference against the primary in the vector diagram. If a three-phase distributing system contains a transformer supplying a low-voltage network, the voltage vectors of the primary will form a certain angle with those of the secondary, and this angle depends on the winding of the transformer. This angle, which is formed by the voltage vectors of two networks connected together by the transformer, is called by the author the "network angle" (netzewinkel). The condition which must be fulfilled if two three-phase transformers are to be connected in parallel is that their networks angles are the same. The author recommends to indicate the networks angle of a transformer on the name-plate of the machine.—*Elek. Zeit.*, Oct. 10.

Separating the Losses in Induction Motors.—W. Linke.—Bragstadt and LaCour have shown that the retardation method may be used for determining the friction and no-load losses in induction motors. For this purpose the machine is run as a synchronous motor, the rotor being excited by means of direct current in such a way that the phase difference in the stator is zero. By varying the frequency of the stator current, the watts are determined as a function of the number of revolutions. With the same direct-current excitation and, therefore, with the same flux, a retardation curve is then plotted, with disconnected stator. The present author shows that this method in connection with a no-load test may be used for determining the iron losses caused by the flux pulsations in the teeth.—*Elek. Zeit.*, Oct. 3

Lamps and Lighting.

New Lamps.—Notes on two recent British patents of the British Thomson-Houston Company. One refers to a graphite filament. Pure graphite, produced by heating a deposit of lampblack in an electric tube furnace to 3000 deg. C., is mixed with some suitable binder to produce a plastic mixture. This is squirted or otherwise shaped into threads or filaments, which are then heated to 400 deg. C. to carbonize the binder and produce a filament entirely of graphite. The filament is then mounted on lead wires and heated with a current in a vacuum. The second patent refers to a magnetite flame arc lamp. The electrode consists of a sheet-iron envelope having a metal closure at the bottom and contains a filling of 30 parts of rutile, 70 parts of magnetite, and 12½ parts of chromite mixed with ¼ per cent of sodium fluoride. When the electrode is in use, the sheet-iron envelope burns away with the filling, so that the end of the electrode presents a smooth surface, and a dense cap over the surface, which is sufficiently conductive to permit the relighting of the arc without difficulty.—Lond. *Elec. Eng'ing*, Oct. 31.

Arc Lamps.—O. Arendt.—An illustrated article on recent practice in the construction of electric arc lamps with vertical and slightly inclined electrodes. The latest construction of the Beck lamp is described. It operates with constant distance between the electrodes. Tests of Wedding with flame-arc electrodes 7 mm. or 8 mm. in diameter gave a mean hemispherical candle-power of 2469 for a mean voltage of 44.2 and a mean current of 9.1 amperes, and a specific power consumption of 0.163 watt per candle-power. Since the distance between the electrodes is constant, pulsations of voltage would cause pulsations of the current. These are avoided by using in series with the lamp a ballast resistance of the same type as used with Nernst lamps.—*Elek Zeit.*, Oct. 10.

Flame Arcs.—Illustrated notes on an experimental display of electric street lighting in a London city with centrally-hung flame arc lamps. They are to be hung and maintained at a rate of $87.50 each per year, all costs of the experimental installation being borne by the company. Two types of lamps are used, both with long-burning hours, one lamp being of the magazine type, while the other lamp is of the multiple electrode variety.—Lond. *Elec. Eng'ing*, Oct. 31.

Power.

Power Plant.—An illustrated article on electric power supply in Yorkshire. Considerable progress has been made during the last two years in the supply of the Yorkshire Electric & Power Company. The power house now contains three 2000-kw Curtis turbo-alternators. An improvement has also been made in the boiler house, which enables the boiler feed make-up water to be obtained from the canal instead of from the town pipes as formerly. This improvement consists in the installation of a rotary sand filter, of the Lassen & Hjort type, through which part of the condenser circulating discharge water is passed, and then delivered both warm and clean to the hot-well. The filter

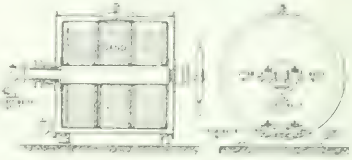


FIG. 1.—DIAGRAMS OF FILTER.

is shown in Fig. 1, and consists of an external mild steel plate drum, designed for the required pressure. Within this is a second drum, perforated all over, and revolving upon a hollow spindle fitted with glands. The inside drum is partially filled with silicate sand. The water to be filtered enters at the bottom of the outer drum, envelops the internal drum, and passes through the sand into the hollow shaft, and away through the filtered water outlet. For cleaning the filter the flow of the water is reversed and the sludge outlet is opened, while simultaneously the inner drum is revolved to agitate the sand. The area of supply served by the company comprises 1800 sq. miles in extent, with an aggregate population of 2,800,000, and an aggregate industrial power demand of 2,000,000 horse-power. The connections are now increasing rapidly, and it is expected that by February of next year the output will reach a quarter of a million kw-hours per week. In most cases the energy is charged for by making a rate per kilowatt of maximum demand and adding a charge per kw-hour consumed, according to a sliding scale dependent upon the extent of consumption. This method encourages consumers to increase their load factor; the station load factor is well above 30 per cent. Three-phase currents at 10,000 volts are transmitted to nine substations, where the e. m. f. is reduced to 2000 volts.—Lond. *Electrical Eng'ing*, Oct. 31.

Chili.—Some notes on the development of water power in Chili. For instance, at Santiago a 20,000 horse-power scheme is being developed at 16 miles from the city. A report is also given by Prof. A. E. Salazar on the proposed electrical equipment for the railway from Arica to Tacora (100 miles). The single-phase system is recommended, and an increased economy is expected.—Lond. *Electrician*, Nov. 1.

Gas Engines and Steam Turbines.—E. J. Fox.—A communication criticising some figures in the recent comparison by Andrews between gas engines and steam turbines. It is claimed that Andrews' figures are too favorable to gas engines.—Lond. *Elec. Eng'ing*, Oct. 31.

Traction.

London.—An abstract, with an editorial discussion, of the accounts of the London County Council tramways. The chief points brought out in the report are the much better financial results obtained with electric traction than with horse traction, and the decrease in the cost per car-mile for electric working, due to the erection of their own generating station.—Lond. *Electrician*, Nov. 1.

[illegible] P. Dawson.—In a continuation of his long illustrated serial on electric traction on railways, the author tells how to ascertain the resistances required for speed regulation with direct-current traction motors.—Lond. *Electrician*, Nov. 1.

Installations, Systems and Appliances.

Electricity Supply in France.—Some statistical figures on central stations in France. On Jan. 1, 1907, there were 1413 generating stations which supplied 2912 towns with energy for lamps and motors. There were besides 824 gasworks, supplying 1209 towns. Each station supplies energy to the inhabitants of one or more towns. In each of four departments there are more than 100 villages connected to one station, and each of 12 departments there are over 50. The Department of Isere contains the greatest number of stations, namely, 60. There are 942 direct-current and 157 single-phase, 20 two-phase and 256 three-phase alternating-current stations. The remaining 38 stations supply both alternating and direct current. More than two-thirds of the stations, viz., 1000, are driven by water-power, 831 of these have water turbines alone, while 124 have also a steam reserve; 306 stations are steam-driven, 71 are worked by gas engines (including 43 by power-gas) and 10 are provided with oil engines.—Lond. *Electrician,* Nov. 1.

Lightning Arresters.—F. NEESEN.—A comparison of various types of lightning arresters with instructions as to their construction so as to be most efficient.—*Elek. Zeit.,* Oct. 3.

Electrophysics and Magnetism.

Production of Static Electricity by the Action of Heat and Light.—G. MELANDER.—The author thinks that a connection exists between the intensity of sunshine and the phenomena of terrestrial magnetism, and that it is not improbable that the rays of the sun are the indirect cause of the magnetism of the earth, the earth currents being the effect of sunshine. He has made a number of interesting experiments in which plates of different substances were exposed in sunshine and their electric charge before and after exposure measured. In making the experiments he observed that a piece of paraffin wax and a sheet of gutta-percha, which had lain in the dark for at least a year, even before exposure showed a negative charge; a stick of sealing-wax which had lain in the ordinary light of a room showed also slight negative charge; while the charge on an old ebonite plate and on a glass rod were scarcely perceptible. After exposure to sunlight all these bodies were charged; the paraffin, gutta-percha and sealing-wax were highly charged, the charge on all three being of negative sign. The ebonite plate showed a slight negative, and the glass rod a strong positive charge. One-half of the glass rod was rough and the other half smooth, but both parts were positively charged by exposure. With artificial sources of light (like a bunsen flame, the mercury-vapor lamp, arc lamps) very much smaller effects are obtained. The active rays are specially strong in sunlight and are not stopped by a glass window. The author then discusses the excitation of electricity by friction, and describes various experiments in this respect. When two pieces of paraffin, which have the same temperature, were rubbed one with the other, both pieces were negatively charged, but by keeping the temperature of one piece of paraffin higher than the temperature of the other, the warmer piece shows after rubbing a positive charge and the colder a negative charge. Similarly a glass rod, rubbed with a piece of woolen cloth was positively charged, but if the same woolen cloth before friction was made very hot, the same glass rod showed after rubbing a negative charge. The author proposes the following hypothesis. He thinks the different bodies at the same temperature may be in different electrical states. He calls this state the "electron temperature" of the bodies and he thinks this temperature is very different from the ordinary molecular temperature. By rubbing two bodies one with the other, the body which has the lower electron temperature is negatively charged and the other, which has the higher electron temperature, is positively charged, for the following reason: If two bodies have the same electron temperature, the electrons will be removed in the same proportion from both bodies. But if the electron temperature of two bodies is different, the number of electrons removed from the "electrically warmer" body will be greater than the number of electrons removed from the "electrically colder" body. The electrically warmer body will thus by rubbing be depleted of electrons and left with an excess of positive ions. It will, consequently, be positively charged. The electrically colder body will collect the electrons which the electrically warmer body has lost, and it will thus be negatively charged.—*Phil. Mag.,* October.

Magnetic Induction in Spheroids.—D. N. MALLIK.—A highly mathematical paper on the problem of magnetic induction in a magnetic substance in the form of a prolate spheroid, due to a current in a wire wrapped around it along a part of its length —*Phil. Mag.,* October.

Electron Theory.—E. CUNNINGHAM.—A mathematical note on the electromagnetic mass of a moving electron, with respect to an objection raised by Abraham to Lorentz' hypothesis of the form of an electron.—*Phil. Mag.,* October.

Radium Emanation.—G. RÜMELIN.—An account of a determination of the period of radium emanation (or the time required for the emanation to be half transformed), which is found to be 3.75 days, agreeing very closely with the original value of Rutherford and Soddy.—*Phil. Mag.,* October.

Units, Measurements and Instruments.

Direct-Current Moving-Coil Galvanometer.—A. SCHORTAU.—An illustrated description of a new direct-current galvanometer,

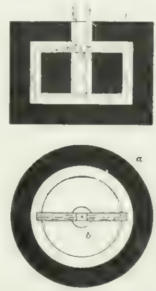


FIG. 2.—DIAGRAM OF GALVANOMETER CONSTRUCTION.

the construction of which is shown in Fig. 2. The cylindrical iron frame *a* forms one pole shoe of the permanent magnet. The other pole shoe *b* of the same magnet is an iron cylinder placed concentrically within the frame, so that the whole air-gap between the two cylinders is filled with lines of flux of uniform density. Within the air-gap a double coil is suspended. The two halves of their windings are either connected in series and wound in opposite directions, as shown in Fig. 2, or are connected in parallel and wound in the same direction as shown in Fig. 3. When a current passes through the coil, the coil moves under the influence of the magnetic field. By connecting two coils together it is possible to increase the torque and the sensibility. Further, since the flux density is the same at all points of the magnetic field, the angle of deflection of the coil must be proportional to the current. This is, indeed, the

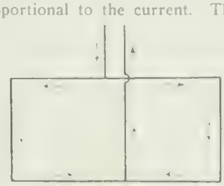


FIG. 3.—PARALLEL WINDINGS.

case in the instruments as constructed. The air-gap is only one-half that of the Deprez d'Arsonval type.—*Elek. Zeit.,* Oct. 3.

Meters.—The Engineering Standards Committee has issued a standard specification for motor meters for electric supply consumers. A new departure is to fix a limit of inaccuracy at loads under one-tenth full load for all sizes. The meter must be capable of running on a minimum current equal to the one hundredth part of its rating, and must start running and continue on this current when it is not less than one-tenth of an

ampere. The meter must be able to withstand an overload of 25 per cent for one hour without impairing its working or accuracy, or a current in the main circuit 30 times the ordinary rating for a period of half a second, and it must be able to withstand a 10 per cent pressure variation, or a 5 per cent frequency variation in alternating-current circuits with an error of not more than 1 per cent. The committee has defined very minutely the construction of the instrument with regard to the prevention of dust getting into the works, improper adjustments, or the interference of the purchaser with the mechanism, also defects in the construction and workmanship. A time limit of three years is fixed during which the manufacturer is liable for any defects for meters whose seals are intact.—Lond. *Elec. Eng'ing,* Oct. 31.

Induction Meter.—An official communication from the Reichsanstalt in which the admission for calibration of a single-phase induction meter of the Isaria Meter Company is recorded and the construction and operation of the meter is described in detail with illustrations.—*Elek. Zeit.,* Oct. 10

Megger.—Some illustrated notes on some recent forms of insulation and resistance-measuring sets of English make, called the "megger," and consisting of a combined ohmmeter and hand-driven generator. In one type an additional resistance box is provided for the accurate measurement of low resistances. Several illustrations are given. The principle has been noticed before in the Digest.—Lond. *Elec. Eng'ing,* Oct. 31.

Measurement of Mutual Inductance.—A. Campbell.—An account of a method measuring mutual inductance by a modified Carey-Foster method, with the aid of a vibration galvanometer. —*Phil. Mag.,* October.

Standard Cells.—F. A. Wolff and C. E. Waters.—A paper giving preliminary specifications for Clark and Weston standard cells. The Clark cell is defined as a voltaic combination having as its positive electrode pure mercury covered with a paste consisting of pure mercurous sulphate mixed with finely divided mercury and pure zinc sulphate crystals and solution, and as its negative electrode an amalgam containing 10 per cent by weight of pure zinc, covered with a layer of pure zinc crystals, the electrolyte being a solution of pure zinc sulphate in saturation equilibrium with the other constituents of the cell. The Weston cell is defined as a similar combination in which the zinc sulphate is replaced throughout by cadmium sulphate and the zinc amalgam by an amalgam containing 12.5 per cent by weight of pure cadmium. The purification and preparation of the different materials is described in detail, and in various cases several different methods are given.—*Bulletin, Bureau of Standards,* Vol. III, No. 4, October.

Series-Parallel Lamp Resistor.—N. T. M. Wilsmore.—A Faraday Society paper describing the arrangement shown in

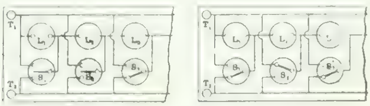


FIG. 4.—LAMP RESISTOR.

Fig. 4. In the figures only three lamps are shown, but the number may be increased indefinitely. The lamp sockets, L_1, L_2, L_3, etc., are connected in series with each other, and with the terminal T_1; but, by means of the two-way switches, S_1, S_2, S_3, etc., they may be connected in several different ways, so that a wide variation in resistance between the terminals T_1 and T_2 may be produced. Thus with three lamps of the same size, the following six combinations are possible: Three lamps in series (left-hand diagram); two lamps in series, one lamp; one lamp in parallel with the other two in series, two in parallel or three in parallel (right-hand diagram). However the switches are moved it is not possible to cause a short between T_1 and T_2.—Lond. *Elec. Eng'ing,* Oct. 31.

[illegible] Hole Interrupter.—W. [illegible].—A description of a new and convenient form of the hole interrupter which works for months without giving trouble. For diaphragms the author uses thimble-shaped tubes of thin porcelain, made at the Imperial German Porcelain Factory. Each porcelain tube has a small perforation in the bottom, from ⅛ mm. to 2 mm. in diameter. The thimble is inserted in the bottom of a beaker in a hole bored for the purpose of receiving it, and is held in position by a short length of india rubber tubing, which surrounds it. The beaker is placed in a larger vessel containing the same kind of liquid as does the beaker. The electrodes are thin leaden pipes, bent in spiral coils, one inside the beaker and one outside it in the larger vessel. The latter is bent so as to envelope the lower portion of the thimble. The two ends of each coil emerge from the liquid, and during the action of the interrupter cold water is kept running through them. In this way any heating of the interrupter is prevented. The author has succeeded in working it with strong currents, as high as 12 amperes, using in this case the larger hole. If the beaker has several holes in the bottom, several thimbles may be inserted and kept in reserve by closing them up with india rubber stoppers.—From *Phys. Zeit.,* Oct. 15; abstracted in Lond. *Elec. Eng'ing,* Oct. 31.

Battery for Testing Mains.—A letter and a note on batteries for the testing of mains. A set of small, portable dry cells is suitable, but the old-fashioned portable batteries of wet Leclanche cells last much longer if used carefully. An ideal battery for the testing of mains would be a set of well insulated secondary cells with a viscous or pasty electrolyte.—Lond. *Elec. Eng'ing,* Oct. 31.

Resistance Thermometers.—H. C. Dickinson and E. F. Mueller.—The authors describe a special form of electric resistance thermometer intended for calorimetric work. It has been found applicable for general temperature measurements in the interval between zero degree to 100 deg. C. The transition temperature of sodium sulphase has been redetermined, and found to be 32.384 deg. C. for the purest salt.—*Bulletin, Bureau of Standards,* Vol. III., No. 4, October.

Standard Scale of Temperature.—C. W. Waidner and H. C Dickinson.—A long paper on the standard scale of temperature in the interval from zero to 100 deg. C. This standard scale is the scale of the constant-volume hydrogen-gas thermometer The conclusion reached in the present paper is that the standard scale of temperature of the Bureau of Standards within the above interval, as defined by their standard mercury thermometers and with certain corrections, is in agreement with the hydrogen scale of the Bureau International to within the limits of accuracy at present attainable in mercurial thermometry, which may be about 0.002 deg.—*Bulletin, Bureau of Standards,* Vol. III, No. 4, October.

Telegraphy, Telephony and Signals.

London Telephone Exchange.—W. U. L[illegible].—An illustrated description of the equipment of the new Gerrard telephone exchange in London. The change-over from the old to the new exchange recently took place successfully. A feature of the switchroom is that, while the subscribers' lines are multipled over every six panels of the junction sections of the switchboard, they are only multiplied over every nine panels of the subscribers' sections. The switchboard is made up of eight-panel sections, each equipped for three operators' positions. One hundred and three subscribers' positions and 41 junction positions are already equipped, dealing with 7840 subscribers' lines and 1101 in-coming junction lines. Four-party line ringing keys have been fitted on the subscribers' positions. A plugging-up circuit of new design is used, capable of dealing with any kind of fault. In the apparatus room, the cables are brought to the vertical side of the main frame, on which side are the fuses, lightning arresters and heat coils.—Lond. *Elec. Eng'ing,* Oct. 31.

Condensers and High-Frequency Currents.—W. Hahnemann and L. Adelmann.—An account of an experimental investigation of the losses in condensers with solid dielectrics and their damping effect in closed high-frequency oscillating circuits.—*Elek. Zeit.,* Oct. 10 and 17.

High-Frequency Oscillations.—J. Sahulka.—By connecting a Nernst-lamp filament in parallel with an oscillating circuit

(in an analogous way, as in Duddell's experiment with an arc lamp) the author endeavored to produce high-frequency oscillations, but was unsuccessful.—*Elek. Zeit.*, Oct. 24.

Electrolytic Wave Detector.—M. Tissot.—The electrolytic detector which has been in use for several years for the telephonic reception of wireless telegraphic messages is, in principle, a voltmeter with two very unequal platinum electrodes immersed in sulphuric or nitric acid. As usually employed, a constant e. m. f. is applied to it, the fine point being the anode. A telephone in the circuit yields a sound when the voltmeter is submitted to the action of a train of waves. The author has compared the indications of the electrolytic detector (using a galvanometer instead of a telephone) with the bolometer. From his measurements he infers that the direct current resulting from the action of the waves on the electrolytic detector is proportional to the square of the amplitude of the oscillatory current in the receiving antenna. Nernst's theory of the concentration charges at the electrodes is then applied to this case, and is shown to represent the facts.—Lond. *Elec.*, Oct. 18.

Wave Detector.—An account of a recent British patent of R. A. Fessenden for a detector for wireless signalling. It is an electrolytic detector in which the gas from the fine platinum point is carried by a current of liquid to a narrow tube, which it partially obstructs, and thus interrupts a local current.—Lond. *Elec. Eng'ing*, Oct. 24.

Cable.—An illustrated description of the new West Indian cable recently laid between New York and Havana. Two types of deep-sea cables are employed, and two weights of intermediate cable. A rock cable is used at the Havana shore end and in this the cores are laid sheathed, in addition to being bronze-taped.—Lond. *Elec. Eng'ing*, Oct. 24.

Miscellaneous.

Meeting of Electrical Engineers of Switzerland.—An account of the general joint meeting, held at the end of September in Luzerne, by the Swiss Electrical Association (president, Nizzola; number of members, 802), the Association of Swiss Electricity Stations (president, Zaruski), the Incandescent Lamp Buying Syndicate (president, Wagner), and the Association of Swiss Electrical Contractors (president, Kummler). The representative of the Swiss Railway Department had formerly suggested to the electrical engineers to get together and agree on a certain electric traction system as the most suitable for operating the Swiss Railways. A report was presented by Prof. Wyssling for the committee for studying electric traction in Switzerland, an abstract of which will be found under Traction. The technical testing stations of the association have done a great deal of work during the past year. In discussing the incandescent lamp situation, it was emphasized on all sides that it is important to get better lamps, and that a somewhat higher price for the lamps should not prove an obstacle. The difference in the price might be made up by the electricity works, since they then would be in a position to give better light to their consumers.—*Elek. Zeit.*, Oct. 24.

BOOK REVIEWS.

Recipes, Formulas and Processes. Edited by Gardner D. Hiscox, M. E. New York: Norman W. Henley Publishing Company. 787 pages. Price, $3.00.

This volume, the full title of which is "Henley's Twentieth Century Book of Recipes, Formulas and Processes," is stated in the sub-title to contain nearly 10,000 selected scientific, chemical, technical and household recipes, formulas and processes for use in the laboratory, the office, the workshop and in the home. The compiler states that in selecting the matter for the book he drew only from trustworthy sources, and modified such formulas as he considered ill-adapted in their original form for the needs of every-day life. The text is intelligently arranged and adequately cross-indexed, and the book is well printed and bound. A glance through the pages indicates that the matter has been carefully selected, both with respect to subject and to the present state of the arts to which the recipes apply.

Practical Illumination. By James R. Cravath and Van Rensselaer Lansingh. New York: McGraw Publishing Company. 361 pages, 385 illustrations. Price, $3.

Until within comparatively few years electric lighting as an art dealt directly only with the generation of power and its transformation into light. While every detail up to the utilization of the light had received most minute attention in theory, design and construction, lighting plans were in most cases left to the draughtsman of the architect or of the wire contractor, who, with no knowledge of the principles of illumination, located lamps in accordance with the most primitive considerations. The late Luther Steiringer was, perhaps, the first who sought to bring illumination to the stage of an art, and the classical book by Dr. Louis Bell, "The Art of Illumination," originally published about seven years ago, was the first systematic treatise on the subject. While it is only within the past two or three years that the desirability of applying scientific engineering principles to everyday problems of artificial illumination has become generally recognized, the advancement in that short period has been so rapid that illuminating engineering has now become definitely established as a specialty. For its practice, however, there has been a great dearth of specific engineering data, and the present work, having for its leading object the supply of this deficiency, is, therefore, particularly welcome.

Some of the chapters of the book are revisions and enlargements of articles by the authors which have appeared from time to time in the past two years in the columns of the Electrical World. Much other matter has been added, however, including chapters on gas lamps and comparisons of illuminants. The first part of the book is devoted largely to curves showing the distribution of light about incandescent electric lamps, gas burners, gas and electric clusters, Nernst lamps, arc lamps and mercury-vapor lamps equipped with various forms of reflectors, shades and globes. Considerably more than 100 photometric curves of this kind are shown, practically all the result of tests made at the Electrical Testing Laboratories in New York. These tests cover most of the common forms of glassware used with gas and electric lamps, and are of the greatest importance to the engineer in planning effective illumination. Chapters on the laws and measurement of light, calculation of illumination and the physiological effect of light with respect to the eye—a most important consideration in practical illumination—are also included in the early part of the book. A chapter on comparisons of illuminants gives the mean spherical candle-power of all the common electric and gas lamps, the data being taken from the most authoritative sources available. An interesting chapter is on "Demonstration Room Tests," in which is shown a set of engravings made from photographs of a pair of rooms, side by side, of exactly similar dimensions and color. In these rooms incandescent lamps, equipped with different kinds of shades and globes were compared to determine the relative effect of the glassware in modifying the distribution of light. These tests show to the non-technical mind the effect of different glassware in a much clearer manner than photometric curves. The latter half of the book is devoted to a discussion of examples of interior lighting. A chapter is devoted to the principal classes of interior lighting, including residence lighting, office lighting, public halls, theaters, churches, stores, shops, factories and many other classes. In these chapters numerous illustrations are presented of rooms with good and bad lighting arrangements, the reason for the success or failure of the design being pointed out in the text. This method enables the essential features of good and bad design to be presented much more clearly than by simply discussing general principles without examples to illustrate them. In fact, the book makes no attempt to take up general principles at length or to go into the historical or extremely scientific and technical portions of the subject. The aim of the authors appears rather to have been to give specific practical information of a kind that has heretofore been largely lacking and to present it in such shape that it can be easily understood by non-technical men as well as engineers. The information contained on the light distribution

from various illuminants is particularly necessary to all who aim intelligently to plan illumination.

Recent discussions on central-station business methods have brought out clearly that no policy pays other than that of aiding consumers to obtain the most effective and economical illumination. Every central station, however small, should have one person on its staff who is, to some extent, at least, an expert on illumination, and to these the present book will be of the highest value, both for instruction in the art and for the practical data contained.

Reinforced Concrete. Part I. Methods of Calculation. By Albert W. Buel, C. E. Part II. Representative Structures. Part III. Methods of Construction. By Charles S. Hill. Second edition. New York: *Engineering News* Publishing Company. 499 pages, 80 illustrations. Price, $5.00.

In their preface the authors state that in preparing this work they had in mind a treatise for designing and constructing engineers, following American practice and governed by the conditions which prevail in America. Theoretical discussions are omitted in favor of practical working formulas, examples of representative structures, and records of actual practice in the selection of materials and of methods of workmanship and construction. The book is divided into three sections. In Part I are given working formulas for the calculation of the various classes of structures in reinforced concrete and such facts about the properties of concrete and steel as relate to economical engineering designs. Part II contains illustrations and descriptions of representative structures of reinforced concrete. Materials, workmanship and methods of construction are considered in Part III, and illustrated by examples from actual practice. In this part attention is given to the construction of centers and forms for concrete work and to methods of facing and finishing exposed concrete surfaces.

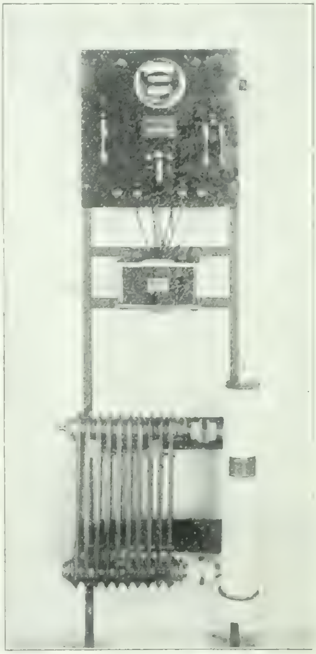
Electrolytic Current Rectifier.

The most interesting characteristic of aluminum is its asymmetrical resistance when placed in certain electrolytes. That is to say, the resistance is quite low for current in one direction but it is extremely high when the current reverses. This characteristic is caused by the formation of an insulating film on the aluminum surface by electrolytic action.

In the equipment illustrated herewith an aluminum cell with a special electrolyte is used for obtaining a unidirectional current when the supply e. m. f. is alternating. The rectifier proper consists of a circular iron tube about 4 ins. in diameter and 2 ft. in length, with which is connected a sheet-iron radiator through which the electrolytic compound circulates; the only other element is an aluminum rod which hangs in the center of the iron tube from which it is thoroughly insulated. The radiator serves for maintaining the temperature of the electrolyte at a safe value. In a 10-ampere rectifier operated at 133 cycles, the temperature of the solution reaches about 100 deg. F.; when the same equipment is used at 60 cycles, the temperature is very much lower. In either case the solution is kept in circulation, a result that contributes to the long life of the electrolyte and the electrodes.

The equipment illustrated delivers unidirectional current at 85 volts when the supply e. m. f. is 110 volts alternating. By the use of a small transformer the equipment may be rendered suitable for any value of supply e. m. f. The rheostat serves for adjusting the delivered current at any desired value from one ampere to the full rating of the equipment. An ammeter at the top of the board indicates the value of the unidirectional current delivered by the rectifier.

The type shown in the accompanying illustration is particularly arranged for charging small storage batteries for sparking and other purposes; as many as 30 cells can be charged in series at one time, taking from two to ten amperes. A larger type is designed for charging 24 or more cells of an automobile battery with a current not exceeding 25 amperes. These outfits are manufactured by the Eugene L. Richter Electric Company, 1914 Columbus Avenue, Philadelphia, Pa. They possess the advantageous characteristics of starting automatically when the circuit is closed, of requiring practically



ELECTROLYTIC CURRENT RECTIFIER.

no attention because there is no mechanism to get out of order, and of preventing the batteries from discharging into the supply lines when the circuit is broken.

Electric Switching Locomotive.

The Bush Terminal Company employs for switching purposes, around its extensive docks and warehouses in South Brooklyn, a number of steam locomotives and one electric

ELECTRIC SWITCHING LOCOMOTIVE.

locomotive. This latter was built by the General Electric Company about three years ago, and has given such satisfaction in the way of tonnage capacity, ease of control and low cost of maintenance that the company has recently given an order for a second electric locomotive.

The new machine has just been jointly completed by the General Electric Company and the American Locomotive Company. Some illustrations of this machine, presented in this article, show some features of the locomotive which are worthy of comment.

While the truck is a bar-frame equalized design, the construction adopted differs from that ordinarily used on electric motor trucks and follows rather a type which has been used with a good deal of success for the tender and guiding trucks of steam locomotives. The bolsters are carried rigidly on the side frames, and the weight of the frame and bolster is transmitted to the equalizers through one semi-elliptic spring on each side, instead of through bolster springs and helical side springs, as is the customary construction in the so-called M. C. B. equalized truck. This produces a simple, substantial form of truck suitable for locomotive service, and having a low cost of maintenance in such service.

Each truck is equipped with two 90-hp motors, with a gear ratio of 52 to 21. These motors, with this gearing, will give at their one-hour rating a tractive effort of 3000 lbs. per motor, or 12,000 lbs. per locomotive, at a speed of approximately 18 miles an hour.

The cab is built of sheet steel, supported by a frame work of small angle-irons, and consists of a main operating cab and sloping end cabs, with narrow side platforms extending from the main cab to the ends of the locomotive. The floor of the locomotive is of ⅜-in. sheet steel, but the floor of the main operating cab is covered with a ¾-in. wood covering.

Fig. 2 shows the arrangement of apparatus in the cab. The locomotive is provided with both straight and automatic air equipments. In the center of the main cab there is an air compressor, capable of compressing 50 cu. ft. per minute, and supplying air for the brakes. In the operating engineer's corner is located a master controller, and the valves and handles for operating the combined straight and automatic air. In the end cabs are located a sand box, air drum, contactors and rheostats. As the locomotive is to be used solely for switching service, it is supplied with a pantagraph trolley, thereby obviating the necessity of the frequent reversal of the trolley which would be necessitated in such service by a wheel trolley.

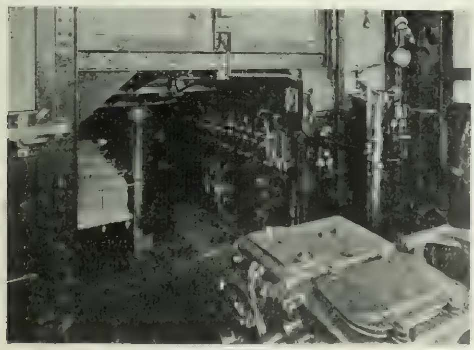


FIG. 2.—ARRANGEMENT OF APPARATUS IN CAB.

Portable Instruments for General Service.

Messrs. Machado & Roller, of New York, have brought out a line of portable instruments which have been designed with special reference to their use in general testing work. The instruments, together with a tool and utility box, are arranged for convenient handling as a unit by the use of a simple system of hooks and buttons. This is of great convenience, especially where the instruments must be transported to test apparatus in place and where time is a consideration, the unit forming a full testing equipment. The mechanisms are built solidly into their polished hard-wood carrying cases and the covering lids of the instruments are double hinged so that while the instruments may be thus entirely enclosed, leaving no projecting parts, the compartment enclosing the binding posts may be utilized for holding flexible leads and a moderate capacity shunt in the case of an ammeter.

One type of the unit system boxes is fitted with fibers, combined wire scraper and screw-driver, wire gage, screw wrench and foot rule, and the other type is merely an empty case large enough to carry a good-size shunt or such special tools and equipment as may be selected for individual needs.

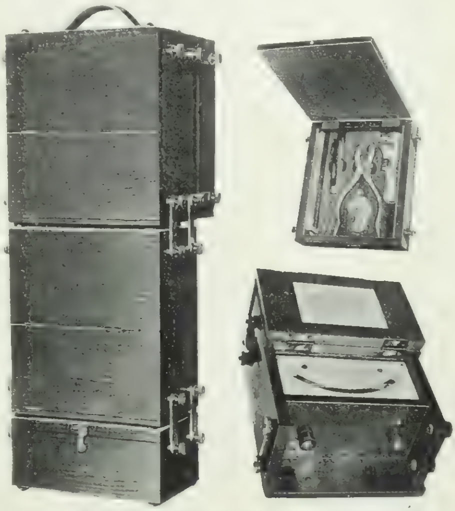


FIG. 1.—PORTABLE TESTING INSTRUMENTS.

The direct-current instruments are of a wire-guided d'Arsonval type. The coil itself is rectangular, the wires being wound on a seamless metal frame whose vertical sides turn about the axis of the rectangle as a center in air gaps existing between the concave faces of the pole pieces of a permanent magnet and a cylindrical central iron core, in the conventional manner. In the "wire guided" mechanism, the coil *A*, Fig. 2, has attached to it ruby jewels, *B*, through which are pierced smooth cylindrical holes with rounded lips. Through these holes is threaded a length *C C* of hard drawn phosphor bronze wire of a diameter slightly less than that to which the holes were drilled and this wire, being tightly stretched and permanently secured at its ends to the U-shaped stationary frame-work of the instrument, thus forms a guide maintaining the coil truly centered with reference to the axis of the cylindrical iron core. To support the weight of the coil and prevent its touching the core, spiral springs *D D* have their one extremities attached to the coil, the other ends being stretched and secured to insulated brackets on the stationary framework. These springs also furnish the force opposing rotation of the coil when current exists and conduct the current in and out. If an instrument so built is dropped, the coil *A* will evidently dance up and down on its springs a few times without causing any damage. When in use and at rest, the coil moves with absolute freedom from

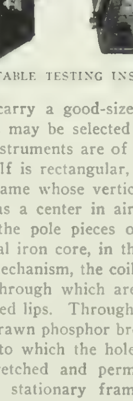


FIG. 2.—DIRECT-CURRENT INSTRUMENT MECHANISM.

frictional restraint other than the molecular friction of the metal of the springs.

The voltmeters have self-contained resistors. Ammeters of under 75 amperee capacity have their shunts self-contained, for convenience in higher capacity ammeters, the shunts are separate, being of the standard switchboard types, but with the clamp screws having wing nuts so that they may be tightened with the fingers if desired.

All the direct-current shunts give a uniform drop of 50 millivolts at their terminals when carrying full load, so that any number of different-capacity shunts may be used with a single instrument, the scale indications being multiplied by a suitable simple factor, according to the shunt selected. All separate shunt instruments are thus also millivoltmeters suitable for very low potential measurements.

The alternating-current instruments are of the hot-wire type and have been described in these columns before. The standard general service instrument case measures 6¾ ins. x 7½ ins. x 4 ins. The tool box is 6¾ ins. x 7½ ins. x 1¾ ins. and the utility box is 6¾ ins. x 5 ins. x 4 ins.

New Storage Battery Developed in Boston.

A new storage battery has recently been developed in Boston by Mr. E. C. Ekstromer, of Cambridge, Mass., which has been made the subject of an exhaustive study by Dr. William L. Hooper, professor of electrical engineering at Tufts College, extracts from whose report are given below.

The positive and negative elements of the Ekstromer battery consists of pasted lead grids, as do those of most other batteries, but by a special treatment the active material on these grids is rendered porous and, therefore, permeable to the electrolyte to a much greater extent, it is claimed, than in the case of other batteries. In the ordinary pasted grids the immediately useful part of the active material is limited to the relatively thin layer upon the surface of the plates that can be freely reached by the electrolyte, and the capacity of such cells is quite definitely limited to 0.28 to 0.30 ampere-hour per sq. in. of positive plate surface, which capacity per unit of area is, moreover, nearly independent of the size and thickness of the plate. In the Ekstromer cell the greater porosity of the active material allows the electrolyte to penetrate more readily and deeply, the active material, forming a deeper layer of immediately useful active material and resulting in a greater ampere-hour capacity per unit area of plate. Prof. Hooper states that he finds a capacity of 0.4 ampere-hour per square inch of positive plate for the Ekstromer cell.

The greater freedom with which the electrolyte reaches the active material results in less polarization, and the cells, therefore, yield a somewhat higher potential on discharge. The watt-hour efficiency is, therefore, somewhat higher. Dr. Hooper states that mechanical, as well as electrical, considerations demand that only a fraction of the thickness of mechanically stable plates shall be available for storage purposes; therefore, an obvious and necessary consequence of the greater porosity and ampere-hour capacity per unit area of the Ekstromer plate is that for a given weight of battery a greater output can be secured, and, on the other hand, a given number of ampere-hours can be secured from a lighter cell. Dr. Hooper's tests showed an ampere-hour efficiency of about 90 per cent and a watt-hour efficiency of about 85 per cent for the cell. In the accompanying table are given other results and data on six other cells of standard make, denoted by A, B, etc., compiled from figures published by their manufacturers.

The report shows that comparing the cells on the basis of ampere-hours per pound of weight, assuming the Ekstromer cell to have 8-lb. negatives, the average superiority is expressed by 85 per cent. Thus, an Ekstromer cell weighing 35¼ lbs. should have a capacity of $35 \times 7.11 = 250$ ampere-hours, and at 35 amperes should be discharged in seven hours. The cell denoted by D with 11 plates and weighing 35¼ lbs., has a capacity of 140 ampere-hours, and at 35 amperes could be discharged in four hours. The same cell weighing 27 lbs. would have a capacity of about 107 ampere-hours, and at 35 amperes would be discharged in about three hours. An Ekstromer cell weighing 27 lbs. is discharged at a 35-ampere rate in five and one-half hours. The above comparisons are based upon a somewhat

	[illegible]	A	B	C	D	E	F
Plates:							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sq. ins. of + surfaces	482	[illegible]	[illegible]	[illegible]	[illegible]	397	480
[illegible]	[illegible]	[illegible]	[illegible]	22	[illegible]	23½	39
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	53
Discharges:							
[illegible] hours	48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ampere hrs.	192	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ampere hrs. per:							
[illegible] surface	0.4	0.282	0.286	0.289	0.282	0.282	[illegible]
Lbs. of plates.	8.65	[illegible]	[illegible]	[illegible]	4.87	4.77	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	4.03	[illegible]	3.90	2.64
Relative capacity:							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	73
Unit weight	100	[illegible]	[illegible]	56.7	[illegible]	[illegible]	[illegible]

lighter negative for the Ekstromer cell than was used in making up the test cell, but tests with the cadmium electrode seem to show that this decrease in weight can be made without reduction of capacity. The great porosity of the plate increases the effective area, and should enable the plates to stand up well under heavy discharges. Its construction should give it some degree of elasticity and thus enable it better to withstand the jolting of an electric vehicle. For stationary batteries where weight is of little account, Prof. Hooper states that a battery of Ekstromer plates of a given area will have about 40 per cent greater capacity than one of ordinary make of standard cells.

During a recent discussion, Dr. Ekstromer stated that on a test an electric automobile of full weight was run 150 miles on one charge. A new factory is being equipped on Altro Street, Cambridge, Mass., by the American Electric Battery Company, for the manufacture of these cells on a large scale, and it is expected that the average output will be 1200 cells a week.

A report has also been made by Prof. John Stone, pointing out the usefulness of the battery in electric launch, vehicle, telephone, telegraph, lighting and power-station work. The manufacturing cost of the battery per pound is substantially the same as with other storage cells of the best quality, so that the manufacturing cost for a given capacity will be less.

Motor-Starting Panels.

The F. Bissell Company, of Toledo, Ohio, has brought out a new form of motor-starting unit which is said to combine all the safeguards required by the underwriters in such apparatus. The panel, which is shown herewith, is compact in

design and is made in two types. The automatic circuit-breaker type permits of an adjustment to suit the load and does not require the use of fuses. The other type of panel is fitted with a knife switch and fuses. Either type of motor-starting panel may also be obtained with or without the starting rheostat.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—As a whole, trade was quieter and industrial operations are being curtailed by reason of the readjustment process necessitated by the prevailing financial stringency and the widespread scarcity of currency. On account of this, wholesale buying for future delivery was restricted; jobbing was confined to actual necessities and retail trade was curtailed by the necessary use of credit instruments. In manufacturing lines there is apparently a determination to fill orders only as they are received and an indisposition to accumulate stocks, the result being a slowing down of operations. The situation, however, is not without favorable aspects. Conservatism is the rule in the business community, and there is a steady determination to make the best of the situation. Favorable news comes from the agricultural sections in which the crops are being marketed as freely as the supply of money will permit. Manufacturing returns show an increase in idle machinery to prevent an accumulation of stocks during the period of cautious buying, and in some cases of lessened demand and lower prices wage earners have wisely accepted moderate reductions in pay in order to continue at work. Railway earnings thus far reported for the first week of November show a gain of 7 per cent over last year's figures. A better supply of railway cars is reported. Collections are poor and the banks are not making new loans. New business in all branches of the iron and steel trade was very quiet, and prices tended downward. In finished lines producers are disposed to grant requests for postponements of shipments. Coal is lower, owing to the money stringency. The demand for copper was confined mainly to small lots, and prices are easier. The closing quotations were 13⅜c. for Lake, 13⅛c. for electrolytic and 12⅞c. for casting stock. Bradstreet's reports 259 business failures during the week, which is the largest number of any week since January. In the week previous the number was 226, and in the corresponding week last year 222.

ALLIS-CHALMERS CONTRACTS.—J. G. Brill Company, of Philadelphia, has recently purchased an additional power unit for enlarging the present plant in the shape of an Allis-Chalmers 22-in. x 36-in. horizontal Reliance Corliss engine direct connected to a 300-kw direct-current generator, of the same build, for lighting and power service. The engine will operate non-condensing. The Steptoe Valley Smelting & Mining Company, of Ely, Nev., recently purchased through the American Smelters Securities Company, of New York City, six 150-hp Allis-Chalmers induction motors, each for operating on 60-cycle, three-phase, 550 volts at a speed of 600 r. p. m. The Northwestern Pacific Railroad Company, of San Francisco, a consolidation of the old North Shore and the San Francisco Northwestern Railway, now owned by the Southern Pacific System, has recently purchased additional power equipment for installation in the San Anselmo sub-station of the North Shore Railroad. This equipment comprises two 500-kw Allis-Chalmers two-bearing motor-generator sets, a 30-kw induction motor generator exciter set and three 300-kw oil-filled water-cooled transformers of 54,000 volts. The San Anselmo sub-station will receive three-phase, 60-cycle alternating current at 54,000 volts and furnish direct current at 600 volts and at 1200 volts by means of synchronous motors driving 600-volt direct-current generators through a double set of bus-bars. These synchronous motors will have normal rated full load capacity of 800 hp. The Buffalo Copper & Brass Rolling Mill, of Buffalo, N. Y., has recently purchased electrical equipment for the new plant at Black Rock Station consisting of a 500-hp and two 250-hp, 2300-volt, Allis-Chalmers variable speed induction motors. These units are for use in driving rolling trains in a copper mill where the chief product is the manufacture of copper sheets. Mr. B. J. Dashiells, C. E., is consulting engineer in [illegible]

[illegible] progressive Japanese make it a point to purchase nothing but the most up-to-date material. The Japanese were among the [illegible] great many American turbine engines have been installed in that far-away country. A total of 69 units, aggregating 60,000-hp capacity, of the Curtis type of turbo-generator, manufactured by the General Electric Company, of Schenectady, N. Y., have been installed in that country. The 69 machines are distributed as follows: Chita Cotton Mill, one 25-kw unit; Fuji Cotton Mill, two 1000-kw units; Hskata Electric Light Company, one 500-kw and one 20-kw units; Ichinomiya Cotton Mill, one 25-kw unit; Imperial Steel Works, one 25-kw unit; Imperial Government Railway, one 35-kw unit; Kawasaki Dockyard Company, Kobe, one 500-kw unit; Kaneko Cotton Mill, Osaka, one 25-kw unit; Kure Naval Dockyard, one 500-kw unit; Maidzuru Naval Dockyard, one 300-kw unit; Miye Cotton Mill, Osaka, two 25-kw units; Miike Mine, Omuta, three 1000-kw units; Nisshin Cotton Mill, two 1000-kw units; Nagoya Electric Light Co., two 500-kw and one 25-kw units; Oji Paper Company, Oji, one 500-kw unit; Osaka Electric Light Co., four 500-kw and two 1000-kw units; Osaka Military Arsenal, Osaka, eight 500-kw units; Osaka Municipal Railway, three 1000-kw units; Sanyo Railway Company, one 25-kw and one 15-kw units; Saseho Naval Dockyard, two 500-kw units; Senju Woolen Mill, one 150-kw unit; Tokyo Electric Light Company, one 500-kw unit; Tokyo Military Arsenal, Tokyo, four 500-kw and two 500-kw units; Tokyo Military Arsenal, Oji, three 500-kw units; Tokyo Railway Company, five 1500-kw units; Tokyo Cotton Mill, three 1000-kw units; Tenma Weaving Company, two 25-kw units; Yokohama Union Electric Light Company, two 500-kw, one 1000-kw and one 1000-kw units.

TO MAINTAIN PRICES OF IRON AND STEEL.—The American Steel & Wire Company in a letter addressed to the managers of departments and salesmen enjoins price cutting to stimulate business on account of the falling off in demand. The salesmen are instructed to advise their customers that they will be protected in the matter of prices on the decline just as they were on the rise, which culminated last spring. The letter, which is signed by Vice-president Franck Baackes, says in part: "Indulge in no cutting of any kind: maintain schedule prices absolutely. This is no time to think of anything else. No additional sales would result from a drop of any kind, and I want to emphasize the point that you are not to sell the trade any more goods than they can take in and pay for. If this is not sufficient to take care of our production, the goods will not be manufactured."

WESTINGHOUSE MACHINE.—It is stated, from Pittsburg, that a plan has been prepared, to be submitted to the creditors, to take the Westinghouse Machine Company out of the hands of receivers and place it in the hands of a creditors' committee, giving the company a reasonable time to pay its indebtedness. The debt is to be secured by bonds now in the treasury. Statements of the condition of the company show it to be in excellent shape to meet all its debts if given reasonable time. The business is large and profitable, and nothing but patience on the part of creditors is needed to put the company's affairs in good shape.

PLANT FOR JAPAN.—The complete equipment for one of the largest flour mills so far erected in Japan was recently contracted for with Allis-Chalmers Company, Milwaukee, through the American Trading Company, Yokohama, Japan, for the Meiji Flour Mills. The capacity of the new mill will be 800 barrels of flour per day and the equipment comprises ten carloads containing 20 roller mills, bolters, centrifugal reels, purifiers and the usual complete complement of auxiliary and trans- [illegible]

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a more hopeful feeling in the stock market early in the week in view of the improved financial condition, but this was counteracted by reports of widespread curtailment in the iron and other industries, and by renewed liquidation in leading stocks, such as St. Paul and the Steel shares. The tone of the market at the close of the [illegible] In the list of electric stocks General Electric and Westinghouse

experienced declines in the net results of the week's business. General Electric advanced to 114, but dropped to and closed at 103½, which is a loss of 10⅜, and Westinghouse ranged between 48 and 32, the latter being the closing quotation and representing a net decline of 17 points. Other stocks were quite steady in price, the tendency being upward. On the curb market prices tended toward a lower level, with renewed liquidation. Trading was on a smaller scale. Following are the closing quotations of Nov. 19:

NEW YORK.

	Nov. 11	Nov. 18		Nov. 11	Nov. 18
Allis Chalmers Co.	[illegible]	—	General Electric	[illegible]	103½
Allis Chalmers Co. pfd	14	14	Hudson River Tel	—	—
Am. Dist. Tel	—	—	Interborough Met com	5⅝	[illegible]
American Locomotive	39	34	Interborough Met pfd	17½	14
Amer. Locomotive pfd	[illegible]	[illegible]	Mackay Cos	[illegible]	47
American Tel & Cable	[illegible]	[illegible]	Mackay Cos pfd	53	52¾
American Tel & Tel	[illegible]	[illegible]	Marconi Tel	—	—
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	20	23
Electric Boat	—	—	N. Y. & N. J. Tel	96	91
Electric Boat pfd	—	—	Western Union Tel	64	62
Electric Vehicle	—	—	Westinghouse com	44	34
Electric Vehicle pfd	—	—	Westinghouse pfd	160	160*

BOSTON.

	Nov. 11	Nov. 18		Nov. 11	Nov. 18
American Tel. & Tel	[illegible]	[illegible]	Mass. Elec. Ry. pfd	40	38
Cumberland Telephone	—	—	Mexican Telephone	1¼	
Edison Elec. Illum.	[illegible]	[illegible]	New England Teleph.	98½	96
General Electric	—	107	Western Tel. & Tel.	4	4
Mass. Elec. Ry.	9¾	9½	West. Tel. & Tel. pfd.	53	50

PHILADELPHIA.

	Nov. 11	Nov. 18		Nov. 11	Nov. 18
American Railways	44½	44½	Phila. Electric	6⅞	6⅝
Elec. Co. of America	8	8	Phila. Rapid Transit	16	12½
Elec. Storage Battery	30	[illegible]	Phila. Traction	83	82½
Elec. Stor. Battery pfd					

CHICAGO.

	Nov. 11	Nov. 18		Nov. 11	Nov. 18
Chicago City Ry.	140	[illegible]*	National Carbon	50	—
Commonwealth-Edison	80	—	National Carbon pfd	99	—
Chicago Subway	[illegible]		Union Traction	—	—
Chicago Tel. Co.	110	105	Union Traction pfd	—	—
Metropolitan Elec. com.	19	19*			

*Asked.

NORTH AMERICAN EARNINGS.—In discussing the affairs of the North American Company the *Wall Street Journal* says: The statement of earnings put out by the company for the ten months ended Oct. 31, 1907, is not entirely reassuring. It shows that during the period the North American Company's net income was equal only to 4.29 per cent on its $29,791,300 outstanding capital stock. If its net income for the remaining two months of the year is in the same proportion, which it may be or may not be, the total net income for the year will be equal only to 5.15 per cent, thus giving practically no margin for the 5 per cent dividend. As a matter of fact the actual net income of the company in the past has been inadequate to meet 5 per cent dividends on the present capitalization. The company has followed the practice of including in its income account the increase in value of assets as readjusted by it at the end of each year. By this means large earnings for the stock have been shown. This is shown by the following table, giving for three years the total earnings, as given by the income account, the charges and the amount and percentage earned on the stock by this method of computation:

	Total Earnings	Charges	Earned on Stock	Per Cent
1906	$2,773,892	$99,270	$2,674,622	8.97
1905	2,298,613	97,628	2,200,985	7.38
1904	1,670,985	78,324	1,592,661	5.34

The percentage earned on the stock as shown above is on the basis of the present amount outstanding, $29,791,300, the total outstanding having been increased in the last two years. As shown above, the company earned during the year ended Dec. 31, 1906, an amount equal to 8.97 per cent on its stock, which would leave a wide margin for the 5 per cent dividends. As a matter of fact, however, there was included in the income account an item of $1,721,500, representing the increase in the value of assets as readjusted. Deducting this amount, as not consisting actually of income, there remained an amount equal only to 3.19 per cent on the stock. In the income account for the year ended Dec. 31, 1905, there was included $920,000 in the same way and in the income account for the previous year $701,119. After deducting these amounts the actual earnings for the stock on the basis of the amount now outstanding were as follows:

	Earnings After Charges	Deductions	Balance for Stock	Per Cent
1906	$2,674,622	$1,721,500	$953,122	3.19
1905	2,200,985	920,000	1,280,985	4.30
1904	1,592,661	701,119	891,542	2.99

There is no question that the value of the company's assets has increased with the years, as the time when it will receive larger returns in the shape of dividends on its securities draws steadily nearer. The company's equity in the earnings of its subsidiaries is increasing each year, and in the year ended Dec. 31, 1906, it amounted to $982,345. This amount is equal to 3.29 per cent on North American stock.

GOOD TELEPHONE EARNINGS.—In a letter to stockholders of the American Telephone & Telegraph Company, President Theodore N. Vail, speaking of the company's gains in earnings, says that for the 10 months ended Oct. 31, 1907, the net earnings were $13,715,000, against, for the same period in 1906, $11,579,000. October showed net earnings of $2,567,000, against $2,004,000 for October, 1906. The company has cash in banks of over $18,000,000, and will not have to do any financing until the requirements of 1909. The company has earned, in the first 10 months, its entire 8 per cent dividend for the year upon its enlarged capital with a balance of nearly 1 per cent to spare. A fairer comparison of earning capacity would be to take as the average amount of stock outstanding during the 10 months the $131,551,400 issued at the beginning of the year plus the first 50 per cent payment on the $21,925,200 stock offered in June, making a total of $142,514,000. On this basis the percentage of earnings was 9.6 per cent as compared with 8.8 per cent last year. The $13,715,000 of net earnings shown above does not by any means measure the full earning power of the parent company. For instance, on Sept. 30, at the end of the first three-quarters of the current fiscal year, there was a balance in round figures of $6,000,000 representing the undivided earnings of the 30 odd associate companies. The American Telephone Company share in this total may be roughly figured at 55 per cent—its percentage of the total outstanding stocks of all the sub-companies—or say $3,300,000. The addition of this sum to the actual net earnings of $13,715,000 gives a total of over $17,000,000, or better than 11 per cent on the full amount of stock now issued.

ELECTRIC MATERIAL COMPANY.—Cleveland P. Manning and Paul M. Burnett have been appointed receivers for the Electrical Material Company, 221 North Calvert Street, Baltimore, Md., after the company had been adjudicated a bankrupt with its consent. The receivers bonded for $30,000. Attorney-General Charles J. Bonaparte, to whom the company owes $2,500 on an overdue promissory note, is one of the creditors who petitioned to have the company adjudicated a bankrupt and for the appointment of receivers. Fred Diecken and Conrad Young, to whom the company owes $61.75 and $66.57, respectively, are the other petitioners. It was alleged in the petition that the company is insolvent, and it committed an act of bankruptcy on Nov. 4 by permitting its check for $1,000 to go to protest. The petition stated that the company has stock and fixtures valued at $20,000 and open accounts of about $30,000. The receivers were authorized to continue the business of the company until the further order of the court. Suit for the appointment of a receiver for the same company was instituted in Circuit Court No. 2 by Hugh G. Ferguson, trading as the United States Incandescent Lamp Company, through Carville D. Benson, attorney. The suit is based on alleged indebtedness of $2,290.

AMESBURY, MASS., LIGHTING.—The Gas & Electric Light Commissioners of Massachusetts had a recent hearing on a petition of the Amesbury Electric Light Company for permission to issue $50,000 of additional stock. The company was originally a side issue of a manufacturing concern whose business was unsuccessful, and when it was finally disposed of the electric light company had a deficit of over $25,000. By withholding dividends this has been reduced to about $8,000. The field has grown so that an enlargement of plant was necessary. This has been made, but a large floating debt has been incurred which it is now proposed to wipe out by the proceeds from the bonds. Meanwhile the majority of the stockholders have paid an assessment of $45 a share, but there are some twenty-five shares whose holders refuse to pay up. The company wants a condition put into the permission to issue bonds that no dividends be paid until the assessments on all shares have been paid.

UNION SWITCH & SIGNAL.—The Union Switch & Signal Company, one of the large Westinghouse concerns, makes the following statement of earnings for nine months ended Sept. 30:

	1907	1906		
Sales	$3,758,170	$3,699,786	Inc.	$58,383
Other income	23,050	[illegible]	Inc.	[illegible]
Cost of prod. and sales	$3,782,138	$3,702,638	Inc.	$79,500
Interest, etc.	[illegible]	2,974,700	Dec.	45,900
Net inc. 9 mos.	$853,333	[illegible]	Inc.	[illegible]

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Muscle Shoals Power Company and the Hydro-Electric Company are contemplating the construction of a series of three locks and dams across the Tennessee River near Muscle Shoals in Alabama for the purpose of securing power to generate electricity.

FORT PAYNE, ALA.—A company is being formed to be known as the Alabama Railway & Power Company to construct an electric railway which will connect Birmingham and Chattanooga and also furnish electricity for lighting. The officers of the company will be: H. T. Henderson, of Durango, Col., president; J. H. Hill, of Fort Payne, Ala., vice-president; C. L. Young, of Durango, Col., secretary and treasurer. The capital stock of the company will be $100,000.

TUSCALOOSA, ALA.—Bids will be received until Nov. 23 for the construction of the proposed engineering building and geological and biological laboratories for the University of Alabama. The engineering building will be of reinforced concrete and the equipment will include two 100-kw generators, direct connected; one 25-kw generator; water tube boilers of 500 hp capacity, with coal-weighing and ash-removal plant; mining and hydraulic equipment and heating plant, and complete equipment for physical, cement-testing and road materials laboratories. The Legislature has appropriated $500,000 for equipment and buildings, which is now available. Edgar B. Kay is dean of the Department of Engineering.

FORT SMITH, ARK.—The Nelson Investment Company has been organized with a capital stock of $100,000 for the purpose of constructing an interurban railway between Fort Smith and West Fort Smith, a distance of about ten miles.

GREEN FOREST, ARK.—The Farmers' Union Telephone Company has purchased the plant and system of the Green Forest Telephone Company in this place.

HOT SPRINGS, ARK.—Atwood Benton, of Kansas City, is making arrangements to install a new electric light plant in this city. Mr. Benton states that his company will have the plant in operation by April 1, 1908.

HOT SPRINGS, ARK.—The Southwestern Telegraph & Telephone Company has purchased the local exchange of the Southern Telephone & Telegraph Company and will make extensive improvements in the equipment and service. P. K. Baker is division superintendent of the Southwestern company.

SULPHUR SPRINGS, ARK.—Plans are being prepared by Smith & Powers for a combined electric light plant and water works system, to cost about $25,000.

COMPTON, CAL.—Work has been discontinued on the construction of the plant for the Compton Electric Light & Power Company, and an investigation is demanded by W. D. Gould, acting as attorney for the stockholders of the company, who declare they were mulcted in building the plant. E. Riveroll & Company are the contractors.

HANFORD, CAL.—The contract has been awarded for the construction of an interurban railway from Hanford to Kennewick, a distance of 75 miles, and machinery has been received for the power plant, which is to be located in Hanford. The plant will have a rating of 40,000 horse-power, and will furnish electricity to operate the road and for heating purposes, and will also furnish water for irrigation purposes.

LAKEPORT, CAL.—A. E. Dickinson, president of the Sonoma & Lake County Railway Company, states that all the rights of way, terminals and franchises have been secured and that work on the construction of the road will commence next spring. The road will connect Cloverdale, Lakeport and Kelseyville and will be 30 miles long. The company is capitalized at $1,000,000. Col. J. E. Fulton, of Lakeport, is vice-president and general manager.

NAPA, CAL.—The officials of the Standard Portland Cement Co. have decided to [illegible] the bank of the Napa River, [illegible] miles. The company has been obliged to close down its plant owing to the Southern Pacific Railroad being unable to supply it with cars in which to ship its product.

OXNARD, CAL.—The Ventura County Power Company has completed the construction of a 70-mile, 33,000-volt, 3-phase transmission line tapping the Edison Electric Company's 66,000-volt line. Sub-stations have been erected at Piru, Castaic, Fillmore, Santa Paula, Saticoy, Ventura and Oxnard. The steam plant at Oxnard will be used as an auxiliary, and the plants at Ventura and Santa Paula will be closed down. J. E. Barker is superintendent.

PASADENA, CAL.—The City Council has decided to ask for additional bond issues for completing the municipal electric light plant in two propositions, aggregating $[illegible], at the recommendation of the [illegible]. One proposition is for $[illegible] in bonds to complete the plant as it was started, and [illegible] to equip the plant for commercial lighting.

RICHMOND, CAL.—The [illegible] has granted a franchise for an electric railway to W. S. [illegible]

SAN DIEGO, CAL.—The County Commissioners have granted E. W. Scripps permission to erect and operate poles, wires and conduits for a telephone and telephone lines in San Diego County.

SONORA, CAL.—The Tuolumne Electric Company is extending its transmission line to Confidence for the purpose of supplying electricity to the mines in the vicinity of Confidence and Tuolumne. The company has a contract to supply the Confidence mine with electricity by Jan. 1.

VALLEJO, CAL.—Bids will be received until Dec. 3 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for five induction motors, to be furnished at the navy yard, Mare Island, Cal., as per schedule 448. Applications for proposals should designate the schedule by number. E. B. Rogers, paymaster general, U. S. A.

BRIDGEPORT, COL.—J. S. Cain, V. Bernard and Mr. Woodbury, a Nevada mining man, have perfected right and title to the waters of Rush Creek at the power plant site, and work will be commenced on the plant early in the spring.

CRESTED BUTTE, COL.—The Crested Butte Light & Water Company has been incorporated with a capital stock of $50,000 by Henry C. Wright and others.

MERIDEN, CONN.—The Board of Public Works has entered into a contract with the Meriden Electric Light Company to furnish electricity to light the city for a term of five years. Under the terms of the new contract, which takes effect Dec. 1, the city will pay $100 per lamp per year, which is $20 less than the present contract, and by which the city will save $4,000 a year on the 200 lamps the company is now furnishing the city.

SMYRNA, DEL.—The Smyrna, Kent County & Delaware Bay Traction Company has secured the right of way through New Castle County within one and a half miles of Delaware City for an electric railway, work on which is expected to commence soon. The company also expects to construct a power plant at St. George. J. W. Endean is interested in the enterprise.

WILMINGTON, DEL.—The Commercial Light, Heat & Power Company has been granted an extension of time for twelve months from Jan. 1, 1908, by the Board of Sewer and Street Directors. The company was granted a franchise to begin operations in the city by June, 1907. Owing to the present condition of the money market the company is obliged to ask for a second extension of time.

ALBANY, GA.—Plans and specifications will be prepared by J. E. Sirrin, of Greenvile, S. C., for the Albany Power & Manufacturing Company for the development of 10,000 horse-power at Porter Shoals, on Flint River, where the company plans to build a dam and power plant and install machinery for generating and transmission of electricity. The present plant of the company has an output of about 3000 horse-power.

ANDERSON, GA.—The stockholders of the Savannah Power Company on Nov. 11 voted to authorize the directors of the company to transfer all its property to the Georgia-Carolina Power Company. The latter company was formed several months ago with a capital stock of $8,500,000 and is merging many companies on the Savannah and Tugaloo Rivers. The company will develop between 125,000 and 150,000 horse-power. H. A. Orr, of Anderson, is president of the Georgia-Carolina Power Company.

LA GRANGE, GA.—The city is contemplating increasing the capacity of the municipal electric light plant by the installation of additional boilers and engines, the cost of which is estimated at about $20,000.

MARIETTA, GA.—Application will soon be made for the incorporation of the Marietta-Macland Railway Company. The company proposes to construct an interurban railway from Marietta to Macland, thence to Powder Springs, Austell and on to Atlanta. It is said that prominent capitalists of Atlanta are interested in the project.

LEWISTON, IDAHO.—The Washington-Idaho Light & Power Company, which supplies several towns in Palouse County, purchases its electric energy for operating its system from the Lewiston-Clarkston Company and from the Washington Water Power Company. The towns of Pullman, Uniontown and Colton, Wash., Moscow and Genesee, Idaho, are supplied from the plant of the Lewiston-Clarkston Company, while the plant of the Washington Water Power Company supplies the towns of Palouse, Garfield, Oakesdale, Farmington and [illegible]

MILNER, IDAHO.—Instructions have been received by Superintendent McWaters, of the North Side Twin Falls Land & Water Company, to start at once construction on the new electric railway from Gooding to Wendell. W. S. Kuhn, of Pittsburg, Pa., is president of the company.

MOSCOW, IDAHO.—The City Council is reported to be considering the question of establishing a municipal electric light plant.

KNIGHTSTOWN, IND.—The managers of the municipal electric light plant are [illegible] will install a 100-kw, 2300-volt, 3-phase, 60-cycle Curtis steam turbine and two boilers of [illegible] hp each. [illegible] is superintendent.

KOKOMO, IND.—W. T. Meck, city clerk, writes that the contract for lighting the city has been awarded to the Kokomo, Marion & Western Traction Company [illegible]

[illegible]

[illegible] and taken over by William Wilgus, of Lafayette. Mr. Wilgus announces [illegible] the system. The price paid for the plant was $20,000.

SEYMOUR, IND.—The City Council has granted a 20-year franchise to the Citizens' Mutual Telephone Company, a local company operating a rural system, to construct and operate a dual system in Seymour.

VINCENNES, IND.—It is reported that the Black Hawk Light, Heat & Power Company, recently incorporated with a capital stock of $1,000,000, will soon ask for bids for the construction and equipment of gas and electric plants. H. C. Bauer and M. Gentry are among the incorporators.

WASHINGTON, IND.—The City Council has decided to sell the 207 shares of stock which the city owns in the municipal electric light plant. The plant will be sold Dec. 16 to the highest bidder, the purchaser to operate the plant under the present franchise. The city purchased the plant several years ago for $80,000 and has been operating it at a loss ever since.

WILLIAMSPORT, IND.—It is reported that the Williamsport electric light plant, which was recently destroyed by fire, will be rebuilt at once.

ALBIA, IA.—The Albia Electric Light & Power Company is planning extensive improvements and extensions to its system, and will install a 200-kw generator for railway service, a 200-hp Ball engine, and construct four and one-half miles of track, and will also purchase four cars, 25-hp motors and two trailers. W. E. Gant is manager.

NEVADA, IA.—M. A. Harrison and H. H. Caughlin are reported to have purchased the electric light plant of the Nevada Electric Company [illegible]

OSKALOOSA, IA.—The Iowa Telephone Company is contemplating installing a new switchboard next season.

SIOUX CITY, IA.—The Automatic Telephone Company is making improvements to its plant and installing additional equipment.

VINTON, IA.—The Iowa Can Factory is in the market for a second-hand 10-kw, 110-volt, direct-current dynamo; could use a dynamo of 7½ kw. Dr. C. C. Griffin is president.

BELOIT, KAN.—The local electric light plant owned by A. T. Rogers has been purchased by the city.

PARSONS, KAN.—C. D. Moore, representing capitalists of Huntington, W. Va., has been granted a franchise by the City Council to construct and operate a street railway in this city. Mr. Moore and his associates contemplate building an interurban road.

LECOMPTE, LA.—The city is advertising for plans and specifications and for bids for installing an electric light plant to cost about $10,000. For further information address the Mayor.

BUCKSPORT, MAINE.—The Penobscot Bay Electric Company has applied to the Selectmen for a franchise to erect poles and wires on the streets and highways for the transmission of electricity in Bucksport.

BALTIMORE, MD.—It is stated that financial arrangements have practically been completed for the construction of the Baltimore, Halethorpe & Elkridge Railway Company's line from Baltimore to Halethorpe, surveys for which have been made and the right of way secured. Carville D. Benson is one of the incorporators.

AMESBURY, MASS.—The Amesbury Electric Light Company has applied to the Board of Gas and Electric Light Commissioners for permission to issue $50,000 of additional capital stock.

BOSTON, MASS.—The State Board of Railroad Commissioners have authorized the Boston & Worcester Street Railway Company to issue $300,000 in bonds.

CHELSEA, MASS.—The Chelsea Gas Light Company has announced a reduction in the price of electricity used for signs and outside lighting. The new rate is 10 cents per kw-hour, being a reduction of 37½ per cent from the present net rate of 16 cents per kw-hour.

NORTHBORO, MASS.—The streets of the town have been in darkness since the contract expired with the Blair Automatic Light Company Nov. 1, and unless some arrangement is made with the company will remain so for several weeks. The Marlboro Electric Light Company has the contract for lighting the town, but will not have its system installed [illegible]

PEABODY, MASS. Owing to changes in the special committee on the electric light plant the committee has taken a different position in regard to the municipal electric light plant and will recommend the rehabilitation of the plant, rather than abandoning the generation of electricity and purchasing it from a power company. The committee will recommend an appropriation of $55,000 for three new generators, two new engines, a power line and other changes. No changes will be made in the boilers at present. The amount asked for is $20,000 less than that recommended by the auditing committee.

PLYMOUTH, MASS.—[illegible] installed a 60-kw generator and made other improvements to its plant.

[illegible]

[illegible] for the street railway lines.

[illegible] for two 250-hp boilers for the electric light plant have been rejected [illegible] The lowest bid amounted to $9,800.

DETROIT, MICH.—The Detroit Traction Company, recently organized, has applied to the Common Council for a franchise to operate a street railway system in the city.

[illegible] erection of a municipal electric light plant.

[illegible] pany is planning to increase the output of its plant and make other improvements.

MUSKEGON HEIGHTS, MICH.—The city is considering the question of installing a municipal electric lighting plant.

NEGAUNEE, MICH.—A new 300-kw Westinghouse-Parsons turbo-generator has recently been installed in the municipal electric light plant. H. T. Pearce is superintendent.

OWOSSO, MICH.—The Owosso Light & Power Company has been organized by E. M. Hopkins, of Detroit, who will be president of the company, and Frank Wescott, of Owosso, treasurer. The company proposes to build a dam, 500 feet long and 30 feet high, at a point on the Shiawassee River, two miles and a half north of the city. The proposed plant will furnish electricity to operate the proposed Grand Rapids-Pontiac electric railway, and for light and power in Owosso. Work will commence on construction of the dam next spring.

PORT STANLEY, MICH.—It is reported that the citizens are considering the question of enlarging the municipal electric light plant in the near future.

SAGINAW, MICH.—The Board of Public Works has adopted a resolution notifying the telegraph and telephone companies and the electric light company to commence at once the work of placing their wires underground in Michigan and Washington Avenues, so as not to interfere with the paving of those streets, work on which will begin next spring.

GLENWOOD, MINN.—The owners of the Glenwood electric light [illegible] is secretary.

LITTLE FORK, MINN.—Joseph E. Cummings, of Duluth, is contemplating developing the water power of Little Fork and Sturgeon Rivers for electrical purposes.

SAUK RAPIDS, MINN.—The City Council is contemplating establishing a pole line system for street lighting and will purchase electricity to operate same.

MERIDIAN, MISS.—The Meridian Light & Power Company is planning to extend its line to the south side of the city, work on which will commence soon.

NATCHEZ, MISS.—An ordinance has been introduced in the City Council to authorize the Municipal Water Works Commission to secure estimates on the cost of adding an electric light plant to the water works system to generate electricity for street lighting. The city now pays $15,000 a year for public lighting.

INDEPENDENCE, MO.—The City Council has instructed the light committee to increase the municipal street lighting system by the installation of 32 additional arc lamps. There are now 100 arc lamps in use.

MARYSVILLE, MO.—The capital stock of the Marysville Electric & Power Company has been increased from $25,000 to $35,000.

CHINOOK, MONT.—Bids will be received until Dec. 21 by the Town Council for the construction of an electric light system. John C. Duff is town clerk.

HELENA, MONT.—The forest service at Washington has decided to extend the telephone lines in the reserves of this state. Acting Supervisor George H. Cecil, of the Little Belt National Forest, has been [illegible] his forest, which will provide for about 70 miles of new lines.

CLAREMONT, N. H.—L. N. Wheeler, manager of the Claremont Power Company, writes that the company is developing a hydro-electric [illegible] an output of 2250 horse-power, which will be transmitted to Claremont, a distance of 15 miles. The equipment of the plant will consist of three [illegible] three 500-kw, 60-cycle, 3-phase, 11,000-volt generators; one turbine-driven [illegible] 300-kw, 60-cycle, 3-phase, 2300-volt, Fort Wayne generator, are being installed at the Claremont station, increasing the output of the plant to 500 horse power.

GRASSMERE, N. H.—The American Fiber Company has installed an electric plant to furnish electricity for lighting its mills, and is installing [illegible]

HAVERHILL, N. H.—A contract has been made with the Bradford Electric Lighting Company to light the streets of the village for a term [illegible]

MANCHESTER, N. H.—The Nashua Street Railway Company has been granted permission by the State Board of Railroad Commissioners to increase its capital stock by $25,000 to pay for improvements, which have already been made.

ASBURY PARK, N. J.—Three 500-kw Westinghouse-Parsons turbines are now being installed in the power station of the Atlantic Electric Railroad Company.

ATLANTIC CITY, N. J.—City Electrician A. W. Farrand has reported that it will cost $200,000 to place all of the electric lighting wires under ground in the city. Under an agreement between the city and the companies the work will be commenced in the spring and completed in three years.

EAST LAS VEGAS, N. M.—It has been decided to commence work on the construction of the Las Vegas-Mora Taos Electric Railroad at once. More than $80,000 of the $100,000 necessary to be subscribed in order to insure the construction of the road has been raised. W. A. Buddecke, president of the Las Vegas Railway & Power Company, is interested in the enterprise.

SILVER CITY, N. M.—The Silver City, El Paso & Southwestern Telephone Company has purchased the line of the Texas & New Mexico Telephone Company between Las Cruces and El Paso. The former company is a new company which is installing a long-distance line connecting El Paso, Las Cruces, Silver City, Deming and intervening towns.

GOUVERNEUR, N. Y.—It is stated that the International Pulp Company, which is building a large lace mill at Hailesboro, will construct a large electric power plant about a half mile above the mill.

LOCKPORT, N. Y.—The International Power & Transmission Company has renewed its application to the Common Council for a franchise to operate in the city of Lockport. The International company is a subsidiary of the Niagara, Lockport & Ontario Power and already has its lines erected to the city limits, where it is furnishing electricity to a factory. Secretary W. H. Higgs states that the company has a private right of way into the heart of the city.

PORTCHESTER, N. Y.—The Public Service Commission has granted the New York & Stamford Railway Company permission to double-track its railway in the towns of Larchmont, Rye and Portchester.

ROCHESTER, N. Y.—The Rochester Railway & Light Company has been granted permission by the Public Service Commission to supply electricity to the village of Irondequoit for light and power.

ROCHESTER, N. Y.—The Buffalo, Rochester & Eastern Railroad Company has applied to the Public Service Commission in the second district for authority to construct its proposed road from Troy to Buffalo. The company has been incorporated with a capital stock of $3,500,000, and asks for permission to operate a steam or electric road.

WATERVLIET, N. Y.—Forty new arc lamps will soon be added to the municipal street lighting system.

BREVARD, N. C.—The Brevard Light & Power Company is planning to enlarge its plant next spring to meet the increased demands made upon it. The company also plans to install an ice plant next season. J. W. Chapman is manager.

MOORESVILLE, N. C.—Extensive improvements and changes have been made in municipal electric light and power system. The old steam plant has been abandoned and electricity for operating the system is now purchased from the Southern Power Company, of Charlotte. A day service for lighting and motors has just been started. The steam plant is for sale. J. A. Donald is superintendent.

MOUNT AIRY, N. C.—The Mount Airy telephone system, which was owned by E. C. Heinze, has been sold to a new company formed by local business men. The new company is composed of W. G. Sydnor and others.

SCOTLAND NECK, N. C.—The managers of the municipal electric light and power plant are contemplating the installation of a storage battery in the plant. L. R. Mills, Jr., is manager.

WILMINGTON, N. C.—The Consolidated Railways, Light & Power Company is contemplating increasing the capacity of its power plant and will purchase the following equipment: One 500-kw Westinghouse-Parsons turbo-generator set; one 250-hp Babcock & Wilcox boiler, and a 500-hp Alberger barometric condenser.

WINSTON-SALEM, N. C.—The Carolina Valley Railway Company has made application for a franchise to construct and operate its railway system in this city. The company proposes to build an electric railway from High Point to Winston-Salem, and has recently taken over properties and holdings of the High Point & Winston-Salem Railway Company. Dee Allen is president of the company.

EDGELEY, N. D.—The Pomona Valley Telephone Company has been granted a franchise to erect a telephone line to Streeter.

FARGO, N. D.—The Fargo & Moorhead Street Railway Company is contemplating an extension to its lines of about one and one-half miles.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has applied to the County Commissioners for a franchise to cross the Hudson Road, a short distance from the Chittenden's Crossing. The railway will be built on a private right of way to complete the general plan of the system in Akron.

CANAL DOVER, OHIO.—The Tuscarawas Valley Transit & Power Company will construct its road from Canal Dover to Canton by the way of Zoar and Bolivar, over a private right of way. The line will be extended from Canton to Columbus passing through Coshocton.

CLEVELAND, OHIO.—President John C. Keys, of the Cuyahoga Light Company, states that if the franchises applied for are granted, four electric light and power plants will be built in the downtown section of the city. The company will depart from the system used in supplying a large amount of electricity, and instead of one large central station will have several smaller plants. One will be located on the river or on the lake front, and will be used for emergency purposes. One station is now being equipped on East Third Street. Another plant in the rear of the Guardian Trust Building has been in operation for some time and is supplying electricity at the low rates proposed in the franchise that is now before the City Council. Mr. Keys states that arrangements will be made to take care of a large amount of business, as the Council has required that the service be extended as rapidly as possible if a franchise is granted.

COLUMBUS, OHIO.—The directors of the Columbus Railway & Light Company have decided to increase the capacity of its plant and place an order for a number of new cars.

MILLERSBURG, OHIO.—At a recent meeting of the stockholders of the Millersburg & Eastern Railway Company the capital stock was increased to $600,000 and the following officers elected: Dr. D. S. Olmstead, president; Daniel M. Miller, vice-president; Joseph Hahn, secretary, and W. W. Adams, treasurer.

NEW BREMEN, OHIO.—A. M. Sternberg, village clerk, writes that the citizens on Nov. 12 voted to issue $20,000 in bonds, the proceeds to be used for an electric light plant.

RAWSON, OHIO.—The Village Council is considering the proposition of lighting the streets of the village by electricity.

SWANTON, OHIO.—Bids will be received until Nov. 25 by the Board of Trustees of Public Affairs for furnishing a deep well pump, together with an electrically driven pump head, motor and the necessary switches and controlling devices; also one elevated tank having an approximate capacity of 22,000 gallons and a tower. A. B. Lathrop is secretary of board.

YOUNGSTOWN, OHIO.—A new 1000-kw generator, driven by a gas engine, will soon be put into operation at the Ohio works of the Carnegie Steel Company. The No. 5 and No. 6 furnaces of the plant will be operated with electric power hereafter.

ZANESVILLE, OHIO.—The Center Valley Railway, Light & Power Company, which has been formed to develop lands and locate manufacturing plants at a point nine miles south of Zanesville, proposes to build a large electric plant to furnish electricity for light, heat and power, and will also construct an electric railway 74 miles in length. Bids will soon be asked for the building and equipment of power plant and railway. H. A. Williams is manager.

MUSTANG, OKLA.—The Mustang Telephone Company has absorbed the Farmers' Mutual Telephone Company, and the following officers have been elected: Frank Dalton, president; F. G. Dennis, vice-president; R. C. Malroy, secretary.

PAWHUSKA, OKLA.—W. H. Cook & Son, of Muskogee, I. T., have been awarded the contract for constructing the water works, electric light plant and sewers, to cost about $100,000.

SHATTUCK, OKLA.—The capital stock of the Shattuck Electric Light Company has been increased from $3,000 to $15,000.

NEW PINECREEK, ORE.—The power house of the California & Oregon Light, Heat & Power Company was recently destroyed by fire. F. E. Russell is chief electrician. It is reported that plans are being considered for rebuilding the plant.

TYGH, ORE.—Arrangements have been made with the Wasco Warehouse Milling Company for furnishing electricity to light the streets and residences of this village. Work will commence immediately on installing the system. John A. McArthur is superintendent of the Wasco Warehouse Milling Company.

PANAMA.—Bids will be received until Dec. 13 at the office of Lieut. Col. H. F. Hodges, corps engineer, U. S. A., purchasing officer, Isthmian Canal Commission, Washington, D. C., for furnishing motor generator sets, switchboard, electric switches and fuse blocks, electric fans, etc., as per circular No. 403.

FRANKLIN, PA.—The Borough Council has granted the Citizens' Light, Heat & Power Company a franchise to light the streets of the town.

JOHNSTOWN, PA.—The Borough Council of East Conemaugh has granted the Southern Cambria Street Railway Company permission to construct and operate an electric railway in this town.

LEBANON, PA.—George C. Unger, of this place, has been awarded the contract to erect a pole line for the transmission of electricity from Mish's Mill to the Weaver bologna factory, a distance of about 15 miles. It is understood that the Swatara Electric Light & Power Company will furnish electricity for lighting the factory.

NORRISTOWN, PA.—We are informed that about $20,000 will be expended for improvements and extensions to the municipal electric light plant. George W. Kit is secretary of the electric light committee.

PHILADELPHIA, PA.—Application for a charter has been made by the Equitable Electric Power Company, which desires to compete with the Philadelphia Electric Company and the United Gas Improvement Com-

[illegible] Philadelphia & Western Railroad Company at Cobb's Creek. The incorporators are: James Collins Jones, J. C. Splane, of Pittsburg, and others. It is said that George R. Sheldon, of New York, N. Y., is also interested in the company. Mr. Sheldon was one of the incorporators of the Commonwealth Electric Company, which tried to enter the field here two years ago.

POTTSVILLE, PA.—The new power plant of the Pottsville Union Traction Company has been put into operation and the subsidiary plants at Pottsville and Minersville have been abandoned. The new plant cost $250,000.

WAYNESBORO, PA.—Plans are being considered by the officials of the Chambersburg, Greencastle & Waynesboro Street Railway Company for increasing the output of the power plant to supply electricity for the extension of the line from Greencastle to Chambersburg. J. F. Geiser is superintendent.

CHARLESTON, S. C.—The Sewerage Commissioners have decided to install an electric pump as an experiment to take the place of the compressed air pumps now in use at the sewerage plant with a view of reducing the cost of operation. The Charleston Consolidated Railway, Gas & Electric Company will furnish the energy to operate the pump.

FLORENCE, S. C.—The City Council is reported to be considering the installation of an electric light plant to cost about $25,000.

ABERDEEN, S. D.—The Wagner, Lake Shore & Armour Traction Company, which recently secured a franchise, is planning to organize a new company, which will be known as the Aberdeen Light & Power Company, and will have a capital stock of $200,000. It is said that work is expected to begin on its system here before the first of the year.

BRISTOL, TENN.—It is reported that the Young Men's Christian Association has decided to install an electric plant to light the building by electricity.

BRISTOL, VA.-TENN.—We are informed that the Fish dam development, near Bristol, Tenn., of which Charles Hansel, 43 Exchange Place, New York, N. Y., is engineer, has not yet been financed. The matter of construction has been deferred for the present.

CHATTANOOGA, TENN.—An addition is being built to the power plant of the Street Brothers Machine Works near East End Avenue.

CHATTANOOGA, TENN.—The Chattanooga Electric Company is having estimates prepared for a 1500-kw turbo-generator set, which will increase the output of the plant to 5000 kw.

SOUTH PITTSBURG, TENN.—The municipal electric light and power plant has been purchased by D. A. Tate, of this city, who has been granted an exclusive franchise for ten years and a perpetual franchise thereafter. The conditions are that the city is to be furnished with 50 incandescent lamps of 50 cp for five years free of charge, if at the end of the time the service has been satisfactory the plant will become the property of Mr. Tate without further pay or consideration. The new owner will practically rebuild the plant and replace the wires and other equipment with new.

AUSTIN, TEX.—The Austin Electric Railway Company is increasing the capacity of its power plant by the installation of a 600-hp engine and a 400-kw General Electric generator. W. J. Jones is president of the company.

CHELSEA, VT.—The citizens have voted to instruct the Selectmen to make a contract with the Chelsea Electric Light & Bobbin Company to furnish electricity for street lamps and lighting the town hall from Nov. 1 to April 1, the cost not to exceed $33.33 per month. E. D. Barnes, secretary and treasurer of the company, states that it cannot afford to run the plant at the present rates and has proposed an advance of 50 cents per year on each 16-cp lamp and $33.33 per month for lighting the streets and town hall.

RICHMOND, VA.—The City Council is considering the installation of an electric lighting plant to generate electricity for use at the new pumping station, and may also furnish electricity for lighting the streets and parks.

ANACORTES, WASH.—Application has been made to the City Council for a franchise to operate an electric railway in this city, which, it is intended, shall form part of the projected interurban railway, being promoted by Benjamin Weeks.

CHENEY, WASH.—The large transformers of the Washington Water Power Company at Jamieson were burned out recently, which will put the plant out of commission for some time for repairs. The company furnished electricity for several manufacturing plants in this city which will close down until the plant resumes operation. Electricity for operating the street lighting system of the city is also furnished by the company.

[illegible], WASH.—The City Council has decided to secure [illegible] services of an engineer to report fully upon the project of establishing a municipal electric light plant.

SPOKANE, WASH.—C. A. Lunceford, promoter of the Adams County Electric Railway, has organized a company with a capital stock of $10,000,000 to build an electric railway from Spokane to the Columbia River; [illegible]

SPOKANE, WASH.—The Interstate Telephone Company is making arrangements to extend its lines to Wallace. It is expected to complete [illegible] and complete the work to Wallace early in the spring.

SPOKANE, WASH.—The Washington Power Company has nearly completed its conduit system in this city and will soon place its wires under ground within the fire limits. Electricity for operating the shops of the Great Northern and Northern Pacific shops will, it is understood, be supplied from a small sub-station on East Front Street. The transmission lines on Lincoln Street, which carry power to the towns and mines in the Coeur d'Alene district, will go under ground as far as Third Avenue, the southern fire limit.

WHEELING, W. VA.—The City Council on Nov. 7 made an appropriation of $150,000 for improvements to the gas and electric light plant.

APPLETON, WIS.—Plans have been prepared by W. W. De Long, architect, for a new telephone exchange building for the Fox River Valley Telephone Company to cost $10,000.

EAU CLAIRE, WIS.—The City Council has decided to ask for bids for lighting the streets and highways with either gas or electricity for a term of five years.

MARINETTE, WIS.—The Economy Light & Power Company, of Oconto, has applied to the City Council for a franchise to furnish electricity for lighting and motors in Marinette. The company offers to furnish energy for lighting at 8 cents for the first 20 kw-hours; for 60 kw-hours, 7½ cents; for 100 kw-hours, 7 cents; for 140 kw-hours, 6½ cents; for 180 kw-hours, 5 cents; for 220 kw-hours, 5 cents, and for any over this amount at 4 cents. They also offer to install 90 200-cp arc lamps at $50 per lamp per year for each lamp. If the franchise is granted the company will commence work within 60 days and promises to have the lamps installed before Jan. 1. Power for operating the system will be purchased from the Perley & Company, which has a water power plant of 1000 horse-power in the city of Peshtigo. It is estimated that the cost of the system, including the transmission line from Peshtigo, will be about $13,500

STANLEY, WIS.—The City Council has granted the Northwestern Lumber Company a franchise to furnish electricity for lighting in this city.

WEST BEND, WIS.—The State Railroad Commission has granted the West Bend Heating & Lighting Company authority to issue $25,000 in capital stock to make improvements to its plant.

CAMPBELLFORD, ONT.—E. C. West, city secretary, writes that John S. Fielding, 15 Toronto Street, Toronto, is engineer for the proposed power plant, which is to be constructed at Middle Falls. The cost of the plant is estimated at $60,000.

COBALT, ONT.—The Town Council is negotiating with the Cleveland Cobalt Company with a view of making a contract for lighting the streets of the town with electricity.

COBALT, ONT.—Franchises have been granted by the municipalities to C. M. Stone, of Cleveland, Frank Latchford and others to construct an electric railway from Cobalt to Haileyburg. The line from Cobalt is to run north to the Silver Queen mine, and will eventually run to New Liskeard.

GALT, ONT.—Estimates for distributing power from Niagara Falls have been submitted by chief engineer of the Hydro-Electric Power Commission. The total cost of a distributing plant for manufacturers was estimated at $46,195; the cost of plant for street lighting at $16,583, and for private service $18,000 to $19,000.

HAMILTON, ONT.—The sub-committee of the Board of Works is negotiating with the Cataract Power Company to install an electric lighting system in the West End. The committee is considering placing Nernst lamps on the streets. W. C. Hawkins is manager of the Cataract Power Company.

LISTOWEL, ONT.—Bids will be received for lighting the town of Listowel with electricity with both arc and incandescent lamps. For further information address C. A. Lee, chairman light committee.

PETROLIA, ONT.—The Petrolia Electric Light, Heat, Power & Gas Company, Ltd., has awarded contracts for gas engines and gas producers, which it is expected will be installed next January. W. G. Fraser is manager.

SAULT STE. MARIE, ONT.—Extensive changes and improvements are being made in the plant of the Togona Water & Light Company. The single-phase, 133-cycle generators are being replaced by 3-phase, 2200-volt, 60-cycle generators. The new dynamos are being installed by the Lake Superior Power Company, from whom the Tagona Light & Power Company purchases its power. The entire station equipment will be owned by the Lake Superior Company, which consists of four 225-kw, alternating current, 2200-volt, 3-phase, 60-cycle generators; one 225-kw motor generator. The 500-volt, direct-current day circuit for motors in the town of Sault Ste. Marie will be abondoned. L. H. Davis is engineer.

ST. THOMAS, ONT.—The City Council has decided to ask the Hydro-Electric Power Commission to furnish estimates of the cost of distributing electricity from Niagara in St. Thomas.

WEST LORNE, ONT.—The West Lorne Electric Light Company, Ltd., is contemplating the installation of a producer gas power plant soon. D. J. W[illegible] is secretary.

WOODSTOCK, ONT.—Chief Engineer Richards, of the Hydro-Electric Power Commission, has submitted to the Council his estimate of the cost of equipment for distributing Niagara power in Woodstock. The total cost is estimated at $18,000.

MONTREAL, QUE.—Bids will be received until Dec. 16 by the fire and light committee of the City Council for furnishing electric energy and gas for lighting the streets, squares and other real estate belonging to the city; also for lighting and heating and industrial purposes for the citizens. Bids are to be submitted separately for gas and electricity.

FORT QU'APPELLE, SASK.—The Provincial Government is making arrangements for the construction of a long-distance telephone line from here to Balcarres, Sask, a distance of approximately 30 miles.

JIMENEZ, MEX.—A. J. Warren and C. D. Norton, formerly with the Parral Electric & Water Company, have acquired the electric light and power plant at Jimenez.

MEXICO CITY, MEX.—Arrangements are being made to operate the Euskaro flour mill by electricity. Two motors having a combined output of 75 horse-power have been installed. The motors were furnished by the Westinghouse Electric Company through its Mexican City agents, C. and O. Braniff & Co.

New Industrial Companies.

THE AMERICAN BATTERY COMPANY, of Cedarhurst, N. Y., has been incorporated with a capital stock of $200,000. The directors are: W. H. Orr, I. T. Kortz, of New York City, and H. F. Rhatigan, of Brooklyn.

THE LECTROID SIGN CLEANING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $500. The directors are as follows: Jacob Cahn, Arthur Cahn and P. Percival Lichtenberg, of New York, N. Y.

THE OLIVER ELECTRIC COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $6,000 for the purpose of conducting a general electrical business, installing and repairing all kinds of electrical machinery. The officers and directors of the company are: S. W. Oliver, president; J. P. Balding, secretary and treasurer, and R. G. Rother.

THE SECURITY ELECTRIC SUPPLY COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $25,000 by M. Jones and others.

New Incorporations.

VENTURA, CAL.—The Ventura Gas & Electric Company has been incorporated with a capital stock of $250,000 by F. B. Cole, R. H. Burnham, D. H. Steele and H. C. Norris, all of Los Angeles.

DENVER, COL.—The Intermountain Railway Company has filed articles of incorporation with a capital stock of $1,000,000. The incorporators are C. H. Chase, T. J. Milner, Caldwell Yeaman, Frank Loveland and Thomas B. Doran, all of Denver. The new company has purchased the Denver & Intermountain Railroad, which operates between Denver, Lakewood and Golden, which will be converted into an electric line.

CHICAGO, ILL.—A charter has been granted to the Woodstock, Marengo & Sycamore Railway Company, of Chicago, with a capital stock of $25,000 for the purpose of constructing a railway from Woodstock to Sycamore. The incorporators are Charles A. Spenny, Edward B. Harang, M. W. Powell, H. S. Hedberg and E. C. Spinney.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago & East Louis Short Line Railway Company for the purpose of building an electric railway from East St. Louis to Chicago. The company is capitalized at $50,000 and the incorporators are: H. C. Osterman, William M. Drennan, H. C. Dolph, Thomas W. Flynn and William Anderson.

EDWARDSVILLE, ILL.—The St. Louis & Staunton Railway Company has been incorporated by George M. Mattis, W. H. Carnahan, C. Zilly, D. E. Brambel and R. H. Watson, all of Champaign, for the purpose of building an interurban railway from Edwardsville to Staunton. The capital stock is $25,000.

MURPHYSBORO, ILL.—Articles of incorporation have been filed with the Secretary of State for the Murphysboro Electric Railway, Light, Heat & Power Company, with a capital stock of $36,000. The company proposes to operate an electric railway and other public utilities. The incorporators are: John G. Hardy, Walter Alexander and Philip H. Eisenmeyer.

PRINCETON, ILL.—The Bureau County Light & Power Company has been incorporated with a capital stock of [illegible] to operate a heat, light and power plant. The incorporators are H. H. Priestly, C. F. Stertevant and B. C. Lindley, of Princeton.

ARDMORE, I. T.—The Ardmore Traction Company has been organized with a capital stock of $500,000 for the purpose of either purchasing the railway system of the present Ardmore Street Railway Company, or procuring a franchise to construct and operate another line.

ST. LOUIS, MO.—Articles of incorporation have been filed for the Carondelet & Webster Groves Railroad Company, with a capital stock of $200,000, for the purpose of building a railway from St. Louis to Webster Groves, a distance of eight miles. Willard E. Winner and J. G. Hughes are the promoters of the project.

RENO, NEV.—Articles of incorporation have been filed for the Lower Truckee Electric Company by T. W. Haines, Oakland, Cal.; W. H. Hall, of Gridley, Cal., and Henry W. Esden, of Reno. The company is planning to build a large dam across the Truckee River near the Logarmarsino's Ranch, a few miles east of Reno, and will also build a large power plant to supply the mines of Fairview, Wonder and Olinghouse with electricity, and will probably extend its lines to Reno and Carson City. Surveys and plans for the construction of the plant have been completed. The company is capitalized at $50,000.

BROOKLYN, N. Y.—The United Consumers' Electric Company has been incorporated with a capital stock of $10,000. The directors are: Laurence O'Byrne and George Fuller.

OKLAHOMA CITY, OKLA.—The Johnstown Electric Company, of Oklahoma City and Johnstown, Pa., has been incorporated with a capital stock of $50,000. The incorporators are: John E. Mognet and Charles M. Moses, of Johnstown, and E. V. Remington, of Oklahoma City.

MT. UNION, PA.—The Mt. Union Light & Power Company has been incorporated to take over the plant and business formerly carried on by Scott Dibert, who is president of the new company. New transmission lines will be built to supply the increasing demand for electricity for lighting and motors. The company has a capital stock of $25,000. Thomas N. Kurtz is treasurer, and John L. Dixon, superintendent.

MITCHELL, S. D.—The Mitchell Illuminating & Power Company has been incorporated with a capital stock of $100,000 by local capitalists. The company will overhaul the electric light plant and will put in a water gas plant to supplant the acetylene plant. Electricity for incandescent lamps will be furnished by the company at 10 cents per kw-hour.

WALLA WALLA, WASH.—Articles of incorporation have been filed for the Washington-Oregon Traction Company. The company proposes to operate in Oregon, Washington and Idaho, and will construct and operate steam and electric railways, and also own and operate steamship lines and control water rights. The company contemplates the construction of about 75 miles of electric railway out of Walla Walla, work on which will begin within a year. Power for operating the system will be secured from the Wenaha River, about 25 miles from Walla Walla. Power will also be furnished for manufacturing purposes.

MARINETTE, WIS.—The Economic Light & Power Company has been incorporated with a capital stock of $25,000 by Albert Gillette and others.

Legal.

PATENT FOR ALLOY FOR BEARINGS HELD VALID.—It has been held that the Hendrickson and Clamer patent No. 654,402, for an alloy for anti-friction bearings, which consists of a copper tin-lead alloy, having "less than 7 per cent of tin and more than 20 per cent of lead and the balance of copper," covers a superior alloy for journal bearings, having a higher percentage of lead, which is the lubricant, than it was previously thought possible to make successfully. It discloses invention, and is not void for anticipation nor lack of novelty, nor because of prior knowledge and use of the invention. The mere substitution of one material for another is not, as a rule, patentable. But to this there are exceptions. And while it may not be possible to define just when it is so, it must be recognized that, under some circumstances, the adaption of certain materials, singly or in combination, to the production of certain desired results, may amount to invention; and that too, even though it involves no more than the taking advantage of certain inherent qualities, developed or discovered experimentally. This is particularly the case with regard to composite mixtures or alloys of metal, such as is the character of the device in suit, the object of which, as declared by the inventors, was to provide an anti-friction alloy for journal bearings, which should hold up within itself more lead than was theretofore considered possible. The value of alloys, composed of tin, lead and copper, for the bearings of railroad cars and engines, had long been recognized, but up to 1892 there had been no attempt at any definite mixture; old brass and copper scrap and shells, of heterogeneous character, being somewhat indiscriminately made use of. About that time, however, the invention in suit began to take definite form. Ajax Metal Company vs. Brady Brass Company, United States Circuit Court, 155 Fed. Rep. 407.

OPERATION OF ELECTRIC LIGHT PLANT BY CITY AND CONSEQUENT LIABILITY FOR NEGLIGENCE.—Under the statutes of the state of Nebraska a city of the second class of less than 5000 inhabitants is authorized to operate an electric lighting plant for municipal and commercial purposes. In an action against the city of Crete, which maintained and operated a lighting system by virtue of the statutory power, the plaintiff was a railway brakeman in the employ of the Chicago, Burlington & Quincy Railway Company, which operates a line of railway through the limits of the defendant city. His cause of action was based upon the complaint that the defendant, in the operation of its lighting plant, had stretched wires over and across the right of way of the railway company in so negligent and careless a manner that they were not sufficiently high to clear the body of a man standing on top of a freight car in the usual course of the operation of the trains of the railway company; and that the plaintiff, while engaged in his duties as a brakeman, without knowing the dangerous situation of the wires, and in the darkness of the night, was caught by one of the wires of the defendant's lighting system, thrown to the ground and seriously injured. It was urged that the city could not be held liable because at the time the accident occurred the wires were not in use, their commercial use having been abandoned; it was conceded that, had the accident occurred while the wires were in actual use, the defendant would have been liable for the negligent acts and omissions of its servants. It was held that, under the facts and circumstances presented, the city was liable, as it was expressly authorized by statute to erect and maintain electric lighting plants,

[illegible] Todd vs. [illegible] W. Rep. [illegible]

[illegible] OF AN EMPLOYEE [illegible] CONTRIBUTORY NEGLIGENCE PRECLUDING A RECOVERY OF DAMAGES FOR INJURIES CAUSED BY ELECTRIC SHOCK.—An action was brought against an electric street railway company for damages for the death of an employee, who was engaged as a "pitman," and whose duty it was to remove the "plows" from the cars as they passed from a line, using the underground system for the transmission of energy, to the tracks of the defendant on which the overhead trolley system was used. It appeared that the employee's death resulted from his unnecessarily touching the uninsulated parts in adjusting the leads connecting the motive power of one of the cars with the overhead circuit. It was held by the United States Supreme Court, in the case of Looney vs. Metropolitan Railroad Company, 201 U. S. 480, that the employee was guilty of contributory negligence, and that the company was, therefore, relieved from liability for damages, although the conductor of the car was negligent in permitting the trolley pole to come in contact with the trolley wire while the employee was in the act of removing the plow. The decision in effect holds an employee to the same standard of care and caution in handling an electric wire, which he has a right to assume is "dead," that he is bound to exercise in handling a "live wire." Where the employee is found to have been contributorily negligent, the company by which he was employed or which owned the apparatus which caused the accident cannot be held in damages. What acts on the part of an employee amount to contributory negligence is a question which has been presented in many cases, and it is held that the question is one for the jury to determine. In Harrows vs. Brush Electric Light Company, 96 N. E. Rep. [illegible] held by the New York Appellate Division that the jury could properly find that the failure of a lamp trimmer to use rubber gloves in trimming an arc lamp in the day time on a supposed dead wire was not negligence which contributed to his death from a shock due to a crossed wire where it was only customary to wear such gloves, when trimming a lamp at night on live wires, and where it would have been impossible for him to do the amount of work required of him had he used rubber gloves. In General Electric Company vs. Murray, 74 S. W. Rep. 50, the finding of a jury that an experienced electric lineman, injured by coming in contact with two high-voltage wires improperly placed within a few inches of each other, on the same side of the pole, was sustained by evidence that he had no knowledge that they were live wires, although he knew that the current would be turned on as soon as the repairs then in progress were completed, and testified that he might have escaped injury had he known the current was on, and that it was good practice to handle all wires as though they were live wires, unless they were positively known not to be charged, and that such was the general custom among linemen. Where the danger is obvious, neglect to take ordinary precautions against electric shock will defeat a recovery. Thus, where a lineman was sent to look for a break in the circuit while the current was on, and took with him a defective shunt cord, which he himself selected from among others which were good, and after finding the break, grasped the shunt cord at its defective end, and at the same time, with his other hand, grasped the naked end of the line wire, and thereby received a deadly current, which he would not have received by taking hold of the shunt cord if he had not taken hold of the line wire at the extreme end where it was not insulated, it was held that there could be no recovery of damages against the company. Piedmont Electric Illuminating Company vs. Patteson, 6 S. E. Rep. 4. And neglect to use rubber gloves provided for the very work of handling wires when a lineman is making connection of wires on a high pole, and is killed by touching their exposed ends, was held in Junior vs. Missouri Electric Light & Power Company, 29 S. W. Rep. 988, to constitute contributory negligence. A lineman cannot recover of an electric light company for injuries received from electric wires occurring by reason of a defect in his gloves, which it was his own business to inspect and keep in good condition, and to exchange, when necessary, for new ones, although the gloves were thrown to him from a wagon, with directions to put them on, by a foreman, the latter having no special charge of the gloves and his direction being merely advisory. Smart vs. Louisiana Electric Light Company, 17 So. Rep. 346. A lineman, employed by a telephone company, who receives a shock from a charged guy or span wire belonging to a street railway company is chargeable with negligence which will preclude his recovery of damages from the telephone company, where he failed to test the insulation, although he had apparatus for the purpose and knew that defects in the insulation of such wires were common, and that there were no persons but the linemen to make such tests. Anderson vs. Inland Telephone & Telegraph Company, 53 Pac. Rep. 657. In Law vs. Central District Company, 140 Fed. Rep. 558, it was held that a cable splicer, working for a telephone company, who, on climbing a telephone pole to repair the sheathing of a cable, took hold of a guy wire without noticing that it was in contact with an electric light wire at a point not a foot away from his eyes, was chargeable with contributory negligence such as would defeat his right to recover damages from the telephone company for injuries, occasioned by the resulting shock, although his vision was hampered by the fact that the sun was in his eyes. 50 Sawyer's Edition 564.

Obituary.

MR. D. L. BENSON, for a number of years past on the construction and operating staff of H. M. Byllesby & Company, of Chicago, Ill., died [illegible] Monday, Nov. [illegible] Middle West, having been prominently connected with the construction of utility plants at Shelby, Ohio; Muskogee, I. T.; Oklahoma City, Okla.; [illegible] by a widow and a daughter.

WILLIAM F. SHIEBLER.—Mr. William F. Shiebler, a Maiden Lane jeweler in New York, died at his home in Brooklyn on Nov. 13. Mr. Shiebler was formerly a telegraph operator in Washington. He received at Washington the first message which came over the first Atlantic cable laid between this country and Europe, and delivered it in person to President Buchanan at the White House, to whom it was addressed. He served as an operator in and about Washington all through the war. In 1870 he retired from the telegraph business to enter the firm of George W. Shiebler & Co., jewelers and silversmiths. He was a member of the Old Time Telegraphers' and Historical Association, and was one of the four or five surviving operators in the country who worked the old House instruments. Mr. Shiebler was 66 years of age, and is survived by his widow and four children.

Personal.

MR. A. BICKEL has resigned as sales manager of the Hodge Electric & Manufacturing Company and is now identified as contract manager with the Freeborn Engineering & Construction Company, Scarritt Building, Kansas City, Mo.

MR. H. W. PECK has resigned as assistant superintendent of the Consolidated Gas & Electric Company, and has accepted a position with the Rochester Railway & Light Company, of Rochester, N. Y., as assistant electrical engineer.

MR. F. R. WELLES, of Aboilard & Company, French representatives of the Western Electric Company, is again visiting his native country, and is at present in Chicago. He will spend a little time in New York before returning to Paris, where he has made his home for many years [illegible]

MR. S. MATSUMO, mechanical engineer of the Imperial Government Railway of Japan, has arrived to pay a visit to the Westinghouse works at East Pittsburg, with a special view to inspecting the single-phase, alternating-current railway system. He will also take a trip over the Pittsburg & Butler Electric Railway to see this system in practical operation, and will inspect some of the other large local industrial plants.

MR. S. MITSUI, an engineer of Osaka, Japan, is making a visit of a few weeks in this country to inspect electric railway and lighting plants and electrical apparatus ordered here by electric lighting and railway companies in Japan. He was in New York last week and from this country goes to Switzerland, where he will spend several months studying hydraulic installations.

MR. WILLIAM S. GORSUCH, of the electrical engineering department of the New York Central & Hudson River Railroad Company, has been selected by the authorities of the Y. M. C. A., of New York, to conduct its evening course in electricity. This course extends over two years. The first is devoted to the principles of electrical engineering and the second to their practical application. The local power plant, together with the well-equipped laboratory, will be used for demonstration.

RENSSELAER POLYTECHNIC INSTITUTE.—The New York Alumni Association of the institute had its annual dinner at the Hotel Astor on Nov. 8 when there was a large attendance and much enthusiasm. President E. S. Jarrett was in the chair and among the party were fifty seniors from Troy. The guests and speakers included Prof. Burr, of Columbia; Mr. Charles Macdonald, Mr. N. P. Lewis, engineer of the Board of Estimate and Apportionment; Mr. O. F. Nichols, chief engineer of the Bridge Department, and Mr. J. M. Wakeman, vice-president of the McGraw Publishing Company.

MR. A. L. WHIPPLE, eastern manager of the Curtain Supply Company, of Chicago, has resigned that position to become second vice-president of the Telharmonic Securities Company, of New York. This company is the financial agent of the Cahill Telharmonic Company, of Broadway and Thirty-ninth Street, New York, which is developing the distribution of telharmonic music by electricity. Mr. Whipple is one of the best known railway supply men in the country through the active part taken by him in the [illegible] railway convention and at previous conventions of the Master Car Builders and Master Mechanics. He has been connected with the Curtain Supply Company for the last nine years and has been engaged in the railway supply field for fourteen years. During the last convention of the Master Car Builders and Master Mechanics at Atlantic City Mr. Whipple made an effort to have telharmonic music transmitted by wire from New York to Atlantic City for the entertainment of those in attendance at the convention. It was largely through the negotiations carried on in connection with this proposal that Mr. Whipple became intimately acquainted with the system of the Telharmonic Company, a fact which led up to the present engagement.

DR. A. G. BELL.—[illegible] with which Alexander Graham Bell hopes to solve the problem of aerial navigation was successfully launched at Baddeck, Nova Scotia, on Nov. 10, in the presence of a large number of intimate friends of the inventor.

The launching took place at Prof. Bell's laboratory. Mrs. Bell, in breaking a bottle of champagne over the bow the ship, declared its name to be Signet. The great doors of the workshop were thrown open, and the kite was conveyed to a float upon which it was lowered out on the waters of Bras d'Or Lake. Owing to adverse weather conditions, however, a flight was not attempted. The ship, or kite, in itself a section of a tetrahedron, is 13 meters long on top, 10 meters along the bottom, by 3 meters deep. It is composed of 3393 units, or small tetrahedrons, two faces of which are covered with silk, this forming a two-winged cell. These cells are arranged to give, as the result of many tests, the maximum stability with the lightest weight. A hole has been cut through the center of the contrivance to furnish accommodation for the motor and a navigator. The ship is also provided with a bow for flying purposes. Three floats are used as a part of its construction to support it while on the lake. A motor with four cylinders of 20 horse-power will drive two solid screw propellers on the same shaft, but in opposite directions. With the motor in position the airship weighs 220 pounds. Prof. Bell says he does not claim for the Signet that he has now solved the problem for which it was constructed. He says the threshold has been merely reached in the development of the machine, and the experiments now to be made will be mainly productive in furnishing data for future experiments.

Trade Publications.

CALIBRATOR FOR WATT-HOUR METERS.—Bulletin No. 1097, of the Fort Wayne Electric Works, Fort Wayne, Ind., deals with a convenient portable rotating standard meter for calibrating watt-hour meters in service.

TELEPHONE MANUFACTURE.—The Dean Electric Company, Elyria, Ohio, has issued a booklet describing its telephone factory. For the third time within the three years of its existence, the company has been compelled to make additions to its plant.

SPRAGUE GENERATORS.—Bulletin 107 of the Sprague Electric Company has for its subject continuous-current direct-driven generators for general service. This type of generator is described and illustrated in full detail and views of a number of plants are given in which it has been installed.

Business Notes.

THE ALUMINUM COMPANY OF AMERICA, formerly the Pittsburg Reduction Company, has established an office at 1331 Candler Building, Atlanta, Ga., under the management of Mr. John H. Finney, formerly of its St. Louis office.

HORNSTEIN & CORY.—Mr. F. C. Hornstein and A. S. Cory have formed a copartnership in Indianapolis, Ind., with headquarters in the Pythian Building. The firm is conducting a business in steam and electrical appliances, and carries a complete line of goods. Mr. Hornstein was formerly connected with the Warner Arc Lamp Company, Muncie, Ind.

THE WESTERN ELECTRIC COMPANY, Chicago, during the past year at its Clinton Street plant produced telephone switchboards to give service to 1,000,000 subscribers, while telephone sets were turned out at the rate of 100,000 per month, and wire was insulated at the rate of 6,500 miles per day. This company has 26,800 employees, 8750 of which are at the Clinton Street plant. The sales for the company's fiscal year, 1906, amounted to $69,000,000.

THE ALLIS-CHALMERS COMPANY has won a substantial bonus for delivering to the American Gas & Electric Company, Scranton, Pa., a 1500-kw steam turbo-generator fully a month in advance of the date specified. The equipment for the plant comprises two of these units, which are designed to receive steam at 150 lbs. per square inch and deliver three-phase, 60-cycle energy at 4000 volts. In addition to the Scranton turbine, Allis-Chalmers machines have been installed in the Canton, Ohio, and Madison, Wis., plants of the American Gas & Electric Company, one of which, that at Canton, has been operating continuously for several months.

PITTSBURG GAGE & SUPPLY COMPANY.—When John Wanamaker built his new store in New York City the Pittsburg Gage & Supply Company, Pittsburg, Pa., equipped his power plant with a White Star continuous oiling system. This installation having proved its usefulness, Mr. Wanamaker has just ordered a duplicate system for his Philadelphia store. The Pittsburg Gage & Supply Company is also furnishing the Lackawanna Steel Company's Lackawanna, Pa., plant with its third system. The company has just moved into its new seven-story factory, where, with unlimited facilities, it will be better able than ever to fill orders promptly. It might be said that its new plant is the largest and most complete of its kind between New York and St. Louis.

THE EXCELLENT EXCELLO.—We are advised by the Excello Arc Lamp Company, 24 East Twenty-first Street, New York, that the large contracts placed lately by the United States Department of the Interior on behalf of the Ellis Island Immigration Service include, among others, a considerable number of Excello luminous arc lamps. These contracts are part of appropriations involving a total expenditure of more than half a million dollars, necessitated by the improvements the Department is making. The Excello lamps which have been decided upon, after exhaustive trials with other illuminants, are used for both outdoor and indoor service and are the Excello Snow Ball type, a recognized type of lamp producing the pure white light of high candle power. To judge from the repeated orders which the Excello Company has received since its first arcs were installed at Ellis Island the lamps give great satisfaction to the Department.

THE WISCONSIN ENGINE COMPANY, Corliss, Wis., which has built some very large and successful Corliss steam engines, is building gas engines for all services in sizes from 400 b. h. p. to 5000 b. h. p. The engines utilize natural gas, producer gas, coke-oven gas or blast-furnace gas in the Otto cycle (4-stroke), and are of the horizontal tandem and twin-tandem double-acting type. This company controls the Sargent patents on internal combustion engines and has employed Mr. Charles E. Sargent as the engineer of its gas engine department. The gas engines built by the Wisconsin Engine Company bear some of the distinctive features of their big Corliss engines. There is but one poppet valve for each explosion chamber, and this is located on the bottom of the cylinder. Provision is made for preventing the dangerous pressures caused by possible pre-ignitions, and the engines are started automatically. Tests of even small Sargent engines show a heat consumption of less than 9000 B. T. U. per brake hp-hour. This company has recently shipped some large steam engines to the Illinois Steel Company, Jones & Laughlin Steel Company, Packard Motor Car Company, American Sheet & Tin Plate Company, Amoskeag Manufacturing Company, New Hampshire Spinning Mills, National Tube Company, City of Milwaukee, Carnegie Steel Company, American Woolen Company, United States Envelope Company and the Carnegie Natural Gas Company.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED NOV. 12, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

870,539. SHAFT OSCILLATOR; W. F. Bouché, Norwood, Ohio. App. filed Sept. 14, 1905. A form of shaft oscillator, having a stationary disc opposite a spring buffer revoluble with the shaft and transmitting endwise movement thereto through a steel ball guided by a radial arm.

870,545. PLATING DEVICE; Geo. W. Clough, Cleveland, Ohio. App. filed Oct. 10, 1906. A rocking receptacle for holding metal articles while they are immersed in a plating liquid heavily charged with metal in solution, and through which the electric current is passed to decompose it and liberate the included metal and deposit it upon the articles.

870,551. CENTRAL ENERGY TELEPHONE SYSTEM; Francis W. Dunbar, Chicago, Ill. App. filed Dec. 19, 1900. The combination with [illegible] said bridge, one on each side of said source of electricity, and a [illegible] both of said windings and adapted to be actuated by the passage of [illegible]

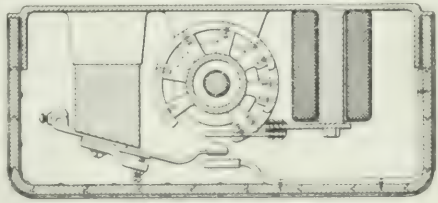
870,555. CONTROLLER; F. W. Garrett, Norwood, Ohio. App. filed [illegible] adjacent to the contact fingers.

[illegible] in sections normally de-energized, but which are electrically connected in circuit during the passage of a train by the magnetic attraction of a magnet on the train.

870,574. FIRE-ALARM SYSTEM; C. W. McDaniel, Kansas City, Mo. App. filed April 23, 1906. Diagram of circuit for a telephone system [illegible] alarm signal is automatically sent by a magnetically acting automatic switch.

870,577. ELECTRICAL WATER HEATER; [illegible] New York, N. Y. App. filed July 17, 1906. The water is passed through a resistance element comprising serially connected hollow carbon rods.

870,595. CONTROLLER; L. L. Tatum, Norwood, Ohio. App. filed April 16, 1906. The controller contacts have a toggle lever connection



[illegible] Controller.

by which they are moved for the purpose of attaining a wide separation to open the circuit and a very strong engagement to close the circuit.

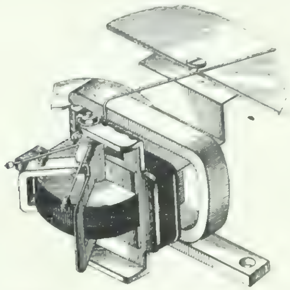
[illegible] MOTOR CONTROLLER; [illegible] App. filed Aug. 31, 1906. Relates to modifications of the above.

870,611. SERIES SHUNT FOR DYNAMO ELECTRIC MACHINES; H. C. Beckley, Norwood, Ohio. App. filed Nov. 29, 1905. Includes a frame having separable sections capable of being assembled in different sizes and each of which has insulting studs by which the resistance element is supported. In this way a resistance element of [illegible]

8[illegible]. ELECTRIC RAILWAY SIGNALING SYSTEM; N. P. Fraser, [illegible], Mass. App. filed May 17, 1907. Relates to signaling system whereby trains may receive warning when they approach within danger limit. Makes use of special sectional third-rail.

870,622. ELECTRIC SIGNALING SYSTEM; W. H. Gilman, Medford, Mass. App. filed Oct. 31, 1906. A railroad signal system of the type in which communication is had to various points along the roadway [illegible]. A particular station on the line is responsive by mechanism acting with current pulsations of a certain character.

870,632. ELECTRICAL MEASURING INSTRUMENT; J. M. Lea, Chicago, Ill. App. filed June 4, 1906. Relates to electrical measuring instruments for alternating currents having a primary coil and



870,632.—Electrical Measuring Instrument.

a secondary coil linked in inductive relation to the primary by a suitable laminated core. The secondary coil is movable and carries an indicator.

870,634. CALLING DEVICE FOR TELEPHONE EXCHANGES; Frank A. Lundquist, Chicago, Ill. App. filed May 28, 1906. In a calling device, the combination with a plate, and a lever adapted to move in one direction on one side of said plate and in the opposite direction on the other side, of an electrical connection arranged to be closed when the lever is on one side of the plate and to be open when it is on the other side.

870,643. AMALGAMATOR; G. E. Paullins, Colorado Springs, Col. App. filed Oct. 6, 1905. A metallic trough has a longitudinal rotatable shaft therein, rigid arms from which carry inclined blades movable in close proximity to the walls of the trough. Electrodes are provided by which the amalgam is subjected to a current.

870,674. APPARATUS FOR ELECTROCHEMICAL ANALYSIS; G. A. Guess, et al., Silverton, Col. App. filed April 26, 1905. An electrochemical apparatus comprising a combination of three terminals slit longitudinally, and an independent electrode arranged in the slit of each terminal and frictionally held thereby, the electrode in the metal terminal adapted to receive the deposit, and the several terminals connected up in the circuit.

870,675. ELECTRODE; G. A. Guess, et al., Silverton, Col. App. filed April 26, 1905. Relates to details of an electrode for the above.

870,688. AUTOMATIC ELECTRIC STORING DEVICE; J. W. Ringer, Castleton, Ind. App. filed July 17, 1906. An arm moves over a circular series of contacts so as to cut out the end cells of a series. The position of the arm is governor controlled.

870,714. ELECTROTHERMAL PROTECTOR; F. B. Cook, Chicago, Ill. App. filed Feb. 15, 1907. Two conical shells telescoped together, in which relation they are maintained by solder. The interior shell contains a thermal element which melts the solder and allows the shells to separate.

870,732. BURGLAR-ALARM; H. R. Lassen, Hamburg, Germany. App. filed May 21, 1907. Patentee has a pair of arcuate spring blades disposed in the path of a weight which electrically connects them to close an alarm circuit.

870,736. ELECTRIC FIXTURE; H. R. Mitchell, North Yakima, Wash. App. filed Feb. 23, 1907. A canopy fixture of the type having a transverse spring reel from which the electric connections depend and which is operated in a manner analagous to a curtain roller.

870,755. TROLLEY POLE GUIDE; L. A. Allen, Passaic, N. J. App. filed Aug. 14, 1907. Patentee has a long roller of double conical form which is impelled into position to guide the trolley wheel on the wire by tension on the operating core.

870,779. ELECTRIC SOLDERING IRON; W. G. Hartwig, Chicago, Ill. App. filed March 21, 1907. The head of the soldering iron is made hollow and contains carborundum crystal which is in the electric circuit so as to be heated by the passage of the current.

870,803. ELECTRICAL MEASURING INSTRUMENT; C. B. Thwing, Philadelphia, Pa. App. filed Jan. 25, 1907. Has a terminal magnet with an armature movable in its field and a thermal element for separating the magnet poles to compensate for changes in temperature.

870,816. VEHICLE MOTOR CONTROL SYSTEM; W. Cooper, Wilkinsburg, Pa. App. filed Jan. 3, 1906. Has means for decreasing the torque exerted upon the leading pair of wheels of each truck during starting.

870,847. METHOD OF MAKING A JOINT IN THIN FLAT MATERIAL; A. F. Rietzel, Lynn, Mass. App. filed Oct. 15, 1903. The process of forming a joint in thin metal which consists in pressing the up-turned margins or borders of the material into contact with one another by the pressure applied to clamping or holding devices, so as to cause them to be in contact throughout substantially the whole plane surface of said up-turned portion and applying a lateral pressing force while they are in heated condition.

870,891. AUTOMATIC GAS CONTROLLER; Joseph C. Landes, Collegeville, Pa. App. filed Feb. 15, 1907. Gas controller of the type in which the gas is made to flow for a certain interval by the deposit of a coin. Has means for automatically opening the circuit of a cut-off device when the gas in a certain receptacle is exhausted.

870,892. ALTERNATING CURRENT MOTOR; Robert Lundell, New York, N. Y. App. filed [illegible]. Alternating current motors [illegible] commutator and operated by a single or multiphase current. Has means for reversing the direction of rotation of the armature or rotary part. Employs stationary brushes in combination with a pole changing controller.

870,893. ALTERNATING CURRENT MOTOR; Robert Lundell, New York, N. Y. App. filed Nov. 27, 1905. Relates to modifications of the above.

870,915. PROCESS OF MANUFACTURING ARSENIC COMPOUNDS OF LEAD; Cornelius D. [illegible], [illegible], N. J. App. filed Feb. 5, 1906. The process of manufacturing arsenic compounds of lead which consists of the formation of a soluble salt of lead by electrolysis in the presence of a soluble compound of arsenic and the simultaneous precipitation of the lead.

870,927. ELECTROTHERAPEUTIC INSTRUMENT; Benjamin Y. Boyd, Chicago, Ill. App. filed Jan. 18, 1907. A therapeutic apparatus for throat diseases and including specially constructed electrodes suited to the anatomy of the throat.

870,938. ALTERNATING CURRENT GENERATOR; George H. Cove, Roxbury, Mass. App. filed May 7, 1906. A series of fixed magnets having their poles set alternately of opposite polarity and co-operating with electromagnets which oscillate back and forth, thereby generating alternating currents in their circuits.

870,946. CONTROLLING MECHANISM FOR ELECTRIC CIRCUITS; Taylor T. Fogel, Reading, Pa. App. filed May 1, 1907. Relates to controlling mechanism for electric circuits and particularly rheostats or starting boxes. Designed to operate for underload and overload conditions.

870,950. TROLLEY; Walter P. Gisske, Los Angeles, Cal. App. filed April 10, 1907. Flaring arms are fulcrumed on the axis of the trolley wheel so as to swing upward and guide the wheel on the wire by springs which act when the vertical pressure of the wheel against the wire is released.

870,963. ALARM BOX ATTACHMENT; Lee G. Holden, Portland, Ore. App. filed March 12, 1906. Provides means for throwing open the door when unlatched and while the local alarm is sounding, which will call the operator's attention to the hook or handle necessary to operate the distant or central alarm or signal.

870,970. ALTERNATING CURRENT METER; Robert C. Lanphier, Springfield, Ill. App. filed Sept. 8, 1904. Provides a mercury motor watt-hour meter for measuring alternating currents which is free from the field displacement ordinarily encountered in meters of this type.

870,973. STORAGE BATTERY; Homer E. R. Little, New York, N. Y. App. filed Jan. 17, 1907. Relates to specific details of the electrolyte and the composition of electrodes used.

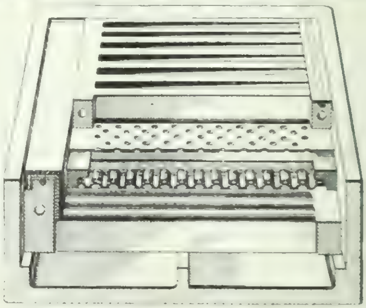
870,985. CARBON ELECTRODE FOR GALVANIC ELEMENTS; Wilhelm Mollenbruck and Wilhelm Dielmann, Dusseldorf, Germany. App. filed Oct. 23, 1906. A carbon electrode for dry batteries composed of circularly grouped carbon members firmly embedded into the ordinary depolarizing matter, and forming a central cavity and a removable carbon contact plug adapted to fit into said cavity and come in close contact with said carbon members.

870,999. TROLLEY HARP; Samuel T. Simmons, Columbus, Ohio. App. filed April 16, 1906. The trolley wheel swings on an axis in vertical alignment with that of its pivot support through a limited angle.

871,002. INSULATING FIXTURE; Louis Steinberger, New York, N. Y. App. filed Nov. 5, 1906. Has a ring with eyebolts extending radially therein and sleeves of insulating material extending through the eyebolts, said sleeves having metallic members by which they are fastened to the ring.

871,042. TELEPHONE EXCHANGE; Samuel A. Norstrom, Chicago, Ill. App. filed July 13, 1905. The combination with a polarized magnet, a battery, and means by which impulses in a given direction are sent from said battery through said magnet of a second magnet, and means by which upon completing an impulse through the first magnet, said second magnet will cause a brief impulse of the kind described to flow in the opposite direction through the first-mentioned magnet.

871,043. TELEPHONE EXCHANGE; Samuel A. Norstrom, Chicago, Ill. App. filed Aug. 23, 1905. In the switching mechanism of a



870,973.—Storage Battery.

telephone exchange, the combination with a movable ratchet wheel, of a pawl-locking device carried by said wheel and adjustable with respect thereto.

871,067. APPARATUS FOR ALIGNING CONDUIT SECTIONS; Joseph T. Rice, West Hoboken, N. J. App. filed March 11, 1907. Relates to devices for aligning conduit sections when laying the latter under ground to contain electric wires or serve as ducts generally. Has strips in opposed relation and having inclined meeting rideways which co-act in the movement of said strips in opposite directions and at right angles to the plane of the hypotenuse or meeting surfaces of the strips.

871,092. SELECTING DEVICE FOR TELEPHONE EXCHANGES; Frank A. Lundquist, Chicago, Ill. App. filed [illegible]. A numbered dial, a pointer adapted to be moved to any position on said dial, automatic devices for returning said pointer to a normal position, means controlled by the movement of said pointer for sending a series of electrical impulses over a given course, a switch, and means for operating said switch by the movement of said pointer, so as to send an additional electrical impulse over a second course

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NEW YORK, SATURDAY, NOVEMBER 30, 1907.

CONTENTS.

Improving Conditions.

Elsewhere in this issue will be found a report of the meeting held by the American Trade Press Association last week, to consider the financial situation, and to throw its influence in support of measures tending to restore confidence and check the hoarding of money. This meeting, at which all branches of the technical and trade press were represented, was addressed by Mr. Henry L. Doherty, past president of the National Electric Light Association, who as the active guide of a score of public utilities and as an economic student, has had to deal at first hand with many of the problems involved in the situation and has reached some striking conclusions as to the evils and their readiest remedies.

We can earnestly recommend to our readers the perusal of the remarks quoted in our columns from the speech made by Mr. Doherty, regretting that the synopsis does much less than justice to its thoughtful and vigorous argument. All of us must support him in his protest against the hoarding of money, whether by individuals or by banks; and all of us must respond to his appeal for the exertion of every influence to restore cheerfulness, courage and confidence. The very fact that such a meeting is held, that such a heartening address is delivered, and that such ringing resolutions have been adopted, helps to bring about the very conditions sought and which every underlying element of national welfare and prosperity justifies. What Mr. Doherty and the American Trade Press Association have done, every public-spirited man and every patriotic body ought to do and can do.

Dishpan Grounds.

A suggestion made by Mr. R. T. Rossi at the Colorado Electric Light Convention, in September, as to the form of ground plate to be used in dry, sandy soil may be worth more attention than the brief space accorded to it in the convention proceedings. This form of ground plate, which has been used to some extent on the lines of the Northern Colorado Power Company for lightning-arrester grounds, consists of a copper pan so placed that whatever moisture descends from the ground above is held in the pan. While Colorado immediately east of the Rocky Mountains is not absolutely devoid of rain, the precipitation is so light that for much of the year the ground is very dry where there is no irrigation. The conditions are, therefore, about as trying as any which can be found as regards securing good ground connections. How far the principle of retaining moisture in a pan-shaped ground immediately after a rainfall holds in dry times is a matter worth experiment. It is to be expected, of course, that in the course of a season the wet earth contained in the pan will gradually be transferred by capillary action to the surrounding dry earth. It is also conceivable that the earth or gravel all around the ground might become so dry that even the moist dishpan ground would be fairly well insulated. These are matters which need trying

out in different soils and climates. The question of getting good grounds for secondary circuits in order properly to protect customers, is one of the very first importance. In some cities ground plates and ground rods work very well when buried in moist clay. In rocky and sandy soil, and even in damp Eastern climates, ground plates have been found very unreliable, so that recourse has been made to waterpipe connections or to continuous grounded neutral wires run over an entire district.

The International Electrotechnical Commission.

The international electrotechnical commission, reference to which is made this week on page 1032, was inaugurated by the resolution of the Chamber of Delegates of the International Electrical Congress at St. Louis, in 1904. The duties which lie before such a commission are easy to define in outline, but difficult to execute in detail. It is manifest to the briefest enquiry that there are certain mechanical and physical properties of electrical machines that are the same at all parts of the earth's surface and are not changed when the machine is carried from one country to another. For example, one of these properties is the temperature elevation of the machine under an assigned steady load, and under assigned environing conditions of air temperature and pressure. It is illogical to the verge of ridicule that any piece of electrical apparatus should have a rating of, say, 100 kilowatts in one country, and of, say, 120 kilowatts in an adjacent country. Such discrepancies tend to bring discredit upon applied science and upon engineering. Everyone will admit that a machine should have one and the same rating in all parts of the world. The only way in which to eliminate discrepancies in the rating of machines is for electrical engineers in all countries to agree upon a common set of rules and specifications under which ratings shall be assigned.

In some particulars, international agreement is facilitated by deferring the period of such formal international action, while in other particulars, lapse of time tends to make international agreement more difficult. In regard to the general advance of applied science, every year makes international agreement easier upon technical questions; because knowledge and experience eliminate obscurity, and general understanding of difficulties in the behavior of machines becomes more precise. The general advance of civilization and mutual good will also tend, as time goes on, in the same direction. On the other hand, delay in reaching international agreement on such important matters as determining the rated output of a dynamo, makes uniform agreement more difficult. This is for the reason that every year sees national standardization rules in firmer position and more rigid local control; so that where there may be disagreement between the rules adopted by the electrical engineers of America, Belgium, England, France, Germany, Italy and other countries, the local practice may be so closely connected with such rules that no agreement or compromise may be forthcoming. Already these differences of detail in national standardization rules are becoming conspicuous, although no differences of detail yet appear on the surface to be ineradicable.

Up to the present time, three years after the St. Louis congress, very little has been accomplished towards international standardization except the formation of local national committees. There is nothing to criticise in the formation of national committees looking towards international cooperation. On the contrary, such organization is to be commended. At the same time, over-organization is one of the best means for involving procrastination and delay that the history of nations has yet produced. If a doubtful scheme is advanced by enthusiasts, there is no better way of deferring it indefinitely, than by establishing a large and dignified international commission to consider it. The time required to accomplish any result varies possibly as the cube of the number of men engaged in committee work for its accomplishment. It is, therefore, earnestly to be hoped that at the next meeting of the committee some definite step may be taken towards adopting uniform international standardization. Fortunately, there is no difficulty of weights and measures to stand in the way. Electrical machine outputs are always either directly expressed in kilowatts or capable of being so expressed, and the methods of electrical testing do not introduce any conflict between national units of measure. In this respect, the task before the international commission is much easier than a corresponding duty before mechanical engineering associations would involve.

Armature Reaction of Synchronous Alternators.

When one compares the effect of the armature m. m. f. upon the field magnetism in a direct-current machine with the corresponding effect in a single-phase machine, he finds that in the former machine the armature m. m. f. occupies a constant position with reference to the main field and it varies in value only as the load changes, while in the latter machine the armature m. m. f. alternates in value and is carried along synchronously with the rotation of the armature. In a polyphase machine the m. m. f.'s of the several armature phases combine to produce a resultant m. m. f. which, although fluctuating somewhat in strength and vibrating in position at double the circuit frequency, yet occupies a mean position with respect to the main field magnetism, which varies merely with the value of the load current and its time-angle of "lag" of "lead." If the current were exactly 90 time-degrees out of phase with the internal generated e. m. f. of the alternator, the armature m. m. f. would directly assist or oppose the field circuit m. m. f. in producing magnetism, but if the current were directly in time-phase with the internal e. m. f. it would not directly affect the main field magnetism, but would merely produce a "reactive field" in electrical space quadrature with the main field. When the angle of θ of time-phase displacement is less than 90 deg., but greater than zero deg., the equivalent single-phase current I can be considered as made up of two components, in electrical-space and electrical time quadrature, $I \sin \theta$, which directly assists or opposes the main field magnetism, and $I \cos \theta$ which produces true "reactive" flux.

As clearly shown by Prof. A. S. Langsdorf on page 1046 of this issue, if the reluctances of the path of the main field magnetism and that of the path of the reactive flux were equal, then the effects of the "armature reaction" and of the magnetic reactance of the armature could be combined vectorially and considered as due to a single equivalent "synchronous reactance." The article by Prof. Langsdorf furnishes an excellent proof of the accuracy of the simplifying assumptions upon which all practical mathematical treatments of the phenomena of synchronous alternators have been based—with almost no excep-

tions without any proof whatsoever. It is worthy of special notice that the simplifying assumption, the accuracy of which is proved in the article in this issue, hold true only under the exact conditions stated, which conditions do not exist in any commercial alternator. That is to say, the reluctance of the path of the main field magnetism is not only not equal to that of the path of the reactive flux, but it varies greatly with the degree of saturation of the field magnets, and the results obtained from any method of analysis involving the use of a constant "synchronous reactance" differs from test results in so far as the several reluctances are not equal in value and constant under all operating conditions.

COLOR PHOTOMETRY.

We print this week a valuable résumé of this important subject by Mr. J. S. Dow, well known to photometrists by his researches on the Purkinje phenomenon and kindred matters. Just at the present time color photometry is taking on a commercial importance which until recently it has lacked. A very few years ago Purkinje's phenomenon was merely a thing to promote wrangles among physiologists; to-day it is in a position to promote lawsuits for large damages, by reason of the fact that it comes strongly into action under conditions all too common in street lighting. The main difficulty in the matter is that very little is definitely known about color perception. It is one of the subjects which have been neglected by the physicists for lack of physiological training and mishandled by the physiologists through neglect of the ordinary precautions of physical investigations. The literature of the subject is scattered almost beyond the possibility of collection and requires very critical examination if collected. A few brilliant investigators, in part physicists, in part physiologists, have now given the subject a start which bespeaks real progress in the near future. The theory of rod and cone vision closely approximated by Abney, Charpentier and others, and put into definite form by Von Kries, has given a basis of scientific investigation which before was lacking.

The chief difficulty in experimenting on color photometry is that the lights are not only very different in hue but present wonderfully impure color effects, which mask the real sources of error. In comparing, for example, a Welsbach mantle with an electric glow lamp one has two lights of notably different color, yet with very large common components. A third source, almost identical with one or the other in general effect, but with a discontinuous spectrum, would give radically different results. Much of the early work carried on with so-called "red" and "green" or "blue" glasses must be thrown aside entirely as hopelessly indefinite in its data. Even in some recent work one finds physiologists blandly stating that they worked with a certain "non-spectral" color; *i. e.*, some sort of mixture, the relations of which to the primary color sensations were unknown or ignored. Mr. Dow has done photometry a good turn in emphasizing the practical importance of the absorption of the yellow spot, which has been in part confused with Purkinje's phenomenon. The former effect, being probably a fine case of selective absorption, appears in the absorbing region whatever the intensity of the light, being naturally rather more conspicuous when the light is not too dazzling. The latter becomes striking only at very low intensities, depending as it does on the weakening of the cone vision at low illuminations. The absorption of the yellow spot is often noticeable on reversal in using the ordinary Lummer-Brodhun screen. As a matter of fact, it affects chiefly the conspicuously blue end of the spectrum, while Purkinje's phenomenon is most in evidence at the other end.

Between the two there is a hard outlook for the accurate photometry of colored lights. It is possible, of course, to compare two lights in detail by the spectro-photometer, but the process is laborious. Crova's method, based on photometric comparison of the spectral region of highest luminosity, gives a simpler way to the same practical end, but is open to the objection that it might be unfair to sources giving discontinuous spectra. We think that Mr. Dow has somewhat overestimated this failing. There is a central region of the spectrum which is very slightly affected by the absorption of the yellow spot and within which the Purkinje effect is quite insignificant, save at values of the illumination impracticably low. Were Crova's limits thus somewhat widened, his method would remain fair even for sources giving discontinuous spectra, since these have a luminous value practically proportional to the radiation within about the same limits as in case of continuous spectra.

Aside from this the human eye is non-achromatic and brings rays of different color into focus in different focal surfaces within the eye. The relation of the retinal surface to these, as due to the configuration of the eye, determines the extent of accommodation required to bring various colored images into focus. Young people can accommodate, starting with normal vision, over a range wide enough to cover a multitude of peculiarities. With abnormal vision and in middle life when accommodation is rapidly failing, the difficulties noted by Mr. Dow multiply and a change in color of illumination would demand suitable glasses to avert eye strain. Hence one is on rather uncertain ground in acuity tests in color photometry. Mr. Dow seems to share a certain distrust of the flicker photometer, which is not uncommon among practical photometrists. The early reports from this type of instrument were very sanguine. When it began to be claimed, however, that the same results were reached by red-blind patients and persons with normal color vision, natural suspicions arose. Obviously if the red component of the light were properly evaluated in the flicker instrument, its removal from perception must change the result. Very possibly, however, the net effect of the flicker is to give predominance to the central region of the spectrum, of high luminosity, so that one might reach an average result, which would be upon the whole fairer to lights of different color than the premises would indicate. For this reason the flicker photometer deserves to be followed up until its color peculiarities are well worked out. At present, illuminants of striking and sometimes bizarre colors are multiplying and demand proper means of photometry. Further, in illumination tests the color is often modified by light reflected from the interior finish so much as to produce a chance for material errors. Color photometry is therefore a very vital question and one that deserves immediate attention. It has reached the point where it is important in the commercial sense as well as being a subject profoundly interesting and well worth study on its own account.

International Electrotechnical Commission.

From time to time references have been made in these columns to the Electrotechnical Commission organized by cooperation of the leading electrical engineering societies of the world. Below is given a statement in detail relating to the organization of the commission and its objects.

The meeting leading to the formation of the commission was held in London, in June, 1906, at which delegates from some 14 countries were present. Lord Kelvin was elected the first president and Colonel R. E. Crompton, C. B., honorary secretary. A set of proposed rules relating to the general organization of the commission was drawn up and adopted, subject to ratification by the bodies which had appointed the delegates. These rules have been practically accepted by all of these and will come up for final action at the first meeting of the council, which is set for next summer. The rules are based upon all countries being on an equal footing with equal taxation and equal voting power; they provide for the manner in which recommendations are to be arrived at and place the affairs of the commission and the method of carrying out its objects in the hands of a representative council, consisting of the president of the commission, the presidents of the local committees, who are vice-presidents of the commission ex-officio, one delegate from each of the local committees and the honorary secretary.

The general objects of the commission are set forth in the following resolution, adopted by the Chamber of Government Delegates at the International Electrical Congress held at St. Louis, in September, 1904:

"That steps should be taken to secure the cooperation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery."

Up to the present time local committees have been appointed in Austria, Belgium, Denmark, England, France, Germany, Hungary, Mexico, Sweden and the United States; and the question of appointing a local committee is also being considered in Australia, Canada, Japan, New Zealand, Russia, South Africa and Switzerland. In a movement of this nature progress must necessarily be slow, but the fact that so many countries have already appointed committees is not only very gratifying but shows the interest taken in electrical standardization throughout the world.

From the commencement the Institution of Electrical Engineers of Great Britain has taken a very prominent part in the matter and not only has it defrayed the preliminary expenses but has most generously granted a substantial loan to the commission in order that no financial difficulties should hamper the work of organization during the first year. The success which the movement is meeting on all sides will not, however, necessitate any great inroads being made into the funds placed at the disposal of the honorary secretary by the Council of the Institution.

At the end of the last year the British local committee appointed a sub-committee on nomenclature, under the chairmanship of Mr. A. P. Trotter, the electrical adviser to the Board of Trade. This sub-committee is now engaged in drawing up a list of terms, with their explanations, in general use in the electrical industry, and the council of the commission will most probably publish a glossary of electrotechnical terms in French and English, the languages in which it has been decided all reports of the commission are to be published. Under nomenclature is to be included the question of symbols, which will be taken up at a future date. When the local committees in the different countries have settled down to work, the British committee will appoint a sub-committee on electrical machinery and apparatus to consider in particular what matters can be brought to the notice of the commission with a view to possible international agreement. The British local committee is working in conjunction with the local committee of those countries taking part in the labors of the commission, and the secretaries of the various local committees are kept in touch through the medium of the central office now established in London at 28 Victoria Street, Westminster. The secretarial work of the central office is in charge of Mr. C. le Maistre, A. M. Inst. C. E., the acting secretary of the commission, to whom all inquiries should be addressed.

Financial Meeting of the American Trade Press Association.

A special meeting of the American Trade Press Association was held at the Hardware Club, New York City, on Nov. 21, in response to a call from President E. C. Brown, which said: "The meeting is called for the purpose of considering the conditions now prevailing in commercial and financial affairs and to determine what action should be pursued by this association and its members in assisting to restore public confidence, so ruthlessly shocked by the recent troubles among our local banking institutions and which is powerfully augmented by the 'currency' disturbances now prevailing throughout the length and breadth of the land. As exponents of the financial, commercial and manufacturing interests of the United States, the trade press must assume its natural position and at this critical juncture offer substantial evidence of its ability to lend material aid in stemming the tide now so strongly set against normal business operations."

Mr. Brown in calling the meeting to order emphasized the points made in the call, and stated that the subscribers and advertisers of the publications looked to them for all the assistance in their power. Their editorial columns should show independence of spirit in considering these weighty affairs, especially in dealing with the attitude of the banking community in regard to the merchant, the manufacturer and business people in general.

Mr. T. C. Martin stated that Mr. Henry L. Doherty was present by request to address the association. This gentleman, past president of the National Electric Light Association and of the Ohio Gas Light Association, and now prominent in a score of public utility corporations, had made economic questions a close study and his method of rate charging is familiar on both sides of the Atlantic. In administering these large interests Mr. Doherty, as an economist and analyst, had been led to diagnose closely the conditions noted by Mr. Brown and had addressed himself to an examination of the present state of affairs with a care more than ordinary, with results and data that would be very interesting at this juncture.

Mr. H. L. Doherty then made a most admirable address dealing with the financial stringency, the hoarding of money, the retrenchments in industrial enterprises, and the remedy for existing anomalous conditions, urging that a body like the American Trade Press Association has a large power to influence events favorably. Amongst other things, he said:

"Retrenchment is not the cure for the condition which now confronts us, but is the result of such a condition, either by anticipation and voluntary retrenchment or eventually enforced retrenchment. Every business enterprise which is making any unnecessary retrenchment is adding just that much to the situation which is bringing about a threatened industrial depression.

"In the parlance of the electrical business, 'contraction or expansion in business is a self-exciting process'; that is, every contraction induces further contraction and every expansion induces further expansion.

"If the situation were not so serious it would be almost ludicrous. The situation that confronts us is not incurable, and, in fact, is not even difficult. We are suffering merely from the lack of confidence. United effort on the part of the men of influence of this country could quickly restore the confidence which is lacking, but unfortunately they have as yet no means of taking united action, no attempt has heretofore been made to do so, and of the numerous half-baked suggestions which have been offered as a cure, few, if any, would stand the analysis of proper logic.

"The burden of present conditions rests primarily with our leaders in finance and business. These men have proved themselves the most capable of all by the well recognized law of 'The survival of the fittest.' They are the natural leaders of men, and are supposed to possess the highest order of intelligence; but in spite of this boasted intelligence and universally recognized ability, no attempt has been made to formulate a plan to secure united action for the execution of this plan to avert the extremely serious condition which now threatens us.

"The principle of united action is universally recognized by all groups of men other than these; and it is a fact worth noting that if any other group of men—no matter how low in order of intelligence—were suffering from a common menace they would co-operate and by united action do what they could to relieve or better their condition.

"In times like these, where it is simply a question of restoration of confidence, the very fact that a large number of men would express their willingness to do anything, or even to express their faith, by active co-operation, that something could be done, would in a large measure improve present conditions, if not entirely cure them.

"The correction of this condition can be summed up in a few words: Find some way, or ways, to bring the hidden money back into circulation before retrenchments have taken place to a point which will not permit re-extension to normal conditions.

"The value of the ordinary business enterprise is not alone the value of its tangible property. In fact, the tangible assets of any business are often far less than its intangible assets. Their selling organization, their good will, their managerial organization and their corps of skilled workmen may represent a value far in excess of the tangible property. Unnecessary retrenchment reduces the value of these intangible assets, and a shut-down—even though intended to be only temporary—often dissipates them all and wipes out their value entirely, and also sometimes reduces the value of the physical property to that of junk.

"The average business man facing the situation of inability to secure money for his immediate needs is very apt to turn toward retrenchments without due consideration to the fact that the very great degree of present stringency of money insures a plentiful supply later on.

"The main thing now is to convince the men who are leaders in industrial business affairs, first, that it is possible for them to continue, in most instances, without retrenchment with the assurance that an abundance of money will be available in the near future, and, second, to interest them in coaxing this hidden money into circulation. It is proposed, for example, to organize a bureau here in New York in which every responsible business, or responsible business interest, that is willing to take the responsibility of doing so, can recommend the purchase of securities, provided they are willing to make this recommendation to their employees and friends as well, and make the communication so read. It is proposed to notify all people seeking investments that this bureau is at their disposal.

"It is proposed to make this an exchange bureau of information where men seeking a buyer or lender can find him, and the man who is seeking an investment can find out just what is available, and either by the exercise of their own judgment or through conference with their friends, find a satisfactory way to invest or loan their funds.

"It is also proposed that this bureau receive and duplicate all plans for enabling the purchaser and the seller or the borrower and the lender to get together. It is also proposed to give out this information to the other cities throughout the country and invite their co-operation with the New York bureau. It is proposed to induce the press to convince the owners of hidden money that now is their opportunity to safely invest or lend it. It is also proposed to induce the press and others to bring influence to bear on the banks to induce them not to attempt to increase their reserves at this time, but to put all possible money in circulation that they can possibly do. It is also proposed to induce all of the banks to take out the limit of their circulation for the relief of the present conditions. It is proposed to formulate some plan that will enable both the active and inactive constructionists to at least record themselves as supporters of all plans for improvement."

Mr. John A. Hill said that it was their duty to teach the people that it is absolutely wrong to hoard money; that the money does not belong to them. The cash that any person has is not totally his; he is only entitled to the use of it. A man who paid an assessment for fixing a sidewalk might as well claim the walk as his own and put people off it. The people own the sidewalk and they also own the circulating medium. As soon as any one takes out of circulation the money which is the medium of exchange, he takes something which he has no right to. The medium of exchange belongs to the whole people, and does not belong to any individual further than as a medium for conveying a given amount of value. A man has no right to take $50,000 out of bank and say: "This is my money." It is not his money. It is a public convenience, just as the railroads are, just as the other roads and rivers and sidewalks and sewers are. No man has a right to take and stake out his part and say that he will hold that for his personal use. If a man owns 10 per cent of another man and says that the 10 per cent he owns is blood, that puts the other man out of business entirely if he takes that part out. In short, they must teach people that the $12.50 or $15 in their pants' pockets doesn't belong to them to hoard and hold there.

Mr. John R. Dunlap spoke in favor of the "practical expedients" that could be immediately applied in cases where men have property and cannot get money. There are railroad and other bonds in the country better than even government bonds.

Mr. J. H. McGraw cited one or two instances where there had been restriction of business not from lack of orders, but from the inability to get money to pay help. Any step, therefore, to re-establish and increase the public confidence is desirable. As publishers they did not realize their influence, and it was their duty in a conservative way to get together and start this good work for the public welfare. He was not frightened by the future. "The good sense, the common sense of the American people will soon assert itself, and ways and means along the lines of Mr. Doherty's suggestions will be provided to draw the hidden money out." He deprecated hoarding by banks and insurance companies.

Mr. C. T. Root suggested the formation of a committee to give shape and force to the discussions of the afternoon so as to help restore confidence and to reach those who hoarded, whether banks or other concerns.

On motion to the effect of appointing such a committee President Brown appointed with power to act on behalf of the association Messrs. James H. McGraw, C. T. Root, John A. Hill and David Williams, with himself as ex-officio, said committee to be known as "The Committee on Public Relations."

At a full meeting of the special committee on Nov. 22 the following resolutions were adopted:

RESOLVED, That the so-called business depression now paralyzing the industries of this country is due principally to a want of confidence which is unwarranted by agricultural and industrial conditions, and that one of the worst results of the panicky feeling that prevails is the hoarding of money, in which many banks are principal offenders—many holding much more cash than the reserves called for by the banking laws, and setting a most hurtful example to individuals.

RESOLVED, That bank reserves are for just such emergencies as now exist and should be used rather than increased.

RESOLVED, That it is the duty of the trade press and the business men of this country to make every honest endeavor to find such hoarded money and bring pressure to bear upon its holders to put it back into circulation.

RESOLVED, That any bank holding more currency than its legal reserve is doing great harm to every business interest and merits no consideration whatever at the hands of merchants, manufacturers or labor.

RESOLVED, That the trade press be urged to organize business men's meetings in every city to present to the small hoarder of money a means of investing it in safe securities paying good

interest, guaranteed if need be by such association themselves.

RESOLVED, That money thus released be deposited only in banks that agree to put it back into legitimate channels of trade forthwith, and that manufacturing and mercantile interests be asked to do business with such banks and with them only.

RESOLVED, That the countermanding of orders, the closing of factories and the laying-off of thousands of wage-earners is uncalled for by any underlyiny condition of business itself, and that immediate steps to check the senseless scare is demanded of every conservative and politic American.

Wireless Telephony Before the New York Electrical Society.

An informal talk on wireless telephony by Dr. Lee DeForest at the meeting of the New York Electrical Society on Nov. 20 proved to be one of the most interesting and instructive lectures delivered before the society in recent years. Dr. DeForest, in explaining the fundamental difference between wireless telegraphy and wireless telephony as practiced to-day, stated that in telegraphy use is made of waves of steadily decreasing amplitude obtained from a spark-discharge for periods corresponding to the signals of the Morse code, while in telephony the waves are of constant frequency steadily maintained, only the amplitude being varied to correspond to the frequency of the voice tones. The "sustained" oscillations have a frequency so high that not only is the ear unable to detect them, but it is probable that the telephone receiver diaphragm cannot follow them; the frequency is never less than 20,000 cycles per second and it may reach a value of 500,000 per second. By adjusting the "natural period" of the receiving circuits, the equipment may be "tuned" to respond to the transmitting circuit having the corresponding period of "sustained" oscillations. These facts, together with the practical features of wireless telephony, were discussed on page 926 of our issue for Nov. 9, 1907.

To the labors of Duddell can be attributed the knowledge of the fact that oscillations are produced in a circuit, containing a condenser and an induction coil in series, shunted across a direct-current arc lamp. Poulsen showed that sustained frequencies as high as 1,000,000 cycles per second may be obtained by operating the arc in an atmosphere of hydrogen. It has been found that high sustained frequencies can be obtained by using compressed air around the arc, by keeping the electrodes cool artificially, or by placing the arc in the flame of an alcohol lamp. The last method is the one most easily applied, and is the one adopted by Dr. DeForest.

No satisfactory explanation has yet been offered for the production of the sustained oscillations, although the necessary conditions are well known. Thus the resistance-current characteristic of the arc is the one feature upon which the existence of phenomenon depends. Moreover, the "pinch phenomenon," as discovered by Hering and further investigated by Northrup, probably plays an important part in the production of the oscillations.

A description of the transmitting and receiving circuits employed by Dr. DeForest was given in our issue for November 9. In his talk, Dr. DeForest stated that many types of receivers are suitable for wireless telephone work. In fact, any of the self-restoring wireless telegraph receivers may be used. The crude carbon block and steel needle device is usable, but the "articulation" with it is poor; the carborundum receiver is quite good, and the electrolytic is excellent. However, the Audion receiver, especially in its latest form in which the antenna is joined to an isolated grid interposed between a tantalum filament and a platinum wing, gives perfect "articulation." (The Audion was described in our issue for Nov. 3, 1906.) The speaker mentioned also the type of detector employing a gas flame for maintaining the medium separating the electrodes in ionic activity, as noted on page 843 of our issue for Nov. 2, 1907, which gives promise of excellent results in long distance wireless telegraphy. At the present time the use of the microphone transmitter limits the talking range to less than 25 miles, but doubtless by the use of a suitable substitute for the microphone the range will be increased enormously.

Although "damped oscillations" are now commonly used in wireless telegraph communications, the excellent results obtained with "sustained oscillations" in the incidental calling telegraph signals, as used in wireless telegraphy, point to the abandonment of the spark method of producing damped oscillations in favor of some method of producing sustained oscillations. In the present telephone calling system the antenna circuit at the transmitting station is interrupted periodically by a "buzzer" device operated by a "chopper" telegraph key, and the interruptions are recorded as a loud hum in the telephone receiver.

The Right to Regulate Rates.

At Albany, N. Y., on Nov. 20, the Appellate Division, Third Department, upheld the right of the Legislature to delegate its power to fix a tariff of rates for a public service corporation to a commission. The constitutionality of the new Public Service Commission act was involved in this case. The prevailing opinion was by Presiding Justice Smith. Justices Chester and Cochrane concurred. Justice Kellogg in an opinion dissented and was concurred with by Justice Sewell. The court thus stood three to two. The appeal was from an order of the State Commission of Gas and Electricity, recently succeeded by the Public Service Commission in the Second District, fixing a maximum charge for gas and electricity within the village of Saratoga Springs. Presiding Justice Smith in his opinion referred to the brief submitted by the Public Service Commission in which he said was a quotation from the opinion given by Attorney-General Moody to Congress, in which he reaches two conclusions:

1. There is a governmental power to fix the maximum future charges of the carriers by railroads vested in the Legislatures of the States with regard to transportation exclusively within the States, and vested in Congress with regard to all other transportation.

2. Although legislative power, properly speaking, cannot be delegated, the law-making body, having enacted into the statutes the standard of charges which shall control, may intrust to an administrative body not exercising in the true sense judicial power, the duty to fix rates in conformity with that standard. In the same brief 22 States are named which have similar statutes.

"In the courts of this State this question has not been directly decided, but the principle is, I think, established in analogous cases.

"It will thus be seen that the assumption of this power by the commission is justified by convincing authority. Not a decision is cited in the State or Federal courts which questions the power provided the determination of the commissioners is directed by some standard which is presented in the statute."

Justice Smith said that "the words 'within the limits prescribed by law,' can have only one significance. The standard which is to guide this commission in the exercise of its administrative duties in fixing rates is a reasonable charge for the product of the public service corporation, one reasonable to the public and reasonable to the corporation. Such a standard is sufficiently defined within the authorities which have been referred to.

"Without these words of limitation, the act might be deemed to give to the commission the power possessed by the Legislature," continues the opinion.

"A complete answer, however, is that it cannot matter whether the standard by which the commission is to be guided be fixed by common law or by the statute. In either case no legislative discretion is delegated to the commission. Without such discretion, their functions will be held administrative and not legislative."

In discussing the reasonableness of rates, Justice Smith says in part:

"It thus appears that the stockholders of a public service corporation are not entitled to require the public to pay dividends upon fictitious stock or for their extravagance or waste. Such a corporation, however, is entitled to a fair return upon the actual value of its property that it is devoting to the public use, after paying all expenses and liabilities reasonably charged against the same. What is deemed a fair return must depend ultimately upon the judgment of the court."

In the dissenting opinion Justice Kellogg sustained the validity of commissions created by the Legislature to perform administrative duty only. The law in dispute, he holds, attempts to fix the rate as conclusive, and, therefore, to give the commission judicial powers. Justice Kellogg further held that any person or corporation engaged in a public utility business is charged with a duty and clothed with the right of rendering a reasonable service to all persons alike, and at a reasonable price, and has a legal right at any time when the reasonableness of the price is in dispute to have a determination by due process of law. Persons furnishing a public service have no legal right, he holds, to fix arbitrarily the price, and, therefore, within the powers of the State the Legislature may fix a price which is valid until determined otherwise.

He declared that it is impossible for the Legislature to fix a price which would be reasonable in every locality; therefore, it is proper to appoint a commission charged with the administrative duty of determining in the first instance what is a reasonable price. The commission, he holds, is performing only an administrative act to compel persons furnishing a service to furnish it as they have agreed. Any attempt by the Legislature or commission to compel persons to furnish a service at an unreasonable price violates property rights and deprives such persons of equal protection of law.

The validity of this statute, Justice Kellogg believed, must depend on its provisions, and the recent public service commissions law is not considered by him in assailing the old law.

Tests of Track on the Pennsylvania.

Some rather extraordinary reports in the daily newspapers recently concerning certain tests the Pennsylvania Railroad has been making on the West Jersey & Sea Shore Railroad near Clayton, N. J., have created an entirely erroneous impression. It has been stated that the company was racing steam and electric locomotives, with a view to determining the speed capability of each type. The Pennsylvania Railroad has other, more accurate and much less dangerous methods of testing the speed of locomotives than trying them out in such a manner as this.

Furthermore, the types of electric and steam locomotives which have been used in these experiments were not designed primarily for speed, and any inference based on their performance in this regard would be incorrect. What the company is doing is this: Experience indicates that the operation of electric locomotives, owing to their lower center of gravity, has an effect upon the track entirely different from that due to the action of steam engines. In order to ascertain the exact nature and extent of this pressure upon the rails the motive power department has devised the apparatus which is being utilized at Clayton.

A stretch of track about 166 ft. in length has been equipped with rails and cast steel ties, designed and made especially for this purpose. Instead of attaching the rail to the ties by spikes, a special form of block has been substituted which allows a slight movement of the rail as the engine goes over it; this movement registers the force with which the flanges of the wheels strike or press against the rails. It is expected that a large number of experiments with this apparatus will show the company quite accurately what the effect is of either steam or electric locomotives moving at different speeds over either straight or curved track.

Necessarily, to make these tests, the engines must move at different speeds, and at all times each attains its maximum speed. An electric apparatus has been devised to measure the precise amount of time elapsing while the different locomotives pass over this 166 ft. of track, in order that in computing the effect upon the track the exact speed attained may be known. The steam and electric locomotives, however, go over the track at different times, and there is no element of contest as to speed between the two types. The matter of speed is purely incidental to the main purpose of the tests, which is to enable the company, in planning its electric installations in New York, to design a track so safe as to be absolutely secure against any form of locomotive that may be utilized.

Cleveland Branch of A. I. E. E.

The first regular meeting of the Cleveland branch of the American Institute of Electrical Engineers was held in the Electrical Building, Case School of Applied Science, Nov. 18. After completing a few details of organization which were left open at a former meeting, the subject of the evening, "Industrial Applications of the Electrical Motor," was taken up. Mr. J. R. Wilson read a paper on motors, both of the direct-current and alternating-current type. For many uses, he said, the best results have been obtained from direct-current motors, although alternating-current machines are perhaps better adapted to long-distance work. The standard voltage for both systems is 230 volts. For operating groups of machines, Mr. Wilson stated that the shunt wound motor is best fitted, though under certain circumstances the compound motor may be used to better advantage. High-speed machines should not be used for group work.

Passing over the multi-speed motor, which has not come into general use, the speaker said there are many adjustable speed machines on the market, of which the single-voltage weakening field type is perhaps the more generally used. The advantages and objections to this type of motor were discussed in detail, as were the means of obtaining adjustable speeds. The speaker said that he had seen 230-volt motors reversed at 600 amperes without making a spark.

Mr. J. C. Lincoln discussed variable speed motors for the operation of machine tools, and incidentally stated that they are better adapted to rotary tools than any other kind of power. He illustrated his point by a number of experiences and gave examples of speeds at which economy is reached in operation. He discussed the manner of securing variable speed, such as varying the flux, varying the air-gap reluctance and one or two other modes. The use of the commutating pole, he said, has made possible many pieces of apparatus that would not otherwise have come into existence. Mr. Lincoln said that the first patent on the commutating pole was issued to Richard Mather in 1884 and was used in the Mather motor, which is now a thing of the past. Repairs on the commutators, he said, are greater, however, on field weakening systems than on the multi-voltage systems.

The method of control of motors was discussed by Mr. R. I. Wright, who illustrated his ideas by means of curves, the result of experiments. The subject of central station power was discussed by Mr. Mark Knabenschue, who is connected with a large central station company. The speaker said he believed that energy can be furnished cheaper by a large company than by an isolated plant. Fuel can be secured at a lower price usually and the investment is not as costly in proportion to the power furnished. In the central station one man is required for each 1000 horse-power, while in an isolated plant two men are usually employed for each 100 horse-power. The cost of an isolated plant is figured at about 5 per cent interest, while a manufacturer always counts on making at least 20 per cent on his money. If he can do this his investment is worth more in his business than in an electric plant. Space is also valuable in and about all manufacturing plants and may be utilized to better advantage in the business than for a plant. Consider-

able attention has been given to gas engines for driving small stations, he said, and in some cases they have given satisfaction. The depreciation is usually heavy, however. Central station supply is reliable and is better for motors, as there is no danger of overloading. It is valuable for a growing plant from the fact that power stations do not have to be enlarged to allow of putting in new machines or making additions.

Mr. A. M. Allen discussed the size and application of motors for various purposes. He said that very often motors selected are too small for the work for which they are intended. Manufacturers should give more information about their product, so that engineers may understand just what they are doing when installing plants. Printed lists are often misleading, because they do not go into detail. Every little point should be taken into consideration in the selection of a motor. A machine that will do a certain work in one place will often not perform the same work in another, because the conditions are different. A motor should always be chosen that will operate a machine to its maximum efficiency. The speaker discussed the importance of a balance wheel for motors that operate with intermittent loads. He said it is easy to equip a plant where the load is constant, but when not then the question is a different one. Occasionally it is necessary to connect a test motor with the load and then by a careful reading of the wattmeter the size of the flywheel may be determined. Poor attention and bad management often cause failure in modern plants designed by good engineers. Alternating-current systems are more simple and require less attention than the direct-current, but the power factor must be considered in all installations.

Mr. Herkner gave an interesting talk on the automobile motor and the types best adapted to the machines. Various combinations of designs were illustrated and explained. The kind of motor and the power depends to a great degree upon the tires to be used and other peculiarities of the automobile. Batteries, electric braking, speed and application of power were all discussed at length.

Mr. Dusenberre insisted that more data should be given regarding motors in order that they may be adapted to application in certain uses. Heat limits and ultimate commutation limits should be made known, he said. Mr. Ricker spoke of the use of alternating-current induction motors for coal and ash handling, because they will stand the dust and rough usage.

Electrical Equipment of the Steamship Mauretania.

Although interest in the new turbine-driven quadruple-screw Cunarder *Mauretania*, which has just made her first trip to this country, naturally centers in the dimensions and capabilities of the craft, the completeness of her electrical equipment and the various applications of electricity on board are worthy of mention.

Before entering on the latter subject it will not be without interest to note the principal data of the ship. The length of the vessel is 790 ft.; beam, 88 ft.; draft, 33.5 ft.; displacement, 38,000 tons. The boilers contain 192 furnaces with an aggregate grate area of 4060 sq. ft., consuming about 50 tons of coal per hour. The horse-power is 68,000. There are four three-bladed propellers, the shaft of each of the two inner ones having a low-pressure Parsons turbine, and the outer shafts each a high-pressure turbine. The inner shafts are in addition each fitted with a high-pressure turbine for backing. The steam pressure is 195 pounds. Aside from the sister ship, *Lusitania*, the next largest vessels now afloat are the North German Lloyd *Kronprincessin Cecelie*, finished the present year, with a displacement of 27,000 tons, and 45,000 hp; the North German Lloyd *Kaiser Wilhelm II.*, finished in 1903, with a displacement of 26,000 tons, and 40,000 hp; and the Hamburg liner *Deutschland*, finished in 1900, with a displacement of 23,620 tons and 36,000 hp. These three vessels have quadruple-expansion reciprocating engines.

Besides having the distinction of being the largest and fastest ocean steamship yet built, the *Mauretania* also has the distinction of possessing the largest electrical plant afloat. From the outset it had been intended that everything that could be operated electrically would be done so, and this has been carried out quite extensively. The turbo-generator sets, of which there are four, are placed in two rooms abaft the main turbine rooms. The rooms are separated by a watertight bulkhead and each room possesses besides two 115-volt, 375-kw turbo-generators, a switchboard for controlling the circuits on its side of the boat. The boards may be connected in parallel by means of a connecting bar and switch.

From the port and starboard switchboards main cables run direct to various distribution boards, and each board is connected to the corresponding board on the opposite side of the ship. The cables are laid as far as possible below the waterline on the side of the ship and carried between porcelain insulators, the positive cables on one frame and the negative cables on another. The switchboards are similar, each consisting of two generator panels, 12 feeder panels and one disconnecting panel. Each generator is connected to a maximum reverse-current and time-limit relay, while each feeder is equipped with a maximum-current, time-limit relay.

The turbo-generators have a normal rating of 375 kilowatts when working against a back pressure of 10 pounds, so that nearly double the output can be obtained when the turbines are operating condensing; auxiliary condensers being installed for that purpose. The speed of each unit is 1200 r. p. m. and the generators present some interesting points in design owing to the heavy current developed (nearly 4000 amperes) and the restricted length and diameter of the commutator. The latter is cooled by a ventilating trough, the mouth of which is brought under the commutator.

The illumination, despite the fact that over 5000 incandescent lamps are in use, requires only a small portion of the energy generated. Many of the staterooms seem to have been designed to show to greatest advantage with the electric light. They are fitted, for instance, with glass domes and between these and the ordinary skylights are placed several incandescent lamps, which at night give to the rooms a magnificent appearance. There is, of course, a considerable difference between the types of fittings found in various parts of the boat, the most luxurious being placed in the suites, dining saloons, library, ladies' boudoir, etc., occupied by the passengers. Perhaps one of the most beautiful lighting effects is that seen in the dining room for first-class passengers. Here the dome is decorated in white and gold and around its base are arranged numerous incandescent lamps which have their rays directed on the ceiling whence they are reflected to the tables beneath. Not a lamp is visible, and the soft glow at night is very pleasing. Electric radiators, portable reading lamps, and such luxuries as curling-iron heaters, cigar lighters and fans are to be found in the staterooms.

The chief demand for energy and the most constant one comes from the fans for producing the forced draught for the boiler furnaces. For each of the four stokeholds there are two fan rooms directly over the boilers they operate, each being well ventilated by a 5-hp series motor. In each fan room there are two separate fan motors independently wired, each motor driving two fans. The fans take air directly from the top of the boilers, so that it is already heated before being delivered into the furnaces. The motors driving these fans are shunt-wound and rated at 50 horse-power. They are fully enclosed, but ventilated by a small fan on the same shaft and connected to the motor by an air duct. The motors thus run cool and are protected from dust and dirt. They are controlled from the stokehold by levers which operate the controller handle in the fan room. There are 16 motors with a maximum aggregate rating of 800 horse-power used for this service.

Electricity also plays an important part in the cooling and heating of the saloons and berths. There are 60 thermo tanks distributed about the ship and in each of these is a motor-driven fan which forces the hot or cold air into the distributing trough. The motors vary in size averaging from 3 to 8 horse-

power in output. For ventilating various other parts of the ship, such as the turbine rooms, 30 motor-driven fans, ranging in output from 5 to 10 horse-power, are used.

For ease in dismantling the turbines for repairs, six sets of lifting gear are provided, each set being operated by a 30-hp motor capable of taking double load at starting. There are also four 12-hp motors for operating the sluice valves, the controllers for operating which are placed inside the starting pedestal.

For unloading and loading baggage, four electric cranes, each capable of lifting over half a ton, are installed. When hoisting they travel at 200 ft. per minute, when turning they operate at 300 ft. per minute, the lift being 40 feet and the swinging radius 24 ft. for two of the cranes and 18 ft. for the other two. Electric hoists are, of course, used and these are operated on the push-button, relay principle. The passenger elevators are equipped with an electromechanical brake which automatically operates as soon as the electric circuit is opened and releases again as soon as the circuit is closed. The operator's handle is fitted with a spring so that if the hand is released the handle automatically returns to the "off" position and opens the circuit.

Motor-driven cargo winches are used, as well as four electric boat hoists. The latter are operated by 14-hp, series-wound motors. For the preservation of perishable cargo two refrigerating units are installed on the orlop deck aft of the forward funnel. Each unit is driven by a 35-hp shunt-wound motor. The brine pumps are driven by 3½-hp motors particularly silent in their running.

For minor purposes the applications of electricity are numerous. Knife cleaning and sharpening machines are to be found in abundance, as are boot-cleaning machines, ham slicers, bread cutters, etc. There are three large electric grills and various motor-driven roasters in the kitchen, as well as electric dish washers, plate warmers, vegetable peelers; in fact, every conceivable operation that can be mechanically carried out is done so by electric motors.

Passengers occupying the best cabins have all the telephone facilities of a modern hotel. A complete central energy system is installed and when in port this system is connected with the land exchanges on the moment of arrival and up to the time of sailing. The switchboard is capable of operating 200 stations and 20 exchange lines. For connection to the shore 10 pairs are run from the switchboard to a box on each side of the ship. Several similar boxes are placed on the dock or landing stages and a cable connects them.

Two interesting applications of electricity are found in the torsion meter for measuring the power developed in the propeller shafts, and in the electric whistle operator and telegraph for sounding the whistle at definite intervals. The ship is also equipped with a complete wireless telegraph outfit.

George Washington University College of Engineering.

Although it is only three years old, the College of Engineering of the George Washington University, at Washington, D. C., is worthy of the attention of the electrical world. Its connection with the university and its command of the governmental machinery for research give it two advantages that perhaps no other institution of the kind in this country enjoys. Each year is certain to see its usefulness grow. Prof. Howard Lincoln Hodgkins, dean of the department, is enthusiastic over the steady growth in attendance. This has been regular ever since the College of Engineering was established in 1905. "The student body has grown 10 per cent each year in the three years of our existence," he said, "and we have an attendance now of 150 students. [illegible] enabled to offer students in this city become known, I fully expect our present accommodations will be too inadequate to care for those who will want to matriculate. We are especially well situated. Among the many departments of the government open to our students is the Bureau of Standards, which boasts of the finest equipment for pure science investigation to be found in the United States. Two of the investigators there are members of our faculty; they are the chief physicist, Dr. Edward B. Rosa, who is one of our professors of physics, and Dr. Frank A. Wolff, professor electrical engineering.

"Only a day or so ago the chief electrician of the Navy Yard called upon me to offer the facilities of the yard in his line to our students. The fact that another member of the university faculty, Prof. N. Monroe Hopkins, is chief of the electrical division of yards and docks of the Navy Department, insures our students still another field rich in opportunity for original research."

This spirit of co-operation with the college shown by government officials is one reason why the institution has already taken its place in the front ranks. An added reason is found in the comprehensive curriculum laid down for the students. In connection with his technical training, he is educated along other lines necessary to turn out a graduate who will be an honor to his profession and to his alma mater. According to the university catalogue: "The courses in engineering are planned to give the student a thorough understanding of the theory underlying engineering practice, and such a practical knowledge of the instruments and methods of his particular profession as will enable him to apply the theory properly. In all the courses a thorough training in mathematics, pure and applied, and in drawing and descriptive geometry is required as the basis of the analytical and graphical study of engineering topics. Much stress is laid on the work in the drawing-room and laboratory. The work is planned to give him a thorough knowledge of principles on which he may build, and by which he may be able to solve the new problems he meets in practice.

"The work of the first year is the same for all students. It is taken up partly with general studies, which have both an educational and a cultural value, and partly with work in mathematics and drawing, which lays the foundations for subsequent courses. In each of the other years there are studies taken in common by all engineering students, these studies including courses in English, in French, and in German, in pure and applied mathematics, in drawing and descriptive geometry, in chemistry and in physics. The requirement in French and German is intended to give the students an accurate reading knowledge of these languages, with particular reference to scientific literature.

"The electrical students begin their special work in electricity in their junior year. Theoretical electricity is first studied, and is followed by engineering electricity and by courses on direct-current machinery. In the laboratory, experimental work in exact measurements is followed by the study of the dynamo. In the drawing-room are studied related problems in design. In the senior year alternating-current machinery is studied, both theoretically and practically; and courses on the application of electricity and on light and power distribution are taken. Many hours are given to work in the electrical and general engineering laboratories."

It will be seen from this that the electrical engineering course is laid down with thoroughness. It is destined to turn out men who, living up to the requirements, cannot fail to grace the profession. In connection with the course mapped out, the College of Engineering is well equipped, physically, to carry it out.

This department of the George Washington University found it necessary during the current year to provide larger quarters for its students. Two buildings were leased, a couple of city blocks distant from the main university buildings, and have been arranged for class room and drawing-room work. Provisions also have been made in these buildings for offices for all the instructors, and this has been found of great advantage. The students are under better supervision, and at all hours several instructors are on hand to give assistance and information [illegible]

[illegible] for the college's excellent library.

All of the laboratories are at University Hall, in the main building. Because of the necessity for being near apparatus used in illustrating lectures, practically all the classes in electrical engineering meet in the physics room and the adjoining room in University Hall. The laboratory work in physics and in electrical measurements is done in the physics room and in two rooms adjoining.

Immediately off the physics room is the dynamo hall. In this hall is an excellent equipment of dynamos and motors, most of which are modern machines, presented to the university two years ago by Mr. Westinghouse, and selected with especial reference to their adaptability for experimental work. The college is looking forward to adding a number of ammeters, voltmeters and wattmeters, and when these are installed it will be able to give, in a very thorough manner, all of the usual dynamo and motor tests.

In a room under the mechanical laboratory has been installed a 25-kw Westinghouse dynamo, directly connected to a Westinghouse gas engine. This dynamo was especially constructed so that it might be adapted to experimental requirements, for it generates both direct and polyphase alternating currents. The engine is a two-cylinder, single-acting machine, giving an explosion every revolution, with an exceptionally close regulation. In addition to this engine, there is another one in the battery which also is well adapted for experimental work.

Between the mechanical laboratory and the law building is installed the steam laboratory, which is also used as a room for shop work. There are work benches for such students as care to pursue studies in bench work, both in wood and metal. The shop is equipped with lathes, jig and circular saws, planers and drill presses. Power for this machinery is supplied by a motor. In addition to this equipment, there is a 40-hp boiler, which supplies power for a high-speed Shepherd engine and for a horizontal Armington & Sims engine. A dynamo and water rheostat and a Prony drag furnish load for this engine. There is also a modern De la Vergne refrigerator machine, which is to be used for experimental tests and demonstrations in connection with regular class work in the course of compression and refrigeration machinery.

The teaching staff of the college is exceptionally efficient. Aside from the many government experts who aid in the work of the department, the force of instructors in technical engineering subjects now consists of seven men giving their entire time to the work. One of these instructors is a graduate of the university; one is a graduate in civil engineering of Dartmouth; two are graduates of the Massachusetts Institute of Technology; one is a graduate of Rutgers College; one a graduate of Cornell University, and one a graduate in mechanical engineering of Columbia University. Three of these men joined the faculty this year. However, these seven men do not constitute the full force of the College of Engineering, by any means. Students of the college take, in common with the other students of the university, the general subjects of mathematics, English, languages and sciences, so that the faculty of engineering, therefore, may be correctly stated as containing 27 officers of instruction.

The personnel of the board of trustees insures the success of this especial department of the George Washington University. The trustees are: Charles W. Needham, president of university, ex-officio member of the board; Thomas W. Chatard, mining engineer; Bernard R. Green, superintendent, Congressional Library; John B. Larner, attorney at law; Frederick H. Newell, director, United States Reclamation Service; T. Commerford Martin, editor of Electrical World; Admiral Charles W. Rae, engineer-in-chief, United States Navy; Samuel W. Stratton, director, United States Bureau of Standards, and Otto H. Tittmann, superintendent, United States Coast Survey.

Altogether, this school seems destined to attract more and more attention as it adds years to a record that is so auspiciously begun. It has all the natural advantages for an institution of its kind. Its chief need is encouragement in a financial sense or through donations by liberal-minded men in the electrical field of machinery and apparatus necessary for the thorough drilling of its students.

CURRENT NEWS AND NOTES.

TECHNICAL PUBLICITY ASSOCIATION.—The Technical Publicity Association held its November meeting on the evening of the 21st, in New York, and listened to an address on "The Evolution of Fine Printing and Its Influence on Advertising Literature," by Paul Pfizenmayer. As usual, new members were elected.

NORTH CAROLINA TRANSMISSION PLANT.—Work is now in progress on a 60,000-volt, 120-mile transmission plant from Blewett Falls, N. C. Electrical power will be supplied to cotton mills, central stations, etc., extending in one direction to Hartsville, S. C., and in another direction to Wilmington, N. C. Lockwood, Green & Company, of Boston, are the designing and constructing engineers.

SOUTHERN TELEPHONE REBATES.—Vice-President W. T. Gentry, of the Southern Bell Telephone & Telegraph Company, announces that after the first of January all rebates for telephones will be abolished in Savannah, Ga. The giving of rebates in Savannah and many other Southern towns is explained as having been a necessary evil heretofore in meeting competition from independent companies.

A. I. E. E. MEETING.—The next meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineering Societies Building, 33 West Thirty-ninth Street, New York City, on Friday, Dec. 13, at 8 p. m. Mr. Walter S. Finlay, Jr., of the Interborough Rapid Transit Company, will present a paper on "The Ratio of Heating Surface to Grate Surface as a Factor in Power Plant Design."

TELEPHONE COMPETITION.—At Hartford, Conn., on Nov. 25, the subject of telephone competition was discussed at length by the members of the National Grange, and the body went on record as favoring open competition. A resolution was passed calling upon the members of the different organized bodies of the Grange, "members of the Legislature in the different States, members of the House of Representatives and Senate in Congress convened, and the President of the United States, to use their best endeavors to allow free competition."

NEW STOCK OF RADIUM.—A despatch from Vienna dated Nov. 22 states that the Academy of Science has just made the largest quantity of radium yet produced—46 grains. Ten tons of uranium and pitchblende, given to the Academy by the Government from its mines in Bohemia, were used in its production. Its extraction cost $10,000. The Academy will present a small fraction of the radium to Sir William Ramsay, the well-known English scientist, for experimental purposes. It will use part of it to test Prof. Ramsay's theory regarding the convertion of radium into other elements.

INSTITUTE YEAR BOOK.—Secretary Pope has just issued the year book of the American Institute of Electrical Engineers, a substantial publication of 244 pages, making the first volumes of complete transactions look slim. It contains a list of officers and committees, a catalogue of members, the constitution, standardization rules, etc. The catalogue of membership, as of Aug. 1, occupies 180 pages and includes 4861 names. The actual list is now about 5200. Of 10 past presidents all but two are living, and of 63 past vice-presidents all but five are surviving. There are only two honorary members, Lord Kelvin and Sir W. H. Reece. A few other Europeans would not be amiss outside of England. The institute now has 10 local or sectional organizations, and 17 university branches, with six local honorary secretaries in New South Wales, South Australia, Canada, Mexico, West Indies and England.

LIQUOR OR LIGHT.—A special dispatch from Hudson, Ohio, of Nov. 14, says: "If the village of Hudson will bar liquor for 50 years, with the exception of beer, which the donor is willing to let the villagers imbibe, $75,000 will be forthcoming for an electric light and sewerage system. This offer has been made to the village council over the signature 'Hudson Citizen.' Although none is breathing it aloud, the name of the donor is understood to be Jas. W. Ellsworth, millionaire coal operator, retired."

TRANS-CONTINENTAL WIRELESS TELEGRAPHY.—The Pacific Wireless Telegraph Company, the home office of which is at 805 Union Trust Building, Los Angeles, Cal., has announced its intention of establishing a chain of land stations from San Francisco to New York. The company has as yet not selected a site for the New York station, but it has installed equipments at Santa Catalina Island, San Pedro and Los Angeles, Cal.. Fort Casey, Port Townsend, San Juan Island and Seattle, Wash., Victoria, B. C., and Chicago, Ill.

CARNEGIE A SEPTUAGENARIAN.—Mr. Andrew Carnegie celebrated the seventieth anniversary of his birth on Nov. 25. The day found him hale and hearty and playing an 18-hole round of golf at the St. Andrews links. When asked for some appropriate reflections, he said: "The world is growing better. I find improvement in every case. Men are more kindly disposed, more charitable, more solicitous for others, less selfish. The outlook of men is broadening everywhere. Their capacity of sympathy is expanding; their sense of duty to others and responsibility for others is growing more acute. Man becomes more and more his brother's keeper." The Engineers' Club is to celebrate Mr. Carnegie's birthday with a banquet on Dec. 9, when he will be the guest of honor in the new house. It will be a memorable occasion, and John Fritz and Mark Twain are to speak.

EDISON ON WIRELESS.—In a recent *New York Times* interview in regard to its pages of foreign news received from Europe by wireless telegraphy, Mr. Edison said last week: "This thing is in its infancy yet. It is easy to see that. This young fellow Marconi does not know a tenth part now of the possibilities of wireless that he will learn in the next 10 years. The possibilities of the thing are limitless. The obstacles in the way now can easily be overcome. As for a ship getting out in the ocean and taking off the messages from the current, or another man setting up his apparatus and interfering with the connection, these things can be prohibited by law. You know that a great invention was never perfected in less than seven years. When a man has made his discovery he has just begun. Then he has to work for years and years before he has the thing anywhere near completed."

DR. STEINMETZ LECTURES ON RADIATION.—On Thursday evening, Nov. 21, at 8 p. m., Dr. Steinmetz delivered at the Polytechnic Institute of Brooklyn one of the most instructive and interesting lectures which he has ever given. The topic of the lecture was the "Physiological Effects of Radiation; Visible, Infra-red, Ultra-violet, and X-radiation." This lecture is the second of a series of popular evening lectures on the subject of radiation, light and illumination which Dr. Steinmetz will deliver at the Brooklyn Polytechnic. The lecture was beautifully illustrated with striking experiments performed with silicon, the mercury-vapor arc, and with an iron arc operating under a high-frequency condenser discharge. The subjects of radiation, reflection, refraction, absorption, fluorescence and phosphorescence were gone into in Dr. Steinmetz's customary thorough manner. The lecture was well attended and great interest prevailed.

[illegible] Frank L. Hess, geologist, is published in an advance chapter from "Mineral Resources of the United States, Calendar Year 1906," where the production of antimony, arsenic and bismuth in 1906 is also reported. At present the metal selenium is variously quoted at from $13.33 per kilogram (2.2046 pounds) to $2 per ounce, as there is no steady market and the prices vary with different dealers. No selenium is known to be produced commercially in this country, but during 1906 one copper refinery made some in an experimental way, and it is possible that it was produced at other refineries also. At this refinery the selenium was obtained from the anode slimes or mud, where it is left with gold, silver, and other residues in the electrolytic refining of copper. Minerals containing selenium are of rare occurrence in the United States, but a demand for the metal due to electrical development could probably be supplied by utilizing the small quantities found in the copper-refinery slimes.

GOVERNMENT TELEGRAPHS.—A recent economic writer discusses the British state telegraphs in a very pessimistic manner. None of the forecasts of the earning power of the system appear to have been realized. The operating expenses exceed on the average 92 per cent of the gross earnings. The annual telegraph deficits aggregate 25.5 per cent of the capital invested. One of the worst features of the existing systems is the pressure of employees upon the House of Commons for increased wages and salaries. The civil service unions curtail the power of the government to dismiss incompetent and redundant employees. To make matters still worse the House of Commons curtails the executive power to promote employees according to merit, and intervenes on behalf of the public servants who have been disciplined. The advantage of the civil service is less in evidence than one would suppose. The author considers that the House of Commons represents extravagance and not good management. The case is summed up thus: "The nationalization of the telegraphs has corrupted British politics by giving a great impetus to the insiduous practice of class bribery. It also has placed heavy burdens upon the taxpayers. But that is not all. The public ownership of the telegraphs has resulted in the state deliberately hampering the development of the telephone industry."

CHICAGO EDISON MERGER.—An opinion has been filed by the assistant corporation counsel of Chicago, and accepted by the city electric light committee, declaring that the recent consolidation of the Edison and Commonwealth companies was legal. This will require the Commonwealth-Edison company to operate under the Commonwealth ordinance, and takes in the entire city, while the old Edison ordinance covered only a part. Besides, it is a long-term grant, running for 50 years, while the Edison grant expires within five years. It carries a provision that 3 per cent of the gross receipts shall go to the city. On receipt of the opinion the committee at once ordered the corporation counsel to prepare an ordinance acknowledging the validity of the consolidation and requiring that the new company, on its passage, pay 3 per cent of the entire gross receipts of the two former companies to the city. This will make a total of something over $225,000 a year from the consolidated company. But last year the Commonwealth company paid a little more than $75,000, so that the gain will come from the added $150,000 from the Edison Company's business. The Edison Company's franchise covers the territory bounded by the lake, Thirty-Ninth Street, Western and Fullerton Avenues. Its gross receipts last year were $4,744,823, but the city got nothing of it. The Commonwealth covers not only this territory but all of the rest of the city, but before the consolidation was operating only in the outside districts. Its gross receipts were $2,507,772. Of this the city got 3 per cent. In addition to holding the consolidation valid, the Miller opinion holds that the electric company can cut rates in parts of the city to meet real competition, while not making the same cut in others; that the test of a reasonable rate is not whether there is a fair profit on each individual account, but on the business as a whole; that the city has the right to regulate the rates so as to make them reasonable, and that the Commonwealth Company is entitled to mortgage its franchise for the sale of bonds.

[illegible] Germany, of Nov. 11, says: "A German company is now telephoning wirelessly from Nauen to various places in Germany, 50 to 60 miles distant. One of the managers of the company said to-day that conversations had been conducted with extreme clearness and precision."

STEAM TURBINES.—At a meeting of the New York Electrical Society, to be held on Dec. 18, in the Engineering Societies Building, Mr. H. H. Barnes, Jr., will deliver a lecture dealing with the present status of the steam turbine. This will be an illustrated lecture, and will be most valuable in its data as to the condition of the art.

CONTROL OF CORPORATIONS.—The Georgia State Railroad Commission is to issue an order requiring all the gas and electric light companies of the state to report to it respecting the details of their business, including charges for depreciation, physical condition of the works, etc. The plan for the reporting is along the lines of the tabulation put out for the Southern Bell Telephone System.

[illegible] an open meeting, the New York Public Service Commission passed a rule concerning the filing of complaints against gas and electric lighting companies. Complaints must be signed by not less than 100 customers, and no single complaint shall include both gas and electricity; they must be kept separate. Upon such complaint being filed the commission may order a hearing, not only on the matters contained in the complaint, but on such other matters as it deems advisable.

[illegible] Department on Nov. 16, according to a Washington despatch, executed contracts with the Electric Boat Company of New York for the construction of seven submarine torpedo boats, aggregating in cost $2,270,000. Some of the boats are to be of the same size and types as the Octopus, which won the competition at Newport last spring, and others are to be of the same type, but larger and of greater speed. The construction of the boats is to be started at once, the work being done at the yards of the Fore River Shipbuilding Company, at [illegible]

STREET RAILWAY ACCIDENTS.—The Public Service Commission has given out a record of the street railway accidents in New York during October. Forty-seven persons were killed last month in street car accidents in this city according to the reports made to the Commission. This is a decrease from the number killed during September. It is thought to be due to the fact that the closed street cars have been put on in place of the open cars, to which there are several exits and in the operation of which there are consequently more chances of accidents. The total number of accidents recorded for the month was 4866 as against 5202 for September, and 5500 for the last 26 days of August. The total number of serious injuries inflicted, including the fatal cases, is given as 191 for the month, as against 216 for September and 189 for August.

X-RAY TEST OF DEATH.—Advices from Paris state that according to a report of Dr. Vaillant of the Lariboisière Hospital, presented at the Academy of Science last week, all danger of burial alive has been removed by the use of X-rays. Dr. Vaillant has discovered that, after numerous experiments with radiographs, the living and the dead present numerous differences. In the radiograph of a living person the viscera is invisible and the abdominal organs are in constant movement, and so leave no trace on the photographic plate. In the radiograph of a dead person, on the contrary, the stomach and intestines are clearly marked—this being the case even when the radiograph is taken only a few minutes after death. Dr. Bordas, whose experiments with radium on the color of precious stones attracted so much attention, recently made a report to the same session of the Academy in which he showed that practically the same results could be secured by submitting the gems to the influence of the X-rays. In the presence of the assembled scientists, a pale ruby was placed under a Crooke's tube; 40 minutes later it was found to be a dark, brilliant red and greatly enhanced in value.

THE NIMBLE NICKEL.—During the late financial panic in a Western city, remote from dreadful Wall Street, and where the troubles were therefore of purely local origin, the street railway company could not collect fares, owing to the shortage of cash, and issued promissory slips, punched for each ride, to be paid for later. Last week, the Omaha Street Railway Company flooded Omaha with nickels by meeting its monthly payroll with 600,000 five-cent pieces, $30,000 in all. Ever since the money stringency the street railway promised its employees actual cash on pay day, and to this end had been holding the daily receipts of nickels. When the men lined up for their pay, it was handed them in neat little packages of 20 nickels each. By paying out the nickels the street-car company made change plentiful around town. Most of the nickels went right back into circulation through the shops.

SLY MUNICIPAL POLITICS.—In an article on juggled city payrolls, referred to as in the above caption, the *New York Tribune,* otherwise an advocate of municipal ownership, lays bare a great scheme of graft and fraud, and says: "In both the Bronx and Manhattan there has been a great deal of mysterious juggling with payrolls, and thousands of workmen are employed year in and year out in repairing park roadways and boulevards whose wages are paid out of money raised through the sale of corporate city stock. There are also a large number of salaried officials who have been paid for years out of budget appropriations for maintenance, so that their names have never appeared at all in the annual statement of accounts. Much of the increase of $420,000 in next year's budget over this had to be voted in order to provide for the salaries of these officials in the regular budget appropriation for salaries. This was one of the results of the investigation ordered by the Comptroller. But even now there is a staff of some 60 or 70 permanently employed engineers who have been in the service of the Park Department for years whose names do not appear upon any salary list provided for in the budget. They are paid out of various corporate stock funds, and their salaries are carried from one account to another year after year."

TELEPHONE THEN TRAVEL.—One of the favorite telephone catch phrases has been: "Don't travel, telephone." Now we have a variation that may become just as popular. Tickets and Pullman accommodations on the New York Central lines can be obtained by telephone or letter, under a plan just inaugurated by F. L. Vosburgh, general Eastern passenger agent. By this arrangement anyone can obtain tickets by a messenger, who is authorized to collect for them and complete any other arrangements necessary for the comfort of the traveler. At each of the New York City offices of the Vanderbilt lines these messengers will be constantly on duty, making possible hasty preparations for travel at any hour of the day. Although New York is the best equipped city in the world for the accommodation of the traveling public, offices of the various roads being located in all parts of the business district, Mr. Vosburgh says he has found that many persons who at times are hastily called away need still further aid in preparing for their trips. "We have inaugurated the plan to accommodate the busy traveler, and believe that the increased business will merit keeping it in operation," Mr. Vosburgh said. "There are many persons who find it necessary to arrange for their accommodations in their home, hotel, club or office. We have competent representatives, who on the receipt of a note or telephone call will be sent to the prospective traveler's residence or office. He will take with him the necessary tickets and Pullman accommodations, collect for them and make all other necessary arrangements for the comfort of the traveler."

Transmission System and Sub-Stations of the Dunedin City Corporation, New Zealand.

LAST week's issue contained an illustrated description of the hydro-electric generating station erected on the Waipori River for the Dunedin City Corporation. Electrical energy from this station is transmitted to a sub-station in Cumberland Street, Dunedin, through an intermediate sub-station at Halfway Bush. The distance from the power-house to Halfway Bush is about 28 miles and the total distance to Dunedin is approximately 30 miles. It is the purpose of the present article to describe the transmission system and sub-stations.

TRANSMISSION LINE.

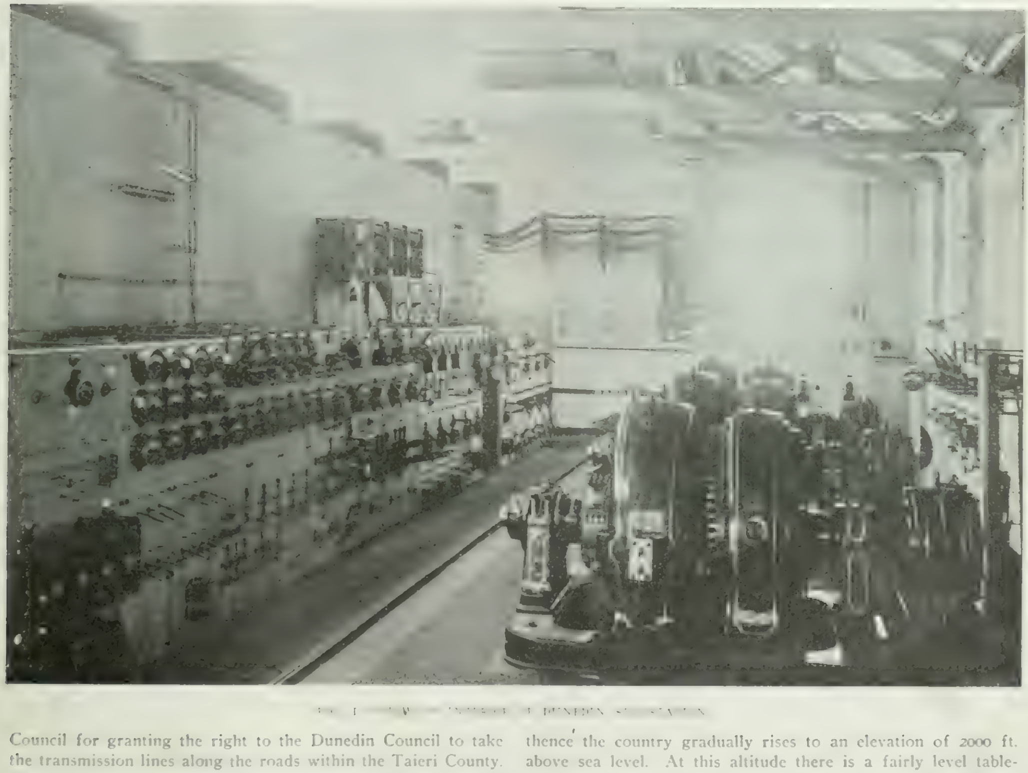
After leaving the power-house the high-tension transmission line runs to sub-station No. 2, located about 21 miles from the power-house. This sub-station is situated on the Taieri Plains in order to meet the conditions demanded by the Taieri County Council for granting the right to the Dunedin Council to take the transmission lines along the roads within the Taieri County. The nature of the agreement is that so soon as the Dunedin Council has contracted for a demand that will take four-fifths of the maximum output of the station, the remaining fifth may be utilized for the benefit of the residents of Taieri County at a rate not exceeding that given to the most favored consumer in the City of Dunedin under like conditions of supply. In this sub-station the connections are so arranged that the transmission lines may be inter-connected in any manner. There will [illegible] miles from this sub-station is the town of Mosgiel, where there is a large woolen factory and several mills, which eventually will [illegible]

When fixing the route for a transmission line, special consideration must be given to the character of the country facilities for patroling, climatic conditions and the voltage. The voltage, of course, depends upon the distance, the price of copper and the limit of line loss. The question of good regulation practically governs the latter, and after careful consideration a voltage of 35,000 was adopted as being reasonable for insulation and economical as regards weight of copper in the line. The transmission line is in duplicate throughout, and each line is entirely independent of the other.

The site of the power station is 436 ft. above sea level, and the hills forming the banks of the river have an angular slope ranging from 30 degs. to almost vertical. These hills are covered with dense bush to about 1000 ft. above sea level, and as it would have been a very expensive matter to construct the transmission line on the slopes of the hills the route chosen was across the top of the divide between the power station and the Taieri Plains.

On the opposite bank of the river to the power station there is a small plateau, and then the hill rises with an average angle of about 40 degs. to a height of 1095 ft. above the sea level, and thence the country gradually rises to an elevation of 2000 ft. above sea level. At this altitude there is a fairly level tableland, which is about two miles across, and then the mountain, which is known as Maungatua, slopes towards the Taieri Plains with a series of sharp spurs. The country on the top of the mountain is entirely open, and mostly used for grazing purposes. In winter it is exposed to severe southwesterly winds and is covered for days with snow. This route was chosen as being the most direct to the Taieri Plains, and at the same time because of the ease of construction for the line and facility of patrolling.

The transmission lines leave the power station at the top of the lightning arrester annex, the wires passing through fibre tubes held in glass shields. From this point the wires are taken to a terminal tower on a spur about 80 ft. above and at the back of the power station. From this tower the wires span the



[illegible]

ravine to a steel tower located on the top of the first bluff on the opposite side. It was decided that the line should be run in one span in preference to erecting poles at short intervals down the rugged face of the mountain side. This span is 1700 ft. in length, and the horizontal distance between the towers about 1600 ft., the upper tower being 650 ft. above the terminal tower.

The tower at the upper end is constructed of angle steel throughout, and with the insulators so arranged to take the angular strain of the long span cable. This tower was specially built to withstand the strain of the seven cables. The strain of each wire is taken up by four pairs of insulators. Around the neck of each insulator is a "U" bolt, the ends of which pass through a wooden cross-bar. The wire passes through a hole in the center of the cross-bar, and iron clamps are fastened rigidly to the wire and rest against the upper side of the cross-bar. By this means the strain on each pair of insulators can be equalized by means of the nuts on the "U" bolts. Two pairs of insulators are sufficient to take care of the strain of the wire, so that ample margin of safety is provided. Seven wires are suspended across the span, three for each transmission line and one spare cable for use should any of those in service be carried away. This provision was necessary, as owing to the nature of the country at this point it would be a most difficult matter to repair a span. Four of the wires are of steel and

FIG. 2.—HILL-TOP TRANSMISSION LINE TOWER.

three of No. 2 B & S gauge copper, and the latter appear to be as satisfactory as the former, except, of course, that there is not the same factor of safety.

The tower is erected on solid rock, and the cables have a minimum clearance of 10 ft. from the face of the hillside. The spans are not affected by the wind, which blows with great velocity at times through the gorge. They are spaced 10 ft. apart triangularly, and each cable is drawn to the same tension. The lower terminal tower is made entirely of wood, consisting of six hardwood poles. This tower is anchored by guys, so that the only work it does is to hold the cables off the ground; the same methods of attaching the wires to the insulators was adopted as on the hill-top tower.

After leaving the hill-top tower, the transmission wires are carried on Australian hardwood poles, those used on the mountain top being 30 ft. in length with 6 ft. buried in the ground. The question of towers versus wood poles was carefully considered, but as the Taieri Council would not agree to towers being erected along the roads, there was no alternative. The cost is slightly in favor of wooden pole construction.

The insulators are spaced 42 ins. apart, triangularly, the top insulator being attached to the pole. The bottom insulators are carried on ironwood cross-arms gained and fastened to the post by two lag screws. The gains were cut slightly slanting, so as not to provide a pocket for moisture. The cross-arms are 4 ft. 6 ins. long by 4 ins. by 5 ins. The poles are spaced 150 ft. apart, and the two lines of poles are 30 ft. apart over the mountain top.

The transmission wire is of two sizes, No. 2 B. & S. gauge and No. 3 B. & S. gauge, and is of medium, hard-drawn copper with a tensile strength of 50,000 lbs. per sq. in. The reason for two sizes of transmission wire being used was that the Council had purchased, some years previously, 72 miles of No. 2 B. & S. gauge wire for a system then contemplated but never built. This wire was sent out on reels, and was used on the portion of the transmission line on the plains. The No. 3 wire was purchased later and was sent out in bundles for ease of transportation over the hills. There are 164 miles of copper wire in the transmission lines.

After leaving the table-land referred to, the route of the transmission line is along the ridge of the Kowhai Spur or Razorback, and in this case it was also necessary to keep the pole line on the top of the ridge as the sides are covered with dense bush.

In a few places small creeks and depressions were crossed with spans ranging up to 300 ft. in length. Before reaching the

FIG. 3.—WIRE AND POLE LINES ALONG THE HIGHWAYS

bottom of the Kowhai Spur another long span had to be adopted in order to cross a small valley. This span is 900 ft. in length, and the wires are spread out to 6 ft. spacing, the two lines being supported on long double cross-arms on three poles at the upper end.

The line then continues across private property until it strikes the main road on the plains, seven miles from the power station. From this point the poles are erected along each side of the road, being located in the fence line where the roads are 40 ft. wide, and 6 ft. from the fence alignments where the roads are 66 ft. wide. The line then continues on poles until it reaches the township of Outram, 14½ miles from the power station. At this point towers had to be erected for crossing the railway. These towers were specially designed to prevent any possibility of a wire falling across the railway line, either due to breakage of the insulator or of the wire. The insulators on the towers are only subject to compression strain. Steel wires with a tensile strength of 6000 lbs. are used for the crossing and as the working strain is only 400 lbs. the factor of safety is ample. It is impossible for the cable to fall from the tower if all the insulators break; the copper wires which terminate on the tower above the steel cables are connected to the latter by soldered clamps.

After leaving the Outram railway crossing, the lines run

through private property in order to cut off a long detour and to avoid going through the township of Outram. The line proceeds along the Outram-Mosgiel road and the Northwest Taieri Road until it reaches the site of Sub-station No. 2, 21 miles from the power station, which has already been described. The wires are then carried on steel towers across private property, in order again to avoid a long detour, crossing another line of railway and proceeding thence along the Northwest Taieri Road to the Silver Stream River, 23 miles from the power station.

From this point the route leaves the plains, and is taken four and one-tenth miles through private property, ascending at an average grade of 1 in 8 over a spur of Flagstaff mountain rising to an altitude of 1125 ft., and then descending until it reaches the sub-station at Halfway Bush, 645 ft. above sea level.

At the point where the route of the transmission line is taken through private property at Outram and again after leaving Sub-station No. 2, the lines are carried on steel towers because the property owners objected to a double line of poles running through their lands. These towers are spaced 500 to 600 ft. apart, and each tower carries the six transmission wires and a telephone line. The towers are rectangular structures, the length of the base parallel to the line is one-fifth of the height,

FIG. 4.—POLES AT CROSSING, SHOWING LINEMEN'S TELEPHONE.

and the width is 14 ft. The towers vary from 40 to 50 ft. in height, according to the nature of the ground, and the angle steel sections are in 10-ft. lengths. The bracing stays consist of two No. 7 S. W. G. steel wires, twisted with Spanish windlass and with eccentric washers in the bolts to provide for adjustment of the strain.

Before the design of the tower was decided upon an experimental tower was made, and a strain of 2400 lbs. was put on the extreme end of the tower, this strain being equal to the tortional strain that would result in the event of five of the wires carrying away on one side. In the design of the line a factor of safety of six was allowed. This factor was insisted upon by the Board of Control as being sufficient to provide a safe margin against all snow and wind stresses.

The linemen were provided with adjustable sighting pieces, which were hung at each pole and the cable strained with a sag to correspond with the length of span and temperature of the atmosphere. The wires are tied to the insulator with No. 8 soft-drawn copper, and McIntyre joints are used throughout. No ladders were used in the erection of the line, as the men climbed the poles with spurs, two types of which were used. Neither of the high-tension lines is transposed throughout its length.

One of the Government telephone lines runs parallel to the transmission line for a length of two miles, and at a distance of 1320 ft. from the line, and no trouble is experienced due to induction, only a very slight humming being perceptible.

The insulators and pins were delivered along the route and deposited at the foot of the poles. At first the pins were fixed in with litharge and glycerine cement, as this is quick setting, but as the men complained it made their fingers very sore, and it was found the public did not damage the insulators, Port-

FIG. 5.—TOWERS AT OUTRAM RAILROAD CROSSING.

land cement, mixed one part to one part sand, was used instead and the pins were allowed four days to set. The pins are of ordinary 2-in. galvanized iron pipe swaged in. Iron pins were adopted because it was thought that if wooden pins were used there would probably be trouble due to absorption, owing to the very moist climatic conditions which prevail during a great portion of the year. The pins were made by the Johns-Manville Company, and the insulators by R. W. Thomas & Sons, New York. The insulators are made of brown porcelain throughout.

In the line there are 1802 poles and 15 steel towers. All poles and towers are numbered with enamelled iron plates, and on every alternate pole there is a notice on enameled iron offering

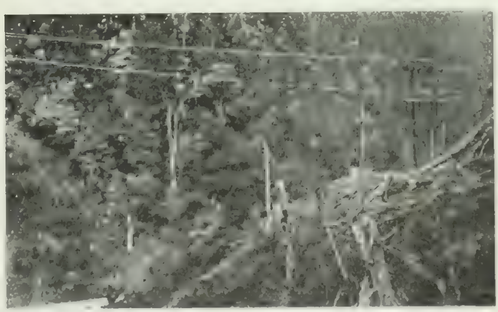


FIG. 6.—BOTTOM TRANSMISSION LINE TERMINAL TOWER AT REAR OF POWER HOUSE.

a reward for information leading to the conviction of any person found damaging the lines or insulators.

At all road crossings there are 45-ft. poles with double cross-arms and insulators, which are also used at all angles. Most of the poles are 35 ft. in length and rough dressed, the wood being either blue gum, flooded gum, tallow wood, blackbutt or turpentine, and cost on an average $11.25 each, erected. All poles are ringed at the top.

There are two linemen whose duty it is to patrol the line daily. They both reside at Outram and are provided with horses, one man proceeding over the 17½ miles of line to the

power station one day, staying there for the night and returning to Outram the next day. The other lineman patrols the 9.6 miles of line from Outram to Halfway Bush, returning to Outram every night. The lineman on this section hands in both linemen's daily reports on every alternate day to the sub-station attendant, who forwards them to the head office.

Each lineman has to call up and report to the power station and sub-station No. 1 at each telephone box along the line, stating the direction in which he is going. These calls are entered up in the log books. The lineman on the power station section has a very rough time during the winter months, as heavy snowstorms prevail, and the ascent and descent is very steep on both slopes of the mountain, so much so that many persons prefer to walk. During the month of June there were several heavy falls of snow, but no snow adhered to the line wires and no line troubles were experienced.

All the insulators were erected by the end of February, and up till May 18 no insulators had been reported broken; in fact, there had been no line troubles of any kind. Since that date three insulators have been broken, but it was not necessary to renew them immediately. It was found necessary to cut down no less than 1400 trees along the route. These trees were mostly blue gums, ranging from 80 to 120 ft. in height. With respect to the ten miles of transmission line through private property, the rights of erection and of patrol were obtained for the moderate sum of $3,000.

The efficiency test of the line confirmed the calculated loss. As previously mentioned, each line consists of 12 miles No. 2 wire, and 15.1 miles No. 3 wire. The calculated resistance is 26.23 ohms, and the measured resistance is 27.11 ohms. Taking 1000 kw at 30,000 volts with 90 per cent power-factor at the receiving station, the line current is 21.1 amperes, the calculated voltage drop, allowing for inductance and impedance, is 2192 volts, and in the test made the measured voltage drop was 2200. Each line is designed to carry the station output with a loss of 8.75 per cent at full load with 85 per cent power-factor.

On one occasion an interesting experiment was made by connecting the transmission lines at sub-station No. 1 and transmitting the energy from Waipori by one line to Halfway Bush and back by the other, and driving the second generator as a motor, the total length of transmission being 54.2 miles.

A telephone line connects the power station to sub-station No. 1, and is carried on bracket insulators on one line of poles. It is a metallic circuit throughout, and the telephone wires are alternately 7 ft. 3 ins. and 7 ft. 9 ins. from the line wires. The wires are transposed vertically and across the pole every three pole lengths, so that a complete helix is obtained in every 12 pole lengths. On the towers, as the spacing of the line wires is different to that on the poles and the interval between the towers is irregular, in order to keep the inductive effect on the telephone line a minimum, instead of the bare copper, as used on the poles, two ordinary insulated telephone service wires were twisted together and strung from tower to tower.

There are nine telephone stations along the line; these are arranged so that the lineman stands on a platform supported on four main-line insulators. The connections in the telephone boxes are made so that the lineman can talk to either end or both ends simultaneously. The telephone instruments are protected with long fuses and a grounding device, so that should the main line wire fall on the telephone, at the time the lineman is using the instrument, it would be grounded and blow the fuse. This system was adopted because it was not deemed advisable for the lineman to carry portable telephones to connect the wires at any point. At the power station and sub-station the telephone instruments are protected in a similar manner. The power station telephone box consists of two independent cabinets, one inside the other and each one lined with felt. This cabinet effectually shuts out sound, and the noise of the water-wheels cannot be heard from inside. The telephone line is only used for service purposes.

Halfway [illegible]

The sub-station at Halfway Bush is connected to the Dunedin station by telephone wires running on the Government poles, as the Board of Control would not allow the main line telephone to be taken into town.

In order to provide a duplicate connection with the power station another telephone line connecting the power station to the Government telephone bureau at Berwick was installed. This line consists of two wires erected on an independent line of poles running parallel to the transmission line and at a minimum distance of 178 ft. from the same over the Maungatua Mountain to the bottom of the Razorback Spur. From this point it is taken along the main roads to Berwick: connection is then made with Dunedin by connecting on to the Government lines, the ordinary bureau charge of 6 cents being made for each conversation. The operators can therefore use this line for private purposes.

Sub-station No. 1 at Halfway Bush, is designed to contain two banks of transformers of three each and one transformer as a spare. Four transformers of the Westinghouse oil-insulated, self-cooling type are installed, three being for service, and one as a spare. Each has a rated capacity of 600 kilowatts, with a ratio of 18,000 to 3300 volts. Taps are brought out on the high-tension side at 17,000 and 16,000-volt turns. The efficiency is 98 per cent at full load, with unity power-factor and 97½ per cent at 90 per cent power-factor. The regulation is 1.1 per cent and 2.9 per cent at 90 per cent power-factor at unity power-factor.

The transformers are connected in "star" on the high-tension side and in "delta" on the low-tension side. As it was found necessary to take distributing mains from this sub-station, in order to provide easy regulation of the single-phase circuits, these mains are connected in "star," and an artificial neutral is provided by means of a No. 2 B. & S. gauge bare copper wire carried on the top of the low-tension transmission lines poles from the sub-station and connected to the neutral point of the synchronous motors in the Dunedin station. Each transformer is connected to an oil system, so that the oil can be drawn off into a well from where it is elevated by means of a hand-pump to overhead tanks. Each transformer is on wheels, so that it can be wheeled underneath the crane for repairs.

The system of wiring in the sub-station is similar to that adopted at the power station. The high-tension transmission lines enter through openings of the southern end of the building, and are connected to oil insulated choke coils and low-equivalent Westinghouse lightning arresters, similar to those at the power station. Each line is then taken to an automatic oil

[illegible]

switch connecting to the high-tension bus-bars, and an oil switch is located between line oil switches for paralleling the high-tension bus-bars.

The series and shunt transformers for overload relays and voltmeter are located on the line side of the oil switches and protected by long fuses enclosed in porcelain tubes. A three-phase transformer is connected to the low-tension bus-bars for the lighting circuits in the power station and residence. The

transformers are connected on the high-tension side, with flexible cables and plug switches to the bus-bars, so arranged that the spare transformers may be cut into any phase of either bank. The low-tension leads are connected by clamps to the 3300-volt bus-bars, which are overhead and run to the low-tension switchboard located at the northern end of the building. This switchboard is 20 ft. long; there are three panels controlling the transmission lines to Dunedin. On each panel there is an automatic oil switch with time-limit relay, and one double-throw, oil-switch, by means of which the outgoing line may be

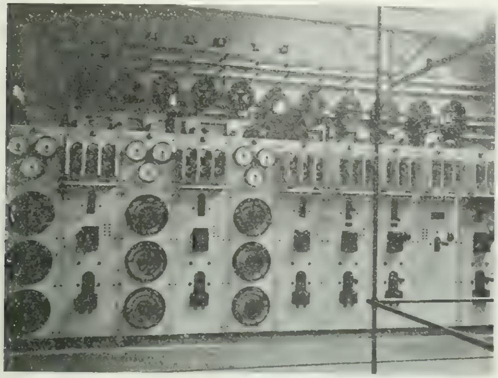


FIG. 8.—3000-VOLT SWITCHBOARD IN HALFWAY BUSH SUB-STATION.

connected to either bank of transformers. There is a voltmeter receptacle and six knife disconnecting switches, for the purpose of isolating the oil switches; three of these are on the front of each panel, and three on the back. There is also a one-line paralleling panel, on which there are six disconnecting switches and one hand-operated, oil-switch, for paralleling the low-tension bus-bars. Provision has also been made for three local circuits to be taken from the sub-station; each circuit is controlled by two panels, on which are mounted six disconnecting switches, one automatic oil switch with time-limit relay, one double-throw oil switch, one voltmeter receptacle, three ammeters, one on each leg, and three potential regulators, by means of which the line potential can be varied 10 per cent either way.

At the back of the switchboard there are choke coils and Westinghouse lightning arresters on each line. The building is 68 ft. by 36 ft. by 16 ft. high, constructed of wood and galvanized iron, with concrete floor and lined inside with fibrous plaster on expanded metal.

An air duct runs under each bank of transformers by means of which air is forced from a blower, and can be impinged on the transformer cases to facilitate cooling.

Adjacent to the sub-station is an attendant's cottage for the electrician-in-charge.

The low-tension transmission line leaves the sub-station at the northern end, and conveys the energy to the sub-station in Dunedin. The line is in duplicate and carried overhead for 1½ miles and then underground for ½ mile through the business section.

The overhead cables are 0.2 sq. ins. in section and have triple-braided, weatherproof insulation. The six cables are carried on one cross-arm, and are spaced 12 ins. apart, and both lines are transposed twice. The poles are dressed hardwood, 35 ft. long, with 6 ft. in the ground and located along the curb line.

At the point where the line is taken underground a large [illegible] arresters for the protection of the two underground cables, which are 3-core, paper-insulated, and drawn into conduits laid under the sidewalks. Each line is designed to carry 1000 kilowatts. A second cross-arm has been provided on each pole for extra lines when required.

DUNEDIN SUB-STATION.

The Dunedin sub-station is practically in the center of gravity of the [illegible]

From the station alternating-circuit is distributed in and around the city for commercial lamps and motor circuits, and direct-current for the railway and street arc lighting system. The building is of brick, and is 65 ft. wide by 99 ft. long.

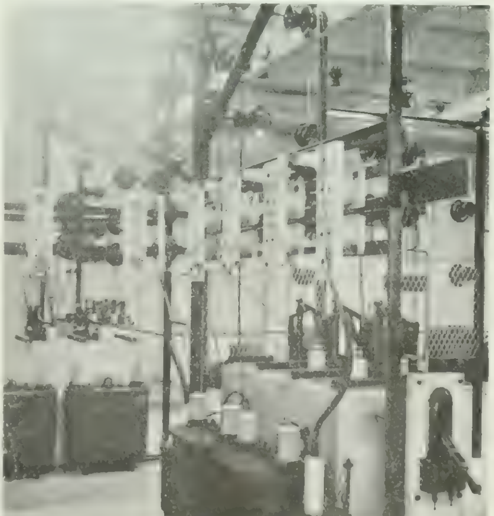
The generator room is 28 ft. 6 ins. wide by 77 ft. long, and contains the machinery and switchboards. Adjoining this room is the transformer fireproof chamber, 10 ft. wide by 52 ft. long; to the right of the transformer room there are two battery rooms, one above the other, and each 23 ft. wide by 77 ft. long.

In the generator room there are three motor-generators, each unit consisting of one Westinghouse 440-hp, 3000-volt, three-phase synchronous motor, coupled to a 300-kw, 550-volt, direct-current generator. The field structure of the motor, and the armature of the generator are mounted on one shaft, which is extended at the motor end to carry the rotor of a 40-hp, 400-volt induction, starting-motor. The connections are arranged on the switchboard so that the set may be started and synchronized from either the direct-current or alternating-current side.

It was first intended to install rotary-converters as the translating device from alternating-current to direct-current, but owing to the contemplated nature of the motor load on the system it was decided to install motor-generators in order to get the advantage of leading wattless current by means of the synchronous motors when required.

The switchboard is located on three sides of the generator room, and its total length is 68 ft. The board adjoining the transformer room is divided into three sections. The first section comprises five panels; one for controlling the incoming transmission line, one for controlling the exciter and motor, and three panels for controlling the synchronous motors. The second section, consisting of five panels, controls the low-tension distribution circuits and the other incoming transmission line. The third section consists of four panels for controlling the 3000-volt circuits.

At the end of the first section are the panels for controlling the railway circuits and two arc-lamp panels; there being 60



[illegible]

enclosed arc lamps erected on top of the railway poles. On the opposite side of the room is a switchboard for controlling three [illegible] station. This plant, consisting of three 200-kw generators coupled to Bellis engines, will be kept for stand-by service. This equipment has been used during the past three and one-half years for operating the railways.

[illegible]

synchronous motor. This is made up of a 400-volt induction motor and a 20-kw, 125-volt generator. A special motor-generator set has been installed, consisting of a 500-volt, direct-current motor coupled to a 60-kw, three-phase, 400-volt, 50-cycle generator. This unit is intended to supply electrical energy to the railway department in the event of the failure of the transmission lines, the energy for operating the motor being obtained from the steam-driven plant. There is also a differential battery booster consisting of a 37½-kw generator coupled to a 50-hp, direct-current motor.

In the transformer room at the rear of the switchboard are four 150-kw, oil-insulated, water-cooled transformers (one being a spare), ratio of 3000 to 242 volts, connected in "delta" on primary and in "star" with neutral grounded on secondary. The high-tension side is wound to give 10 per cent regulation up or down, and has turns tapped for 3300 and 2700 volts.

The high-tension bus-bars are run overhead, and connect to the oil switches on the switchboard. The transformers are connected to water and oil service systems; and in the trans-

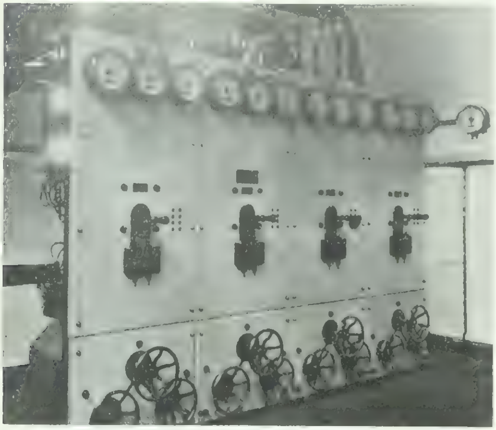


FIG. 10.—3000 VOLT DISTRIBUTION BOARD IN DUNEDIN SUB STATION.

former room there are also 39 regulating and instrument transformers. In the lower battery room there is a 300-ampere battery with 200 cells. The whole of the sub-station equipment was supplied by the Westinghouse Electric & Manufacturing Company.

The low-tension distributing net-work in the business section of the city is by means of underground Callender's vulcanized bitumen cables, laid on the solid system in a new form of cement conduit. The feeders to the net-works are four-core cables. The four cores are of equal sectional area, so that in the event of any core feeding the outers becoming grounded, it could be exchanged with the core serving as neutral.

The mains are laid along each side of the streets under the sidewalks and consist of four separate cables, the neutral having half the sectional area of the outers. These mains are also laid on the solid system, and service boxes are provided at every alternate building. The out-lying portions of the city and suburbs contiguous to Dunedin have been supplied with overhead mains at 3000 volts, with local transforming stations at points of distribution.

RATES FOR ENERGY

After a careful consideration of the capital charges per unit sold per annum and the cost of generating and distributing the energy, the following rates were fixed:

Energy for lamps lighted during ordinary hours, 10 cents per kw-hour for the first 1½ hours, and afterward 2 cents per kw-hour.

Energy for special lighting during extraordinary hours, 8 cents per kw-hour for the first hour, and 2 cents per kw-hour thereafter.

Energy for motors, 4 cents per kw-hour for 50 kw-hours consumed per month per kilowatt or brake horse-power installed, and 1 cent per kw-hour thereafter.

For special consumers whose average demand is over 25 kilowatts, special rates are quoted to suit the nature of the demand.

The railway is charged for energy at the rate of 1½ cents per kw-hour since all the moving machinery, the battery and half the switchboard is used solely for railway purposes and necessitate three extra attendants.

In Dunedin the summer days are long and the twilight lasts till 9 p. m. Nearly all the shops close on ordinary week nights at 6 p. m. and at 9 p. m. on Saturdays: the large retail houses close at 1 p. m. on Saturdays. For these reasons, and bearing in mind the probable nature of the load factor, and the anticipated diversity factor, no flat lighting rates are in use, and a high rate on the maximum demand system for one and one-half hours per diem was used instead. This system of charging, considering the latitude of the locality, is undoubtedly the fairest to the long-hour consumer, as the larger shops and retail houses would only require lighting during about four months of the year from 4 p. m. to 6 p. m., Saturdays and Sundays excluded, and as the capacity of the generating plant, mains, etc., has to be sufficient to supply consumers of this class for such short periods of the year, it follows that there should be a wide range between the high and low rates of the "maximum demand system." The large shopkeepers, therefore, will pay 10 cents per unit, but the small householder, who will probably keep all his lamps running for an average of three hours per night throughout the year, will pay 6 cents per unit. The reason the charge for energy for motors was fixed on the consumption per kilowatt installed was to avoid the use of maximum demand indicators on the motor circuits.

The whole of the work in connection with the dam, flume and pipe-line was designed and carried out by Mr. F. J. Williams, the corporation's hydraulic engineer. The electrical installation was designed and carried out by Mr. W. G. T. Goodman.

Electrical Equipment of the Fort Dodge, Des Moines & Southern Railway.

The cities of Fort Dodge, Boone and Des Moines, Ia., separated by a total distance of only about 90 miles, were for the first time on Nov. 4 placed in direct railway communication by the opening for traffic of the Fort Dodge, Des Moines & Southern Railway. This system combines the electrical equipping of a steam road with new interurban construction. Fort Dodge, like Des Moines, is a very active business town and is also a railroad center of importance. The town of Boone, located midway between, is also an active center. Each of these three cities is situated on one or more important trunk line railroads, which in no case connect directly with the other cities. The railroads in question are the Illinois Central and Chicago Great Western at Fort Dodge, the Rock Island and Chicago, Milwaukee & St. Paul at Des Moines, and the Chicago & Northwestern at Boone, all of which, with one exception, lie practically parallel. The new system links the towns, and therefore connects the railroads at these points, and it will readily be seen that its operation bears vitally on the local traffic problems of the trunk lines concerned, although it is essentially an independent interurban property. The operation of this railway will undoubtedly afford data useful to steam roads in the general problem of the electrical equipping of branch lines.

When the project was undertaken there was a small steam railroad property, the Newton & Northwestern Railroad, running about northwest from Newton through Boone to Rockwell City, or almost in the direct line between Fort Dodge and Des Moines, though without reaching either city. Briefly then the

present project has consisted in the electric equipping of 42 miles of this steam road and the construction of 25 miles of new line from each end of the electrical section to Fort Dodge and to Des Moines, respectively. A branch line 5 miles long has also been built from Kelley on the main line to Ames, where the Iowa State College is located.

The plans originally contemplated and now in force involve the operation of through electric cars between Des Moines and Fort Dodge, but certain portions of the original Newton & Northwestern, which now become spurs to the through route, are still operated by steam.

The electric passenger train service is based on an average speed of 27½ miles per hour, including 15 regular stops, which means that a maximum speed of nearly 60 miles per hour is frequently attained between stations by the heavy electric express and passenger cars. The total running time from terminal to terminal is 3 hours 50 minutes, but 43 minutes are consumed in covering 4 miles within city limits at Des Moines and 2½ miles in Fort Dodge.

To provide for the high maximum speed on the system it was necessary to rebuild the permanent way of the electrically equipped section of the Newton & Northwestern Railroad. The road was reballasted with gravel and equipped with heavy rails throughout, and the extensions were constructed to the same standard. Fairly level country is traversed, permitting small gradients except near Boone, where the line crosses the Des Moines River, and the country is rugged and cleft by deep ravines. On this section a 2½ per cent grade is encountered, while still heavier grades were obviated on the original line in the Des Moines River Valley only by a series of trestles, bridging the ravines before mentioned, where they emerge into the river flats. One of these trestles just west of Boone is among the highest and longest in the country.

Each car is provided with four 75-hp direct-current motors, which give a maximum speed on the level of nearly 60 miles an hour. All cars are single ended and have locomotive pilots. They are equipped with standard radial draw bars and M. C. B. railway couplers to permit coupling to the steam railroad cars. Multiple unit control apparatus is installed on all electric cars for operating in trains.

The passenger car bodies are 43 ft. long over corner posts. At the front end there is a baggage compartment 10 ft. long containing movable seats, and back of that a smoking compartment 12 ft. 6 ins. long containing seats. The heating is by hot-water apparatus. With the seats filled these cars weigh about 38 tons.

The energy for electric operation is derived from a 3000-hp turbine-driven plant, located at Frazer, on the Des Moines River, about equidistant from the terminals. Coal mines nearby supply cheap fuel in the form of Iowa bituminous slack coal, while the feed water comes from the river, passing through purifiers to reduce the scale-forming salts. The main generating equipment consists of two 1250-kw Parsons type turbo-generators supplied with steam at 175 lbs. pressure from two batteries of water-tube boilers, the flues of which connect with an 180-ft. chimney.

The energy is generated, alternating, three-phase, 25 cycles at 2300 volts. The e. m. f. is stepped up to 20,000 volts for transmission to five sub-stations located at Ankeny, Kelley, Boone, Fort Dodge Junction and Otho, at an average distance apart of about 15 miles. The sub-station in the power house consists of three 145-kw water-cooled, oil-insulated, 2300 to 370-volt single-phase transformers and one 400-kw, 600-volt rotary converter. The other sub-stations are uniform, each containing three 145-kw, single-phase, 20,000 to 370-volt, oil-cooled transformers and one 400-kw, 600-volt rotary converter, with room for the installation of a second converter if desired. The converters are of standard Westinghouse design.

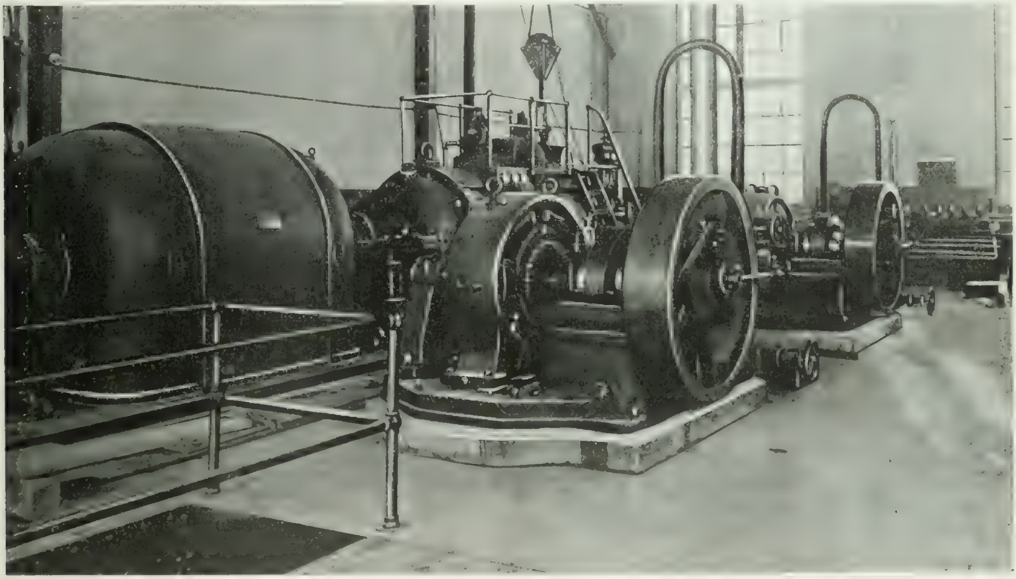


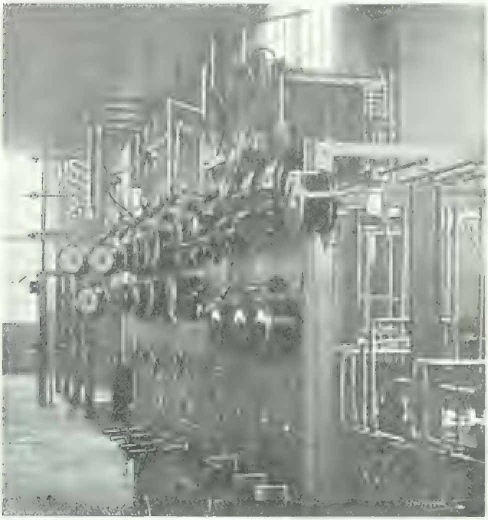
FIG. 1.—INTERIOR VIEW OF THE FRAZER GENERATING STATION.

The transmission line is designed for a maximum e. m. f. of 33,000 volts, the wires being No. 4 B. & S., spaced 48 ins., and carried on porcelain insulators 7½ ins. high and 8½ ins. in diameter. The insulators are tested to 75,000 volts. Poles of not less than 8 ins. top diameter are used and are spaced 100 ft. apart on tangents, being set in concrete points where advisable.

The overhead work is the standard bracket construction except at turnouts, where span construction is used. Frogs are not used on the trolley wires at turnouts, the wire for the siding being run parallel to the main wire with a space of 18 ins. for a distance of 100 ft. beyond the end of turnout in either direction. The track is bonded with 300,000 cir. mil soldered bonds and cross bonded at intervals of 500 ft. with No. 4-0 B. & S. copper wire.

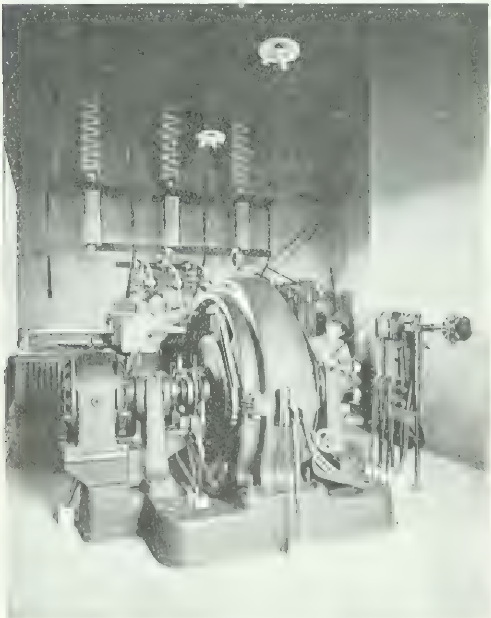
The engineering, construction and equipment of the sys-

tem, including generating station, transmission lines, sub-stations, overhead work and bonding, telephone dispatching facilities, rolling stock and car barns, have been in charge of J. G White & Company. The Northwestern Construction Company



[illegible]

carried out the construction and reconstruction of the permanent way. The entire work was carried out under the supervision of J. L. Blake, general manager of the Fort Dodge, Des



[illegible]

Moines & Southern Railway, representing the owners. The main turbo-generators with the other principal electrical apparatus, including [illegible] equipment, [illegible] Westinghouse manufacture. The cars were made by the Niles Car & Manufacturing Company, and the trucks by the Baldwin Electric Works. They are heated by the Peter Smith hot-water apparatus. In the power house the boilers are of the Babcock & Wilcox Company, Aultman-Taylor type. Wheeler Condenser & Engineering Company's surface condensers and Cochrane feed-water heaters are used. The chimney was built of concrete and steel by the American Chimney Company under the specifications of J. G. White & Company.

Representation of Armature Reaction of the Synchronous Motor as an Equivalent Reactance.

[illegible]

In an article on "Excitation Characteristics of the Synchronous Motor," published in the issue of the Electrical World for Oct. 19, the author derived a series of equations representing the behavior of the motor under various conditions of operation. The results as there recorded are expressed somewhat differently from those usually found in the literature of the subject in that the effects due, respectively, to armature impedance and armature reaction are separated from beginning to end, instead of being combined at the outset into one term as "synchronous impedance." After the completion of this paper, but before its publication, the appearance of the excellent article on "Circular Current Loci of the Synchronous Motor," by Dr. A. S. McAllister (Electrical World, Aug. 24), indicated that the writer's former results might be reduced to corresponding graphical form, and this has been done in what follows. While the results are the same in the two cases, the methods are quite different; and, in addition, the results here given afford a basis of comparison between the usual expression for synchronous impedance and its value in terms of its components, armature reaction and pure armature impedance; and also a proof that the "synchronous reactance" is constant under the conditions assumed.

The assumptions made in deriving the original equations are here repeated for the sake of completeness. They were: Unsaturated magnetic circuit (induced e. m. f. proportional to excitation); constant magnetic reluctance and constant armature magnetic reactance, or that the actual variable values of these quantities might be replaced by their averages: and finally, the possibility of combining vectorially the m. m. f.s of the armature and the main field currents, in determining the resultant m. m. f. These assumptions are equivalent, in part, to assuming that the magnetic reluctance around the air-gap is constant, which is, of course, not the case in reality.

Fig. 1 represents the time-phase relations of the various quantities involved in the operation of the motor. E_0 is the impressed e. m. f., E_1 the counter-generated motor e. m. f., e the "resultant" e. m. f. in the motor circuit, i the armature current, and F_a, F, and F_r the m. m. f.s corresponding to the armature, main field and resultant field, respectively. The necessary condition is that F_r and E_1 shall be in time-quadrature. In the equations below, r and x are the resistance and average local magnetic reactance of the armature, respectively; k is a constant, such that $F_a = ki$; and m is a constant, such that $F_r = mE_1$. It was shown in the writer's former paper that the following equations hold:

$$[illegible] \quad (1)$$

$$[illegible] \quad (2)$$

where P is the total power developed by the motor, and where

$$[illegible]$$

The meaning of the angle α is clearly shown in Fig. 1.

It was also shown that the current i consists of horizontal

and vertical components (that is, quadrature and in-phase components, as per Fig. 1), which are, respectively,

$$i_a = \frac{a(mE_0 - F\sin\alpha) - bF\cos\alpha}{a^2+b^2} \qquad (3)$$

$$i_r = \frac{aF\cos\alpha + b(mE_0 - F\sin\alpha)}{a^2+b^2} \qquad (4)$$

Inspection of equation (1) shows that the minimum value of i, for a given value of F, occurs when $\alpha = \frac{\pi}{2}$; and that the

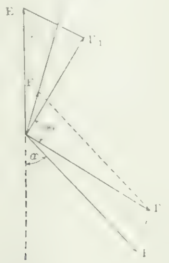


FIG. 1.—VECTOR DIAGRAM OF SYNCHRONOUS MOTOR.

maximum value of i occurs when $\alpha = -\frac{\pi}{2}$. The actual values of i corresponding to these two special cases are,

$$i_{min} = \frac{mE_0 - F}{\sqrt{a^2+b^2}} \qquad (5)$$

$$i_{max} = \frac{mE_0 + F}{\sqrt{a^2+b^2}} \qquad (6)$$

The phase positions of these two currents are determined by obtaining the ratio $\frac{i_r}{i_a}$ from equations (3) and (4), which ratio gives the slopes of the current vectors from the horizontal. In both cases the ratio is $\frac{b}{a} = \cot\Phi$, Φ having been defined by the relation $\tan\Phi = \frac{a}{b}$. That is, both of these special currents lie along a line OC (Fig. 2), which makes an angle Φ with E_0. If in Fig. 2 the following values are chosen,

$$OC = \frac{mE_0}{\sqrt{a^2+b^2}}$$

$$CH = \frac{F}{\sqrt{a^2+b^2}}$$

and a circle is drawn with center C and radius CH, the circle is the locus of the current i, so long as the excitation retains the value which fixes CH. For if the line FCE is drawn perpendicular to OC, and CI is drawn so that angle FCI is equal

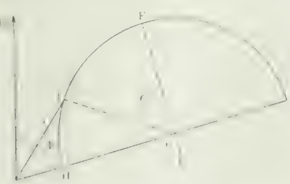


FIG. 2.—[illegible]

to α, the side OI of the triangle OCI is determined by the well known trigonometrical equation

$$OI^2 = OC^2 + CI^2 - 2\,OC \cdot CI \cos(90° - \alpha)$$

$$= \frac{m^2E_0^2}{a^2+b^2} + \frac{F^2}{a^2+b^2} - \frac{2mE_0F\sin\alpha}{a^2+b^2} = i^2$$

which is identical with equation (1).

Comparing Fig. 2 with the corresponding diagram of Dr. McAllister's paper, it will be noted that here the angle E_0OC is $\Phi = \text{arc tan}\,\frac{a}{b} = \text{arc tan}\,\frac{k+mx}{mr}$, while in the latter the same angle is $\Theta_2 = \text{arc tan}\,\frac{x_s}{r}$. That is, $x_s = \frac{k}{m} + x$, or, in other words, the "synchronous reactance" is a constant, under the conditions assumed. Further, in the analysis above,

$$OC = \frac{mE_0}{\sqrt{a^2+b^2}} = \frac{E_0}{\sqrt{\left(\frac{k}{m} + x\right)^2 + r^2}}$$

Which agrees with the value $\frac{E_0}{\sqrt{r^2 + x_s^2}}$ given by Dr. McAllister. Similar remarks apply to the value of CH. It may be stated, therefore, that to the extent that the armature m. m. f. may be combined vectorially with the field circuit m. m. f. and the air-gap reluctance may be considered uniform, "armature reaction" is equivalent in its effect to a virtual increase in the local magnetic reactance of the armature.

The total power developed by the motor, as given by equation (2), includes the losses due to friction and windage, hysteresis and eddy currents. It excludes the armature ohmic loss. Consequently,

$$E_0 i\cos\theta = i^2r + P \qquad (7)$$

where θ is the angular phase difference between E_0 and i, (See Fig. 3) and P is the power developed by the motor, in watts.

Equation (7) may be written

$$i^2 = \frac{E_0}{r} i\cos\theta - \frac{P}{r} \qquad (8)$$

adding $\left(\frac{E_0}{2r}\right)^2$ to both sides of (8), there results

$$\left(\frac{E_0}{2r}\right)^2 + i^2 - 2\left(\frac{E_0}{2r}\right) i\cos\theta = \left(\frac{E_0}{2r}\right)^2 - \frac{P}{r} \qquad (9)$$

Imposing the condition that the power developed by the motor shall be constant, the right-hand side of (9) becomes constant; or if

$$\left(\frac{E_0}{2r}\right)^2 - \frac{P}{r} = \rho^2$$

it follows from (9) that

$$\left(\frac{E_0}{2r}\right)^2 + i^2 - 2\left(\frac{E_0}{2r}\right) i\cos\theta = \rho^2 \qquad (10)$$

The geometrical meaning of equation (10) is seen in Fig. 3. It is that the locus of i, for constant power, is a circle of radius

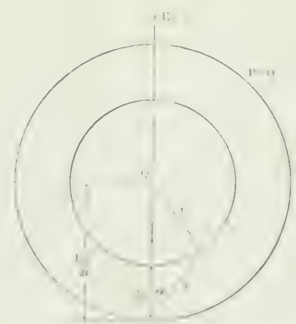


FIG. 3.—[illegible]

ρ, whose center is at a point Q, such that OQ equals $\frac{E_0}{2r}$. Since under the above conditions, the armature current is a minimum when $\theta = 0$,

$$\frac{E_0}{2r} - \rho = i_m$$

i_m being the minimum current consistent with the chosen value

of *P*. Fig. 3 is identical in all respects with the corresponding figure in Dr. McAllister's paper.

By superposing Figs. 2 and 3, the usual "V-curves" may be

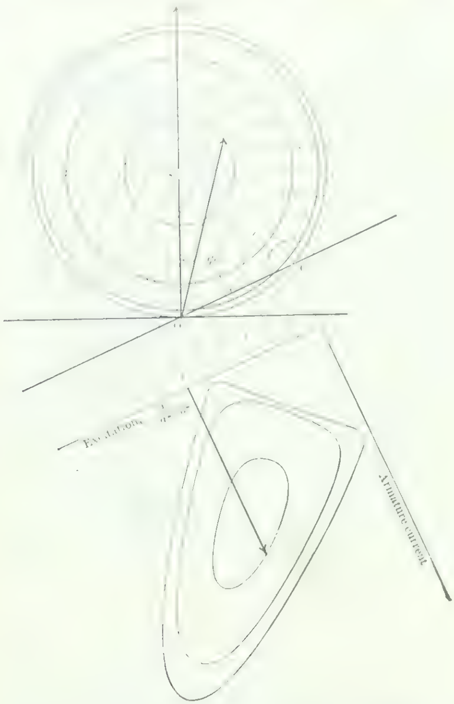


FIG. 4.—COMBINED CIRCLE DIAGRAMS AND V-CURVES.

readily constructed, as indicated in Fig. 4. Inasmuch as this step is clearly explained in Dr. McAllister's article, explanations are here unnecessary.

The Problem of Color Photometry.

By J. S. Dow.

THE letter by Dr. Lummer in the ELECTRICAL WORLD of Sept. 21, and the editorial comments on the subject of color photometry occasioned thereby, are of special interest at the present moment.

Until recently our sources of light resembled each other very closely in color, because our light was invariably derived from incandescent solid particles, which, however, resembled the theoretical "black body" more or less closely. Under these circumstances, the natural period of the atomic systems of which the incandescent body was composed were not given free play; we therefore obtained a confused jumble of vibrations and a continuous spectrum. The radiation so produced, as we now know, is not even confined to the visible spectrum. In most cases the vast majority of the energy is generated in an invisible form and the efficiency of light production is correspondingly low.

But lately, the utilization of "selectively radiating" substances—that is, which exhibit a preference for radiation of a particular wave length not in accordance with the black body law—has entirely altered the aspect of color problems. By the use of this principle we may hope to be able to control ultimately the spectrum of our illuminants much more completely than at present; we may, even, succeed in limiting the output of a source of light to radiation of a single frequency, and, therefore, the value of light to certain colors, for particular purposes, is of greater interest than in the past.

Already the flame arc, and especially the mercury-vapor lamp, yield spectra differing considerably from the older illuminants, and the introduction of the German quartz-tube mercury lamp, which enables us to obtain ultra-violet energy in far greater profusion than hitherto, has already brought to light many unsuspected uses to which energy of this description may be put.

It is evident, therefore, that the problem of comparing the illuminating powers and other qualities of differently colored lights requires early consideration, and the object in writing this article is to point out some of the photometrical difficulties with which illuminating engineers will have to contend.

In the first place, it must certainly be definitely recognized that, quite apart from the technical difficulties of color-photometry, no rigorous photometrical system, not even measurements upon the spot with illuminometers, can yield all the information about a source of light that the illuminating engineer will frequently desire to know.

A source of light may be called upon to achieve many different objects, some of them not really connected with the power of creating brightness, i. e., the "illuminating power" of the source. One extreme instance is the chemical and photographic properties of a source of light, but there are many others less remotely connected with the brightness, and yet depending upon certain frequencies of vibration, which may be of but little use from the point of view of illumination.

It does not follow that a source of light which is intended to illuminate a dwelling room is also a good one to read by, or for the revelation of fine detail. In the first case we chiefly desire to exhibit the æsthetic qualities of the room, and our source of light must therefore be such as to give to delicate shades of color their true values. In the second case we are chiefly anxious that the fine detail we are illuminating shall appear as "sharp" and clear as possible, and this is not a matter of brightness only.

Yet other cases occur in which the *brightness* is the essential quality, quite apart from the true delineation of color. In such cases our object should clearly be to produce the efficient yellow light in the spectrum only, and not to waste energy in producing the deep red and violet components which, for a given expenditure of energy, add but little to the total luminosity of the source. Lastly, reference may be made to the vexed question of the value of light of different colors for the purpose of penetrating mist and fog, which is admittedly not a matter of brightness alone, though the exact influence of the wave length of the light utilized is a matter of some doubt.

These are only a few of the many existing cases, each of which demands special qualities from the light employed, and therefore special methods of measurement. Photometry, as usually understood, concerns itself with the measurement of the power of creating brightness, on the part of the light tested—certainly its most useful but not its only function. In order to measure the value of light for other purposes we can only devise additional tests, not, however, made upon a strictly photometrical basis.

Let us now turn to the consideration of some of the difficulties which beset photometry proper.

In accordance with what has been said already, it will be admitted that a photometrical method of testing any illuminant, ought, strictly speaking, to be carried out in such a manner as to compare the brightness of two illuminated surfaces. This is accomplished in photometers of the ordinary "equality of brightness" pattern, such as the Lummer-Brodhun, the Joly, and the grease-spot protometer.

Unfortunately, in the case of differently colored sources of light, the average observer finds it very difficult to decide when the two photometrical surfaces appear equally bright. The author, however, is inclined to think that there is no insuperable difficulty in making such a judgment, that proficiency is chiefly a matter of practice, and that the personal differences of different observers, who are not actually color-blind, are not so great as is commonly supposed. Probably many supposed "personal" errors may be traced to the fact that the two

observers did not utilize the same portion of the retina during their observations, or otherwise failed to secure exactly the same physiological conditions.

To facilitate such judgments, however, many special systems of photometry have been proposed. With these methods we shall presently briefly deal, and we shall see that they are all open to possible objection from one point of view or another.

For the moment, however, let us admit the possibility of a practiced observer being able to make a fairly accurate judgment of the equality of brightness of two differently colored surfaces, and consider what this judgment really means.

Such a judgment must invariably be affected by the effect mentioned by Lauriol, and by Dr. Lummer in his recent letter (Electrical World, Sept. 21, 1907), namely, the influence of the portion of the retina on which the image of the illuminated surfaces is received.

It has long been known by physiologists that the central portion of the retina, the "macula lutea" or "yellow spot" as it is termed, is less sensitive to the green end of the spectrum than the surrounding portion. Suppose, therefore, that the image of the surfaces in a photometer illuminated by two sources which differ in color, is received upon the retina, and we adjust the position of the photometer until the two surfaces appear equally bright. Now, if we walk away from the photometer so that the image of the illuminated surfaces falls more towards the center of the retina, this equality of brightness is found to exist no longer. The redder of the two lights now appears the brighter. And if we keep the distance of the eye from the photometer the same, but select a photometer in which the photometrical surfaces are different in size from those previously used, we may again come to a different conclusion, for the portion of the retina occupied by the image of the illuminated surfaces is again changed.

When dealing with more or less pure colors the effect may be very marked indeed. In a recent paper before The Physical Society of London, (*Proc.* Phys. Soc., Vol. 20, 1906), the author described some experiments involving the protometric comparison of two glow screened with red and green glass respectively. The Lummer-Brodhun, Jolly and grease-spot photometers, which had previously been found to give concordant results for lights of the same color, gave utterly divergent results in this case, while the results obtained from each of the photometers depended upon the distance away of the eye from the photometrical surfaces.

The "yellow-spot" effect, as for shortness we may term it, is well known to those who have studied color photometry, but its importance from a practical point of view, is certainly not sufficiently realized. In the experiment referred to, in which fairly pure colors were used, differences of the order of over 100 per cent could be easily produced. Even when an Argand gas burner and an incandescent mantle were compared under the same circumstances, differences of more than 5 per cent were readily obtainable, while the writer has encountered differences between 20 and 30 per cent when comparing a mercury-vapor lamp with a carbon-filament lamp.

We must remember, too, that quite apart from the discrepancies in the readings of the various photometers, the sources of light which they compare will certainly be used to illuminate surfaces subtending a much greater angle at the eye than the surfaces in the photometers normally do, and that such protometrical tests may therefore fail to represent the illuminating power of a source in practice.

It may be remarked, however, that these effects are much more noticeable when the illumination of the photometer screen is low. There is, as we shall see later, a reason for this. Meanwhile it may be pointed out that, according to the author's experience, the difficulties of color photometry are reduced to a minimum by using a moderately high illumination of the photometer screen, of not less than about one candle-foot, and only become really urgent when the illumination is reduced below one candle-meter.

This question of the illumination of the photometer screen naturally leads us to the consideration of another allied color effect—the Purkinje phenomenon—which has been aptly termed "the nightmare of color photometry." For some reason the Purkinje effect is much better known than the yellow-spot effect. Yet, although both effects are now believed to have a common physiological basis, the Purkinje effect, in spite of its notoriety, seems to exert but little influence on photometry as ordinarily carried out.

By the Purkinje effect is meant that, with increasing stimulus, the luminous sensation produced by the red end of the spectrum increases more rapidly than in the case of the green end. The effect is now understood to be merely part of a more general physiological change which occurs in the behavior of the eye at low illuminations, and has been often illustrated by the following simple experiment:

Suppose we place two similar pieces of green and red paper and illuminate them with white light. The red will then in general appear the brighter of the two when the illumination is strong. But when the illumination is weakened, the red darkens more rapidly than the green, which soon appears unquestionably the brighter of the two. After this point the colors begin to fade, and eventually the green appears white and the red becomes jet black. If the illumination is weakened still further, the green, too, fades away into darkness. In order to show this experiment well, the colored surfaces must subtend a great angle at the eye; while if the angle is very small indeed, the colors fade away together and the Purkinje effect does not take place.

Modern physiological optics endeavors to explain these phenomena by the consideration of the functions assigned to minute light-perceiving organs scattered over the retina and known, from their appearance, as the "rods" and "cones" respectively. According to the modern theory of the action of these organs, which in its most complete form is attributed to the German physiologist Von Kries, the perception of color is associated with the *cones.* These organs are also believed to be most sensitive to yellow light, and, while inactive at very weak illuminations, continue to respond to increased stimulus, once they have started, long after the rods have ceased to do so.

The rods, on the other hand, are supposed to be unable to perceive color. All light, therefore, seen by means of the rods appears white, but the organs are most powerfully affected by light which is blue-green in character. The rods are also believed to be sensitive to very weak light at which the cones do not act; but with increasing stimulus they soon become, as it were, saturated and fail to respond any further.

At ordinary illuminations our vision is mainly carried on through the cone-organs and we see color. At very weak illuminations, on the other hand, only the rods are in action. We cannot distinguish colors properly and all objects appear a "ghostly" gray. As the illumination is increased, the cones suddenly begin to act. The colors appear and a struggle for predominance between the rods and the cones takes place. It is to this struggle that the Purkinje effect must be mainly attributed, though there are possibly other influences at work.

From a photometrical point of view, therefore, it is of interest to know at what order of illumination the struggle between the rods and cones has been decided in favor of cone vision. This question, however, is complicated by the peculiar distribution of the rods and cones over the retina. The extreme central portion of the retina contains practically only cones, and therefore if the image of the illuminated surfaces falls within this nearly rodless region, the Purkinje effect is absent, or at any rate very weak. If, however, the angle subtended at the eye by the illuminated surfaces is great, many rods are in play and by reason of their numerical superiority, exert an influence comparable with, and even greater than, that of the cones. The Purkinje effect is therefore accentuated.

In ordinary protometry the angle subtended at the eye by the illuminated surfaces is usually small and therefore the Purkinje effect does not become really noticeable until at very low illuminations; indeed, in the case of the author, well below one lux are reached. In practice, however, things are somewhat different. In street lighting, in particular, where the illumina-

tion is frequently very low, and where vast tracts of pavement and roadway have to be illuminated, the Perkinje effect cannot fail to be in evidence. Illuminometer measurements on the spot are therefore preferable to values calculated from the candle-power of sources as determined at ordinary illuminations, with which, indeed, they are frequently in disagreement.

The irregular distribution of the rods and cones over the retina also explains very satisfactorily the "yellow-spot" effect, since the variations in the relative brightness of two heterochromatic surfaces can be ascribed to the variation of the proportions of rods and cones on the portion of the retina on which they fall. Other explanations, however, have been suggested.

The physiological peculiarities of the eye which arise out of the behavior attributed to the rods and cones seems to be the chief difficulty in the way of accurate heterochromatic photometry. There are many points in dispute about these organs which are only imperfectly understood, however, and there are also other little understood minor peculiarities of the eye which affect the photometric comparison of sources of light differing noticeably in color.

We see, however, that there is no escape from these physiological color effects. Even if we could devise some method of photometrical measurement which was not affected by them we should still have to face their existence in practice, and the divergencies between the results of photometric tests and practical results would be greater than ever. The most satisfactory plan would perhaps be to fix, arbitrarily, the angle subtended at the eye by the photometrical surfaces, and the order of illumination at which the tests are to be carried out. Tests made on this system would possibly fail to represent the illuminating value of a source in practice, and would therefore have to be applied with caution, but they would at least be consistent among themselves.

Finally, a word or two may be said with regard to the various methods which have been devised to facilitate color photometry. Evidently no such method can get over the inherent difficulties of the subject, but only postpone them. Many of the methods are open to grave objection on other grounds.

One class of these methods involves the comparison of the integral brightness of the differently colored sources by utilizing certain portions of the spectrum only and ignoring the others. In the methods of Macé de Lépinay and Weber the two illuminated surfaces of the photometer were equalized, first when observed through a red and then through a green medium. The photometrical results of the comparison of the red and green components in the spectrum, so obtained, were then introduced into a formula for the comparison of the integral brightness of the two lights which, be it noted, depended on the observation of color effects by the deviser of the method.

Crova proposed to estimate the relative brightness of two heterochromatic sources by observation of brightness in the yellow region of the spectrum only. Apart from the experimental difficulties in the way of applying this method practically, it has much to recommend it, for unlike the previous one, it certainly utilizes the most valuable portion of the spectrum from the point of view of illumination.

But all such methods as those of Crova and Macé de Lépinay are open to one objection which limits their application very seriously. They are obviously only strictly applicable to the comparison of sources yielding a continuous spectrum. In the case of such sources as the mercury lamp, which yields a spectrum composed of isolated bright groups of lines, they break down entirely.

A method which has often been proposed, and which Dr. Lummer in his recent letter seems to approve, is the comparison, not of the power of creating brightness, but the power of revealing detail of a source of light. It has been urged, with a certain amount of justice, that what we chiefly desire from a source of light is this very power of revealing detail. Yet this is not invariably the case, and as the writer has suggested at the commencement of this article, tests undertaken with the object of determining the capabilities in this particular direction, must be regarded as additional, and not as a substitute for photometry proper.

Moreover, while feeling some trepedition in questioning the dictum of such an authority as Dr. Lummer, the author must confess that his own experience does not lead him to suppose that the "sharpness" of detail illuminated by colored light could ever be made the subject of a reliable method of photometry. For, apart from the seemingly inevitable want of sensitiveness of such a method, this "sharpness" seems to depend very greatly on the accommodation of the eye, which is not acromatic. The writer has already described some instances of the effect of this want of achromatism. We are virtually very short-sighted for the violet end of the spectrum. Therefore, while violet light is usually somewhat better than white light for the illumination of detail which is viewed at very close range, it is extremely bad for the illumination of objects which are to be viewed from a distance. *Red* light, on the other hand, is usually best for the illumination of distant objects.

A recent experiment shown by the author before The Physical Society of London to illustrate this effect, was as follows:

Two patches of pure red and blue light were thrown upon the screen, side by side, and the brightness of the red patch was so reduced that to all the audience the blue patch was clearly the brighter of the two. Nevertheless, when the two patches of light were used to illuminate a black and white chessboard pattern, the squares illuminated by the red light appeared quite sharp, while the squares illuminated by the blue light appeared indistinct and blurred, notwithstanding the fact that the blue light was of the stronger intensity. These effects are naturally affected by the optical peculiarities of the eyes of the observer, and are not equally evident to everyone. Indeed, the author has even met with some cases of observers who declare themselves unable to see any difference between the sharpness of the red and blue, under the conditions described above, and whose eyes were presumably either exceptionally well achromatized or capable of an exceptional degree of accommodation. But this only emphasizes the difficulty of devising any system of photometrical measurement dependent upon acuteness of vision. In any case results obtained with a photometer in which near vision is utilized would certainly be found inapplicable to the appearance of illuminated detail viewed at a distance of a few meters. When we remember, too, that the addition of light of an undesirable frequency may, while increasing the *brightness* of illuminated detail, actually render it more difficult to distinguish, the desirability of keeping any such method distinct from ordinary photometry is obvious.

Finally, mention may be made of a type of instrument which has recently attracted some attention, namely the flicker photometer of Rood. From what has been said it will readily be understood that whether the flicker photometer is affected by the usual color phenomena or not, it cannot be expected to give consistent results with photometers of the equality of brightness pattern, which differ among themselves so greatly when the comparison of sources of light which differ in color is attempted. As a means of avoiding the natural difficulty of forming a judgment of equality of brightness in the case of lights of different colors, this type of instrument has certain advantages. On the other hand, while the claim that this instrument is independent of all color effects, such as the results of color-blindness, for instance, certainly cannot be substantiated, there is good reason to believe that the influence of the peculiar behavior of the rods and cones is less evident in instruments of the flicker class. Yet it is very doubtful whether this is to be regarded as an advantage, and whether the instrument is not open to objection on physiological grounds for this very reason. The author has made some experiments on this point, the results of which he hopes to publish shortly. A complete investigation into the theory of the flicker photometer, especially from the point of view of reconciling its behavior with the theory of the rods and cones, is very much to be desired, and no doubt the research which Dr. Lummer is undertaking on this point will afford very valuable information.

Meanwhile a more general acquaintance with the physiologi-

cal peculiarities of the eye as regards the perception of color is greatly needed. The requisite knowledge, which would enable the illuminating engineer to cope with the difficulties which are inseparable from the use of colored light, is almost entirely confined to physiologists, and is rarely available in a form which is applicable to actual problems of illumination. Many of the chief experimental results of the past, too, are the work of only a few, and how far they are applicable to the normal eye, and how greatly the eyes of different individuals differ amongst themselves, has never been satisfactorily determined. The time is now fast approaching when the illuminating engineer will be driven to consider these color phenomena more thoroughly. We have yet much to learn as to the possible uses of light from different portions of the spectrum, and we have yet to contrive satisfactory and universally recognized methods by which the value of these portions of the spectrum for special purposes, can be measured.

Rubber Insulation for Conductors—II.

By Fred J. Hall.

In the first part of this article, published last week, para rubber and its properties were considered and some tests given for rubber used for the insulation of electric wires and cables. In the present and final part other tests are described.

STRETCH TEST.

There is no test to which rubber insulation is subject about which there are such wide differences of opinion as the stretch test. Elasticity is the most obvious property of crude rubber; its other properties are far less apparent. Elasticity being so obvious it has been assumed that good ruber compounds are elastic, and that poor rubber compounds are not. Any rubber compound, good or bad, is at one stage of manufacture a plastic mass of about the consistency of putty. Strength and elasticity is given this plastic mass by vulcanization. Precisely the same compound can, by changes in the quantity of sulphur and method of vulcanization, be made highly elastic or as brittle as glass. Lack of elasticity in a vulcanized rubber compound is, therefore, no proof of inferiority.

In the first part of this article attention was called to the most esential properties of rubber considered solely from the standpoint of insulation: 1. Non-hydroscopic; 2, dielectric; 3, mechanical strength; 4, elasticity.

As all grades of rubber are non-hydroscopic, this quality need not be considered. It is evident that dielectric property and mechanical strength are the most important factors from an insulating standpoint. A substance lacking these qualities, though possessing great elasticity, would be useless as an insulator. The question then is, by what process of manufacture can these qualities be developed to their highest point. The following illustration will throw light on this point.

Take two copper rods and cover them to the same thickness with the same compound. By the process already outlined, vulcanize one so as to bring out the elastic property of the compound to its highest point, and the other until the compound is brittle or hard rubber. The latter will give a higher insulation resistance, will last indefinitely, possess greater tensile strength, and withstand very much greater electrical stress without rupture. From an electrical standpoint every advantage will lie with the non-stretching compound. Hard rubber, however, is useless as an insulator for electric wires and cables for a purely mechanical reason—it will crack when bent. It is obvious, therefore, that the most efficient rubber insulation is one in which dielectric property and mechanical strength have been developed to the highest point consistent with the retention of sufficient elasticity to enable the insulation to stand, without injury, the bending necessary for manufacture and installation.

The following questions are sometimes asked, and it is wise to anticipate them.

Can a very low-grade rubber compound be so vulcanized as to meet the ordinary stretch tests? No.

Does not the stretch test, therefore, prevent the use of a very low-grade rubber compound? It does.

It should be added that such a compound would not meet the maximum acetone test already mentioned, nor would it be likely to meet the electrical tests. In other words, there are tests besides that for elasticity which adequately ensure the purchaser against the excessive use of low-grade rubbers. This being a fact, it is certainly unwise to insist on a test that forces the manufacturer to sacrifice qualities in his compound essential to a high factor of safety, and it is certainly unjust to exact a guarantee from him under such conditions.

It is sometimes stated in justification of the stretch test that it is simple and easily made, requiring only a sharp knife and a rule, whereas the ash and acetone tests must be made in a laboratory with apparatus more or less complicated and by one possessing some technical ability and knowledge of chemistry.

It is a mistake to consider the stretch test so simple that any one can make it. There are several important factors affecting this test which do not receive proper consideration.

Temperature.—Cold hardens rubber, lessening its elasticity. The test should be made at a normal temperature—say, between 50 deg. F. and 70 deg. F.

Cutting.—Rubber is one of the most difficult substances to cut evenly. The sample must be the same width and thickness between the points to be stretched, to properly test its elasticity and return. Minute incisions on the edge of the sample are difficult to avoid, and will materially affect this test

Stretch and Release.—All rubber compounds have a certain set which if violently overcome by a sudden, jerky movement, causes minute ruptures, seriously affecting both stretch and return. The stretching should be done steadily and not too fast, and the release instantaneous from both ends. Holding the sample at a tension even for a short time will affect the period of its return.

One minute should be allowed for the sample to return. If absolutely perfect conditions were always obtainable, a much shorter period would answer, but one minute is only a fair allowance to cover variations in the conditions under which the test is made.

As the sacrifice of the most important qualities of rubber insulation to the least important—elasticity—can sometimes be made without danger, few manufacturers object to meeting the stretch test when aplied to thin insulation on small sizes for low pressure. There are sound reasons, however, why the stretch test should never be applied to the insulation on large conductors or to thick insulation for high pressure, irrespective of the size of the conductor.

The factors of time and heat in vulcanizing should be regulated by the mass to be vulcanized. This mass on large conductors, or when thick walls are used, is so great that it cannot be properly vulcanized without a sacrifice of elasticity sufficient to make the ordinary stretch test impossible. When the outer surface of the outer layer of a thickly insulated conductor has been vulcanized to a point where the elastic property is greatest, the inner layers, particularly the portion lying next to the conductor, is undervulcanized. It is undisputed that a rubber compound undervulcanized is highly perishable. *Another important point is that the principal contributors to the factor of safety in rubber insulation for high tension are firmness and density, both of which are antagonistic to stretch. Specifying a stretch test for high pressure rubber insulation invariably means reducing the factor of safety.*

On the smaller sizes, say, up to No. 4 B. & S., and for walls not over 4/32 in. thick, for low pressure, there is no danger in the enforcement of a reasonable stretch test. Nearly all manufacturers will agree to meet it, not always because they consider it desirable, but because their customers wish it. In determining just what stretch test shall be required, the writer feels justified in again calling attention to the fact that most specifications are based upon unreasonable premises. The purchaser takes the maximum result to be obtained under perfect conditions, and expects the manufacturer always to duplicate these conditions and results in his factory. Specifications

should be drawn and interpreted as broadly as is consistent with the retention of the essential features of the various tests.

For small sizes and thin walls, as indicated above, the following stretch test would give all the assurance of a good compound that such a test could possibly give. A 4-in. sample cut from the conductor to have marks 2 ins. apart placed on it. The sample to be stretched until the marks are 6 ins. apart. The return to be to 2½ ins. For larger sizes and heavy walls, a sample cut from the conductor, containing the full thickness of the insulation, to be bent double and the process repeated in reverse, without any signs of cracking.

TENSILE STRENGTH TEST.

Any good ruber compound properly vulcanized will have a tensile strength of 800 lbs. to the square inch—the usual requirement. Objections to this test cannot, therefore, be based on its being excessive. In making this test the same difficulty exists as in the cutting of the sample as in the stretch. The strain being greater, any fault in cutting the sample will affect the final result much more seriously. The only result obtained by this test is the approximate tensile strength of the sample tested; it is mere assumption that the same strength exists along the entire line of insulation. If there is any reason for this test, it must be to ascertain the mechanical strength of the insulating compound, and this can certainly be much better accomplished by the application of a disruptive force along the entire line of insulation. This is done by voltage, and when an adequate pressure test is applied the retention of a tensile strength test seems unnecessary. Its abandonment would work no injury to the purchaser, and save the manufacturer the injustice and loss which he is likely to suffer in submitting to a test, the results of which may or may not show the real strength of the compound.

Both this test and the stretch test should be made at the factory and in the presence of the manufacturer or his representative, and the goods accepted or rejected on the test there made. Few manufacturers have escaped the unpleasant experience of having their insulation pass these tests at the factory and later received notice of rejection because samples of insulation taken from the factory have failed to pass. The manufacturer is certainly entitled to see that the tests are accurately made and under proper conditions, otherwise he may be subjected to loss and trouble arising from the carelessness and incompetency of the inspectors. In fairness to the latter it should be said that a majority of the inspectors understand their duties quite as well as the manufacturer, but the trouble is that a single careless or incompetent inspector, visiting the different factories, can stir up considerable of an insurrection and in a short time have the purchaser and the manufacturer at loggerheads.

INSULATION RESISTANCE.

Judged by their specifications, many purchasers of insulated wires and cables firmly believe that high insulation resistance means high-grade compound; also ability to withstand electrical stress. Both assumptions are erroneous. There is no direct relation between insulation resistance and pressure. If a number of lengths of the same cable are being tested, and one length has an insulation resistance considerably below the average of the others it will probably break down at a lower voltage than the others, this, however, is due solely to some structural fault or mechanical injury. It is well known that a cheap compound can be made to give high insulation resistance; also that a compound giving a comparatively low insulation resistance will often stand a greater voltage without rupture than one with a much higher insulation resistance. The qualities in a rubber compound that affect these tests are not identical.

No one will deny that only a small fraction of the insulation resistance required in a test is necessary for practical purposes; the excessive requirement is simply to provide a factor of safety in case of deterioration in the dielectric property of the insulation. Under certain conditions the insulation resistance increases with age, owing to the drying out of the insulation, as there is always more or less moisture in all newly made rubber compounds.

Many purchasers take the maximum insulation resistance obtainable for a certain size conductor and wall of rubber, and make that the minimum requirement. They ignore the obvious fact that *absolute uniformity* in mixing and applying the compound and in handling it during the various processes of manufacture is impossible. It has never been attained in any manufactured article, except the wonderful one-horse shay. No two links in a chain are *exactly* alike in texture and strength. The important point is that there should be an ample factor of safety for the service required in the weakest link. It should also be borne in mind that rubber compounds, even when containing the same percentage of para, vary in their specific insulation resistance. This is due to variations in the ingredients other than para and to the method of treatment. In other words, insulation resistance is variable, and in specifying it the object should be to establish a minimum test that would ensure reasonable uniformity in manufacture, while giving an ample factor of safety. This test should be the same before and after the application of pressure, as there may be structural faults that can only be developed by the application of voltage.

The question naturally arises, how can such a minimum insulation resistance test as has been suggested be established? The National Board of Fire Underwriters require for a No. 14 B. & S. with 3/64-in. wall of rubber insulation, 200 megs. after 10 hours' immersion at 60 deg. F. Telephone companies for the same size and wall of insulation require 500 megs., 24 hours immersion at 60 deg. F. For this size conductor and wall of rubber, 200 megs. is ample for all practical purposes, but recognizing the prejudice that exists in some quarters in favor of high insulation resistance tests, suppose we multiply the telephone requirements by three (3) and establish 1500 megs as a basis. This should satisfy the most ardent advocate of high insulation resistance. With this as a starting point the insulation resistance of for any size conductor and wall of rubber can be ascertained by the use of the well-known formula:

$$Constant = \frac{Resistance}{\log \frac{D}{d}}$$

$$Resistance = Log \frac{D}{d} \text{ multiplied by constant.}$$

TEMPERATURE COEFFICIENT.

The variation in insulation resistance due to temperature changes is 2.6 per cent for each degree Fahrenheit. Thus, a difference of 27 deg. F. above the temperature at which the test is made will reduce the insulation resistance by one-half, and the same change below the testing temperature will double the insulation resistance. For high temperatures the percentage of change for each degree Fahrenheit is slightly greater than 2.6, but this figure can safely be used between 40 deg. F. and 70 deg. F. As this allows for a variation of 30 deg. it is ample for all practical purposes.

VOLTAGE TEST.

There is no test so important in determining the practical efficiency of insulation as the voltage test. It has already been stated that there is no direct relation between insulation resistance and ability to withstand electrical stress; it follows that an insulated conductor may have low insulation resistance, but work satisfactorily if there is sufficient strength in the compound to withstand the maximum working e. m. f. Reverse these condtions and the cable is useless. Excessive test voltages should be avoided as they strain the insulation, thereby weakening and shortening its life.

A test of two and a half times the maximum working e. m. f. for five minutes after 24 hours immersion, or for twice the maximum working e. m. f. for 30 minutes, will not strain the insulation, but will develop any structural faults and establish the existence of an ample factor of safety.

When the voltage is nominal and the walls of insulation comparatively thick, as in the case of signal wires and cables, a voltage test based on two and a half times the working e. m. f.

would evidently be inadequate. When these conditions exist the engineer drawing the specifications should determine the maximum working e. m. f. which he would be willing to use on the conductor and wall of insulation in question, and base the voltage test on this. As an example: A No. 14 wire with 5/64-in. wall of rubber could safely be used for 2000 volts alternating e. m. f. The test, with two and a half as the factor, would be 5000 volts for five minutes, or 4000 volts with two as a factor, for 30 minutes, although the actual working voltage might be merely nominal.

This rule may lack scientific exactness, but it is simple and adequate. No insulation successfully tested under this rule could have either structural faults or inherent weakness sufficient to endanger its successful operation. The object of a voltage test should be not to determine the greatest stress to which the insulation can be put, but to establish the existence of a safety factor. Break-down tests, except on a sample, are dangerous. There is always a point, other than where the puncture takes place, where the excessive strain has caused a weakening of the insulation; there may be several such points. These weak places will in the course of time give trouble, whereas the same cable, if tested merely for the purpose of establishing an ample factor of safety in the insulation under maximum working conditions, would have continued in successful operation indefinitely.

BRAID AND TAPE.

There is an erroneous impression that a rubber-filled tape or a weatherproof braid increases the insulation resistance. Numerous experiments have shown that these have no effect whatever on the insulation resistance after a short immersion. A tape or a braid is an important protection to the insulation, particularly while it is in the plastic state preceding vulcanization. With large conductors and whenever thick walls of insulation are employed, irrespective of the size of conductors, the application of a tape before vulcanizing is particularly desirable—almost necessary—to good work. The process of manufacture in some factories is such that it is convenient to have the test made, particularly on the small sizes—before tape or braid is applied. This is never, however, a desirable method of testing, and to require it under all circumstances imposes a dangerous and troublesome condition on the manufacturer, from which the purchaser derives no benefit whatever. Moreover, the purchaser is not interested in the condition of the goods when partially manufactured, but in the condition in which they will be used. If tested plain, *i. e.*, without tape or braid, what assurance has the purchaser that the insulation has escaped injury when being taped, or braided and waxed? None whatever, unless the tests are repeated, which means doubling the cost of inspection and delaying shipment. With leaded or armored cables and with multiple conductors double testing is necessary, but single conductors, when neither leaded nor armored, should be tested only in the completed state.

CHOICE OF A COMPOUND.

In considering the foregoing tests the writer has already called attention to the fact that he had in mind a 30 per cent para compound. Enough has been said to show that rubber compounds of high practical efficiency can be made in which lower priced rubbers enter either in part or in whole, and that difference in price is not a fair indication of difference in quality.

The principal arguments in favor of using a 30-per cent para mixture probably are, first, that being a standard it is likely to run more uniform in quality; second, that having been long in use it has had more opportunities to prove its virtue under trying conditions than most rubber compounds; third, that in case of trouble, the party responsible for the installation would be subjected to less severe criticism if a standard insulation is used.

Without stopping to take up the real value of these considerations, it is sufficient sometimes to justify the additional expenditure necessary to secure a 30 per cent para mixture. The following indicates the conditions under which 30 per cent para might be specified: For high pressure, 10,000 volts alternating and over; all submarine work; when conditions of service are exceptionally severe.

When the nature of the compound is not specifically stated, the tests for 30 per cent para outlined in this article must be modified. Such modification does not necessarily imply a lower practical efficiency for the conditions of service, it simply means that not being the same compound as 30 per cent para, it is impossible to get the same result from all tests. Probably no two manufacturers make their high grades, other than para, exactly alike. There are differences in the quantity and quality of the ingredients, both organic and inorganic. The methods of treatment during the processes of manufacture are not the same. The specific insulation resistances of the compounds may vary as much as 50 per cent. This does not mean that there are the same variations in practical efficiency, but merely that the manufacturers travel somewhat different roads to reach the same destination.

The difficulty of fixing definite tests to meet these variations in the compound is evident. The purchaser's main reliance should be on the reputation of the manufacturer, his guarantee, and on the electrical tests; the insulation resistance to be at least 50 per cent of that required for a 30 per cent para compound and the pressure test the same. If the purchaser does not feel sufficiently safeguarded he could add the following:

Acetone test.—Not over 8 per cent extractive matter.

Ash test.—Same as for 30 per cent, viz., not over 68 per cent nor less than 56 per cent.

Elasticity test.—The same as required for large sizes and heavy walls of 30 per cent, viz., sample to be bent double, and the process is to be repeated in reverse, without cracking.

Such tests would afford ample evidence of the efficiency of the compound.

RECLAIMED RUBBER.

A manufacturer of insulated wires and cables writes these words with a shudder and speaks them in a whisper, because to the purchaser's mind they stand for all that is dangerous in the insulation. Long ago the manufacturer learned that the judicious use of reclaimed rubber in conjunction with raw rubber of all kinds, distinctly improved his compounds. He has not dared to breathe this secret, however, for fear of being blacklisted.

Mineral matters used in rubber compounds have little dielectric property. They are inert, and their mixture with the rubber is almost entirely mechanical, little real assimilation takes place. They give body to the rubber, but otherwise may be considered cheap adulterants. Whereas good reclaimed rubber when properly treated has considerable mechanical strength, high dielectric property and long life. It is thoroughly assimilated by the raw rubber and can be purchased at a price which enables the manufacturer to substitute it for a portion of the cheaper and comparatively useless mineral matter without placing an exorbitant price upon his goods. Like many excellent things, it is the abuse, not the use of reclaimed rubber that is bad. The important point is that the percentage and quality of raw rubber called for is used. The writer has no hesitation in asserting that even if a manufacturer were willing to risk his reputation, and loss under his guarantee, by the excessive use of reclaimed rubber, he could not do so and meet the specifications outlined in this article. It is time that the value of reclaimed rubber became as generally understood as is the danger arising from its excessive use. It has too long been held up as an object of scorn and derision. It might be mentioned incidently that if reclaimed rubber had not come into existence, the cost of all articles into which rubber enters would be so high that serious consequences would result.

FREE SULPHUR.

Reference has been made under the acetone test to free sulphur. The writer realizes that considerable difference of opinion exists as to the effect of free sulphur on a vulcanized rubber compound. For this reason the following points may be of interest:

Weber in his "Chemistry of Rubber" says: *"Free sulphur only becomes objectionable if its amount exceeds certain limits. Excess of sulphur may cause an efflorescence, technically termed 'sulphuring up,' on the vulcanized surfaces which, although objectionable from the point of view of appearance, does not affect the soundness of the vulcanization."*

Weber does not define what he means by "certain limits," but the fact that when there is enough free sulphur to "bloom" on the surface does not injure the compound, it would seem that a much higher percentage than is present in most insulating compounds may exist before the "objectionable" point is reached.

The writer has seen an analysis of rubber insulation stripped from a cable that had been in successful operation for about nine (9) years and is still working, that showed about 2 per cent of free sulphur. The compound was a high grade para mixture and it had retained its strength and resiliency without any apparent deterioration.

A chemist who has devoted a great deal of time and study to rubber and its compounds, stated in conversation that he regarded free sulphur in much the same light as the ordinary mineral adultrants. That a slight increase was no more and no less harmful than a similar increase in talc or the well-known oxides used in dry mixtures. This may be a somewhat radical opinion, but coming from one who has studied the matter, it is worthy of consideration.

Attention should be called to one of the many eccentricities found in the vulcanization of rubber. Assume that a certain compound properly vulcanized has originally contained 3 per cent of sulphur, and that 1 per cent remains free. A natural assumption would be that only 2 per cent of sulphur was necessary, and if this amount was used, the same vulcanizing result could be obtained and the presence of free sulphur avoided. This is far from true. Free sulphur would still be found. This would show that a smaller quantity of sulphur had combined with the rubber, indicating improper vulanization and a perishable compound. In other words the right chemical combination between sulphur and rubber, does not take place except in the presence of an excess of sulphur, and that a certain amount will always remain free. It is a mistake for specifications to limit this amount. A manufacturer can have no reason for using more sulphur than his experience has shown him is best adapted to his compounds and method of treatment.

Perhaps one of the greatest dangers from an excess of sulphur is overvulcanization, unless the factors of time and heat are carefully watched. Weber's comments on this subject are interesting (Page 285)—*"Undervulcanized articles are much more prone to decomposition than overvulcanized ones. Indeed, I have never yet seen a case of decomposition due with certainty to overvulcanization."* It might be remarked incidentally, that there is infinitely greater danger of undervulcanization, in a highly elastic rubber compound, than in one where the process has been allowed to proceed until the compound has assumed a firmness that will not permit of the ordinary elasticity tests. Indeed, in this latter case the danger of undervulcanization is entirely eliminated.

SPECIFICATIONS.

Specifications for rubber-insulated conductors considered in their general form rather than in relation to the details of their requirements, exhibit two striking characteristics.

1. These are one-sided. The manufacturer agrees to everything, the purchaser to nothing except to take and pay for the goods provided they meet the specifications, *as he chooses to interpret them.* There are so many conditions which may affect the results obtained from the various tests, that the writer will agree to turn down any rubber-insulated conductor submitted to him, made under the average specification, and do so with every appearance of honesty. No specifications can be interpreted with hair-splitting exactness, some breadth of intelligence is necessary. The main object of specification should never be lost sight of, namely to assure the purchaser that he is getting goods that will in every respect meet the service requirements satisfactorily. If he is assured of this, it is the essence of folly and injustice to reject goods because they fail in some slight degree to meet every test to which they are subjected.

2. The purchaser displays in his specifications painful evidence of a lack of confidence in the manufacturer. It must be admitted that the manufacturer himself is largely to blame for this. Lack of knowledge begets suspicion. The purchaser seldom has more than a very superficial knowledge of practical cable making, nor can he acquire it except through a manufacturer. When he has sought for it in this way, he has sometimes been given only such information as tended to magnify the virtues of the compound favored by the manufacturer whose advice was requested. Now the average purchaser is just as honest and just as intelligent as the average manufacturer, he will soon discover that the latter always has an "ax to grind" and will therefore accept his advice "cum grano salis." The purchaser's faith in the manufacturer is lessened instead of increased, and this is reflected in the production of specifications more unreasonable and impractical than ever, and in a more rigid enforcement of them. Fortunately few manufacturers now follow this course, so few indeed that it would not be wise to mention the number. The trouble they have had, and are likely to have in the future, would be pleasant to contemplate were it not that they involve others as well as themselves.

In conclusion the writer wishes to emphasize the fact that in the exact proportion that the manufacturer can gain the confidence of the purchaser by offering honest and disinterested advice, and prove its worth by giving insulation of high practical efficiency, will the latter be guided by this advice, and unreasonable and vexatious specifications disappear.

New Telephone Patents.

[illegible]

A patent granted to F. A. Lundquist, of Chicago, refers to a sender dial for automatic exchanges. This is one adapted to a special numbering system. With this system all numbers begin with 100, which digit is set up by giving the pointer any indeterminate movement and allowing it to return to neutral. The tens digit is set up definitely and the pointer released and then the units. Then a group number is set up by means of an auxiliary push-button. This last corresponds to the hundreds. Thus a telephone known in the normal numbering system as 247, by this system would be 147—2; 521 would 121—5.

Another patent concerning automatic exchanges is one issued to S. A. Norstrom, of Chicago. This relates to means for preventing the sticking of the operating magnets between impulses. These magnets are polarized and will be de-energized by a momentary reversed current which will neutralize any residual magnetism. The present patent describes an arrangement of a condenser and relay bridged across the mains. When a normal current impulse ceases, the condenser discharge momentarily operates the auxiliary relay, the contacts of this latter connecting a reversed battery momentarily to the mains.

COMMON-BATTERY CIRCUIT SYSTEM.

Mr. F. W. Dunbar, of Chicago, has patented a common-battery switchboard circuit system wherein the supervisory signals are controlled by a differential relay. At the subscriber's stations with the hook-switch down, the bell is legged off one side of the line to ground. As the two windings of the supervisory relays are connected in parallel with their respective corresponding repeating coil windings, they will receive neutralizing current with the hook-switch up. When the hook is down, but one winding receives current and there is, therefore, no neutralization. With this type of relay it is necessary to place the two windings upon opposite ends of the core so that their impedance to telephone currents will be retained notwithstanding the differential connection.

SWITCHBOARD [illegible]

Switchboard lamps of recent manufacture have practically all been of cylindrical shape with terminal strips secured to

them as a sort of holder. These lamps fit into lamp sockets to a depth such that their ends are within the socket. A lamp cap of approximately hemispherical shape closes the socket and serves as a bull's-eye.

A new design of lamp has been patented by Herman Boehm, of Youngstown, Ohio. This has the usual cylindrical body and terminals, but the lamp is elongated and its front portion is expanded into a button the shape of a lamp cap. This serves at once in this capacity and at the same time forms a limit stop for the lamp.

PROTECTORS.

Some time ago we noted a cable terminal, the invention of Frank B. Cook, of Chicago, which was arranged with removable protector units. By this arrangement, with multiple distribution systems, a line is not hampered by extra arrester

TELEPHONE PROTECTOR.

springs at each multiple point, one set being shifted from point to point as occasion demands. Mr. Cook has now obtained a patent for the protector unit for such a cable head. This unit comprises a sheet metal base carrying an insulating block at each end and spring clips to hold carbons and fuses and to afford terminal joints. A side view of the unit is shown in the figure.

Another patent to Cook covers a test and restoring plug for a special use of his heat-coil protectors. Like the earlier ones, this affords a means of restoring the disrupted parts after operation, the application of an abnormal current to heat the coil, and means for cutting off automatically the heating current as the parts come home into set position.

INTERCOMMUNICATING SYSTEM.

Mr. W. W. Henry, of Wollaston, Mass., has patented a special set for an intercommunicating system. A series of switch buttons are mounted in the box, each bearing a legend showing its station. To make a call, one is selected and depressed and then the ringing key is depressed, and the desired station rung. After conversation, the restoration of the receiver hook resets everything to normal.

Letters to the Editors.

Long Distance Wireless Telegraphy.

[illegible]

SIRS:—The remarks of Dr. Lee de Forest in your issue of Nov. 16, concerning the recent observations of the writer with reference to antipodal wireless telegraphy, have been noted with interest. As it appears that Dr. de Forest failed to grasp the substance and spirit of the letter of the writer published in your issue of the 9th inst., it is presumed that he did not carefully read it or that its contents escaped his memory before he wrote his comments.

The unconfirmed report that a wireless message had been received from Manila at the Marconi station at Glace Bay was recorded as a mere incident, with no significance other than that of having suggested the thought concerning the probable existence of maximum electromagnetic effort at a point antipodal to the source of the waves, assuming that their initial intensity was sufficient for transmission to the terrestrial equator with respect to the sending station.

It would indeed be a powerful station and a remarkable system which could effect such a long transmission, but a contemplation of the successful trans-Atlantic transmission on a commercial basis, now being accomplished by Marconi, lends an optimistic prospect for substantial progress in long-distance wireless transmission of intelligence.

The writer did not fail to take into consideration the "losses" in transmission as stated by Dr. de Forest, as it will be observed that he remarked that "the actual intensity would, of course, be much less than that at the sending station, owing to the dissipation of energy in transmission."

In conclusion, I would suggest that Dr. de Forest's reference to the psychological moment may be properly applicable to the source of the report concerning the Manila-Glace Bay transmission.

CHICAGO, ILL. ERNEST F. SMITH

Standard Wiring Symbols.

To the Editors of Electrical World:

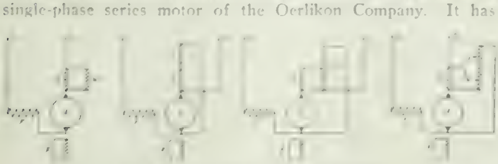
SIRS:—The attention of those who draw up lighting and wiring specifications cannot be too strongly directed to the set of standard symbols issued by the National Electrical Contractors Association, and recently printed in your columns. These symbols were prepared after a careful canvass of the ideas of the various people having a practical interest in the subject, and have been officially adopted by the American Institute of Architects and the above-mentioned association—the two bodies most directly interested in the matter of such symbols. There is certainly no good reason for clinging to the miscellaneous methods of notation that have heretofore been in vogue, when standard symbols answering all common requirements have been sanctioned by such authority. Charts of the symbols, and sheets for inclusion in specifications as explanatory of the standard symbols used in with drawings, may be obtained at a nominal cost by addressing the secretary of the National Electrical Contractors' Association, Utica, N. Y.

[illegible]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

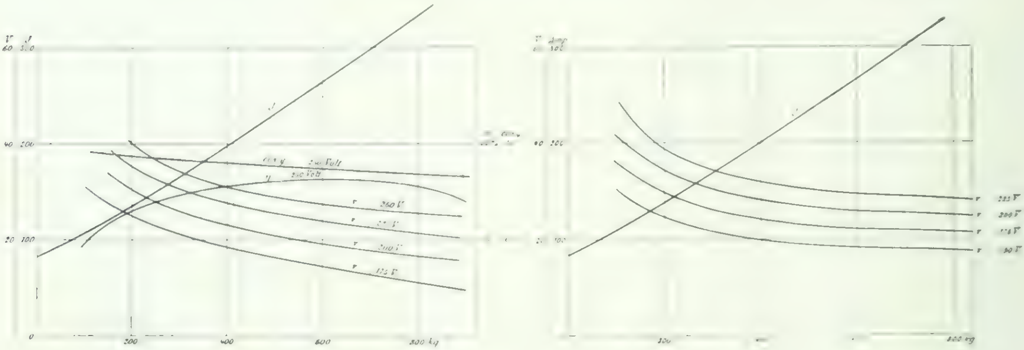
[illegible] single-phase series motor of the Oerlikon Company. It has



[illegible]

been developed in four different types, which are illustrated in [illegible] is the stator winding, which produces the magnetic field and is connected in series with the armature. *K* is the stator winding which compensates the armature m. m. f. This so-called compensation winding is shown in the diagrams as short-circuited, but it could be connected in series with *A* and *F*. *H* is the stator winding for improving the commutation, or the so-called commutation pole winding. In the first diagram *H* is in parallel with the resistor, *W*, and this combination is in series with the armature. In the second diagram, *H* is in series with an inductance coil, *S*, and the two are in parallel with the armature. In the third diagram an autotransformer, *AT*, is made use of, while the fourth diagram shows a combination of the first and third. Drawings are given of a motor built on this principle and used for electric traction. On account of the [illegible]

the available space. The motor normally consumes about 250 amperes at from 225 to 250 volts and 20 periods; the ratio of gearing is 1 to 5.15. The motor runs absolutely sparkless up to 300 amperes during starting, as well as at any speed. A continuous load of 60 horse-power at 250 volts for one hour gave temperatures which are below the limits required by the regulations of the German Association of Electrical Engineers. When the compensated winding is in series with the armature and field circuits the motor may be used as well with direct current as with alternating current. Fig. 2 gives the results of tests of the motor with alternating current; Fig. 3 gives the results of tests of the motor with direct-current. The curve *J* is the current for all voltages, while the curves *v* give the speed in kilometers per hour. The ordinates are the tractive force at the periphery of the wheel in kilograms. Fig. 4 shows the behavior of the motor at starting, both for direct current and alternating current. The alternating-current curves are given in drawn-out lines, while the direct-current curves are given in dotted lines. The motor is used on the Locarno-Pontebrolla-Bignasco Road, which has at present three passenger cars, each being equipped with four motors of this type. The operating e. m. f. is 5000 volts.—*Elek. Zeit.*, Nov. 7.



FIGS. 2 AND 3.—RESULTS OF TESTS OF SINGLE-PHASE SERIES MOTOR.

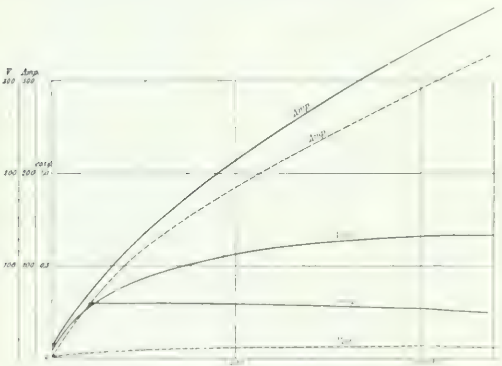


FIG. 4.—BEHAVIOR OF MOTOR AT STARTING.

Commutation.—C. L. R. E. Menges.—A theoretical article on the phenomena of commutation. The author strongly objects to the generally accepted view that in order to get sparkless commutation the short-circuited coil should not be in the neutral zone, but that the brushes should be displaced until the coil comes into a magnetic field of proper intensity. The author considers this view to be wrong, and claims that perfect commutation takes place in the neutral zone. The fundamental principles of his view are explained at length. The same number contains two letters by E. Arnold and A. Ruedenberg on the same subject. They take the opposite view.—*Elek. Zeit.*, Oct. 31.

Power.

Gas Engine Efficiency.—B. Hopkinson.—A note on a paper read before the Institute of Mechanical Engineers in London. The author deals with the report of the committee of the Institution of Civil Engineers on the efficiency of internal combustion engines. This report stated that, in the case of gas engines, indicator diagrams did not give as accurate results as was generally supposed. Tests described by this committee supported this view, and the mechanical losses were, therefore, obtained by running the engine light and estimating the indicated horse-power under these conditions. This value was added to the brake horse-power at full-load, and the sum was taken as being the true indicated horse-power. Having regard to the widespread effect that this view would have on already published efficiency tests, the author undertook some investigations to determine whether the indicated horse-power of a gas engine is so variable a quantity and so difficult to determine as the committee suggested. The paper contains the results of some tests made, with this object, on a 40-hp Crossley engine and on an engine belonging to the Daimler Company. From the results obtained, the author draws the following conclusions: (1) That if precautions are taken to keep the gas supply constant the diagrams given by the engine are very regular, whether the engine be missing ignitions or not, and they afford a measure of the indicated power correctly to within 2 per cent. (2) That the difference between indicated horsepower and brake horse-power is rather less than the horsepower at no-load under the same conditions of lubrication, owing to the difference in power absorbed by pumping. The friction is constant if the temperature of the cylinder walls is kept the same, but is very dependent on this temperature.—Lond. *Electrician*, Nov. 8; the full paper is published in Lond. *Elec. Review*, Nov. 7.

Large Gas Engines.—An account of tests of two 1400-hp gas engines operated with brown-coal producer gas in a German metallurgical works. The tests gave a consumption of 3385 "heat units" per kw-hour. With an efficiency of the electric generators of 75 per cent and with a mean calorific value of 5000 heat units of the brown-coal briquets per kg, one kw-hour requires 0.9 kilograms of brown-coal briquets. At a price of $2.38 per ton at the works, the cost of fuel per kw-hour is only 0.214 cent.—*Elek. Zeit.*, Nov. 7.

Electric Cranes.—H. H. Broughton.—A continuation of his long serial. In the present installment the author deals with the important question of the rating of motors for crane work. The ratio between the working at full-load in the time occupied for a complete cycle of operations and the time of the cycle itself is termed the "load factor," and this method of rating is explained. A comparison is also given showing the misleading results obtained by the usual method of specifying a full-load test for a certain period. Tables referring to motors of English make are given in explanation of these points.—Lond. *Electrician*, Nov. 8.

Motors.—J. T. Mould.—A paper read before the Association of Egineers-in-Charge on the starting, regulating and stopping of continuous-current motors. The construction of starting switches and the proper dimensioning of the steps is discussed and rules are given on the best type of motor and the best method of control for driving different kinds of machines.—Lond. *Electrician,* Nov. 8.

Traction.

Tube Railways in London.—A table giving details of the financial results of the various tube railways in London. From a comparison with tramway returns, it would appear at first sight that very satisfactory results should be obtained, since the cost of working in no case exceeds 14 cents per car-mile, and in one case falls as low as 6.784 cents. However, the revenue is in several cases correspondingly low, and there is a need for a general increase in the receipts. Although in the case of two tubes the ratio of working expenses to receipts is only 47.9 and 49.6 per cent, respectively, on another tube it is actually 71 per cent. On the London County Council tramways the corresponding ratio is 65 per cent, which is not by any means perfectly satisfactory. When the very much greater capital expenditure per mile of route of the tube railways is considered, it is evident that as the working expenses are not likely to decrease, there must be a considerably increased good return on the capital invested. The extent to which the majority of the lines are handicapped by their excessive capital expenditure may be gathered from the fact that this expenditure is in round figures $3,000,000 per mile of route, and the number of car-miles run per year per mile of route is about 6000. Consequently, a sum of about 5 cents per car-mile must be earned to pay 1 per cent on the capital, apart from working expenses. Two of the tubes are in a somewhat better condition, since the corresponding costs are 2.34 and 2.68 cents, respectively. As to the cost of maintenance, the newest tube has a value per car-mile for maintenance of track of nearly two and one-half times as great as in the case of the oldest tube. The larger cars in use may have somewhat to do with it.—Lond. *Electrician,* Nov. 8.

Traffic Estimates.—W. Mattersdorff.—A statistical investigation of the different factors on which traffic on electric street railways depends, so as to permit an estimate of the traffic to be expected on a new street railway. The number of passengers carried per year increases with the square of the number of inhabitants of a city up to 500,000 inhabitants; after that it increases directly with the number of inhabitants. The number averages 67,000,000 trips per year for 500,000 inhabitants. A similar relation exists between car-miles and the number of inhabitants. The author introduces the term "passenger traffic density," which is defined as the total number of passengers per year multiplied by the length of the road and divided by the number of car-miles per year.—*Elek. Zeit.,* Oct. 24.

Electric Gasoline Automobiles.—J. Bethenod.—Gasoline automobiles may be equipped with a dynamo and a storage battery so that the dynamo may act either as generator or to store up the excess energy of the gasoline engine in the battery or as motor, being driven by the battery to aid the gasoline engine when more power is required. The author gives a graphical representation of the properties of such a system.—*L'Eclairage Electrique,* Oct. 5.

Fog Signalling Apparatus.—A description of a new form of auxiliary signalling apparatus in which the signals are repeated in the cab of the locomotive, both at the home and distant signals, which is in experimental use on the Southeastern & Chatham Railway. Telephonic communication between the signal-box and the driver's cab is also provided for.—Lond. *Elec. Eng'ing,* Nov. 7.

Electrophysics and Magnetism.

Ratio of the Electromagnetic to the Electrostatic Unit of Electricity.—E. B. Ros[illegible] of their long account of an experimental redetermination of the ratio of the electromagnetic to the electrostatic unit of electricity. In the present instalment the determination of capacities in electromagnetic measure is described and the ratio of the two units is determined from the electromagnetic and the electrostatic measurements. Their final result is 2.9963×10^{10} $\left[\frac{\text{cm intern ohm}}{\text{sec}}\right]^{\frac{1}{2}}$ in air at 20 deg. C., or referred to vacuo 2.9971×10^{10}, while the results of former experimenters are as follows:

Himstedt	3.0057×10^{10}
Rosa	3.0000×10^{10}
Thomson and Searle	2.9960×10^{10}
H. Abraham	2.9913×10^{10}
Pellat	3.0092×10^{10}
Hurmuzescu	3.0010×10^{10}
Perot and Fabry	2.9978×10^{10}
Mean	3.0001×10^{10}

It will be seen that the value obtained by the present experimenters is a little more than 1 in 1000 less than the mean value of the former determinations. All the above results refer to air. On the other hand, the various determinations of the velocity of light in vacuo have given the value 2.9986×10^{10} cm per second with an accuracy of 1 in 10,000. This differs from the authors' value for the ratio of the electric units by 5 parts in 10,000, with a possible uncertainty of 2 parts in 10,000. The same issue contains a critical comparison, by the same authors, of the various methods of determining the ratio of the electromagnetic to electrostatic unit of electricity.—*Bulletin, Bureau of Standards,* Vol. III, No. 4, October.

Thermoelectricity of Nickel.—H. Pecheux.—The thermoelectric properties of nickel are peculiarly subject to masking by metallic impurities. The author has studied the effect of these impurities, more especially in connection with his copper-nickel pyrometer. Among the specimens of commercial nickel investigated, the most fusible one contained 0.8 per cent of copper, 0.2 per cent of carbon and silicon, and traces of iron and cobalt. The least fusible contained 1.5 per cent of iron, 0.5 per cent of cobalt, 0.1 per cent of carbon and silicon, and traces of copper. The fusible specimen was brittle, and both were hard. The curves of e. m. f. of both specimens intersect at 200 deg. Annealing for 20 hours at 640 deg. has the effect of rendering the e. m. f.'s constant, so that a useful and constant thermoelectric pyrometer may be made with either specimen, but their readings may show differences of some 8 per cent according to composition. An even more marked effect is shown when both cobalt and copper are present as impurities. This is accompanied by a marked change in the resistivity.—From *Comptes Rendus,* Oct. 7; abstracted in Lond. *Elec. Eng'ing,* Oct. 31.

Thermoelectricity.—W. D. Henderson.—A second paper on the thermoelectric behavior of metals in solutions of their salts. In the present paper cadmium amalgam in a solution of cadmium sulphate is investigated. The conditions were found to be the opposite of those which obtain in the case of silver, formerly investigated. He shows that the thermo-electromotive force observed cannot be accounted for on the assumption of an increase of osmotic pressure.—*Physical Review,* November.

Silicon.—F. G. Wick.—The first of a series of papers on electric properties of metallic silicon. In the present installment the thermoelectric behavior of silicon is dealt with. It is thermoelectrically negative with respect to copper; the direction of the current is from silicon to copper through the hot junction. The thermal e. m. f. generated by a lead-silicon junction is very large.—*Physical Review,* November.

Effect of Vibration upon Magnetization.—J. Russell.—An account of an experimental investigation of the superposition of mechanical vibrations and of high-frequency electric oscillations upon magnetization, and conversely in iron and steel and nickel. Two methods were used, in the first of which mechanical vibrations are superposed upon a constant field. The effects of the mechanical vibrations or of the electric oscillations, superposed at all stages of the normal loop, are to lessen those differences of magnetization to which hysteresis without vibrations has already given rise. In the second method, a change of field is superposed upon mechanical vibrations permanently acting. In this case the results cannot be concisely stated in terms of hysteresis. They are, however, subject to the condition that

vibrations or oscillations increase the differential permeability in low fields, and decrease it in high fields. In sufficiently high fields vibrations or oscillations must delay demagnetization.—*Phil. Magazine,* October.

Current and Friction.—P. R. Heyl.—A further paper in his series on some physical properties of current-bearing matter. In the present paper the author discusses the effect of a current upon friction between a solid and a liquid, the liquid being mercury and the solid either carbon or iron. In the case of carbon a change of friction is observed as result of the current, but this can be accounted for as an effect of the heat at the liquid-solid contact surface. This is confirmed by the absence of any effect of current upon friction in the case of iron, where the heating effect is negligible.—*Physical Review,* November.

Radiation.—R. T. Beatty, J. A. Crowther, J. Kunz, R. D. Kleeman.—Four papers on various kinds of radiations. Beatty gives an account of an experimental investigation of secondary Roentgen radiation in air. Crowther deals with the secondary Roentgen radiation from gases and vapors. Kunz discusses an abrupt limit of distance in the power of the positive rays to produce prosphorescence. Kleeman deals with the secondary cathode rays emitted by substances when exposed to the gamma rays.—*Phil. Magazine,* November.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—A summary of a large number of recent publications on this subject. Some notes are given on recent developments in processes using electric discharges through air. Another method of fixation of atmospheric nitrogen is the production of calcium cyanamide. To produce this Frank and Caro simply treat commercially calcium carbide with nitrogen. Others have suggested some additions to increase the yield. Calcium chloride and calcium fluoride appear to be the best additions. The reasons of their action are discussed. A simple method of isolating argon from air is to heat calcium carbide containing 10 per cent of calcium fluoride in a retort to 800 deg. C., and to introduce pure dried atmospheric air. The oxygen and the nitrogen are absorbed by the carbide and there remains nothing but the argon and the other noble gases.—*Electrochem. and Met. Ind.,* November.

Nitric Acid from Air.—I. Moscicki.—A long illustrated description of his experiments on the production of nitric acid by electric discharges through air. These experiments have been made during the last seven years in Freiburg, in Switzerland, on a somewhat large experimental scale. The author first endeavored to use high-frequency high-tension discharges with the aid of special arrangements of condensers and inductance coils. This system was a failure, however, on account of the high cost of the electrical apparatus required. He then took up a new system in which an electric arc is used, which is magnetically deviated. The arc plays between two concentric copper rings which act as electrodes. A magnetic field is provided perpendicular to the plane of the two rings, and the arc is thereby caused to revolve around in the annular space between the two rings so as to give the impression of a luminous ring. The yield is as good as with the Birkeland-Eyde process, and the author hopes to be able to improve it.—*Elek. Zeit.,* Oct. 17, 24, 31.

Electric Steel.—FitzGerald and Bennie.—At the present time the direct production of steel from ores is impossible owing to certain technical difficulties, but by applying the Lash process for the production of steel in the open-hearth furnace with suitable modifications for the electric furnace, it is believed that the problem can be solved. A comparison of the cost of the Lash process in the open-hearth furnace and in the electric furnace shows that in the latter very much less pig iron is required and that the corresponding saving in the cost of raw materials is apparently sufficient to pay for the treatment in the electric furnace.—*Electrochem. and Met. Ind.,* November.

Electric Furnace.—A note on a proposition by Saklatwalla to employ refractory oxides (such as are used as filaments in the Nernst lamp) for resistors in electric furnaces. Since they become conductors only at high temperatures, they must be preheated. For this reason a furnace is suggested in which the temperature is raised step by step. The lowest range of temperature is obtained by means of nickel as resistor material, the next range by tin oxide, which becomes a fair conductor above 600 deg. C., and the highest range of temperature by means of magnesia, which becomes a good conductor above 1500 deg. C.—*Electrochem. and Met. Ind.,* November.

Copper Refining.—J. W. Richards.—A full discussion of electrolytic refining of impure copper, which subject lends itself very well to calculation. The author discusses the energy absorbed by the electrolyte and the energy lost in contacts and in conductors.—*Electrochem. and Met. Ind.,* November.

Bunsen Society.—An account of the annual meeting of the German Bunsen Society, in Hamburg, with abstracts of the papers presented. Among them was a symposium of numerous papers on radioactivity and disintegration of atoms. A paper by Foerster deals with the influence of temperature on metal deposition.—*Electrochem. and Met. Ind.,* November.

Units, Measurements and Instruments.

Cosine Flicker Photometer.—J. S. Dow.—The illumination of the white surface employed in any photometer is inversely proportional to the square of the distance of the source of light from the illuminated surface and directly proportional to the cosine of the angle between the rays of light striking the surface and the normal to the surface. Hence, when measuring the intensity of a source of light, we may either vary the distance, in which case the inverse square law is used, or we may vary the angle of the rays with the normal to the surface, in which case the cosine law is utilized. The latter arrangement has the advantage that a photometer may be kept stationary and the illumination of the photometrical surfaces adjusted in the photometer itself. The two sides of the rectangular Ritchie wedge, *W,* in Fig. 5, are illuminated by the two sources *A, B.*

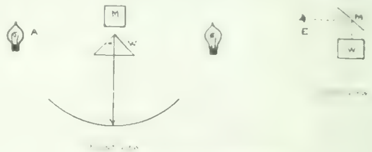


Fig. 5.—Flicker Photometer.

Above the wedge a 45 deg. mirror, *M,* is placed so that the observer's eye at *E* sees an image of the illuminated surfaces reflected in this mirror. The wedge is arranged to rotate about the line of intersection of the photometrical surfaces as a horizontal axis. To the observer, therefore, this line appears stationary as the wedge is rotated. Suppose now that the two sources *A, B,* are equidistant from the wedge. Then, if the intensities of the two sources are the same, photometrical balance is obtained when the wedge is placed symmetrically about a vertical axis, as shown. If, however, *A* is the brighter of the two sources, the wedge must be rotated in a clockwise direction, so that the rays from *A* strike the surface presented towards *A* more obliquely than before, while, conversely, the rays from *B* strike the surface presented less obliquely. Let 45 deg. be the inclination of either surface to the vertical, when the wedge is in its symmetrical position. Then by turning the wedge until equal brightness of the two illuminating surfaces is obtained, the angle of rotation indicates the ratio of the intensities of the two sources of light. This ratio equals the ratio of cosine $(45 - a)$ to cosine $(45 + a)$ if a is the angle by which the wedge was turned. The instrument may be used either on the equality of brightness or on the flicker principle. As shown in Fig. 6, the image of the wedge, as formed by the mirror, *M,* is outside the focal length of the convex lens, L_1, and this, together with the lens, L_2, forms a real image of the illuminated surfaces in the plane of the aperture at *A.* The eye of the observer applied to the third lens, L_3, sees a magnified image of the aperture and the illuminated surfaces—both simultaneously in focus. If, now, an observer is comparing, say, a red source

with a green one, the field of view appears to him as shown in Fig. 7, *a* when the lens L_1 is stationary. He then adopts as photometric balance the position of the photometer-wedge in which the red and green fields appear equally bright. The element of flicker may, however, be introduced by modification of the method due to Rood. The lens L_1 is mounted on springs

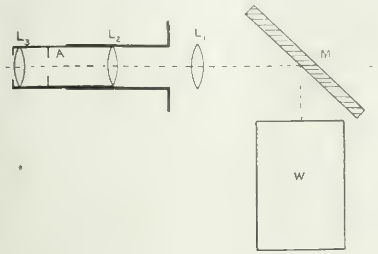


FIG. 6.—FLICKER PHOTOMETER.

and attached to a cord passing over a pin mounted eccentrically on the pulley of a small electric motor. When the motor is caused to rotate the lens oscillates to and fro, and the boundary between the photometrical surfaces appears to oscillate with it. A band of flicker is thus produced, and the field of view assumes the appearance shown at *b* in Fig. 7. The observer may then judge the position of photometric balance by observing the cessation of flicker in the band. Or he may drive the motor so fast that all flicker disappears and the intermediate band merely assumes a color intermediate between that present in the two adjacent portions of the field of view. He may then use this intermediate color to assist him in his decision as to the exact point when all three sections of the field of view appear equally bright. When the instrument is used on the equality of brightness or on the flicker principle, the agreement between the results of the two methods is very close unless there is a great difference of color in the two sources of light.

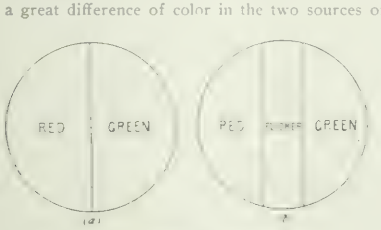


FIG. 7.—FLICKER PHOTOMETER.

For very widely different colors, there is some discrepancy between the results of the two methods, but the flicker method gives rise to the most consistent results.—*Phil. Magazine*, November.

Potentiometer Installation.—W. P. WHITE.—A discussion of a potentiometer installation especially for high-temperature and thermoelectric work. For the most accurate pyrometry, with temperatures up to 1600 deg., the direct-reading pyrometer is not sufficiently sensitive, the resistance thermometer has not sufficient range and is, moreover, too bulky for the best melting-point work. A thermoelement with a potentiometer is the most satisfactory measuring apparatus. The most characteristic requirement in melting-point and calorimetric work at high temperatures is rapidity. This is secured (a) by proper selection and arrangement of the galvanometer, periods of five seconds being almost necessary and being readily obtained; (b) by the use of switches to exchange thermoelements, adjust zero, etc., (c) by relying upon the galvanometer for as much of the reading as possible, so as to [illegible] potentiometer manipulation. For this, constant galvanometer sensibility, and, therefore, constant resistance in the branch circuit of the potentiometer is needed. An adjusting rheostat in the circuit secures this result fairly well for ordinary potentiometers, whose branch circuit resistance is variable. External leakage can be absolutely prevented and internal leakage greatly diminished by equipotential shields, which interpose a continuous metallic surface between the circuit and the source of disturbance. Internal leakage also decreases with the resistance of the potentiometer. The constancy of the potentiometer storage cell is increased by a wrapping which protects it from temperature changes. With galvanometers of familiar commercial types, a sufficiently short period, five seconds, with satisfactory critical resistance and sensibility, can be obtained with a high-resistance potentiometer. Either an especially good galvanometer or potentiometer of low resistance makes possible a somewhat better adjustment. A slide-wire potentiometer is very undesirable in rapid work, and especially in melting-point and calorimetric determinations. By confining the range of the potentiometer to that actually needed in thermoelectric work, an instrument of almost ideal convenience and usefulness can be obtained at relatively low cost. It has constant galvanometer sensibility, low resistance and ease of manipulation, and can be used on two circuits alternately without resetting.—*Physical Review*, November.

Discharge of Electricity.—J. ZELENY.—An account of an experimental investigation of the discharge of electricity from pointed conductors different in size. The author finds it possible to select conditions for the discharge from pointed conductors so that the numerical results obtained may readily be reproduced with new points and apparatus. This is made possible for the most part by using terminals of such a simple and definite shape that they may easily be duplicated with sufficient accuracy. For this purpose it has been found that terminals made of cylindrical wires of a sufficient length, with their ends either rounded or plain, are very convenient and give regular results depending only upon the diameters of the wires. Curves are given from which it is possible to find the current that will be produced in dry air, under the normal conditions given, from a point of any size up to 2 mm. in diameter, for any given potential. Corrections are also given by means of which it is possible to extend the results to any temperature usually found in the room and to a considerable range of pressures near that of the atmosphere. Voltages may be determined with fair accuracy by measuring the current in a point of known size and using a potential-current curve drawn for the particular point by the aid of the results here given. The potential required to start a discharge and the diameter of the point are so related, at least for a limited range, that the minimum potentials minus a constant are proportional to the square roots of the diameters of the points. This relation holds especially well for points with plane end. The relation between the current I at a point and its potential V may be represented quite well for the positive discharge from any point by Warburg's formula, $I = aV\ (V - M)$, where M is the minimum voltage required to start the current and a is a constant. This formula is extended to include at once terminals of all sizes, by changing the constant "a" to $a\ (1 + bd)$, where d is the diameter of the terminal and a and b are new constants.—*Physical Review*, November.

Telegraphy, Telephony and Signals.

Electrical Transmission of Pictures.—A. KORN.—An article on his apparatus for the electrical transmission of photographs. In its elements the apparatus consists of a pair of glass cylinders, one at each end of the line, having a helical motion of such a kind that every element of the surface of each is brought in succession under a beam of light from a Nernst lamp placed over it, and the movements of the two cylinders are exactly synchronized. The cylinder at the sending end carries on a transparent film the picture to be transmitted. That at the receiving end carries a sensitive film, and the light from its lamp is intercepted by a screen carried on the wire of a string galvanometer placed in the line circuit, so that the amount of light falling on this sensitive receiving film varies with the current in the line. The beam of light at the transmitting end, after passing through the picture film, falls on a selenium cell

inside the cylinder, so that the amount of light falling on the cell, and, consequently, the resistance of the cell, varies with the density of the particular element of the film found under the lamp at that moment. The selenium cell and a storage battery are placed in the line circuit, and the current in the line varies continuously with the density of elements of the picture as they are brought in succession under the lamp by the rotation of the cylinder. This line current, by displacing more or less the screen of the string galvanometer at the receiving end, regulates the amount of light falling on the element of the sensitive film, and thereby the density of the photographic negative is produced. The two principal problems presented are (1) the synchronizing of the cylinders, and (2) the regulation of the action of the selenium cells in such a way that the density of the negative produced shall correspond to that of the film at the transmitting end, element to element. As to the method of obtaining synchronism, the receiving cylinder runs a little faster than the transmitter, is checked by a pawl near the end of each revolution, and starts the next revolution in exact synchronism with the transmitter; that part of the receiving cylinder which comes under the lamp during the regulating period is not used for the picture. The regulation of the selenium cell is a much more complicated matter, since its resistance at any instant is not simply a function of its illumination at each instant, but depends upon its previous history; and the effect of any change of illumination is not instantaneous, but requires time to produce its effect. In Fig. 8 a Wheatstone's quadrilateral is constructed of two similar selenium cells, *Se,* 1 and *Se,* 2, and a continuous sliding resistance R_1R_2. A battery of accumulators is connected as shown. The bridge *ABCD* includes a string galvanometer, *B,* whose wire carries a screen, the line wires, the distant receiving apparatus *C,* and

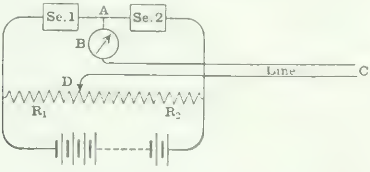


FIG. 8.—TRANSMISSION OF PICTURES BY ELECTRICITY.

the sliding contact *D*. *Se,* 1 is the cell of the transmitting instrument, illuminated by the light passing through an element of the picture. *Se,* 2 is an independent, but similar cell, illuminated by light from another lamp, whose light, however, is intercepted by the screen carried on the wire of the string galvanometer *C,* so that the illumination of *Se,* 2 is proportional to the displacement of *B;* that is, to the line current. The position of *D* and the resistance of the line are now adjusted, so that the illumination of *Se,* 1, *Se,* 2 are equal when the element of the picture under transmission is one having a mean density. The illumination of the sensitive receiving film is then adjusted to give a corresponding density to the negative—that is, when an element of the picture of about the mean density is being properly transmitted, the illumination of the two equal cells, *Se,* 1 and *Se,* 2, are equal. Now, as the cylinder of the transmitting instrument revolves and different elements of the picture come into operation, the light falling upon *Se,* 1 varies continually, up and down, about the mean value for which the above adjustment was supposed to be made; and the current in the bridge and line, and the illumination of *Se,* 2 will also vary up and down about their mean values. Calling the difference, excess or defect, of the bridge current from its mean value a, and the conductivities of the cells c_1, c_2, we may assume as a first approximation that a is proportional to $c_1 - c_2$. The author finds that the conductivity of a cell may be represented by a formula, $C + ki + KI$, where i is the difference between the instantaneous value of the illumination, and its mean value, I, a function of the previous illumination, C, k, K are constants. As *Se,* 1 and *Se,* 2 are similar, the constants C, k, K have the same values in each. The illumination of both *Se,* 1 and *Se,* 2 oscillates about a mean value, the same for the two, and it appears that under these circumstances the values of I may be treated as being equal. Writing, then,

$$c_1 = C + ki + KI$$

[illegible]

and remembering that i is proportional to a and to $c_1 - c_2$ by the construction of the apparatus, we find that a is proportional to i. That is, the excess of the line current over its mean value is proportional to the excess of the illumination of *Se,* 1 over its mean value; and it is clearly only a matter of adjustment to make the total line current proportional to the total instantaneous value of the illumination of *Se,* 1. In this way the use of two equal cells permits the elimination of the effects of the inertia of either. A detailed diagram of the whole apparatus is given.—Lond. *Electrician,* Nov. 8.

[illegible] (British) Physical Society paper on magnetic oscillators as radiators in wireless telegraphy. An open or Hertzian oscillator is called an "electric oscillator," because the effects produced in space are due in part to the potential of the free charges at the ends. A closed-circuit oscillator is called a "magnetic oscillator" because the effects it produces are wholly due to current. Hertz has given a formula for the open electric oscillator, and the present author shows that a similar formula holds good for the closed-circuit magnetic oscillator. The radiation from the open oscillator varies as the square of the frequency, and that from the closed one as the fourth power. The paper describes experiments made with flat square coils of various sizes used as magnetic oscillators in the quadrangle of University College, London. In one circuit undamped oscillations were set up by means of a Poulsen arc, and the induced oscillations created in the other circuit at a distance were detected and measured by means of the author's oscillation-valve or glow-lamp detector. The distance separating the two circuits was varied from about 50 ft. to 250 ft. Curves were obtained showing how the secondary current varied with the distance of the circuits apart and with their relative position. It was shown that the inductive effect was greatest when the flat coils were in a horizontal position, and at a certain distance above the earth. The law of variation with distance proved to be between the inverse cube and the inverse square of the distance. It was then shown that increase in size of the coils had a very marked action in increasing the inductive effect, and also that for equal power the use of the spark method creating intermittent oscillations in the primary gave better effects than the use of the arc or undamped oscillations. It was also shown that for the coils used, the true radiation of energy was very small, and therefore that the distance effects obtained were due almost entirely to magnetic or Faradaic induction. Suggestions were then made for increasing the efficacy of the ordinary inductive type of wireless telegraphy by the use of high-frequency oscillations in the primary circuit, and a suitable detector, such as the author's oscillation valve, combined with a telephone as a receiver in the secondary circuit. Such a method would have a far greater reach than ordinary low-frequency alternating-current inductive telegraphy and would not be open to the objection of disturbing commercial telephonic circuits.—Lond. *Electrician,* Nov. 8.

Milan Exposition.—An illustrated account of various exhibits relating to telegraphy and telephony at the recent international exhibition at Milan. Among those described is a modification by Bogni of the Morse apparatus and the Morse alphabet, a modification by Dubreuil of the Baudot apparatus for multiple telegraphy, and various telephonic apparatus.—*Elek. Zeit.,* Nov. 7.

High-Frequency Arc.—J. SAHULKA.—An illustrated article in which the author describes the production of a high-frequency arc between carbon electrodes in the oscillation circuit of a Duddell-Poulsen arc. In his experiments the frequency was independent of the length of the arc and was about 25,000. The potential difference at the arc was only 14 volts for short arc lengths and 40 volts for a length of 9.5 millimeters. From the very low value of the potential difference at which the arc can be formed it must be concluded that the half waves of the

high-frequency current have a very sharply pointed form.—*Elek. Zeit.*, Oct. 31.

Combination Transformer.—E. Muellendorff.—Describes a transformer (Mischtransformator) with several primary windings which carry sinusoidal currents of any amplitude, phase and frequency, superposed upon each other in the secondary winding. Such transformers are used, for instance, for the transmission of music. The author gives the fundamental equations of such transformers.—*Elek. Zeit.*, Oct. 17.

BOOK REVIEW.

Armature Construction. By H. M. Hobart and A. G. Ellis. New York: Macmillan Company. 348 pages, 418 illustrations. Price, $4.50.

This book contains 13 chapters dealing with the mechanical features of stationary and revolving armature cores and coils, and the testing of completed equipments. Very little of so-called "theory" is given, but the book will prove of value to the theorist. It records modern practice in assembling laminations, insulating coils, building commutators and connecting up the windings. Approximately one-third of the volume is devoted to the various circuit schemes of single-phase, polyphase and direct-current armature windings. Most of the diagrams are printed in colors, a method that assists greatly in tracing the circuits. A brief discussion is given of the insulating of armature conductors. The devices employed in shaping the coils of direct-current and alternating-current armatures are treated at great length, emphasis being placed on the methods developed by the most successful manufacturing companies.

The book should prove of considerable assistance to designers and builders of electrical machinery.

Jamestown Exposition Awards.

Following is a list of awards of medals to exhibitors at the Jamestown Exposition:

GOLD MEDALS.

Allis-Chalmers Company—Electric generators and motors.

Aluminum Company of America—Manufactured products of bauxite and alumina.

Baker & Company—Platinum ore and products.

Babcock & Wilcox Company—Water-tube boiler, semi-marine type.

Carborundum Company—Metallic silicon.

Chas. A. Schieren & Company—"Duxbak" waterproof and "Duxbak" steamproof leather belting.

Carborundum Company—Carborundum and manufactured products.

De Laval Steam Turbine Company—Steam turbines.

General Electric Company—Motors.

General Electric Company—Arc and incandescent lamps and electric cooking appliances.

Goulds Manufacturing Company—Power pumps.

Heine Boiler Company—Water-tube boilers.

International Correspondence Schools—System of technical instruction by correspondence.

Kny Scheerer Company—Surgical instruments, hospital supplies and apparatus.

National Meter Company—Nash gas engines and water meters.

Newport News Shipbuilding & Dry Dock Company—Model of ship fully equipped.

[illegible]

Otto Gas Engine Works—Gasoline engines.

R. D. Wood & Company—Gas producers.

Robins Belt Conveyor Company—Belt conveyor.

Shelby Steel Tube Company—Seamless steel tubing.

Westinghouse Machine Company—Gas-producer engines and stoker.

[illegible]

Atlas Engine Works—Gasoline engines.

Automatic Refrigerating Company—Automatic system of refrigeration and thermostat.

Benjamin Electric Manufacturing Company—Wireless clusters for incandescent lamps.

Contractors' Supply & Equipment Company—"Little Shaver" floor scraper.

F. W. Devoe & C. T. Raynolds Company—School water-color paints.

Jordan Bros.—Jordan commutating truing device.

Middletown Machine Company—Gasoline engines.

Morgan & Wright—Bicycle tires, molded rubber goods and sundries.

The Bristol Company—Bristol's recording voltmeters.

Under Feed Stoker Company of America—Under-feed stoker.

Wagner Electric Manufacturing Company — Single-phase, alternating-current motor and motor-generator set.

BRONZE MEDALS.

Electric Blower Company—Electric forge blower.

General Electric Company—Special motor used with rock drill.

Prometheus Electric Company—"Prometheus" electric air heaters.

Portable and Switchboard Instruments.

The Dongan Electrical Instrument Company of Albany, N. Y., has recently placed on the market a new line of portable and switchboard instruments for alternating current and direct current. Up to the present time the instruments turned out by this company have been dampened by the use of a light aluminum fan attached to the needle. By this method the needle is brought to rest in about 3 seconds after current is thrown on the meter, needle starting from zero. By the construction used in the new type of instrument, the needle is brought to rest instantly.

The instrument is finished with black enameled body with nickel and black covers; raised parts nickel, background black. The scales are large, nearly evenly divided, very clear and distinct. The instrument is furnished in two sizes, the standard being 8⅝ ins. and the small size 7 ins. in diameter. Transformers can be furnished with all alternating-current instruments if desired.

The portable instruments are very accurate and reliable, finished in mahogany and bronze; absolutely dead beat and ironclad, weighing about 2 lbs., measuring 6¼ ins. by 6 ins. at base. While these instruments are of the alternating-current type, they may be used on direct-current circuit with great accuracy by the use of a small constant.

Handy Tools for Wiremen.

The line of standard tools made by the North Brothers Manufacturing Company, of Philadelphia, Pa., and termed "Yankee Tools," embrace ratchet screw-drivers, spiral screw-drivers and hand or push drills. The tools are especially useful for wiremen and other mechanics who have to drive screws, drill holes, etc., enabling them to do such work quickly and comfortably. The spiral ratchet screw-driver operates to insert or to withdraw screws by pushing the handle. The direction of rotation of the blade is easily changed by shifting a small slide. The tool can also be used to ratchet screws in at the finish or to ratchet them out at the start when they may then be pushed either in or out. Attachments are also furnished for drilling holes and for countersinking them. Thus a single tool does a variety of work and does away with numerous tools. For driving smaller screws, such as those used in fastening push buttons, a smaller tool, because of its smaller size and weight, is more desirable and also because this smaller tool has straight bits which will pass through holes.

The hand or push drills required for screws or to make holes for wires through woodwork are made in several styles. Where, as is often the case, holes are required to be drilled

through metal, as well as wood, the drill shown in Fig. 2 is most effective. In the ratchet screw-drivers the friction of the mechanism is said to be hardly felt. On the blade is a knurled washer, by means of which the blade may be turned with a finger and thumb. This permits the hand holding the handle to press steadily against the screw and prevent it from wobbling, while the thumb and finger can turn or ratchet the blade

Figs. 1, 2, 3 and 4.—Handy Tools for Wiremen.

until the screw is well started, when it can then be driven home by the hand on the handle. A slide is provided for changing the direction of rotation as in the case of the spiral ratchet screw-driver. The pocket magazine screw-driver shown in Fig. 4 is equipped with four blades of different sizes carried in the magazine handle. This is a handy tool for adjusting screws in telephones and electrical apparatus. When closed it measures 3 ins. long by ⅝ in. in diameter and weighs two ounces.

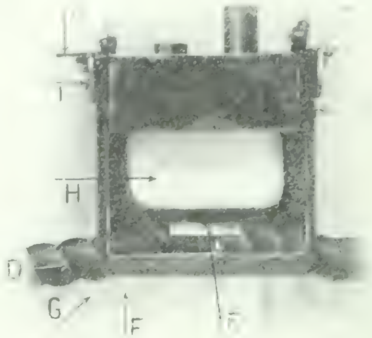
Wall Case for Metal Armored Cables.

The wall case illustrated herewith has been produced to meet the increasing demand for a case for use with metal flexible

Fig. 1.—Wall Case for Metal Armored [illegible]

ducts and flexible metal-covered wires. As indicated in Fig. 1, adjustable lugs are provided for adapting the case to old or new equipments, and the "knock-outs" are placed in the corners. Referring now to Fig. 2, it will be noted that, in placing the wall case, the conduit is drawn through in the position shown by *F*. As the case is pushed into the opening through the wall, the conduit itself describes an arc through the corner of the wall case, taking the position *G*, and finally the position *D*. It is then held in place by clamp *E*, which is fastened with one screw.

The wall case can be inserted in an opening 2 in. x 3 in.

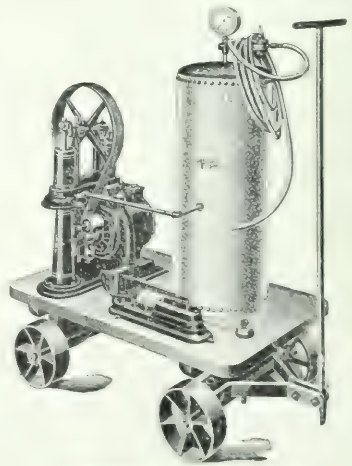


[illegible]

through a wood panel, and the box can be quickly and suitably installed in a 4-in. partition. These boxes are being put on the market by the Marshall Electric Manufacturing Company 301 Congress Street, Boston, Mass.

Portable Air Compressor.

The Victor Electric Company, of Chicago, Ill., has perfected a portable air compressor outfit shown herewith. The equipment is especially useful and effective in cleaning dust and dirt from the back of switchboards and out of the windings of motors and generators. The air pump is driven by a small motor as shown, the electrical energy being supplied through a flexible cord from the nearest socket. The pump is automatic in its operation, the electric circuit to the motor being controlled by a switch which opens or closes the circuit at predetermined



[illegible] Air Compressor.

air pressures. The air tank is fitted with a pressure gage and a rubber hose of ample length for all ordinary purposes. The complete outfit is mounted on a substantially built truck by means of which it may be readily moved from place to place.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Actual business throughout the country, both wholesale and retail, showed some improvement, and a more hopeful sentiment was reported. In wholesale trade circles there was an evident indisposition to do business for future periods. Retail trade felt the effect of the smaller movement of cereals from the farms, and although producers are reported more familiar with checks tendered in payment, lower prices now offered are a drawback to sales. In the industries the features are working out more fully on the slowing-down tendency noted recently. The iron and steel industry, with its kindred lines, such as coke and coal, shows quickest results. Lumber is quieter and there is talk of curtailing production on other lines, thus avoiding unnecessary overstocking. Collections are somewhat slower and business failures were slightly more numerous, but not so important as those of last week and the preceding weeks. Railway earnings for October show a gain of less than half that of September, and those recorded for the second week of November point to an actual decrease. The market for pig iron was almost lifeless. Production is being curtailed, and it is estimated that the U. S. Steel Corporation has something over 40 per cent of its furnaces out of blast, to which must be added the inactive plants of independent interests. At some places wages have been reduced 10 per cent. Business in steel rails was very light, and some mills are closing down. The demand for structural material has improved. The producers of steel have virtually agreed not to cut prices, believing that as finished products have been maintained at a steady level even during times of prosperity, a reduction is not warranted. Copper was dull and weaker, and prices declined about ⅜c., but rallied ⅛c. later in the week, although there was not much new business reported. The metal continues to go abroad in large quantities, principally because it can more readily be financed there than here. Foreign trade in October was larger than in September, both in imports and exports, the exports aggregating $180,559,464, while imports amounted to $111,811,982—gains of respectively 33 and 11 per cent over September. *Bradstreet's* reports 265 business failures during the week ended Nov. 21 as compared with 259 in the previous week, and 212 in the corresponding week of last year.

THE COPPER SITUATION.—The National Conduit & Cable Company's "Copper Gossip," of Nov. 20, says: "In the midst of the recent unfortunate financial situation there came the flurry in the price of copper, when during the three worst days of our money troubles the metal advanced 25 per cent, a most unprecendented advance, length of time considered, and at that without any apparent reason. Our only concern should be to know what has become of the immense volume of copper said to have been sold. If it shall develop that it has not been all sold, but shipped or "sold" abroad for purposes of finance, these bills must some day become due. If, on the other hand, the material shall have gone into the hands of speculators, at some future day what if there should be 100 sellers where a month ago there were but 10. Certain it is that with lack of money new enterprises have not taken the copper, and without new enterprises no such amount of metal could be consumed as is claimed to have been sold. No new undertaking should commit itself for material until it is financed to the limit, since for a long time to come investors will look with suspicion on anything not tried and known. W[illegible] a great supply of money during the first months of 1908, but bankers will necessarily guard it with jealous care lest we precipitate a state of affairs like the present. Everything considered, and the poor outlook for an early improvement in business, we ask should present prices hold? Other phases of the situation might be considered, such as the reduction in output to prevent further accumulation, and the postponement of new enterprise until financial accommodations are obtainable, but in the present temper of business conditions it will take a long time to bring about a restoration of confidence. As things are now we are not surprised that copper has declined from 15. Bottomed on sound conditions these prices would not be considered high, but until the market gets on a solid foundation we believe the safe course for the consumer is the conservative one."

LARGE ALLIS-CHALMERS ORDERS.—In view of the generally unsettled conditions existing in business circles throughout the country, during the past few weeks of financial stringency, a statement of shipments made from the works of the largest engineering and machinery building company of the United States, for the six months preceding Nov. 1, carries more than ordinary interest and significance. During this period Allis-Chalmers Company sent out machinery on orders as follows: May, 23,772,242 lbs.; June, 22,139,757 lbs.; July, 24,225,760 lbs.; August, 26,006,434 lbs.; September, 26,268,764 lbs.; October, 27,821,682 lbs. From these figures it will be seen that, while there has recently been some cessation in "new business," viz., contracts for future fulfillment, the receipt and installation of machinery by industrial, lighting and power companies indicates continued progress. It required nearly five thousand cars to transport the 150,234,639 lbs. of machinery, mentioned above, from the works of Allis-Chalmers Company to the various places where it was to be operated, and, of course, even more than this number of cars was used for bringing in the raw materials, fuel, lumber for patterns, etc., which are necessary in the manufacturing process.

GROWTH AT MONTEREY, CAL.—The new Station "A" of the Monterey County Gas & Electric Company is fast approaching completion at Monterey, and it is expected that it will be delivering electrical energy before the Christmas holidays. While not remarkable for its size, the new plant is noteworthy in the thoroughly modern character of its design. Alternating current at 2300 volts, three-phase, is generated by two 500-kw Curtis steam turbines direct connected to General Electric generators. One 300-kw and one 125-kw motor-generator sets utilize a part of this power for the street railway system and a 2300-volt feeder and network supplies light and power to the cities of Monterey and Pacific Grove and their environs. Steam is furnished by Babcock & Wilcox water-tube boilers with oil furnaces. The new station adjoins the old power house, which will be dismantled as soon as the change over can be made. Wm. H. P. Hill is general manager of the company and F. J. Southerland, general superintendent.

OPPORTUNITY IN ASIA.—One of the American consular officers in Asia reports the granting of a concession for the construction of an electric railway, for the lighting of streets, and the supplying of electric power at the place in question. He furnishes the names of the officials of the new company, and states that it would be a profitable investment for the manufacturers of electrical goods to maintain an active agent there to take advantage of trade opportunities as they present themselves. Details can be had from the Bureau of Manufactures of the Department of Commerce and Labor. An American consul in Asia Minor furnishes the name of a manufacturers' agent there who desires to receive catalogues and information relative to American-made machinery, gas engines, electrical goods, etc.

THE NEW YORK & NEW JERSEY TELEPHONE COMPANY is laying creosoted conduit made by the Wyckoff Pipe & Creosoting Company, of Stamford, Conn., for its underground wires in Brooklyn and Coney Island, N. Y., and Long Branch and Allenhurst, N. J. This creosoted conduit is popular for wires, and this telephone company has used many millions of feet of it during the past quarter century. Conduit laid by this company in Brooklyn 23 years ago is as sound and perfect as the day it was laid, showing no signs of decay.

NAIRN LINOLEUM COMPANY'S NEW PLANT.—Messrs. W. S. Barstow & Company, New York City, are consulting engineers for the Nairn Linoleum Company in the erection of an entirely new plant at Kearny, N. J., on the banks of the Passaic River. A feature of the power house equipment will be a 1000-kw, 60-cycle Allis-Chalmers steam turbine and alter-

nator wound for three-phase, 600 volts. The power house where this unit is to be installed will have an ultimate equipment of 4000 kilowatts, and the Passaic River will furnish the necessary cooling water. The Nairn Linoleum Company is one of the largest, if not the largest, institution of its kind in the world. The company is largely owned by Sir Michael Bairn, whose main works are located at Kilcady, near Edinburgh, Scotland. The American company is, however, operated independently of the one in Scotland.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was subjected to the influence of further liquidation of loans, special features being furnished by the resulting declines in both bond and stock issues, which carried prices in many cases to the lowest point of depression and completely overshadowed the plans of the Treasury for relieving the money market. At the close of the week the market was inclined to rally somewhat on covering of shorts, the decreased currency premium and gold engagements at Paris. The fact that the U. S. Steel 5 per cent bonds were again very unsteady attracted considerable attention. This was attributed, however, to the further sale of holdings received in exchange for Tennessee Coal stock. The U. S. Steel stocks held somewhat better, but naturally eased off slightly with the bonds. Various industrial stocks were affected by the reports of closing down of part of the establishments. General Electric was the only stock of its class that showed any marked improvement; the lowest price of the week was 104, but it advanced and closed at 109, this being a net gain of 4 points. Westinghouse closed at 34¾, which represents a net loss of 3¾ points. In the curb trading, prices fluctuated within a narrow range, the tendency being toward lower prices, as a result of further liquidation of various issues. Following are the closing quotations of Nov. 26:

NEW YORK.

	Nov. 18	Nov. 25		Nov. 18	Nov. 25
Allis-Chalmers Co.	5	[illegible]	General Electric	[illegible]	[illegible]
Allis-Chalmers Co. pfd.	14	12	Hudson River Tel.	—	—
Am. Dist. Tel.	20	—	Interborough Met. com.	[illegible]	[illegible]
American Locomotive	31	[illegible]	Interborough Met. pfd.	[illegible]	[illegible]
Amer. Locomotive pfd.	[illegible]	[illegible]	Mackay Cos.	[illegible]	[illegible]
American Tel. & Cable	60	60	Mackay Cos. pfd.	52¾	53⅝
American Tel. & Tel.	93	—	Marconi Tel.	—	—
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan St. Ry.	[illegible]	—
Electric Boat	[illegible]	[illegible]	N. Y. & N. J. Tel.	[illegible]	—
Electric Boat pfd.	—	[illegible]	Western Union Tel.	[illegible]	[illegible]
Electric Vehicle	—	—	Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd.	—	—	Westinghouse pfd.	[illegible]	—

BOSTON.

	Nov. 18	Nov. 25		Nov. 18	Nov. 25
American Tel. & Tel.	[illegible]	[illegible]	Mass. Elec. Ry. pfd.	38	—
Cumberland Telephone	—	—	Mexican Telephone	—	1½
Edison Elec. Illum.	195½	195¾	New England Telep.	96	99
General Electric	107	—	Western Tel. & Tel.	4	—
Mass. Elec. Ry.	[illegible]	[illegible]	West. Tel. & Tel. pfd.	[illegible]	—

PHILADELPHIA.

	Nov. 18	Nov. 25		Nov. 18	Nov. 25
American Railways	[illegible]	[illegible]	Phila. Electric	[illegible]	[illegible]
Elec. Co. of America	8	8	Phila. Rapid Transit	12½	13
Elec. Storage Battery	[illegible]	—	Phila. Traction	[illegible]	[illegible]
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Nov. 18	Nov. 25		Nov. 18	Nov. 25
Chicago City Ry.	[illegible]	[illegible]	National Carbon	—	—
Commonwealth Edison	—	—	National Carbon pfd.	—	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.	[illegible]	—	Union Traction pfd.	—	—
Metropolitan Elec. com.	19*	19*			

* [illegible]

WESTINGHOUSE NOTES.—It is stated that Mr. George Westinghouse has submitted a proposition of settlement of his personal obligations, amounting to about $8,000,000. Most of these are in the form of notes, and the greater part of their proceeds were used to foster the Westinghouse enterprises. Of these notes banks and banking houses of Philadelphia hold about $2,000,000, while the remainder are held in New York, Pittsburg, Boston and Chicago. All these outstanding obligations are secured by collateral consisting chiefly of stocks of his various companies. According to the plan of settlement Mr. Westinghouse proposes to divide each of his notes into three equal parts, to be secured by the same collaterals now attached to them. The new notes are to run one, two and three years, and are to bear 6 per cent interest, payable at any time at his option. He is also to deposit additional collateral with five trustees, the majority of whom will represent his creditors. All the Westinghouse properties are doing a large and normally growing business.

WESTINGHOUSE ACTIVITY.—President George Westinghouse issued a denial on Nov. 25 of reports that the Westinghouse Electric & Manufacturing Company's plants will close down entirely on Dec. 1. President Westinghouse said: "In line with other industrial corporations the Westinghouse Company has been retrenching, but so far this curtailment does not much exceed 25 per cent. The Westinghouse Company continues to do a very large business, shipments for the East Pittsburg works in October aggregating $2,940,000. October was an unusually large month, and it is not expected that the November shipments will show up as well. However, it is believed they will reach and possibly exceed $2,000,000."

MANUFACTURE OF PHONOGRAPHS.—On the outburst of the recent financial storm, it was announced that the Edison Phonograph Works and other kindred concerns would limit production and cut down their forces. Officials of the Columbia Phonograph Company have now announced that they expect to resume rush work in the company's plant at Bridgeport, Conn., within a few days. When currency was scarce the company laid off a large number of men owing to the difficulty in securing cash for the payroll. Since then, the officials say, several hundred men have been put at work. Conditions are expected to become normal at the plant within a short time.

THE HANNAWA FALLS POWER COMPANY is remodelling its power plant, making many additions to its equipment and extending its transmission lines. When these alterations are completed, the company will have 2100 kilowatts at its disposal, which will be distributed to Potsdam, Gouverneur, Ogdensburg, Stella Mines and other nearby places. Mr. H. W. Connell, of Connell, Sykes & Connell, engineers, 90 West Street, New York, is consulting engineer in charge of this work and expects to have the remodelled plant in complete operation by spring.

UNION SWITCH & SIGNAL—It is estimated that the last quarter of the Union Switch & Signal Company will show results almost as favorable as reported in the first three quarters. Net earnings for the year are estimated at $1,100,000 on a total capital stock of $2,500,000 and outstanding bonds of $243,000. The company is free from debt. It has about $1,250,000 of "accounts receivable," and enough money in the bank to meet the payroll for two months, even if another cent is not collected in that time. It has absolutely no commitments or entanglements of any sort.

EL PASO NOTE ISSUE.—Stone & Webster, of Boston, are offering at 92 and interest, yielding an income of 8 per cent, $350,000 five-year 6 per cent notes of the El Paso Electric Company, Texas. The notes are convertible into common stock at par and are issued to take up $200,000 floating debt and provide improvements and extensions. The notice of sale states that for the year ended Sept. 30 the company earned $474,875 gross; operating expenses were $364,530; interest charges, including issue now offered for sale, $75,202, leaving a surplus for the stock of $34,400.

DIVIDENDS.—The Philadelphia Electric Company has declared a regular semi-annual dividend of 2½ per cent payable Dec. 16. The Norfolk, Va., Railway & Light Company has declared a dividend of 1½ per cent payable Dec. 1. The directors of the Multiphone Operating Company have declared the regular monthly dividend of 1 per cent payable Dec. 2. The Kings County Electric Light & Power Company has declared the regular quarterly dividend of 2 per cent on the capital stock of the company, payable Nov. 30.

CAMBRIDGE, MASS., NEW STOCK.—The Board of Gas and Electric Light Commissioners of Massachusetts has authorized the Cambridge Electric Light Company to issue 800 shares of additional capital stock, to be offered for sale to the stockholders of the company at $175 per share. Of this number, the proceeds of 170 shares are to be applied to the cancellation of an equal amount of the promissory notes of the company, and of the remaining 630 shares to the payment of cost of necessary additions to the plant.

ELECTRIC SWITCH PLATE RECEIVER.—In the Hartford County Superior Court, on Nov. 18, Judge Ralph Wheeler confirmed the appointment of Ernest McC. Stager as temporary receiver of the Electric Switch Plate Company, of Hartford.

HEINZE ELECTRIC COMPANY, of Lowell, Mass., has suspended business temporarily on account of the financial stringency. It has been making a line of X-ray and wireless telegraph apparatus.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Coosa River Electric Power Company is [illegible] the project of [illegible] on the Coosa River at Ten Island Shoals, about 48 miles from Birmingham. Roswell H. Cobb is president.

COLUMBIANA, ALA.—E. N. Cunningham, of New Orleans, La., has been engaged by the [illegible] & Power Company to prepare plans and specifications [illegible] plant. Bids will be received for equipment as soon as plans are prepared.

MOBILE, ALA.—The Tidewater Development Company, which was incorporated with a capital stock of $10,000,000 for the purpose of transporting coal from the Warrior River mines in North Alabama to New Orleans, La., through the Lake Bergne Canal and Mississippi Sound, has commenced work on the construction of an electric railway from Tuscaloosa to Birmingham, for the purpose of making connection with the river end of the line.

VAN BUREN, ARK.—The Fort Smith Light & Traction Company, of Fort Smith, has applied for an extension of its electric light franchise in this town, and proposes to double the present number of street lamps.

CHICO, CAL.—The bid of L. D. Macy of $50 for the electric franchise granting permission to construct and operate an electric light, heat and power system in the city was accepted by the City Council. Mr. Macy states that a small plant will be built at first and enlarged as the demands increase.

EUREKA, CAL.—The North Mountain Power Company will install an 1100-kw transformer at its sub-station in the East End in January, so as to utilize the electrical energy from its plant in Trinity County.

FRESNO, CAL.—The Fresno Home Light & Power Company is making investigations in regard to future operations of its enterprise. The directors are considering an enlargement of the scope of its operations, and are considering the proposition of laying a pipe line from Coalinga to convey oil to Fresno for sale to general consumers. The line would be 45 miles long and would cost approximately $80,000. The company proposes to use crude oil as fuel for the operation of its light and power plants. This company was formed to furnish light and power to compete with the San Joaquin Light & Power Company. H. H. Hart, of San Francisco, is president of the company.

LONG BRANCH, CAL.—The Edison Electric Light Company is planning to erect a new plant here soon after the first of the year, the cost of which is estimated from $100,000 to $150,000.

LOS ANGELES, CAL.—The Board of Public Works has been authorized by the City Council to purchase 831 miles of copper telephone wire for use in connection with the Los Angeles aqueduct, the cost of which is estimated at $60,000. The wire will be used for telephone connections and for power transmission for the cement plant and the railroad near Tehachapi. The Board is preparing to advertise for bids for the transportation of supplies to the Los Angeles aqueduct, involving the construction of a railroad from Mojave to Owens Lake that will parallel the aqueduct. If satisfactory bids are not received the Board of Public Works will have to construct the road.

MONTEREY, CAL.—[illegible] Gas & Electric Company is nearly completed and will soon be placed in operation. The equipment of the plant consists of two 500-kw Curtis steam turbo-generator sets, Babcock & Wilcox water-tube boilers with oil furnaces, and one 300-kw and one 125-kw motor generating sets, which will be used to furnish power for the street railway system. The new station adjoins the old power house, which will be dismantled as soon as [illegible]

PASADENA, CAL.—The City Council has awarded a contract to the Fort Wayne Electric Company for electrical transformers for the municipal electric light plant.

SAN BERNARDINO, CAL.—The Lytte Power Company, of San [illegible] plants, by means of which each plant will supplement the other. The work of extending the present system to all parts of the resident sections [illegible]

SAN DIEGO, CAL.—The Consolidated Gas & Electric Company has reduced its rates for electric service and proposes to double the capacity [illegible]

SAN FRANCISCO, CAL.—[illegible] granted a franchise to construct an electric railway in the southeast [illegible]

SANTA ROSA, CAL.—The Board of Supervisors of Sonoma County has granted the Snow Mountain Water & Power Company a franchise to erect 25 additional transmission lines to be feeders from its main wires. The company bid $250 for the franchise. The company is building a power plant on the Eel River and will have a large reservoir in the mountains near Ukiah, and intends to extend its transmission lines to San Francisco to furnish electricity there, and also to the entire territory between Potter Valley and that city.

WHITTIER, CAL.—The Hadley Land & Water Company has leased the Laguna Ranch of 3500 acres and will install three power plants, develop water for the entire tract, drill artesian wells and put in a 5,000,000 gallon reservoir. The company will spend about $20,000 for the power plants and pipe line and $10,000 additional in drilling wells.

WILLOWS, CAL.—The Snow Mountain Power Company has been granted a permit to occupy a right of way within the Stony Creek national forest in northern California for a dam 16 feet high, a conduit approximately three miles long and a power house covering about three acres.

WILLOWS, CAL.— The Willows Water & Light Company, which was recently purchased by the Northern California Power Company, has been reorganized and the following named officers elected: E. V. D. Johnson, of Redding, president; P. H. Green, of Willows, vice-president; Samuel Boyd, secretary and manager.

CANON CITY, COL.—Ira Mowry, vice-president of the Canon City & Royal Gorge Electric Railway Company, announces that the money has been secured for the construction of the road. The bonds have been underwritten by the banking company of Coggshall & Hicks, of New York City. Surveys are now being made by City Engineer Milton for the line to the lime quarries, which the company owns on the Royal Gorge division, five miles from the city. As soon as the survey is completed bids will be received for the construction of the road and work will commence in a short time.

DENVER, COL.—The contract for the electrical equipment for the auditorium building has been awarded to the Northwestern Electric Equipment Company, of St. Paul, Minn. The contract amounts to about $40,000 and includes a complete electrical system and generating plant. A. J. Perky, superintendent of the Northwestern Electric Equipment Company, has charge of the installation of the plant.

QUINCY, COL.—E. D. Bannister is contemplating building a power plant to supply power to the Genesee Valley mining district.

BRANCHVILLE, CONN.—The Monarch Mining Company is making arrangements to equip its plant with electric light, and will also install air compressors for operating machinery in the quarry.

HARTFORD, CONN.—The Hartford Electric Light Company is seeking the privilege to distribute electricity within the limits of the town of East Hartford. The company now furnishes electricity in the fire district, but is anxious to extend its service to the outlying sections.

PLAINVILLE, CONN.—The citizens have voted to replace the Welsbach system of lighting with electric light service, and have instructed the selectmen to make a contract with the Connecticut Company for the illumination of the town.

STONINGTON, CONN.—The managers of the new electric lighting company, which is to supply Westerly, Stonington and Mystic with a 24-hour service, are preparing to take possession of the overhead plant now controlled by the Mystic Gas & Electric Light Company.

WASHINGTON, D. C.—The Secretary of the Interior has awarded a contract to the Roebling's Sons & Company, of Trenton, N. J., for furnishing approximately 685,000 pounds of copper wire required for the transmission line and other purposes in connection with the Salt River irrigation project in Arizona.

WASHINGTON, D. C.—In the annaul report of Rear Admiral Holladay, chief of Bureau of Yards and Docks, the sum of $628,000 is asked for improvements to the Brooklyn Navy Yard, which include an extension to the electric plant, at an estimated cost of $40,000; underground conduits extensions, at $25,000; telephone system extensions, at $12,000, and central power house to cost $231,000. The amount required for the League Island Navy Yard is estimated at $993,225, which includes electric elevators, $8,000; electric motors for dry dock No. 1, $35,000; extension of electric conduit system, $8,000, and central power plant extension, $222,500.

WASHINGTON, D. C.—Bids will be received at the office of Indian Affairs, Department of the Interior, until Dec. 27, for the construction of a [illegible] power house and electric lighting [illegible] Tulalip School, Wash., in accordance with plans, specifications and instructions to bidders, which may be examined at the office of Indian Affairs, [illegible] *and Engineering Record*, Seattle, Wash.; U. S. Indian Warehouses at [illegible] superintendent Tulalip, Wash

[illegible]

[illegible]

[illegible] tended its electric lighting system from Bradentown to Palmetto, across [illegible]

[illegible]

ATLANTA, GA.—The contract for the construction of the Atlanta-Augusta Interurban Railway has been awarded to the Cook & Laurie Company, of Montgomery, Ala., and orders for the equipment of the [illegible]

LAGRANGE, GA.—[illegible]

MARIETTA, GA.—[illegible]

IDAHO FALLS, IDAHO.—[illegible] Ltd., is constructing a transmission line from its station near Idaho Falls to St. Anthony. The line will be completed to Rigby, a distance of 24 miles, in about 30 days. Two more installations similar to the one now in operation, which consists of a 400-hp water wheel and a 225-kw generator, will be put in operation by Jan. 1, 1908. The company furnishes 100 horse-power to the municipal electric light plant in Idaho Falls, and will operate lighting plants at Rigby and other towns.

MULDOON, IDAHO.—R. T. Tustin contemplates installing an electric light and power plant for the mills.

CHICAGO, ILL.—[illegible] Chicago Edison Company and the Commonwealth Electric Company into the Commonwealth Edison Company by an opinion presented by the Assistant Corporation Counsel Miller to the Council committee on gas, oil and electric light, on Nov. 20, on which the committee took immediate action. The opinion also answers questions referring to rates and franchise rights of the electric company. Under the consolidation the Commonwealth-Edison Company will operate under the Commonwealth ordinance, which requires the company to pay the city three per cent of its gross receipts, which will make a total of something over $225,000 a year.

BEDFORD, IND.—The City Council has granted a 50-year franchise to the Grand Central Traction Company for the construction of an interurban railway through the city and also to construct and operate an electric light system. The company has also applied to the City Council in Bloomington for a similar franchise.

WINCHESTER, IND.—The Citizens Water & Light Company is contemplating starting a day service May 1, 1908, and will be in the market [illegible] manager.

ATLANTIC, IOWA.—Bids will be received until Dec. 7 by T. E. Nichols, city clerk, for a triplex or power pump to be driven by a steam engine operating under 80 lbs. boiler pressure or by electric motor capable of performing the service from a depth of 26 feet and against [illegible]

MARSHALLSTOWN, IOWA.—It is expected that work will soon commence on the surveys and estimates for the new interurban railway, which is to be built from Marshalltown to Melbourne. C. H. Peck, of Chicago, Ill., will have charge of the work.

PELLA, IOWA.—W. H. Fowler has made application for a franchise [illegible]

PLEASANTVILLE, IOWA.—The citizens have voted to grant the Swan Telephone Company a franchise to erect and maintain a telephone [illegible]

CLAY CITY, KAN.—The directors of the Clay Center Telephone Company are contemplating extensive improvements to the local system.

HOLTON, KAN.—The Holton Electric Company has applied to the circuit court for permission to dissolve. The company is capitalized at $20,000 and was organized to light the town of Holton. The stockholders are Clarence A. Rose, Charles D. Mill and Jay M. Lee, of Kansas City, and B. E. Ninde, of Oskaloosa, Ia.

SHREVEPORT, LA.—[illegible] line to the cemetery.

MORRILL, ME.—Herman Merriam has recently installed a dynamo in his mill to furnish electricity for lighting.

[illegible]

BALTIMORE, MD.—The stockholders of the Consolidated Gas, Electric Light & Power Company [illegible] under its terms the Consolidated Company will pay the Baltimore Elec- [illegible] standing and the interest on its outstanding 5 per cent preferred stock, provided that the company does not earn these requirements. As an outcome of the consolidation, it is said that the Maryland Telephone [illegible] be taken over by the Chesapeake & Potomac Telephone Company.

AMHERST, MASS.—The Connecticut River Power Company has [illegible] power, and will supply electricity in Amherst, Pelham, Hatfield, Sunderland and South Deerfield. Electricity will also be furnished to manufacturers. The steam plant in Amherst will be held in reserve for emergencies. C. Fred Duel is president of the company.

BARRE PLAINS, MASS.—Arrangements have been made for install- [illegible] Barre Plains and in the village of Barre Plains. The committee appointed by the town has made a contract with the Barre Wool Combing Company, which has an electric plant at South Barre, to supply electricity for the system. Under the terms of the contract the company is to install the plant and have it in operation not later than Jan. 1. An appropriation of $1,000 has been made, which will pay for installing the system and maintaining the lamps for one year.

CAMBRIDGE, MASS.—The Board of Gas and Electric Light Commissioners has authorized the Cambridge Electric Light Company to issue 800 shares of additional capital stock to be offered for sale to the stockholders of the company at $175 per share, the proceeds of 170 shares to cancel an equal amount of indebtedness and the remaining shares to pay cost of addition.

CHESTER, MASS.—At a hearing before the State Board of Gas and Electric Light Commission the Chester Electric Light Company agreed to furnish electricity for lighting the streets at once, the price to be fixed later by the commission, when they render its findings for the whole case. The streets have been in darkness for some time owing to a disagreement between the town officials and the electric light company in regard to the price charged for street lamps.

FORT REVERE, MASS.—Bids will be received until Dec. 10 by C. O. Zollars, captain artillery corps, at the office of the quartermaster, for furnishing and installing electric lighting fixtures in the hospital at Fort Revere.

GARDNER, MASS.—The Board of Gas and Electric Light Commissioners has authorized the Gardner Electric Light Company to issue $35,000 in capital stock and first mortgage bonds to the amount of $65,000.

GARDNER, MASS.—A new oil engine of 225 horse-power has been received by the Gardner Electric Company and will soon be installed in its plant, which makes the second engine of this type to be added to the station within a month.

LINCOLN PARK, MASS.—It is reported that the Lapointe Machine Tool Company and the Universal Boring Machine Company have practically decided to co-operate and install a power plant to generate electricity to furnish light and operate motors for both companies. A 75-hp steam engine or a Nash triple gas engine will be used. The power plant will be able to supply power for additional industries that may locate here.

NEWTONVILLE, MASS.—Bids will be received until Dec. 2 by George H. Elder, commissioner of public buildings, for furnishing a ventilating and heating plant and an electric plant for the technical training high school to be erected at Walnut Street and Elm Road. George F. Newton, 6 Beacon Street, Boston, Mass., is the architect.

PITTSFIELD, MASS.—Fred D. Retallic & Company have been awarded the contract for the electric wiring of the new armory building. The contract calls for about 400 incandescent lamps, an electric signal service and a telephone system connecting all parts of the building.

SALEM, MASS.—Martin Kelley & Company have installed two 10-hp electric motors in their factory at Tapleyville, displacing steam with electric power.

SPRINGFIELD, MASS.—The United Electric Light Company has applied to the State Board of Gas and Electric Light Commissioners for permission to increase its capital stock sufficient to realize $750,000 to pay for floating indebtedness incurred in making improvements and extensions to its property.

ALMA, MICH.—The Alma Grain & Lumber Company is planning to install a new water wheel and dynamo in its electric plant. L. A. Sharp [illegible]

CRYSTAL FALLS, MICH.—[illegible] of the new power house for the municipal electric light plant.

GRAND RAPIDS, MICH.—[illegible]

LUDINGTON, MICH.—It is reported that the electric light and power plant of the Pere Marquette Railroad Company in this place is to be removed from the city soon.

MANISTEE, MICH.—[illegible] city, is reported to be considering a project to build an interurban electric road between Manistee and Cadillac. The company is making preliminary plans for a dam on Pine River in South Branch Township, where electricity could be generated.

MARQUETTE, Mich.—The Calumet & Lac la Belle Traction & Power Company, it is said, will soon be organized for the purpose of constructing an electric railway between Calumet and Lac la Belle. S. M. Wells, of Chicago, is promoting [illegible]

STEWARTVILLE, MINN.—[illegible] ville Electric Light Company, writes that the company will expend be- [illegible]

SHERBURN, MINN.—[illegible] on the proposition that the village purchase and operate the electric light plant, which was defeated by three votes.

FARIBAULT, MINN.—F. C. Nelson, of St. Paul, has purchased the plant of the Polar Star Electric Company and will make improvements [illegible]

KANSAS CITY, MO.—The County Court has confirmed the granting of the right of way of the Blue Valley Railroad to operate an electric railway to a point on the Blue River. The company was financed some time ago and plans have been drawn for the building of the road, which will commence at an early date. The officers of the company are Alexander Massey, president; P. G. Walton, of Anthony, Kan., vice-president; Joseph S. Chick, secretary and treasurer, and D. W. Pike, chief engineer.

MAYSVILLE, MO.—The citizens will be asked to vote on a proposition to issue $10,000 in bonds for the construction of an electric light plant.

ST. JOSEPH, MO.—The Interstate Railway Company has filed for record a mortgage upon all its property to secure a bond issue of $4,050,000 to the Carnegie Trust Company, of New York, N. Y. The company was organized to build an electric interurban railway between St. Joseph and Kansas City, and the present mortgage will provide ample funds for the purpose.

SPRINGFIELD, MO.—The City Council on Nov. 6 renewed the lighting contract with the Springfield Gas & Electric Company. The rate for each street lamp is $67.50 per year.

FREMONT, NEB.—Frank Hammond, secretary Board of Public Works, writes that former bids for the construction of the water works and electric light station have been rejected, and new bids have not yet been called. The cost of the work is estimated at $25,000. Contracts for engines and dynamos have been awarded. C. A. Chapman, of Chicago, Ill., is consulting engineer.

ELY, NEV.—William B. Thompson has applied to the City Council for a fifty-year blanket franchise covering all streets and alleys in the town of Ely, in return for which he proposes to build and equip an electric railway between the depot at Ely City and the town of Ely.

WONDER, NEV.—Negotiations are now in progress to secure electricity for lighting and power for the town of Wonder from Carson City.

MANCHESTER, N. H.—The State Railroad Commissioners have granted the Manchester Street Railway permission to increase its capital stock by $275,000, the proceeds to be used for improvements that have already been made and for further improvements and extensions, the cost [illegible] estimated at [illegible]

VINELAND, N. J.—The stockholders of the Vineland Gas & Electric Company have asked for a receiver for the company. While the company is in good financial condition, it is brought into litigation through some defect in the incorporation. Certain stockholders have applied to the United States Court for a receiver to be appointed pending the correction of its incorporation, which was demurred by Walter Wood, who was desirous of taking over the company and continuing as an individual.

BAY SHORE, N. Y.—The Bay Shore Gas & Electric Light Company [illegible] pany will expend about $35,000 for improvements, which will include a [illegible] a 110-kw generator and extension of mains, etc.

BROOKLYN, N. Y.—Bids will be received by the Commissioner of Water Supply, Gas and Electricity, at the office of the Department of Water Supply, Gas and Electricity, 21 Park Row, Borough of Manhattan, until Dec. 6, for furnishing and delivering special crossheads for lamp posts in the Borough of Brooklyn. John H. O'Brien is com- [illegible]

[illegible] power plant at Littleville, and low water in the lake, the Ontario Light [illegible]

LITTLE FALLS, N. Y.—The Hudson River Electric Company has [illegible]

[illegible]

WAYNESVILLE, N. C.—The Waynesville Electric Power Company is contemplating developing other water powers and installing further equipment in its plant. George E. Ladshaw, of Spartansburg, S. C., is the engineer.

KENMARE, N. D.—The Kenmare Light & Power Company is considering the question of installing another 100-kw generator and may add another boiler to its plant. F. W. Amsler is manager.

ASHVILLE, OHIO.—Bids are being asked for a complete street lighting system for this place. Arrangements have already been made for securing current from the Scioto Valley Traction Company, which has a sub-station near here.

CLEVELAND, OHIO.—The Council committee on Nov. 20 approved the franchises of the Cuyahoga Heat & Light Company. Under the terms of the franchise the maximum charge for electricity for lighting is 5½ cents per kw-hour. John C. Keyes, president of the company, states that the company will build four plants like the present one in Hickox Alley, within two years, at a cost of $2,000,000, and will give a service of 5000 kw. Revocation of the franchise may be made at any time for violations of its provisions, and the entire plant may be acquired by the city at a valuation of the cost of reproduction, less depreciation, plus 10 per cent. Heating is to be charged for at the rate of not more than 27½ cents per sq. ft. of radiation area.

DEFIANCE, OHIO.—The Toledo & Defiance Railway Company and the Defiance, Hickville & Fort Wayne Railway Company, subsidiary organizations of the Toledo, Wabash & St. Louis Railway Company, have been granted 25-year franchises to construct and operate electric railways in Defiance.

MARION, OHIO.—A new corporation headed by H. D. Critchfield, of Milwaukee, Wis., has applied to the City Council for a 25-year franchise to install a telephone system in this city and county. The Belle and Marion County Telephone Companies were recently merged. The new company will be capitalized at $250,000.

CLINTON, OKLA.—The City Council has granted F. Murch, of Hennessy, an electric light and power franchise, and has also contracted for 20 street lamps.

PANAMA.—Bids will be received until Dec. 23 at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., for electrical material consisting of cable, wire, flexible conduit, wire attachments, switches, push buttons, shade holders, lamp shades, electroliers, incandescent globes, dry cells, wire grips, bit braces, etc. Blanks and general information relating to this circular (No. 405) may be obtained from this office or at the offices of the assistant purchasing agents, 24 State Street, New York City; Custom House, New Orleans, La.; also from the U. S. Engineer offices in the following cities: Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Chicago, Ill.; St. Louis, Mo.; Cincinnati, Ohio; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky.; and Mobile, Ala. H. F. Hodges, Lieut. Col. Corps of Engineers, U. S. A., is general purchasing officer.

CATASAUQUA, PA.—A. N. Ulrich, who as receiver has been in charge of the properties of the Lehigh-Northampton Gas & Electric Company for some time, has turned the same over to the owners, who have perfected organization by electing the following-named officers: M. L. Finckel, president; Horace Evans, secretary and treasurer, and G. W. Steele, manager. The name of the company has been changed to the Lehigh & Northampton Light, Heat & Power Company. The company furnishes gas and electricity for light, heat and power in Catasauqua, Fullerton, Hookendauqua, Coplay, Northampton and Siegfried.

HARRISBURG, PA.—The proposed extension of the Penn & Franklin Street Railway Company from Johnston Street in Wilkinsburg to the dividing line between Braddock Township and North Braddock, has been approved by Governor Stuart. The road will be over private right of way and will be about three miles long.

HARRISBURG, PA.—The following companies have filed a notice of increase of indebtedness with the Secretary of State: The Philadelphia & Garrettsford Street Railway Company has increased its indebtedness from $300,000 to $800,000; The Buffalo & Lake Erie Traction Company from $4,505,000 to $4,755,000 for extensions and betterments to its system; the Newton Railway Company from nothing to $375,000.

HUNTINGTON, PA.—Contracts have been awarded by the Raystown Power Company to the Ayrens Construction Company, of Lewiston for the construction of dam No. 1 to be built on the Raystown branch of the Juniata River. This dam will be built about nine miles from the [illegible] dam 40 feet in height, with a storage capacity of seven and one-half square miles, and is estimated to furnish about 400 horse power. The [illegible] be provided with an auxiliary steam plant, which will be located somewhere in the coal fields contiguous to its water-power plants, and will have a capacity of 10,000 horse power. The Juniata Electric Company, organized by William P. Woods, of Lewiston, and Wallace Wilson, of Huntington, will be the distributing medium for the electricity generated by the Raystown Power Company.

JOHNSTOWN, PA.—The Johnstown Electric Railway Company has [illegible]

NEW CASTLE, PA.—[illegible]

Castle to Greenville, a distance of 11 miles. The Meadville-Conneaut Lake Company is planning to build a line between Linesville and Greenville, 21 miles in length, which will give a through electric railway between New Castle and Pittsburg.

PHILADELPHIA, PA.—Only one bid was received by the Department of Public Safety, which was opened Nov. 15, for lighting the streets by electricity for next year, which was submitted by the Philadelphia Electric Company, which holds the contract for the present year. The prices submitted are the same as this year, but the increase in number of lamps will make the cost of electric lighting next year $1,200,000, as compared with $1,114,224 this year. The price per lamp ranges from 25 to 29 cents per lamp per night.

PITTSBURG, PA.—The City Council has passed an ordinance providing for a contract for three years for furnishing the city with arc lamps at a cost not to exceed $280,000.

PITTSBURG, PA.—On account of present financial conditions the Duquesne Light & Power Company is not doing any construction work on its proposed new plant or purchasing any machinery. The company plans to construct a large plant on the Monongahela River at a cost of more than $1,000,000.

READING, PA.—The Nolde & Horst Company has placed a contract with the Brown Engineering Company for the electric light and power equipment for its new knitting mill. The machinery will be operated by individual motors.

SHAMOKIN, PA.—The Town Council has awarded the contract for street lighting to the Shamokin & Coal Township Light Company for a term of ten years.

UNIONTOWN, PA.—The Brownsville, Masontown & Smithfield Railway Company has been granted a franchise by the Borough Council of Smithville to operate a street railway over certain streets in the borough.

WAYNESBORO, PA.—The construction committee of the Chambersburg, Greencastle & Waynesboro Electric Railway Company is considering the question of providing power for the extension now being built between Greencastle and Chambersburg. The committee has recommended that additional machinery be installed in the Waynesboro power plant to supply electricity for operating the road. The plan as adopted by the directors provides for the transmission of alternating current to Kauffmans by overhead wires, where it will be converted to operate the cars.

WELLFORD, S. C.—The Enoree Power Company is constructing a hydro-electric power plant on the Enoree River at Wellford, and will furnish electricity for lighting and power in Woodruff, and for power at Fountain Inn. Ladshaw & Ladshaw, of Spartansburg, are the engineers.

FREEMAN, S. D.—The citizens and business men of Freeman have petitioned the City Council to take steps to secure the establishment of an electric light plant in the city.

CARTHAGE, TEX.—John C. Whitney, owner of the Carthage electric light plant, writes that he is contemplating installing a larger engine and boiler or gas engine in his plant.

ELGIN, TEX.—B. H. Graham, of Smithville, writes that a stock company is about to be formed to construct an electric light plant, water works and an ice plant, to cost between $50,000 and $60,000. The company will be ready for plans about Jan. 1. No engineer has yet been selected.

EL PASO, TEX.—A 500-kw generator was recently damaged in the plant of the El Paso Electric Railway Company by an explosion, causing a loss of $10,000.

FORT WORTH, TEX.—Bids will be received at the office of James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until Dec. 20, for the installation of a conduit and electric wiring system for extension to U. S. post office in Fort Worth.

NEWFANE, VT.—The citizens are considering the question of having the streets of the village lighted by electricity. The company owning a mill just south of the village, of which James F. Chase, of Boston, Mass., is manager, contemplates installing an electric plant for lighting the mill, and a contract may be made with the company to install a plant of sufficient capacity to light the village.

RUTLAND, VT.—The Rutland Railway, Light & Power Company has made a contract with the Rutland Railroad Company to install two 40-hp electric motors and complete apparatus to equip the car and machine shop of the railroad company with electric power. The steam plant will be abandoned.

CHENEY, WASH.—The new flour mill of the F. M. Martin Company has been placed in operation. The motive power is electricity, which is supplied by the Washington Water Power Company. The power company is furnishing electricity for the street lighting service and for power purposes in this town, and has established a 24-hour service, which began N[illegible].

PORT TOWNSEND, WASH.—The Pacific Electric Company has submitted a proposition to the City Council which contemplates the installation of a water wheel, dynamos, transformers, with outside system and connections for operating 50 arc lamps, at an estimated cost of $11,061.

SPOKANE, WASH.—It is reported that the Panhandle Electric Railway Company is making arrangements to commence work on the construction of its road, and will begin at once work on the construction of a large power plant on Priest River to furnish electricity to operate the railway. The company will also sell power to the mines in the Priest Lake district. Arrangements have been completed between the company and the government for the construction of a telephone service along the new road and reaching into the Priest River Forest Reserve. Half of the cost of the erection of the telephone system will be borne by the government.

BLUEFIELD, W. VA.—The Bluestone Traction Company has been granted a franchise to extend its line on South Bland Street and into South Bluefield. The franchise is for a term of 47 years, in return for which the company is to pay the city $10,000.

FAYETTEVILLE, W. VA.—The Fayetteville Water & Light Company has been granted a 50-year franchise and will soon commence work on the construction of an electric light system. John Hawkins is interested in the enterprise.

SHEPHERDSTOWN, W. VA.—John A. Livers, of Lancaster, Pa., and M. P. Thorn, of Martinsburg, W. Va., who recently purchased the municipal electric light plant in this town and secured a franchise for 30 years, will organize a company. Electrical energy will be secured from the plant of the Martinsburg Light & Power Company at Martinsburg to operate the system, and ultimately power will be secured from the plant of the Martinsburg company now being built at dam No. 4. The transmission lines in Shepherdstown will be reconstructed.

ASHLAND, WIS.—The machinery of the new power plant at White River was put into operation for the first time Nov. 5. The company is now extending its lines to Ashland and will be ready to supply electricity in the city in about two weeks. The new power plant will develop 1000 horse power, and is under contract to furnish 500 horse power for a term of 25 years to the Ashland Light, Power & Street Railway Company. The company also holds an option on the additional 500 horse power that the dam is capable of supplying.

KAUKAUNA, WIS.—The Fox River Valley Telegraph & Telephone Company is planning to build an exchange in this city next summer.

MILTON, WIS.—The farmers of Johnstown and Richmond have formed a telephone company with a capital stock of $2,500. G. M. Holbrook is secretary.

LLOYDMINSTER, ALB.—The Lloydminster Telephone Company has offered to dispose of its plant and system to the provincial government. The offer will likely be accepted.

OKOTOKS, ALB.—At a meeting of the ratepayers it was decided to petition the Council to purchase the electric lighting plant of the Okotoks Electric Light & Power Company, which was closed down recently as it failed to meet expenses. Address W. Fisher.

VANCOUVER, B. C.—The Canadian Pacific Railroad has decided to electrify the Columbia & Western Railroad, in the boundary district. This is for the purpose of securing much of the freight developed by the Great Northern Railroad in late years, the company being able to operate far more cheaply by electricity than by steam. The West Kootenay Light & Power Company will supply the motive power. Address R. Marpole, general superintendent of the Canadian Pacific Railroad, Vancouver.

ST. VITAL, MAN.—The Town Council has decided to construct a municipal electric railway system and will rescind the contract given the Winnipeg Electric Street Railway Company for the construction of a railway system here. The secretary and treasurer has been instructed to secure the services of a civil engineer to prepare plans, specifications and estimates.

ST. JOHN, N. B.—The Nova Scotia Telephone Company has purchased the system of the Central Telephone Company, which operated 70 miles of pole line and 90 miles of wire between Bridgewater and Middleton.

HAMILTON, ONT.—The fire and water committee has decided to advertise for tenders for electric pumps for the water works system, and the competition will be open to foreign as well as Canadian manufacturers.

LONDON, ONT.—The City Council has passed on the first reading of the Niagara power by-law, and the special committee of the Council was authorized to instruct the engineer to prepare a statement of the estimated cost of distribution, and to prepare plans showing the area proposed to be covered.

PORT ARTHUR, ONT.—The Ontario & Michigan Power Company is seeking incorporation to develop electrical power on the Nepigon, Black Sturgeon and Pigeon rivers, north of this town. Address Andrew T. Thompson, Ottawa, Ont.

TORONTO, ONT.—The Stark Telephone, Light & Power System, Ltd., which supplies electricity for light and power in Toronto Junction, has been obliged, owing to the financial stringency, to go into liquidation. The company will probably be reorganized.

TORONTO, ONT.—Various plans and estimates for a municipal plant for the distribution of electricity in the city of Toronto were submitted at a conference held at the Mayor's office Nov. 15, between the city officials, representatives of the Hydro-Electric Power Company and engineering experts. There were seven propositions presented, ranging from $1,775,000 to $5,250,000. Three plans were presented by W. C. Chase, of the firm of Smith, Kerry & Chase; the other plans were from the engineers of the Hydro-Electric Power Commission. If one of the estimates is selected the citizens will be asked on Jan. 1 to vote on the question of issuing bonds for the same.

WOODSTOCK, ONT.—At the coming municipal election a by-law will be submitted to the ratepayers for the expenditure of $27,000 for a distributing plant for Niagara power, and to provide a new motor and electric pump, so as to utilize the electric power for the street lighting and the water works systems.

SASKATOON, SASK.—The Saskatchewan Power Company is applying for incorporation for the purpose of developing and distributing electricity. Stratton, Sutherland & Jordan, of this city, are acting for the applicants.

CORBONEAR, NFLD.—The United Towns Electrical Company, Ltd., is making arrangements to extend its service to other towns, work on which will commence as soon as possible. Louis Williams is superintendent.

Company Elections.

NEW YORK, N. Y.—At the annual meeting of the Electrical Securities Corporation, held recently, the retiring board of directors was reelected with the exception that C. N. Mason was elected to fill the vacancy caused by the death of E. R. Coffin. The vacancy caused by the death of S. M. Hamill was not filled at this time. The office of vice-president, which was left vacant by the death of E. R. Coffin, was filled some time ago by the election of C. N. Mason.

DRUMBO, ONT.—The Princeton & Drumbo Telephone Company, recently incorporated, has elected the following officers: F. J. Daniel, president; T. Conway, vice-president; G. S. Smith, secretary; W. H. Wells, treasurer. The company proposes to operate in the following villages: Princeton, Drumbo, Eastwood, Gobles, and possibly Cathcart and Paris.

New Industrial Companies.

THE EDWARDS & MERRILL COMPANY (electricians), Boston, Mass., has been incorporated, with a capital stock of $25,000, by William G. Merrill, John E. Edwards and Samuel W. Culver.

THE ELECTRO-RADIATION COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $25,000, by Frank W. Douglass, James Lynch, John J. Fischer and others.

THE MASON MOTOR FAN COMPANY, of Boston, Mass., has filed articles of incorporation, with a capital stock of $250,000. The incorporators are A. W. Crankshaw, John Mason and Fremont E. Shurtleff.

New Incorporations.

BIRMINGHAM, ALA.—Articles of incorporation have been filed for the Armstrong Light Company with a capital stock of $5,000. H. L. Armstrong is president.

MANITOU, COL.—The Manitou Incline Railway Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $220,000, and has purchased the cable tram road from Manitou to the summit of Mount Manitou, a distance of one mile, from the Hydro-Electric Company. The line will be re-constructed and re-equipped for the tourist season of 1908.

CLINTON, ILL.—The Clinton Gas & Electric Company has been incorporated with a capital stock of $10,000 by James M. Surdam, John W. Smith, Rolla T. Ingham, Joseph Saenger, A. Saenger and Richard Lindauer. The company proposes to manufacture and sell gas and electricity.

FARMERSBURG, IND.—The Torr Electric Company has been incorporated with a capital stock of $[illegible]. The company has taken over the plant and holdings of A. D. Torr, which furnish electricity for light and power in Farmersburg and Shelburn, 6 miles distant. The officers of the company are: E. W. Jennings, president; A. D. Torr, secretary and general manager, and W. S. Buldridge, treasurer.

VINCENNES, IND.—The Black Hawk Light, Heat & Power Company has filed articles of incorporation with the Secretary of State with a capital stock of $1,000,000. Cyrus Hoffman, George H. Smith, H. S. Shoffer and others are the directors.

ARDMORE, I. T.—The Arbuckle Falls Light & Power Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are Morris Saas, L. P. Adkins, F. B. McElroy and Mark Kirkpatrick. The company proposes to develop water power on Fallas Creek in the Washita River Canyon, near Ardmore, to generate elec[illegible].

ENID, OKLA.—The Enid Pump & Power Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are H. W. Sawyer, R. C. Dickensheets, A. W. Sawyer and others.

OKLAHOMA CITY, OKLA.—The Oklahoma City Street Traction Company has been granted a charter to build an interurban railway from Oklahoma City to H[illegible], a distance of [illegible] miles, at an estimated cost of $10,000 per mile. The incorporators are: C. A. Swartz, J. P. Van Allen, C. E. Richardson, of Frederick; H. W. Curry, of Eaton; J. N. Street, of Bloomington, Ill.; F. B. Lucas, Samuel Ecker, J. E. Woodwroth and T. R. Clift, of Guthrie.

OKLAHOMA CITY, OKLA.—The Red River Railway Company has been granted a charter to construct an electric railway from a point on the Texas state line, north of Bonham, Tex., to Oklahoma City, a distance of [illegible] miles. The incorporators are: George F. Robertson, of Atoka; [illegible] M. Abernathy, [illegible] Hawk and [illegible] Hawk, of Lexington; Albert Rennie, of Pauls Valley; F. P. Kibbey, of Byars; J. W. Hocker, of Purcell, and T. H. Bayless, of Durant.

TECUMSEH, OKLA.—A charter has been granted to the Rapid Transit Interurban Company with a capital stock of $2,500,000 to build an electric interurban railway from Muskogee via Tecumseh to Chickasha, a distance of 137 miles; also a line from Tecumseh to Guthrie, a distance of 55 miles, and also a line from Tecumseh to Sulphur, 55 miles in length. The headquarters of the company will be at Tecumseh. The incorporators are: John A. Clark, S. B. Mitchell, J. W. Sapon, G. M. Ceissnor, T. J. Ray and M. H. Tennion.

Legal.

DECISION ON MAGNET CONTROL FOR ELEVATORS.—Judge Van Fleet, of the United States Circuit Court for the Northern District of California, has handed down a decision in the case of the Otis Elevator Company vs. Van Emon Elevator Company, enjoining the latter from making and selling elevators containing what is called the magnet control, as being an infringement of a patent owned by the Otis company, known as the Baxter patent. This suit was begun several months ago, and a motion made for a preliminary injunction. The device infringed consists of a switch, located in the car, arranged and operated by electrical connections with the motor switch, whereby the motor can be started, stopped or reversed at the will of the operator, to start, stop or reverse the movement of the car. The Van Emon structure, while differing somewhat in minor details of construction, such as the use of push buttons, instead of a lever switch, and a solenoid instead of an electro-magnetic device of horseshoe form, was held by the court to be an infringement of the patent.

ELECTRIC GENERATOR LITIGATION.—We are in receipt of the following from the Allis-Chalmers Company: There has appeared in the technical and popular press an item to the effect that the General Electric Company obtained an injunction against the city of Nashville preventing the use of certain electric generators manufactured by the Bullock Electric Manufacturing Company. This statement is, however, misleading. The facts of the case are as follows: A motion for preliminary injunction was filed by the General Electric Company against the city of Nashville alleging infringement of the Parcelle patent. This patent, which has but a few months more to run, covers very specifically a mechanical device for fastening the laminated pole-pieces of a dynamo-electric machine in position on the frame. This construction was employed in a few machines manufactured several years ago by the Bullock Electric Manufacturing Company, before its affiliation with the Allis-Chalmers Company; but has since been abandoned for a better device. The city of Nashville was given sixty days from the date of the court's order within which to make the necessary changes to avoid infringement. The simple changes required were readily made by the Allis-Chalmers Company, within the time specified, in such a manner that the operation of the plant was not interfered with for a single instant.

CONTRIBUTORY FOOLHARDINESS.—In the case of Shade vesus the Bay Counties Power Company, the Supreme Court of California has held that the deceased plaintiff was guilty of contributory negligence. The facts are set forth concretely in part of the decision as follows, in favor of the company: "The deceased was not a backwoodsman who had never heard of electrical plants and the danger which lurks in live wires—if, indeed, such a person could be found in California. He had been born and had always lived in the city of Vallejo, where, as in nearly every American city, electricity is used, was a business man, 28 years old, and of good intelligence. He knew the danger of live wires, but was not an expert electrician. He had not been placed by the negligence of the appellant in a position of peril from which he must by some means extricate himself, so that he might have been excused if he had not used the best judgment in trying to avoid danger. He was in no danger whatever. It appears probable from the evidence that he and his party could have driven past without any risk, as the distance from the hanging wire to the edge of the road was, at the narrowest point, nine feet and nine inches. However, it was not necessary for them to drive past. They could have turned back, and, if they could not have reached their original destination by some other road, they could have had their picnic at some other place; and, if they had suffered any serious wrong by the obstruction, they could have recovered damages. They were not even tempted by any business interests to incur the danger of trying to remove the wire, nor were they impelled by any sense of duty to do so. They were traveling merely for the purpose of pleasure. Exactly how near the deceased went to the wire does not appear from the testimony of the witnesses who were present at the time. One of them testified that he could not have been closer to the wire than 14 inches. It appears quite probable from the testimony of the expert electricians that the deceased did not receive the shock which killed him through the cord which he held in his hand; but that some part of his person or clothing came in contact with the wire, or was so close to the wire that the electricity 'sparked' or 'jumped' from the wire to his person. While standing so near the wire and being employed in trying to adjust the cord and pole he might readily have inadvertently moved nearer to the wire. At all events, it is clear that he unnecessarily, heedlessly and recklessly placed himself in a most dangerous position which resulted in his receiving the deadly shock. 'No other inference than that of negligence can be drawn from' his conduct. It was careless and negligent in the extreme sense, and is fitly characterized by the old phrase 'foolhardy.' Our opinion is that he was guilty as a matter of law of contributory negligence."

Obituary.

[illegible] mechanical and electrical engineer. Mr. White worked for the American [illegible] to form the White Electric Company in Buffalo. He is survived by his parents and one brother, Mr. Henry G. White.

COL. G. H. DAY.—We record with deep personal regret the death of Col. George H. Day, one of the fathers of the bicycle and automobile industries in this country. He died at his winter home, Daytona, Fla., on Nov. 21, of heart disease. George Herbert Day was born in 1851 at Brooklyn, Conn., and graduated from Hobart College and entered commercial life in Hartford, Conn. In 1877 he became the president of the Weed Sewing Machine Company, at Hartford, which contracted to manufacture the first bicycles for Col. Albert A. Pope, under Mr. Day's direction. The manufacture of bicycles soon superseded all the other work of his company, until in 1890, when the Pope Manufacturing Company, then with headquarters in Boston, absorbed the Weed Sewing Machine Company. In 1897 Col. Pope and Mr. Day, through the Pope Manufacturing Company, developed what was then the greatest surprise in the bicycle business, namely, the chainless bicycle. In 1887 one of the Columbia tricycles at the Hartford plant had been equipped with electric batteries and motor, but it was in 1894 that the question of self-propelled vehicles was taken up actively by the company and the motor carriage department organized. In 1899 the Columbia automobile interests were combined with the Electric Vehicle Company, of New York, and Mr. Day was elected to the presidency of the Columbia Automobile Company. Soon thereafter he was likewise elected to the presidency of the Columbia & Electric Vehicle Company, and became the president of the Electric Vehicle Company when the manufacture of Columbia automobiles and distribution was concentrated in that company. At this time he also was elected to the presidency of the Electric Storage Battery Company. During his incumbency the Riker Motor Vehicle Company was absorbed by the Electric Vehicle Company. In 1899 the interests which he represented acquired the control of the Selden patent, and after several years of litigation all suits pending were disposed of, and, largely due to Mr. Day's energies, all litigants were brought together with the best manufacturers in the country by the granting of licenses under the Selden patent and the formation on March 5, 1895, of the Association of Licensed Automobile Manufacturers. Thereupon Mr. Day resigned the presidency of the Electric Vehicle Company to accept the general management of the Association of Licensed Automobile Manufacturers, to which he devoted his time and energy, resulting in the rapid upbuilding of the strong association of wide influence now recognized throughout the United States and abroad. Mr. Day had likewise been prominently identified with the Western Automobile Machine Screw Company, of Elyria, Ohio, and the Hartford Machine Screw Company, in addition to which he was a director in a number of Hartford (Conn.) banks and three or more Connecticut insurance companies, as well as several other corporations. He was also a director of the Underwood Typewriter Company and one of the trustees of the Colt estate in Hartford, Conn. Only recently he had resumed his connection with the Licensed Association as the representative on its Executive Committee in behalf of the Electric Vehicle Company.

Personal.

[illegible]

SIR CLIFTON ROBINSON, [illegible] traction matters and management, is [illegible] terval of some years. He is a native of [illegible] associates of George Francis Train, who built the famous tramway in that town. [illegible] country, remaining five years and acquiring an intimate acquaintance with American street railways. He returned to Great Britain in 1871 and became connected with the Cork Tramways. Four years later he became interested in the Bristol system, and then again in the Edinburgh, introducing the cable [illegible] London. In the early stages of electrical development he came back to [illegible] the American Street Railway Association, and on his return to England, in 1891, became the advocate of electricity. In 1895 he was the engineer of the pioneer trolley system installed at Bristol, and since that time he has been constantly active in a variety of kindred enterprises. He is to-day managing director and engineer of the London United Electric [illegible] knighted by King Edward in 1905. He is a member of the Institution of Electrical Engineers of England and an associate member of the Civil Engineers. He has been the author of many technical contributions to societies and the press, and has received the silver medal of the Royal [illegible]

MR. ROY PARK [illegible] intendent of the Whitman branch of the Edison Electric Illuminating Company, of Brockton, Mass., taking the position made vacant by the resignation of Mr. Warren Redding.

MR. SAMUEL COOK, chief electrician for the Northampton Electric [illegible] elsewhere. Mr. Cook has been in the employ of the Northampton Com- [illegible]

[illegible] the Public Service Corporation of New Jersey, have resigned, as has Mr. Fred Evans, secretary, who will be succeeded by Colonel Hine.

MR. CHAS. C. LAPHAM, general manager and secretary of the Pacific Wireless Telegraph Company, Los Angeles, Cal., is spending some time in New York City in the interest of his company, which is arranging to install telegraph stations in the East for wireless communication overland.

[illegible] president and general manager of the Lehigh Valley Transit Company, the resignation to take effect Dec. 1. Mr. Hall has also resigned as director of the Allentown Electric Light & Power Company, to become effective at the convenience of the board of directors.

MR. H. VANCE LANE, vice-president and general manager of the Nebraska Telephone Company, has been elected president of the Rocky Mountain Telephone Company, with headquarters at Salt Lake City, Utah, to succeed Mr. George Y. Wallace, resigned. Mr. Lane has been connected with the Nebraska Telephone Company for 25 years.

MR. J. W. McFARLAND has been appointed general superintendent of the Macon Railway & Light Company, of Macon, Ga. Mr. McFarland was formerly superintendent of the Chattanooga Electric Railway Com- [illegible] previous to that was general superintendent of the Savannah Electric Company, Savannah, Ga., for eight years.

MR. C. W. WHITNEY has resigned as manager of the publicity department of Abner Doble Company and accepted a position as purchasing agent with the Ransome Concrete Company, of California, whose main offices are in the Crocker Building, San Francisco. In addition to the regular duties of his new office, Mr. Whitney will have charge as well of publicity matters for which his experience well qualifies him.

MR. GEORGE Y. WALLACE, of Salt Lake City, Utah, has resigned as president of the Rocky Mountain Bell Telephone Company, which operates in Utah, Montana, Wyoming and Idaho. Mr. Wallace has held the office of president for 20 years. He will remain with the company as chairman of the executive board, and will thus have a large voice in [illegible]

MR. L. C. MARBURG, until recently connected with the Allis-Chalmers Company as engineer to the contracting department, has just returned from a two months' vacation trip to Europe. During his stay [illegible] steam turbine and electrical work in Germany and Switzerland. He has not yet decided upon any definite plans for the future, but at present is making his headquarters in New York. Before joining the Allis-Chalmers forces in 1904, when the company entered the electrical field, Mr. Marburg had been connected with the railway department of the General Electric Company for over four years. Among the plants recently designed and partly installed under Mr. Marburg's supervision may be mentioned the main and sub-stations of the Indianapolis, New Castle & Toledo Electric Railway Company.

MR. [illegible] STEBBINS, [illegible] of general manager of the Texas Traction Company, which will put in operation within a few months an interurban railway between Dallas and Sherman, Tex. The line is being built by the American Railway & Lighting Co., which owns and operates six electric lighting and gas proper- [illegible] connected and for whose lighting properties he will act in an advisory capacity. Mr. Stebbins on graduation from the Massachusetts Institute [illegible] Company and had charge of its interests in connection with the many local electric railway and lighting companies in which it was part owner. [illegible] accept the general managership of the important system of interurban railways centering in Columbus, then owned by Mr. A. E. Appleyard. When these went into the hands of a receiver Mr. Stebbins was appointed manager under the receivers and conducted their operation until the early part of 1906, when their mortgages were foreclosed and they were reorganized. Just at this time the National Civic Federation commenced its investigation of the management of public utility companies, and Mr. Stebbins was offered and accepted the position of expert on electric lighting properties during the investigation. He has recently returned from an extensive trip to South America and Europe, undertaken for American and London financial interests. Mr. Stebbins pre- [illegible] American Street & Interurban Railway Association, and is universally [illegible]

Business Notes.

THE INDEPENDENT PNEUMATIC TOOL COMPANY, of Chicago, Ill., has appointed Mr. George A. Gallinger manager of the Pittsburg, Pa., office, at 1210 Farmers' Bank Building, where a complete line of Thor pneumatic tools and spare parts will be carried. Mr. Gallinger was formerly connected with the Chicago office.

THE INTERNATIONAL ELECTRIC & ENGINEERING COMPANY, of New York City, has moved from 150 Nassau Street to 148 Chambers Street, where it occupies a whole floor, which is divided into a stock room, office and a show room, and where it will pay special attention to the export trade, and to the selling of a general line of electrical supplies, besides handling special machinery. The firm is composed of Ralph Straschnow and Felix F. Wiener.

MESSRS. HAMPSON & FIELDING, of 1711 Tremont Street, Denver, Col., mining, milling and smelting machinery dealers, have established an electrical department, and in the future will carry a full line of electrical apparatus and supplies. The complete installation of lighting and power plants, and especially those for mine service, will be given special attention. They also conduct a general engineering business. L. M. McBride, formerly electrical engineer and superintendent of the Carstarphen Electric Company, has been placed in charge of the new department.

THE WHEELER CONDENSER & ENGINEERING COMPANY will remove its general offices from New York, N. Y., to its works at Carteret, N. J., on Jan. 1, 1908. The company is erecting an extensive addition to its present office building in Carteret to provide for the executive offices and to accommodate the increased force. Mr. William S. Love, who for the past eight years has had charge of the business of the Wheeler Condenser & Engineering Company in the Central West, and who for the past year has been in New York as general sales manager, will resume charge of the Chicago office of the company, at 1137-8 Monadnock Building, on Jan. 1, 1908.

THE BELL ELECTRIC MOTOR COMPANY, of 140-142 Prince Street, New York, N. Y., is making arrangements to move its factory from 435-437 West Broadway, New York, to Garwood, N. J., where it is erecting a plant, which will consist of a main erecting building, 100 ft. x 200 ft.; main repair shop, 50 ft. x 175 ft., and a power plant, 40 ft. x 60 ft. The company has installed a boiler plant and a hot-air system of heating, and is arranging to operate all its machinery by individual motors. The power plant will have a 100-hp equipment. The company manufactures motors and dynamos for power and lighting and does a general electrical engineering business.

THE FREDERICK PEARCE COMPANY, 18 and 20 Rose Street, New York City, which has long been known to our readers as expert manufacturers of high-class electrical mechanisms, especially those pertaining to telephone and telegraph work, police and fire alarm systems, etc., and which, something over a year ago, took over the business of the Willyoung & Gibson Company, widely known makers of high-grade electrical test instruments and scientific apparatus, announces that it has arranged with Mr. Elmer G. Willyoung, the former head and expert of the Willyoung & Gibson Company, to take charge of its instrument department. Associated with Mr. Willyoung will be Mr. Walter H. Pearce, son of Mr. Frederick Pearce. Both of these gentlemen are technically trained men of wide experience in this particular line. Besides the full line of Willyoung instruments, which will be made, including the well-known Willyoung induction coils for X-ray and wireless work, this department solicits special work of any kindred sort where exactness and finish in detail is required.

THE BALL & WOOD COMPANY, Elizabethport, N. J., announces to its customers and to all users of compressed air, the addition to its well-known engine business of a line of high-grade air compressors of new and advanced type, designed to meet the modern requirements for air compressing machinery equal in material and workmanship to the highest class of steam engine construction. These compressors are the product of its long experience in the design and manufacture of high-grade engines, combined with important new improvements in the air compressing elements of the machine. They are liberally designed, with large bearings and wearing surfaces, rigid frames, effective lubrication, ample valve areas and intercooling capacities, securing compressors which operate with minimum noise and friction and at the highest economy. Owing to the increased efficiency and output of these machines, they are offered at a price, based on actual capacity, which compares favorably with compressors of inferior design and cheap construction. Inquiries and investigation are invited.

SUNBEAM TANTALUM LAMPS.—The Western Electric Company reports large increasing business in the Sunbeam tantalum lamp. Many users are substituting this lamp entirely for the old-style carbon filament lamp. It is interesting to compare the service of these two lamps. The tantalum, as is well known, gives 20 cp and consumes only 40 watts, whereas the regular lamp gives 16 cp and consumes anywhere from 56 to 64 watts. While the first cost of the tantalum lamp is much higher, the saving resulting from its use will very soon more than pay its entire cost. The light given by the tantalum lamp is of a much whiter and more beautiful quality than heretofore known, and it has been the general experience that those who once try these lamps want them again. During the past two months more than 125,000 tantalum lamps were ordered for the sole purpose of replacing an equal number of the old type carbon filament lamps, which in itself is a very significant fact. It means that the tantalum lamp is to play a very important part in the [illegible]

Weekly Record of Electrical Patents.

[illegible]

[illegible] MEANS FOR DRIVING MOTOR ROAD VEHICLES; Martin Albrecht, Friedberg, Germany. App. filed Feb. 20, 1907. An electric transmission for motor vehicles, including motors geared to the front wheels and driven by a generator on the transmission shaft, which has the usual gear connections to the rear wheels.

[illegible]112. INDIVIDUAL ELECTRIC GAS LIGHTER; William K. Davidson, Boston, Mass. App. filed March 4, 1907. A small dry battery and coil are enclosed within a casing of a form adapted to be hung compactly on a gas fixture.

[illegible]139. ELECTRICAL SWITCH; Franz Orzel, Frankfort-on-the-Main, [illegible] filed [illegible] switch having a spindle [illegible] a switch element sleeved thereon and [illegible] temporarily held against action by a plate [illegible]

[illegible] ELECTRIC HEATER; Hugh [illegible] metal tubes having a spirally wound resistance element thereon and [illegible]

[illegible]161. ART OF PRODUCING PIGMENTS BY ELECTROLYSIS; Edwin D. Chaplin, Boston, Mass. App. filed Feb. 3, 1906. The [illegible] solving metallic lead in an aqueous solution of a non-akaline salt in the presence of a solube chlorate salt.

[illegible] similar to above patent for making lead chromate.

[illegible]

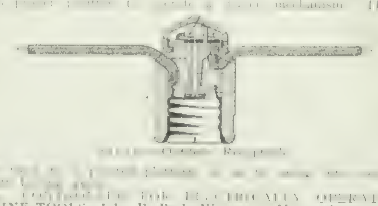
[illegible] N. Y. App. filed March 13, 1907. System whereby vapor electric devices may be utilized for supplying current to a load circuit which is subject to a back flow of energy, such as is formed by an induction coil and its interrupter. Has an inductive current path in shunt with said load and a non-inductive path for current also in [illegible]

[illegible]

[illegible]189. ALTERNATING-CURRENT MOTOR; Leo. Schuler, St. Louis [illegible] connections of which are moved at the will of the operator to reverse the direction of movement of the rotary member of the motor.

[illegible]192. OUTDOOR RECEPTACLE; James S. Stewart, New York, N. Y. App. filed June 6, 1906. A form of incandescent lamp receptacle for outdoor wiring. Is designed to be absolutely protected against ingress of water and contains a fuse in a specially constructed chamber. The threaded shell is positioned within this cup-shaped porcelain housing by a central projecting boss through which the central stud terminal extends. In this way a space is left for the wire connections.

[illegible]193. ARRANGEMENT FOR MOTOR DRIVES; Emmet W. Stull, Norwood, Ohio. App. filed June 30, 1906. Has a plurality of motors and unitary means, whereby one of the motors may be moved [illegible] mechanism [illegible]



[illegible] Outdoor Receptacle.

[illegible]

[illegible] CHINE TOOLS; John R. Back, Worcester, Mass. App. filed May 1, 1906. The range of movement of the controller handle is fixed by [illegible]

[illegible]1,205. CONTROLLING MECHANISM; Herbert W. Cheney, Norwood, Ohio. App. filed June 28, 1906. Provides means for breaking the main circuit of the motor in case the controller handle is moved too slowly and in case of overload and certain other improper conditions.

[illegible] GALVANIC BATTERY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Oct. 31, 1900. In a reversible galvanic cell, an alkaline solution; an electrode consisting of an [illegible] divided insoluble active material tightly packed in such inclosing pocket; and [illegible]

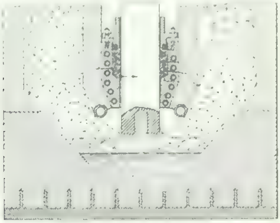
[illegible] CONTROLLER; [illegible] Norwood, Ohio. [illegible]

[illegible]
[illegible]
adapted to heavy currents.

[illegible] DEVICE TO DISCLOSE SHUNTING OF THE CIRCUITS [illegible] ELECTRIC METERS; [illegible] J. [illegible], [illegible] App. filed Jan. [illegible] [illegible] ing of the current in the wire leading into an electric meter and the service wire leaving it, and provides for the detection of attempts [illegible] the meter out of the electric circuit.

[illegible],239. SYSTEM OF MOTOR CONTROL; William F. Schneider, Norwood, Ohio. App. filed Nov. 11, 1905. Has a motor and two sources of current supply and remotely controlled means for connecting said motor to the two sources of supply in parallel or to one of said [illegible]

[illegible],273. ELECTRIC FURNACE AND METHOD; Paul L. T. Heroult, LaPraz, France. App. filed May 3, 1907. Construction of electric furnace having a pair of electrodes with a conductor adapted to form



871,338—Electric Furnace.

part of the path of the current there between and means for shifting the conductor to vary the length of the part of the path formed.

871,298. MAGNETIC SEPARATOR; Alfred Schwarz, New York, N. Y. App. filed Feb. 1, 1906. Concentrator table having riffles with magnets arranged beneath and closely adjacent thereto which are energized in a predetermined order to cause a transfer of the magnetic ore.

871,301. MAGNETIC SEPARATOR; Alfred Schwarz, New York, N. Y. App. filed April 7, 1906. Relates to modifications of the above.

871,338. ELECTRIC FURNACE; Paul L. T. Heroult, LaPraz, France. App. filed April 21, 1906. Features of construction of an electric furnace having special means for establishing good contact with the central electrode.

871,348. PANEL BOARD; Hubert Krantz, Brooklyn, N. Y. App. filed July 6, 1905. Has bus-bars cross-connected to the terminals of a plurality of fuse receptacles and adapted to be engaged directly by the fuse plugs therein.

871,352. SPRING BINDING POST; Horace G. Martin, Rutherford, N. J. App. filed Oct. 27, 1905. Sheet metal binding post having a bar with a transverse hole and a perforated washer spring impelled on said bar in the direction of said hole.

871,360. ELECTRIC AND PNEUMATIC GOVERNOR; William K. Rankin and Thomas F. Kelly, Philadelphia, Pa. App. filed Feb. 11, 1907. Relates to features of construction, including a plurality of horizontally operating and resiliently yielding catches with flattened tops and means to insure the flat top being always uppermost.

871,365. MAGNETIC SEPARATOR; Alfred Schwarz, New York, N. Y. App. filed Feb. 1, 1906. Relates to modification of No. 871,298.

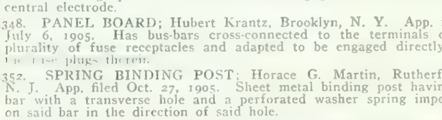
871,367. MAGNETIC SEPARATOR; Alfred Schwarz, New York, N. Y. App. filed April 7, 1906. Covers additional modifications.

871,378. RAILWAY SIGNAL; Louis H. Thullen, Edgewood, Pa. App. filed March 18, 1905. Mechanical construction for operating a semaphore [illegible] from an ironclad solenoid magnet disposed within the standard of the semaphore signal.

871,405. ELECTRICALLY HEATED SOLDERING IRON; Harry Hertzberg and Maurice J. Wohl, New York, N. Y. App. filed Feb. 11, 1907. An electrically heated soldering iron, including a hollow copper body, in which is received a plurality of asbestos sheets spirally wrapped with a resistance filament.

871,407. ELECTRIC CLOCK; Frank Hope-Jones, London, England. App. filed March 26, 1906. The secondary clocks having regulating means by which the vibrations of their pendulums are effective to produce a more rapid or slower movement of the escapement wheel.

871,424. SURFACE ELECTRIC RAILWAY; Timothy Mahoney, San Francisco, Cal. App. filed July 6, 1906. System of distribution for alternating current with a third or single sectional surface conductor-



871,348—Panel Board.

rail, which will avoid electrolysis [illegible] specially arranged reactance wind[illegible] choke coils.

871,442. TROLLEY POLE ATTACHMENT; Robert P. [illegible], Newark, N. J. App. filed Nov. 20, 1906. The upper section of the trolley pole has a yielding spring connecting with the main portion so as to yield in a lateral or in a forward and back direction.

871,[illegible]. ELECTRICALLY PROPELLED VEHICLE; Russell Thayer, Philadelphia, Pa. App. filed April 4, 1907. Has depending conductor [illegible], which may be dropped into engagement with the track rails so as to keep connection therewith, notwithstanding deviations of the vehicle therefrom.

871,468. TELEPHONE MOUTHPIECE; Anna Bebout, St. Louis, Mo. App. filed Jan. 28, 1907. A collapsible individual mouthpiece for telephones comprising a plurality of sections, the mouth section be[illegible] same, connections between the sections permitting such housing, and closures hinged at opposite ends of the mouth section.

871,470. TELEPHONE RECEIVER; Hiram E. Booth, Salt Lake City, Utah. App. filed [illegible] In a telephone receiver, the combination of a vibratory diaphragm, means for causing said diaphragm to vibrate for the purpose of producing sound-waves, and a porous and non-vibratory diaphragm arranged to receive the sound waves propagated by the vibratory diaphragm, with an air space between, said last-mentioned diaphragm consisting of front and back discs with interposed fibrous material.

871,479. ELECTROGENIC BODY DEVICE; Albert R. Cooper, Findlay, Ohio. App. filed Feb. 14, 1907. Construction of shoe having a small dry battery included in the heel thereof.

871,484. ELECTROMECHANICAL POWER GOVERNOR; George H. Davis, West Orange, N. J. App. filed Feb. 13, 1906. Has means for causing a plurality of electromagnets to act with differing force on a governor device comprising a sectional bar.

871,485. TELEPHONE WALL-SET; William W. Dean, Chicago, Ill. App. filed June 15, 1903. Telephone wall-set, including a casing which pulls down to expose interior call bell mechanism.

871,490. INSULATOR PIN MOUNTING; John D. E. Duncan, New York, N. Y. App. filed Jan. 21, 1907. The insulator pin is mounted on the cross arms of the pole by staples with threaded ends engaged by nuts. Has transverse cleats beneath the pin through which the staples pass.

871,496. PROTECTION OF RAILWAY TRAINS; Abel R. A. Gerard, Pontgivart, near Reims, France. App. filed May 1, 1906. Semi-automatic block signal system for railway, in which the train itself effects the operation of setting the signals after passing a section and in which the completion of the signals are effected by a local operator.

871,501. BOND FOR RAILS; Charles Y. Haile and George M. Hugus, Uniontown, Pa. App. filed May 17, 1907. The bond rail is passed in a zig-zag path through the web of the rail and through the fish plates thereof so as to prevent such fish plates from being surreptitiously removed.

871,513. ALTERNATING CURRENT MOTOR; Carl A. Lohr, Schenectady, N. Y. App. filed Sept. 7, 1905. In combination with an alternating current rotary field motor having a stator and a rotor, said stator having a number of poles different from the number of poles of said rotor, means for electrically connecting at will said stator or said rotor to a source of electricity.

871,519. PARTY-LINE TELEPHONE EXCHANGE; Samuel A. Norstrom, Chicago, Ill. App. filed July 14, 1905. The combination with a party line having a series of local stations thereon, and means controlled from a central office for causing the simultaneous advance of all switching mechanisms, of means also controlled from the central office for causing selected ones only of said switching mechanisms to return to normal position.

871,520. TELEPHONE EXCHANGE; Nils E. Norstrom, Chicago, Ill. App. filed Aug. 21, 1905. The combination with a ratchet wheel having one tooth removed, a driving pawl, and a holding pawl, of a special pawl, and a magnet for causing said special pawl to engage said wheel so that the driving pawl can drive the toothless part of said wheel past the holding pawl.

871,535. ELECTRIC WIRE CONNECTION; Frederick B. Thatcher, Providence, R. I. App. filed Jan. 31, 1907. A spark plug connection terminal having somewhat the form of a garter clasp to engage over a metallic button on the spark plug.

871,537. VOLTAGE REGULATOR; Max J. E. Tilney, South Kensington, Eng. App. filed Oct. 17, 1905. A method of automatically regulating voltage in electric light and power circuits with varying loads. Is specially applicable to circuits in which the load varies suddenly and to large amounts.

871,538. APPARATUS FOR INSURING SAFETY OF TRAFFIC ON SINGLE LINES OF RAILWAY; Edward Tyler, Dalston, London, Eng. App. filed Nov. 15, 1905. Method of working railway lines by the staff system in which a tablet issued from an apparatus which may be electrically controlled, must be received by an engine driver before he can take his train to the next section.

871,616. TROLLEY POLE CONTROLLER; Clarence Norland, Los Angeles, Cal. App. filed Nov. 19, 1906. The pole is impelled upward by a spring and is retrieved by a pneumatic cylinder set in action by an abrupt upward movement of the pole

871,652. AIR PURIFIER; Frank A. Ward, Los Angeles, Cal. App. filed Aug. 23, 1906. A rectangular box, contains an induction coil and a multitude of electrodes by which a high potential discharge can be passed therebetween. The ends of the box are perforated to permit a circulation of air therethrough.

871,667. PIPE CAP; William H. Blood, Jr., Wellesley, Mass. App. filed March 22, 1907. A form of hood for outlet connections of telephone conduits having among other features a plurality of minute projections around the edge which facilitate the draining of moisture therefrom.

871,675. OFFICE INDICATOR; Henry P. Davis, Hot Springs, Ark. App. filed Dec. [illegible] A [illegible] descent lamp is displayed on pressing the call bell in case the party called is not at home.

871,686. PLATINUM CONTACT; Anton Freier, Boston, Mass. App. filed May 13, 1907. A method of making the contact screws for vibrators so that the contact element is formed of a thin sheet of platinum on a base of German silver, thereby economizing the platinum.

871,737. TELEPHONE TRANSMITTER; Elias E. Ries, New York, N. Y. App. filed Jan. 11, 1904. In a telephone transmitter, two plates or electrodes and a film of liquid included in a circuit between them and adapted to vary the resistance of the circuit through capillary action when a [illegible]

871,758. BRIDGING BLOCKS FOR DYNAMO ELECTRIC MACHINES; Edward Heitmann, Montclair, and Frederick W. Young, East Orange, N. J. App. filed Oct. 18, 1906. Has a slotted dynamo electric machine element with windings located in the slots, and cast-iron bridging blocks insulated from the element and consisting of [illegible]

871,766. PROCESS FOR EXTRACTING GOLD AND SILVER FROM ORES; Gilbert Gurney, Berkeley, Cal. App. filed May 23, 1904. The process of extracting the values from sulfid ores, which consists in subjecting them to a solution containing perchlorid of a metal of two or more valencies, together with the chlorid of an alkali metal and a free mineral acid.

[illegible]. TROLLEY RETRIEVER; Alfred W. [illegible], Brookfield, Ill. App. filed Aug. 19, 1907. Covers a trolley retriever having a spring drum [illegible] which is rotated to retrieve the pole by a [illegible] powerful spring when the latter is tripped into action.

Electrical World

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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NEW YORK, SATURDAY, DECEMBER 7, 1907.

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INCANDESCENT LAMP TESTS HERE AND ABROAD.

A regular system for testing a certain small percentage of the incandescent lamps purchased and issued by large lighting stations was first inaugurated in the United States, in conjunction with a number of Edison electric lighting companies. At the present time the most complete system for the testing of lamps in this way is found in this country. Other countries have, however, adopted regular systems of testing incandescent lamps on demand at their national testing laboratories. An abstract of an article in the *Elektrotechnische Zeitschrift* on this subject appears in our digest in this issue. It will be seen that in Germany lamps are divided into types A, B and C, according to the watts-per-candle and to the length of life—A being the type of 300 hours to 80 per cent normal candle-power, and C being the type of 800 hours. Long tables are given in the article for the conditions of testing different types and voltages of lamps.

The conditions recognized in Germany, Austria and Switzerland, *i. e.*, in German-speaking countries, are substantially the same. The corresponding conditions in England are distinctly, although not widely, different. In the German countries, the lamp voltages run all the way from 45 to 250. This complicates the testing practice, because a type B lamp for 250 volts will consume more power than a type C lamp for 100 volts. In England there are but two standard voltages, namely 110 and 220, which simplifies the work, especially as only two types of lamps are recognized, namely, 400-hour and 800-hour lamps. In this country, we have practically only one voltage to consider, viz., from 100 to 125 volts. Our specific consumptions are usually either 3.1 or 3.5 watts per mean horizontal candle. and this permits of a still further simplification of testing practice.. In our first issue of August, 1907, we printed the U. S. Government Incandescent Lamp Specifications, as adopted this year between the Bureau of Standards and the various branches of the government service. Such tests are ordinarily conducted either in New York or in Washington. Up to the present time, all of the various government specifications above considered refer to carbon filament lamps only. It remains to be seen what changes will be brought about by the introduction of metallic filaments.

CARRYING CAPACITY OF CONDUCTORS.

Judging from inquiries received relating to the carrying capacity of conductors, there is no small misapprehension as to the meaning of that expression. The belief, in fact, appears to prevail widely among those not versed in electrical principles that the data given by the Underwriters' rules specifying the "carrying capacity" of wire have a significance similar to that attaching to the data of tables of tensile strength; in other words, that the limit set by the Underwriters' table is a physical [illegible] a few more lamps, there will result serious danger from overheated wires.

[illegible] ception is undoubtedly due to the misuse of the word "capacity." The carrying capacity of a conductor, using the expression in its broadest sense, is only limited by the melting point of the material of the wire; or in a restricted engineering sense, the term may apply to the limit of allowable drop. As used by the Underwriters, the term "carrying capacity" does not conform to either of the above criteria, the values in the Underwriters' tables being merely those of currents which, continuously existing in the given sizes of wire, will cause the temperature of the conductor to be increased under unfavorable conditions by about 18 deg. F. But another rule of the Underwriters decreases still further the "carrying capacity" of wires, namely, the requirement that a circuit branching from a cut-out shall not be connected to incandescent lamps creating a demand for more than 660 watts of electrical power. The object of this rule has, of course, no direct relation to the heating of the conductor, its purpose being to limit the amount of power available for damage in case of a break in the installation of the circuit or other fault. The Underwriters' tables of the world are based upon exhaustive experiments made about 20 years ago by Dr. Kennelly, who determined the values of the currents which, existing in insluated conductors encased in wooden molding and also strung in open air, will maintain the said conductors at a temperature of 10 deg. C. above that of the surrounding air. Except in the case of short conductors carrying large currents, such as feeders, this temperature limit usually reduces the drop below the economical point, and the low limit is still adhered to, though the wooden molding upon which it was based is a thing of the past.

Some numerical examples will illustrate the bearing of the above remarks. Taking the case of a No. 14 copper wire, the fusing current is about 250 amperes normally, but very much greater if the conductor is subjected to a current of air or is immersed in oil. If suspended in still air a current of 25 amperes will cause a rise in temperature of about 18 deg. F., or the rise will be 72 deg. F. for a current of about 45 amperes, the wire in each case having a black insulation. If the same wire is encased in wooden molding the rise in temperature is about 18 deg. for 12 amperes. The Underwriters' rules permit a current of 12 amperes with rubber insulation and 16 amperes with other insulation, except in the case of an incandescent lamp circuit controlled by a cut-out, where only 6 amperes at 110 volts are allowed. It will be thus seen that the current permitted in a conductor by the Underwriters merely limits the rise in temperature and this to a very small amount, the current being but a very small fraction of that which the same wire will carry without becoming heated to a degree near melting point, and much below what could with perfect safety be used in iron conduit. The present heating limit could with benefit and with no increase of fire hazard be considerably raised and thus made to correspond with modern methods of circuit insulation; on the other hand, if the rules should be revised, it would be wise from mechanical considerations to prohibit the use of No. 14 wire for interior wiring. In the meantime we strongly recommend that for the present incorrect head "Table of Carrying Capacity of Wires" the head "Limiting Currents for Conductors" be substituted, thus expressing what is actually meant and removing a source of much misunderstanding to many electricians and to all laymen.

Auxiliary Steam Plants.

The article by Mr. William Lee Church on this topic, printed in this issue, is one that can be read with profit both by engineers and investors. The economic features of hydraulic development are even now imperfectly understood, and there is often unreasoning prejudice against doing in the case of an energy transmission plant precisely what has been done for years in the case of mills. It is hard luck, of course, that streams now and then run very low and that occasional freshets drown out the wheels; yet one should rather be thankful for the variety of such incidents than mournful that a little use has to be made of steam. One of the chief difficulties with hydraulic power is that it is somewhat irregular. Every few years comes a season in which either the summer rainfall is greatly sub-normal or the spring floods are exceptionally severe. In the first case the flow may for a few days, or even weeks, fall far below the ordinary low-water mark; in the second. for a few few hours, or at most, days, the fall may be nearly obliterated. In some streams the former condition is the only one to be studied, but in most low-head propositions both are painfully in evidence. The existence of these periods of deficit calls for auxiliary plant if the salable power is to exceed the absolute minimum of the stream, and the length of the periods determines the proportion of steam energy that must be used.

A long-distance transmission plant frequently finds an auxiliary steam plant of great value merely as an insurance against trouble. There come times when it is very desirable to shut down a part or the whole of a plant for the readier execution of repairs to plant or line, and hence some steam reserve, preferably at the sub-station, is extremely useful, quite aside from any question of its use to help over the minima. A plant for such use should be large enough to take the whole load during its minimum hours. As such things go, the minimum load for, say, six hours is quite as much below the peak as is the longer hydraulic minimum; hence in many cases the same plant which is desirable for aid in time of trouble is also adequate for more long-continued aid in time of deficit of power. This phase of the affair is very simple and admits of little difference of opinion. It is when the development is carried so high as to call for some steam power a large part of the time that there is considerable room for its discussion. Taking the price for energy delivered into consideration, it usually turns out that every kw-hour actually delivered from steam is sold at a dead loss. It is the ability to recoup this loss by increasing the total sales of the hydraulic energy on which profit is made that is the economic justification of the steam auxiliary. Often, as in the case cited by Mr. Church, a small total amount of energy supplied from steam enables a large increase to be made in the gross earnings. In the instance given, a reserve supplying an average of 8.5 per cent of the total energy (over a period of six years) would, theoretically, double the gross income.

If this constituted the whole sum of the matter, the case would be a simple one, and the general economy of steam auxiliaries would require no further discussion. That the results are often good, Mr. Church's figures leave no reason to doubt. Yet there are some subsidiary matters that require consideration.

In the first place, it is by no means to be assumed offhand that doubling the amount of salable power will double the gross income of the plant. If the second 10,000 horse-power of output has to be sold on a narrow margin of profit, there may be trouble ahead. There is a tendency in transmission work to try to build up load too rapidly, and at a low price. It is better to lose money by not getting enough load than by getting unprofitable load, for the latter condition is the harder to remedy. If one has to cut the price much to double the load, either from lack of market or from seeking a lower-priced market as an incident to selling the larger output, there is an excellent chance of losing money if one goes too far into the steam proposition. If one is making net, say, 0.25 cents on each kw-hour of energy supplied by water, and losing 1.5 cents on each kw-hour supplied by steam, a year demanding 18 or 20 per cent of steam energy is a year of actual loss, which may be recouped later, but which is, to say the least, discouraging. Mr. Church is certainly wise in advising a cheap and simple steam plant to lessen the burden of fixed charges at times when it is not needed. Such a plant necessarily puts a heavy operating burden on the bad years, and there is a certain danger that in fairly good years the presence of a large auxiliary will serve as a temptation to take on more load than is justifiable. We have actually seen plants taking on load at prices suitable only for cheap water power when the increase forced the daily use of a very uneconomical steam plant designed simply for emergency use.

The actual cost of energy, including fixed charges, as derived from such an auxiliary is rather staggering when one comes to reckon it up. Mr. Church's long experience doubtless put him on safe ground in the case he had under consideration, but it requires a pretty good market and rather cheap hydraulic development to stand so large a use of steam as in this instance. We do not in the least criticise his judgment, yet it is necessary to suggest a good deal of caution in pushing a development up to the point that requires every few years the use of steam in large amounts for nearly half the time. It may pay and it may not, according to the circumstances. A plant ought to be able to show a reasonable return on the investment for each and every year of operation after it once gets fairly under way, in order to be what one would call a conservative investment. In most cases the deficit of power at certain times can be dealt with by less drastic means than a large auxiliary. It is not unusual to find a customer who already has a large steam plant and is willing to take at a fair price a block of power which is secondary to the extent of being at rare intervals temporarily unavailable. This is quite common practice in case of companies that sell water power as such. Again, the periods of low water generally come in the summer and early fall when load due to lighting is low, and hence a fair proportion of lighting load is highly desirable. Railway load, on the other hand, is often high at these times, and is for this reason somewhat less desirable. All this makes imperative a careful investigation of the actual market prior to settling the extent of the development especially desirable. An average requirement of 5 or 10 per cent of steam energy may be conservative or disastrous according to the local conditions. With different distributions of flow it might require a very big or a very modest auxiliary. While, therefore, Mr. Church's view of the matter is broadly correct, it takes a very thorough investigation to decide upon the actual economics of the situation.

LOSSES IN ALTERNATING-CURRENT CABLES.

It is well known that cables carrying alternating currents, for power transmission or distribution, do not behave so well as cables carrying corresponding direct-current strengths at the same voltage. The direct-current cables have a certain IR drop, and a corresponding I^2R loss of power; but that is all. So long as they are able to operate, their dielectric losses are negligible. Alternating currents develop e. m. f.'s of self-induction in the loop formed by the circuit carrying them, and these e. m. f.s produce a virtual increase of resistance by combining the ohmic resistance of the cable with a reactance, the vector sum of which is their impedance. The further apart the going and returning cables, the wider will be the loop they enclose, and the greater will be their reactance and impedance. A very marked increase in reactance occurs if each cable be enclosed in a separate pipe or sheathing of iron. If, however, the going and returning cables lie closely side by side, and within the same iron pipe or sheathing, their reactance will be small, and the impedance of the loop not greatly in excess of its resistance. The reactance of cables carrying alternating currents is objectionable on account of the increase in drop of pressure taking place under load. The drop increases from IR volts, the value with direct current, to IZ volts, where Z is the impedance, always in excess of R. But there is no appreciably greater loss of power on account of the reactances. The loss of power is still limited to I^2R watts, and the cable becomes no hotter on this account than before. It merely does not regulate the pressure so well.

The next item of offense on the part of alternating-current cables is their "skin-effect," or their tendency to crowd the current into the external layers of the conductor, and to leave the central portions of the cross-section unutilized. This effect virtually diminishes the active cross-section of the conductor, and, therefore, increases both the IR drop and the I^2R watts. The effect increases with the frequency, and with the size of the conductor. At the ordinary frequency of 60 cycles, the effect is negligible until the diameter of the wire exceeds ⅜ in. It is usually supposed that stranding the wire, so as to limit the development of eddy currents around the axis, practically stops this effect, even in large cables, so that no attention is paid in practice to skin effects in power cables since they are always stranded in diameters above ⅜ in. The next item on the docket of indictment against alternating-current cables is the loss in the dielectric, or insulating coating, due to the rapidly reversing electric stress. The cable behaves as though its insulation leakage G were much greater than the leakage to direct currents. This produces a loss of E^2G watts that heats the insulator, as though the I^2R watts had been increased. This effect does not appreciably alter the drop of pressure in the cable. In low-tension cables this E^2G loss is usually negligible, but in high-tension alternating-current cables, worked at pressures of 10 kilovolts or more, this indictment is a true bill, and the annual dielectric loss of energy may be much greater than the annual copper loss, because the dielectric loss goes on day and night uninterruptedly, whereas the I^2R loss is usually relatively small except at the peak of the daily load.

Now comes, however, from Germany and Switzerland, a new indictment of alternating-current cables. As noted in our

digest column in this issue, some tests have recently appeared in the *Elektrotechnische Zeitschrift* tending to show that the drop of pressure in fairly large stranded copper cables of from 400,000 to 800,000 circular mils is much greater than when they carry direct currents—from two to six times as great. This is when the going and return cables are laid side to side, so that the loop they enclose is very narrow, and the reactance consequently quite small. Under these conditions, a distinct small percentage increase in impedance might be looked for, but not 100 per cent or more. The author of the article attributes the increased *IZ* drop to the inductance of the spirals forming the lay of the copper strands, and the tests reported seem to indicate that the larger the spirals the greater this increase in drop. Nevertheless, we think that the case has not been sufficiently investigated, and that there is more to be learned by further research. The mere inductance of the loop in stranding seems inadequate to explain the matter. A concentric cable of about 400,000 circular mils in each conductor showed very little effect, whereas on the simple inductance theory the effect might have been expected. It is to be hoped that further experiments will be made along these lines, as the matter is of much practical importance. At all events, the tests reported indicate that in large stranded copper cables for alternating currents there should be introduced thin insulating barriers to break up the strands into bundles of not more than 150,000 circular mils each.

Dielectric Strength of Insulating Materials and the Grading of Cables.

When we realize that we have many air-insulated overhead wires that operate at pressures exceeding 60 kilovolts, whereas we have few electric cables operating at pressures exceeding 12 kilovolts, the importance of knowledge concerning the strengthening of cables under commercial limitations is made evident. A valuable theoretical paper on this subject has recently been read by Mr. Alexander Russell before the Institution of Electrical Engineers in London. In discussing the sparking distance in air between opposed sharp needle-points, the paper shows that the brush discharge from the points, which is seen in a darkened room to precede the disruptive discharge when the pressure is gradually raised, has a marked effect upon the phenomenon. Within a certain radius from the sharp points, estimated in the paper at 1 cm for a separating distance of 7.5 cms and 45 kilovolts alternating, the bush discharge ionizes the air, and renders it conducting. The result is that we are virtually dealing with two approximately spherical conducting knobs, each centered on a needle point and separated by about 5.5 cms. This shows how complicated the phenomena of the needle-gap may be, and how easy it is to obtain different results with this device, if the testing conditions differ. Indeed, the paper seems to recommend the use of spark balls in place of spark needles. The paper also points out that the effect of overstressing a simple cylindrical high-tension cable may be to carbonize the inner layers. At first thought one would naturally suppose that a cable, say, of ¼ in. internal dielectric diameter over copper strand and 1 in. external dielectric diameter under leaden sheath, would necessarily be weakened if the dielectric were carbonized for a radial distance of, say, one-sixty-fourth of an inch all around the copper strand, or, in other words, that since the rubber wall has been diminished from a thickness of ⅜ in. to 23/64 in., and replaced by electrically conducting carbonized matter on the inside shell, the carbonized cable must break down at a lower voltage. The paper shows, however, that this is not necessarily the case, and that until the diameter of the carbonized layer reaches 37 per cent of the external diameter of the dielectric, the electric stresses in the insulator may be reduced by the carbonization.

For reasons closely connected with the above conditions, aluminum is recommended as preferable to copper for some particular sizes or types of simple or ungraded cable. While this is in direct opposition to ordinary views on this subject, nevertheless the reasoning appears to be sound. An aluminum wire has a diameter considerably greater than that of an equally good conductor in copper. Consequently a cylindrical wall of rubber, or other insulator, of given thickness, must have more volume, weight and material over an aluminum wire than over the equivalent copper wire. Although that fact cannot be denied, yet if the volts per radial centimeter at the innermost layers of the insulators exceed the dielectric strength of the material, the insulator will break down and decompose in such a manner as to hand on the stress to the outer layers, where the curvature is less. The local volts per centimeter do not depend merely on the voltage across the wall and on the thickness of the wall, but also on the curvature of the wall. A flat layer of insulator, say, ¼ in. thick, will withstand a much greater voltage than the same thickness of layer bent around a small wire and, therefore, possessing a large curvature. The only way to avoid this curvature increase of electric stress in very high-tension cables is clearly either to use a copper tube or an aluminum wire for the internal conductor. In the ordinary cases practically met with, however, there is no need of a copper tube conductor since the working stresses are not excessive. An example of a cable, tested safely up to 150 kilovolts at the Milan exhibition, is referred to, in which the conductor is a copper strand surrounded closely by a thin leaden tube, 18 mm. in external diameter. The insulator consisted of three successive layers of rubber of graded dielectric constant, collectively 9.3 mm. thick, followed by a layer of impregnated paper, 5.2 mm thick. The total thickness of insulator was thus 14.5 mm, or 0.57 in. It seems likely that very high-tension cables will have to be graded cables, or composed of different successive insulating layers.

Maintenance of Lamps by Central Stations.

The constant shutting down of isolated plants by central stations and the rapid development of new electric illuminants are beginning to raise some question as to what will be the future policy of central-station companies in maintaining electric lamps for customers. At first thought, anyone acquainted with the business would say that the tendency is undoubtedly toward the more general maintenance of lamps by the central-station company. An increasing number of companies are adopting the plan of furnishing free renewals of incandescent lamps, and this has been the policy of the more progressive companies for years. Companies have also been in the habit of maintaining arc lamps for customers, and where substitutes for the arc lamp have been introduced, such as the Nernst lamp, the same practice has been followed. There is, on the other hand, a somewhat unnoticed tendency for many of the largest customers of large central station companies to buy energy by the wholesale, relieving the central-station company

of all responsibility as to the maintenance of lamps on the customers' premises. This has been done in many cases because the installation of the customer is so large as to require an electrician to look after this maintenance, and in some cases the customer operated an isolated plant before taking supply from a central station. When the central station took over the load, it was only natural for it to bid on supplying energy at the bus-bars of the isolated plant, leaving the other part of the plant to go on as before. It must be admitted, however, that except in the case of very large isolated plants, the central station has a good argument when it is able to say to the customer that he will be relieved of all trouble and expense connected with maintenance of lamps. As a matter of fact, the large central-station company is in a much better position to maintain both arc and incandescent lamps than is an isolated plant. The company purchases its incandescent lamps in large quantities under tests which insure its getting the best product and its lamps are likely to be better than those bought by the customer. It would, nevertheless, probably be surprising to learn the exact figures on the proportionate amount of the output of some of our large central-station companies which is sold wholesale to customers who look after their own installation entirely. As far as ordinary arc and incandescent lamps are concerned, the cost of renewals is so well-known to central-station companies that there is no difficulty in making a price on service with and without lamp maintenance.

Another factor which is sure to influence the situation in the next few years is the introduction of incandescent lamps costing considerably more than the regular carbon-filament lamp. The present indications are that the larger companies will start in with these lamps by giving them to customers upon the payment of the difference between the cost of the expensive high-efficiency lamp and the ordinary carbon-filament lamp. There will undoubtedly be some customers short-sighted enough at first not to pay the difference and secure the higher-efficiency lamp. On the other hand, if a company does not handle the high efficiency lamps at all, it is likely that they will be handled by outside dealers and that a great many customers will in time purchase them for such sockets as are used the greatest number of hours a day, just as the incandescent gas mantle is used instead of the open gas jet on the more important burners in a gas-lighted house. It is not to be expected, however, that with the present activity of central-station companies in developing business, they will play into the hands of gas and kerosene competition to the extent that they let all control of lamps and lamp maintenance go out of their hands into those of the customers and the local store keepers. They have too much at stake in seeing that their customers get the most light and best service possible for their money.

Billboard Lighting.

As we predicted some 18 months ago, the lighting of billboards and sign boards at night is becoming an important source of central-station revenue in some cities. The time will come when it will rank along with the sign business as a revenue-producer. In some cities the central station company has taken up the matter and is lighting billboards for the billboard customers at a certain rate per month, turning the lamps on and off just as under the common flat-rate sign contract. In other cities, the billboard companies have taken up the matter and are selling customers either lighted or unlighted billboards. From a commercial standpoint, billboard lighting is very much like sign and show-window lighting. It is used more hours per year than ordinary commercial lighting, and consequently involves a better load factor. It is the kind of load that helps to make a central station earn a larger percentage on its investment. There is nothing particularly new about the commercial questions involved, as it is simply a different form of sign and display lighting.

The engineering side of billboard lighting presents some interesting problems. The great part of billboard lighting by incandescent lamps which has been done up to the present time is accomplished in a very inefficient manner. It has usually been the case that when the contract is taken for billboard lighting, the man having it in charge must put up quickly some sort of illumination equipment, utilizing what is most conveniently at hand and without going into a scientific study of the problem. The lighting of a billboard with a row of incandescent lamps without wasting a large amount of light is not by any means easy, although it may appear simple at first sight. Efficient billboard illumination means that the light which is given out in all directions from a row of lamps must be efficiently reflected so that the flux of light is confined to the comparatively small angle covered by the billboard. It is the show-window lighting problem in a much more difficult form, for the lamps and reflectors must withstand the weather, and, as far as possible, the stones thrown by the mischievous boy. Furthermore, the light must be confined within a narrower angle than in a show window, and in order to avoid excessive light at the top of the board and insufficient light at the bottom, the distribution must be carefully planned to give a very high candle-power in the direction of the bottom of the board and much less near the top, if the lamps are to be placed at the top, as is usually the case.

No common form of painted trough or cone meets these requirements, either as to efficiency of reflection or proper distribution of light. Where some of the lamps can be placed below the board, as is the case when it is installed on roofs of buildings, the reflector problem is considerably simplified. The flaming arc lamp, when hung high above a 25-ft. billboard, gives excellent results. On account of the lavish quantity of light obtainable from a flaming arc, one does not need to be so particular about utilizing it efficiently, as with incandescent lamps. Consequently, even though considerable light is wasted by an inefficient shield, it still has a great advantage in efficiency. A shield on the side of the lamp away from the board should always be used to keep the light from shining in the eyes of those who are trying to read the board. The principal point to be avoided in the use of flaming arc lamps for this purpose is to hang them at such an angle with reference to the board that the glare of regular reflection from the paint will not prevent ordinary passers-by from reading what is on the board. In other words, the angle from the arc to the board should not equal the angle from the board to the passer-by. The use of flashers for lighting and extinguishing the lamps at regular intervals is even more effective in the case of billboards than in the case of electric signs. Such flashers reduce the cost of energy necessary for incandescent-lighted boards considerably, and reduces the disparity between the efficiency of the incandescent lamp and flaming arc.

Hydro-Electric Development in North Carolina.

The Whitney Power Company has just begun work on a power house designed for the generation of 46,000 horse-power for distribution throughout the Piedmont section of North Carolina. The plant is situated on the Yadkin River, near Salisbury, N. C., and is one of the largest power developments undertaken in the South. The power building will be of concrete and have a floor plan of 90 ft. x 260 ft. A large amount of canal excavation remains, but six steam shovels are now at work and 20,000-lbs. of dynamite in one section will mark the final blast along the canal, though there will be touching up along its course for some time. From the crest of the dam to the tail race there will be a fall of 130 ft. The flumes for the six turbines are 700 ft. long by 12 ft. in diameter. A derrick has been raised and the current of the river is being changed by a coffer dam to enable the work of excavation to begin. The railroad has been extended from Whitney, N. C., below Palmer Mountain, where the power house it to go up, and daily materials for the building of the power house are being hauled.

The T. A. Gillespie Company has the contract for the development, and, so far, built, a road over 10 miles in length, has moved 2,000,000 cu. yds. of dirt and put 400,000 tons of granite in the greatest dam in the Southern States.

The energy generated at the Whitney plant will be furnished to manufacturers in Lexington, Thomasville, Greensboro, High Point, Charlotte and many other towns within its range of distribution. The total cost of the plant will be about $5,000,000. The headquarters of the company are at Salisbury, N. C. Surveys have been made and plans adopted for two other plants in the same neighborhood, which will produce 90,000 horse-power. The Whitney Company has laid out a town of 600 acres near the power house and is offering special inducements to manufacturers. The company has its own granite quarry, four miles from Salisbury, N. C., where all the stone required in construction is being obtained. It also owns some 10,000 acres of land in Rowan County and expects to spend large sums on development.

Mr. Gillespie states that the Whitney Company will also develop a fall four miles below the narrows and erect another plant capable of generating 40,000 horse-power.

Consolidation of Lighting Interests at Baltimore.

A consolidation has been effected of the electric lighting and power interests in Baltimore, by which the Baltimore Electric Company passes into the control of the Consolidated Gas. Electric Light & Power Company of that city. There is a probable further change of ownership involved as to the Maryland Telephone Company, controlled by the Baltimore Electric Company, which is now negotiating for its transfer to the Bell interests in the Chesapeake & Potomac Company. Mr. S. Davies Warfield, who has conducted the negotiations, has issued the important and interesting statement given below as to the nature and terms of, and the reason for, the merger in question:

"The Consolidated Gas, Electric Light & Power Company has taken a lease of the property of the Baltimore Electric Company. The lease will run for 999 years, and under its terms the Consolidated company will pay to the Baltimore Electric Company an annual sum equal to the interest on the bonds of that company outstanding and to interest on its outstanding 5 per cent preferred stock, provided that company does not earn these requirements. It must be understood that the securities on which interest and dividends are thus provided for represent actual cash invested in the properties of the Baltimore Electric Company. The electric light and power business of the Baltimore Electric Company will have $2,205,000 of bonds on which to pay interest after deducting the income received from other sources. There is $1,000,000 of preferred stock.

"It has been known by all familiar with such matters that electric energy has been sold in this city at a price below the cost at which it could be produced, and far below that at which it is sold in any other city of the United States where it is produced under similar conditions. It could therefore only be a question of time when these companies must either have privately agreed on a uniform rate or one company pass under the management of the other. It has been my belief that agreements on rates or division of territory between companies operating in the same field were unwise and any proposition of this description was, therefore, never considered.

"I am a believer in the development of the electric field in and around Baltimore. I believe that in supplying abundant electric energy for industrial purposes the development of the manufacturing interests of this city will receive an impetus impossible to be obtained from any other source. All this requires large outlays of money. This money is secured by the sale of the securities of these companies. You cannot sell the securities of a company to advantage when that company is forced to sell its product made by the use of money received from the sale of its securities at a price less than it cost to produce that product. Therefore, when a community secures electric energy at less than its cost of manufacture the effect of compelling such a destructive policy is to stop the investment of money in providing the essentials for the manufacturing or business growth of a city. The result of such a destructive policy was to produce a deficit in the operations of the Baltimore Electric Company from the electric portion of its business after paying interest on its bonds, which, of course, is now to be stopped by receiving a reasonable rate for energy.

"The leasing of this company is but one step in the plans for the development of the electric field. The Consolidated Company has at Westport one of the largest and best equipped electric power stations in the country. As is known, arrangements have been completed with the McCall Ferry Power Company by which the Consolidated Company is to receive a large amount of electric energy generated on the Susquehanna River. The energy from the river will be conveyed therefrom to the city boundary, where it will be turned over to a distributing company. For this purpose all the stock of the Maryland Securities Company has been acquired. This was formerly owned by interests identified with the Baltimore Electric Company, and comes to the leasing company by the purchase of its stock.

"The Maryland Securities Company, which will form the basis of distribution of this river power, will be the company which will own the common stock of the Baltimore Electric Company, which has now been purchased. All the capital stock of the Maryland Securities Company will, of course, be owned by and held in the treasury of the Consolidated Gas, Electric Light & Power Company. In the general plans outlined there are no promotion stocks, no increase or exchanges of securities. Only the machinery necessary to properly conduct a business of the magnitude as that contemplated has been provided. The direct benefits from these various sources will belong to the Consolidated Gas, Electric Light & Power Company.

"Through the Maryland Securities Company the large users of electric energy for manufacturing purposes, located principally in Baltimore County and around the city, will receive their supply, while the commercial motor service within the city and energy for electric lighting will be supplied by the Consolidated Company and the Baltimore Electric Company.

"As stated, under the contract with the McCall Ferry Power Company, the Consolidated Company will sell to that company energy generated from steam at its stations at times when the steam stations of the Consolidated Company are not necessary in the operation of its own business, to enable the McCall Company to make what is called permanent power out

of what is termed non-permanent water power on the river. Thus will be seen the relief service the Consolidated Company will have to offer its patrons. It will have a large supply of power from the Susquehanna River; it will have the product of the large, steam-driven power station at Westport and substations, and with the newly acquired property it will now have the modern station of the Baltimore Electric Company.

"Under the proposed plans for operating the Baltimore Electric Company in harmony with the Consolidated Company and using energy from the Susquehanna River, a broad and comprehensive system for supplying this city and suburbs with electric energy for lamps and motors can be completed, and the immense outlay of money necessary to its success can be obtained when purchases of bonds for extensions and improvements can be assured of safe investment for money paid the companies.

"In this connection I might state that the management of these companies have full regard for the rights of the public and the duty of these companies to the city and to the people. Unreasonable rates shall not be charged and I am able to state as a result of the plans developed and developing and briefly outlined, the people of Baltimore shall be able to purchase electric energy at a price lower than that charged in any of the large cities of this country. It will be the policy of the Consolidated Company to maintain prices below those of the other cities.

"To enable this to be done we must ask fair treatment from the city and state in the matter of taxes. If the people are to have the benefit of cheap light and power we must be given the benefit of at least reasonable taxes. The taxes now paid by the Consolidated Company are about 9 per cent on the entire gross receipts of that company. That company now turns over a larger proportion of its gross earnings to the city and state in taxes than any corporation doing a similar business in any of the large cities of the country."

Boston Edison Rates Defended.

A final hearing was held by the Massachusetts Gas & Electric Light Commission on Nov. 26 in relation to the Public Franchise League petition for an equalization of rates charged by the Boston Edison Company. Mr. E. W. Burdett for the company emphasized the point that of its 30,000 customers but a mere handful appeared to express dissatisfaction. The earnings of the company are reasonable, amounting to practically 5 per cent on its investment. Many authorities and court decisions were cited to show that a differential in rates was not only justified but required whenever there is a difference in the cost of supply.

Mr. Burdett stated that "the commendable purpose of the organization which brings about the complaint is alleged to be to help to bring about fair and friendly relations between the public service corporations and the people. The confidence and approval of the thinking men in the community is the breath of life to such corporations. The time for the display of corporate arrogance toward the public has long ceased to be. The company must in its own interest seek to retain the confidence and respect of the public which it serves. In doing so it must not permit itself to be swayed by popular clamor into the abandonment of sound business principles. It cannot seek popularity if thereby it invites ultimate disaster. For the mere sake of seeming to go right it must not in fact go wrong. It has a right to rely upon its superior knowledge of the principles and practice of the industry in which it is engaged. The Edison Company has a larger consumption of its product per capita and a wider distribution of its service among possible customers than in any of the other cities with which is has been compared, and the alleged widespread dissatisfaction with its prices and methods does not exist. The company seeks the affirmative endorsement and commendation from the commission and public which it believes it merits."

Secretary Eastman of the Public Franchise League concluded by urging that a flat and fixed rate per kw-hour should be charged all customers. The league believes in a sliding scale system, but thinks that the time is not ripe for its use in electric lighting. The board took the matter under advisement.

Changes in National Code Recommended by Inspectors.

At the convention of the Western Association of Electrical Inspectors, held at Hotel Ryan, St. Paul, Minn., Oct. 22, 23 and 24, 1907, action was taken on recommending a number of changes and additions to the National Electrical Code. Out of 73 proposed amendments recommended by the committee, 24 were acted upon favorably and will be urged upon the electrical committee of the National Electrical Association for incorporation in the National Electrical Code. Some consideration was given to a rule prohibiting the use of molding. This, however, was not among those finally adopted by the association and recommended for the national code. It was recommended that a note be incorporated in the code recommending the use of nothing but conduit in show windows.

The following rules and additions were also recommended by the association:

A rule forbidding the dead-ending of a 4½-ft. run on a cleat-type socket or rosette.

A rule requiring petticoat insulators or waterproof conduit on all interior work where water collects or condenses.

Add specifications for waterproof sockets and fixtures in damp places.

Require manufacturers to furnish as a component part all portable fans, etc., a certain length, say 10 ft., of approved portable cord.

A requirement for lamp bases to be protected from accidental contact by persons handling the lamp.

Require wiring in refrigerating rooms, paper mills and other locations exposed to dampness to be in drained conduit or on petticoat insulators.

Rule 3-b. Strike out all words after the words "Non-combustible material."

Rule 3. New classes requiring switchboards to have main switch, main cutout, ammeter, voltmeter and ground detector.

Rule 12-g. Change the last sentence of the fine print note so as to read: "The outer or weather end of conduit is to be provided with an approved device having wires separated and bushed through porcelain."

Rule 13-a. Make grounding of transformer secondaries compulsory when primary exceeds 550 volts. (A number of public service corporations protested by telegraph against the approval of this amendment.)

Rule 14-b. Add following sentence: "For wires smaller than No. 8 B. & S. split knobs shall be used and tie wires and knobs will not be approved.

Rule 14-c. Add a note to indicate a method of insulating a splice on low potential work which would be approved.

Rule 14-c. Omit fine print note as some joints are now approved for use which do not require soldering.

Rule 14e. Omit last sentence which gives inspector power to permit wires in contact with pipe.

Rules 18 and 20. Do not allow the use of series arc lamps.

Rule 22-a. Provide that service switches shall not be less than 25 amperes capacity.

Rule 24-a. Fine print note. Specify what are approved barriers for 300-volt work.

Rule 24-n. Permit use of slow-burning weatherproof insulation in conduit exposed to heat in dry places.

Rule 24-u. Require "Flexible tubing at combination fixtures to be fastened by tape or otherwise to the gas pipe."

Rule 26. Add a requirement for movable canopies so as to permit inspection of splices and insulating joints.

Rule 45. Add a new section giving specifications for approved stage cables, such as are required by the theatre rules.

Rule 54-c. Add this sentence: "Flexible tubing may be used as bushings if run in continuous lengths from the last porcelain support outside to first one inside the box or flush up to base of fittings, i. e., cut out or switch.

Legal Readjustment of Rates at La Crosse, Wis.

The following main points of interest in the decision of the Wisconsin State Railway Commission in respect to the application of the La Crosse Gas & Electric Company for the right to charge higher rates for electrical energy are worthy of attention because of the issue involved. The testimony and facts presented by the petitioner relate mostly to the history of electric lighting in La Crosse; to the character and capacity of the electric plant; to the earnings and expenses of the company for the past 5½ years; to the assets and liabilities of the same period; to the rates which the company was asked to establish; to the various systems of fixed rates that are now in use, and to many other questions that are involved in the case.

From the facts relating to the value of the plant and to its earnings and operating expenses, the Commission says it is quite clear that the plant has not been a conspicuous success as a producer of net earnings. This is especially true when some allowance is made for depreciation at 3 per cent. During the past two years, the net earnings were not enough to meet ordinary depreciation charges, much less any interest upon the investment; and so long as the rates charged for energy remain as low as at present there is but little hope that the net earnings will increase. The decision takes up one of the most important features of the problem—the cost to the company of serving each class of customers. On this point the Commission says:

"When the fixed expenses are prorated upon the total kw-hour capacity of the plant, which was 10,950,000, and the variable expenses are prorated upon the actual kw-hours sold, or upon 1,705,118, the cost per kw-hour for the consumer who consumes energy or who uses his lamps 24 hours daily will be found as follows:

"Fixed expenses, 0.83 cent per kw-hour; variable expenses, 2.87 cents per kw-hour; total, 3.60 cents per kw-hour. When the fixed expenses are prorated upon about 4.17 per cent of the total capacity, or upon about 456,255 kw-hours, and when the variable expenses are prorated upon the kw-hours sold as above, the cost per kw-hour for the consumer who uses his lamps only 1 hour per day will be found. It is approximately as follows: Fixed expenses, 19.90 cents per kw-hour; variable expenses, 2.87 cents per kw-hour; total, 22.77 cents per kw-hour. If the expenses are separated, between fixed and variable on the other basis outlined above, that is, if rental, depreciation, interest and certain other items are divided between both the fixed and variable expenses, instead of being classed as fixed expenses entirely, the results will be somewhat different from those already presented. In that case the cost per kw-hour would probably be close to 5.50 cents for those who used the energy 24 hours daily, and not far from 15.50 cents for those who use the lamps about 1 hour per day only."

The difference in the cost to the corporation in serving patrons for a longer or shorter time per day is then shown to be as follows:

"The respective total costs for 2, 3, 4, 6 and 8 hours' use per day are as follows: Two hours daily, 11.48 cents per kw-hour; 3 hours daily, 8.48 cents per kw-hour; 4 hours daily, 7 cents per kw-hour; 6 hours daily, 5.50 cents per kw-hour; 8 hours daily, 4.74 cents per kw-hour."

Referring to the new schedule, favored by the company and established by the Commission, the state body says:

"In fact, the schedule itself, which can almost be said to be a combination of the 'readiness-to-serve' and the 'maximum demand' methods, is so made up that it appears to meet fairly the requirements in this case. This is significant. It constitutes a strong argument in favor of its adoption. As intimated, however, the adjustment to the cost is not uniform for all the rates. The highest rates in the schedule, for instance, or those for 60 hours or less per month, are somewhat lower than the indicated cost of the services rendered to these classes of users. The reason for this, however, is not found in the faulty method of computation, but in a city ordinance which limits the maximum rate to 10 cents per kw-hour, [illegible] cost for the 1-hour and for 1½-hour consumer is greater than 10 cents. Even those who use the energy equivalent to 2 hours daily may almost be included in this class. Under the proposed schedule, therefore, the short-hour customers, who comprise mostly the residence district, will contribute relatively less to the revenues of the company, when measured by the cost, than the long-hour customers. This is an inequality, however, that it is difficult to adjust so long as the present ordinance remains in effect. It is, of course, possible that it may be obviated by radical improvements in the methods of operation or production, but the chances for this are rather remote."

"Some of the rates for energy for motors, as given in the schedule, may appear to be lower than warranted by the cost in these cases. It is true these rates are quite low, but it is not clear that they are unprofitable. Upon an examination of the facts it will be found that there is a great deal to be said in favor of comparatively low rates for energy for motors. The maintenance charges for the distribution of energy for motors are lower than that for lamps. The consumption of energy, both as to maximum demand and hours used, is also much greater in the former case and this materially reduces the cost per unit. The energy for motors is produced during that part of the day when little or no lamps are used, or while the plant is simply holding itself in readiness to supply such demand for lighting as may be made upon it. There may also be sharp competition between the electric plants on one hand and steam and gasoline plants on the other. For these and other reasons it is customary everywhere to grant much lower rates for energy for motors than for lamps."

That the new schedule of rates is lower than those in effect in any other city within or without Wisconsin, is held. The decision says:

"It further appears that the proposed rates are somewhat lower than those charged in other cities, both inside and outside of this state. The comparisons we have made upon this point are quite extensive. They embrace at least 20 cities in Wisconsin and fully as many in other states. These facts are of considerable importance, not only to the petitioner, but the people who are served by this company.

"The petitioner has duties as well as rights in this matter. While it is entitled to reasonable rates for services it renders, it has not the right to exact more than this. It must also see to it that the services it renders are adequate and that they meet all reasonable requirements in this respect. It is as important that the interests of the public it serves should be as fully protected as those of its own. The best rates are those that are based upon the cost. Each customer should under ordinary conditions contribute his just proportion of all the expenses, as well as of the interest upon the investment.

"From the foregoing examination of the facts involved in this case it appears to us that the rates submitted by the petitioner fairly meet the situation, and that they are just and reasonable. It has been determined, therefore, that these rates shall be put into effect, subject, however, to such revision as may be found necessary when the plants in question have been appraised, or for other reasons. The causes which led to this application, and because of which an increase in the rates is authorized, are of such character as to bring this case within section 99, chapter 499, laws of 1907, which provides for emergency rates under certain circumstances. As soon as practicable after the appraisals of the plant, which have been decided upon, have been made, it is our intention to continue this investigation. Any of the rates in the order herein which are then found to be in a respect unreasonable will be promptly adjusted upon a fair and equitable basis. It is, therefore, ordered that the petitioner in this case, the La Crosse Gas & Electric Company, in lieu of the rates it now charges for electric energy for motors and lamps, shall substitute the following maximum rates:

"The service charge on all lighting and installations shall be $1.80 per year per 16-cp lamp, or equivalent demand, one-third of connected installation, or when one-third of the con-

nected installation is considered to be the demand. The meter rate for a consumption equivalent to 60 hours or less per month per each installation shall be 7½ cents per kw-hour. The meter rate for a consumption equivalent to more than 60 hours per month per each installation shall be 6 cents per kw-hour. The meter rate for 'patrolled service,' or for signs and other installations with fixed hours of use, shall be 5 cents per kw-hour.

"The service charge for motors shall be $27 per year per horse-power demanded. The meter rates for less than 5 hours per day per horse-power demanded shall be 5 cents per kw-hour. The meter rate for over 5 hours, but not exceeding 10 hours, per day per horse-power demanded, shall be 3 cents per kw-hour. The meter rate for over 10 hours per day for horse-power demanded shall be 2 cents per kw-hour."

Lightning Protection.

Dr. C. P. Steinmetz lectured before the Chicago section of the American Institute of Electrical Engineers, Nov. 26, on "Lightning Protection." The meeting brought out the largest crowd of electrical engineers that has been assembled in Chicago for many years. Dr. Steinmetz related the history of lightning protection for electric circuits. The necessity for lightning protection of electric circuits was first felt on telegraph lines. On these lines the problem was simply solved by placing a spark-gap so as to shunt lightning discharges to ground before they reached instruments and apparatus. Circuits carrying electric energy, however, required different treatment. Besides being able to divert lightning discharges to ground, they must be made to interrupt the current from the generator after the lightning discharge had passed over the spark-gaps. On direct-current circuits, the problem of interrupting the current from the generator was solved by the use of magnetic arc rupturing devices which blew out the arc as soon as it was fairly established. For alternating-current circuits, use was made of the horn arrester principle, where the arc was ruptured by traveling upward between a pair of horns which gradually increased the length of the arc until the air currents blew it out.

The next step in lightning arrester development was the result of investigations by Wurts with non-arcing metals. A number of spark-gaps were placed in series between the line and the ground. Such spark-gaps, consisting of cylinders of non-arcing metal, have the characteristic of requiring high voltage to reverse the arc, so that the arc is extinguished at the zero point of the alternating wave. Such non-arcing multi-gap arresters worked well with small dynamos, but with large power stations they burned up. While such arresters protected against lightning discharge, they would short-circuit and shut down the system in doing so.

The arrester problem is one of opening the circuit without shutting down the system. One method of doing this which was tried was to put a resistance in series with the spark-gaps. One company which made arresters with series resistance proved theoretically that this series resistance was not detrimental and that it allowed discharges to pass freely to earth. Another provided no series resistance and talked of the advantages of allowing unlimited discharge current to pass to earth. The next year both companies reversed policy. The next step was to provide a shunt resistor around some of the spark-gaps of an arrester. In this construction, the voltage required to establish a discharge to earth is only that necessary to jump the spark-gaps between ground and the point where the resistor is connected. Should the discharge be of sufficient volume to establish across the shunt resistor a voltage great enough to jump the spark-gaps in shunt with it, a part of the discharge will pass to earth without going through the shunt resistor. The arc established on the upper gaps in shunt with the resistor is very unstable, and extinguishes itself easily.

The difficulty experienced with the shunted arrester was that if a low resistance were used, it would be safe as to the volume of the discharge it would pass, but discharges of large volume frequently repeated would explode the resistor. If the resistor was made of wire, it would burn out. If it was a mixture of clay and graphite, the resistance would be very changeable. The difficulties with clay and graphite resistance mixtures led to the introduction of a more satisfactory resistor, namely, cast-silicon, which has about 10,000 times the specific resistance of copper.

A further development of the shunted multi-gap arrester consisted in the use of several resistors. A resistor of low resistance of considerable current-carrying capacity is shunted around a small number of gaps, an additional resistor of higher resistance of less current capacity is shunted around more gaps, while a third resistor of very high resistance is shunted around the greatest number of gaps. Minute discharges pass over the high resistance, and through the small number of spark-gaps to ground. Heavier discharges will cause voltages which will jump a larger number of spark-gaps and allow discharges to pass through the resistors of lower resistances. This arrester has a great range and is very succesful when the resistor of low resistance is indestructible. It is not good for very large interconnected systems.

Dr. Steinmetz called attention to the fallacy of the triangular arrangement of insulators and transmission lines on iron pole lines. The top conductor, in such a case forming the highest point on the line, can not be protected, as it is located on the top of a lightning rod at the very place to be struck by lightning. A lightning rod carried up from the iron pole to a point above the uppermost wire is a little better than nothing, as in such a case, if the pole were struck by lightning, the insulator may not be shattered, but the lightning discharge will ground the line. The systems in which there is a large amount of underground construction are susceptible to troubles from operation similar to those caused by lightning, because of the electromagnetic and electrostatic energies which are stored in the normal operation of an electric circuit. Circuits with capacity and inductance are, in some cases, susceptible to great voltage rises, owing to their electromagnetic energy and the effect of suddenly interrupting the flow of this energy. The destructiveness of this "internal lightning" increases with the size of the system. These phenomena are always oscillatory in character, and may have a frequency of from ninety to many hundred million cycles per second. The higher the frequency, the less the power and destructiveness of the discharges. The discharges of such circuits may be compared to the action of a hydraulic ram, in which the stored energy of a long column of water is made to produce an abnormal discharge of water at one point.

Dr. Steinmetz then discussed the recent developments in lightning arresters of the types which oppose a counter e. m. f. to the line voltage. With a counter e. m. f. equal to that of the line, it is evident that the current passing to the ground by a lightning discharge is equal to that produced by the excess of the discharge voltage over the line voltage. A storage battery would be one means of providing such a counter e. m. f., but would be impracticable. An electrolytic cell, in which aluminum is the positive terminal, allows no current to pass except that caused by a voltage over and above the regular line voltage, while voltages in excess of the line voltage will cause a discharge through the cell. For alternating current, both electrodes or plates of the cell are of aluminum. Aluminum cells have the peculiarity that they have no definite polarization voltage. The counter e. m. f. which it opposes to the line builds up until it is equal to the line voltage. In the aluminum cell, only a small continuous current can exist, since the cell has a resistance as far as the line current is concerned of about 30,000 ohms per square inch of plate surface. A spark-gap can be placed in series with the cell, but since the cell must then stand on open circuit it gradually loses the film which opposes a counter e. m. f. to the line, and if left for several weeks becomes simply a water rheostat. The cell can be kept built up by connecting it in circuit and having current in it once a day or so. The aluminum cell, while opposing very high resistance to the line voltage, offers only 10 ohms per square inch of resistance to current caused to exist in it by abnormal voltages. He men-

tioned the experiments of Prof. Clayton in Colorado during the past summer, obtaining oscillograms on lightning discharges on a long unloaded transmission line. These showed that discharges follow each other rapidly. The frequencies of discharges were found to be of from one hundred to millions of cycles per second.

More Industrial Training for Massachusetts.

The Massachusetts Commission on Industrial Education has lately held several conferences with the heads of the Massachusetts Institute of Technology, the Worcester Polytechnic Institute, the Lawrence Scientific School, Simmons College and Tufts College in reference to the establishment of a State College of Industrial Training. It is felt that there is a vacancy between the high schools and the professional engineering schools which ought to be filled by an institution capable of training men for positions as industrial foremen and superintendents. The high school training is inadequate for this work, and the training of the engineering school tends to equip men for the highest positions of an executive or advisory character, with general charge over large projects. The lower technical schools do not provide the training necessary for the foreman or superintendent.

Evening courses for persons already employed in trades are now being established in many parts of the state under the general supervision of the commission, notably in Cambridge and New Bedford. Classes in mathematics for men in the machine trade have been opened at Beverly, where the United Show Machinery Company has a large plant. Worcester and Lawrence are considering the establishment of industrial schools for boys, preparatory to entering the machine industry, and in the latter cities the textile workers and firemen have asked for an evening school to meet their needs in their own trades. Waltham has made an appropriation, also, for evening courses in mechanical training. Public hearings will probably be held at the State House in the early future, and in January the commission will report its findings to the Legislature.

Working a Follow-Up System.

Mr. H. H. Lewis has an interesting article in the *Circle* for December, on the "professional systematizer," from which the following is worth quotation: A fair example of the diversity of subjects handled by the professional systematizer is found in the work of a man who not long ago was called to "gear" up the organization of a certain Boston house. The systematizer in question spent the better part of two weeks sauntering through the various departments of the plant.

He asked questions freely and made copious notes in a little book carried in his coat pocket. He watched the men at their work, examined the different machines in the manufacturing department, carefully inspected the various account-books, and even made a trip with one of the collectors. Then he set to work.

Among other things, the systematizer found that the firm in question advertised extensively the articles sold in their retail department. This advertising resulted in a call for the advertised articles either by mail or in person. Nine-tenths were personal calls, and yet probably one-third of the personal calls did not result in sales. To the systematizer this one-third loss did not seem necessary, and he immediately suggested a practical follow-up system.

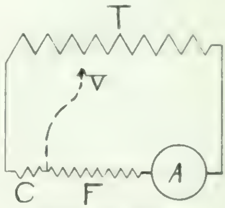
He had printed a form card containing a space for the name and address of the prospective customer, a line for the class of article in question, and a date line and place for remarks. The salesmen in the store were required to carry these blank forms and fill out one for each customer lost. The cards were then filed in a card-index, arranged by dates, so that in a few days or a week the card came to hand for attention.

If Mrs. Blank, for instance, should call to examine an advertised article and should not buy, the clerk attending her would get her name and address, and several days later a form-letter, a good imitation of a typewritten one, referring to the inquiry regarding certain goods and stating that a new stock has recently been added, would be received by her. This touch of personal attention seldom failed to bring good results. From the viewpoint of the professional systematizer, it meant at least the partial elimination of a one-third loss in sales.

Alternating-Current Railway Motors.

The section of the A. I. E. E. at the University of Illinois was favored on Nov. 27 with a lecture by Dr. C. P. Steinmetz on "Single-Phase Alternating-Current Railway Motors." Dr. Steinmetz first classified all motors under two heads—series and shunt motors. In shunt-wound direct-current motors the armature reaction which causes sparking at the commutator is taken care of by the shifting of the brushes if a motor always operates in one direction. If it must operate in two directions, the brushes have to be placed at the middle point between the poles. To prevent sparking in motors which must be reversed and must consequently have their brushes at a fixed position, the commutating-pole type of motor is being introduced.

Any direct-current series motor will run with alternating current if its magnetic structure is properly constructed to prevent heating from the alternating flux. To obtain a large power-factor, the number of turns in the armature should bear as high a ratio as possible to those in the field coils; the air-gap should be small. The sparking caused by the alternating field flux has been minimized by the use of resistance in the leads between the armatüre and the commutator segments. Dr.



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Steinmetz stated that the space is too limited in a railway motor for such leads with sufficient radiating area. While good results are being obtained with them, they are not desirable, and are a source of danger when the motor is overloaded.

He then took up the theory of the repulsion motor. In an alternating-current transformer the magnetic flux is 90 time-degrees behind the primary e. m. f. and 90 time-degrees ahead of the secondary e. m. f. In the repulsion motor the stator coils are connected to the alternating-current source of supply when the brushes are short-circuited. In such a motor the stator coils act as the primary and the rotor coils as the secondary of the transformer. In such a motor there are two magnetic fluxes in quadrature. The rotational flux in the rotor is displaced 90 time and space degrees from the main flux, and acts to assist good and sparkless commutation. When at a standstill, the repulsion motor acts exactly as a series motor, being no better and no worse. After it begins to rotate, the repulsion motor produces a commutating field. At synchronism the commutation is perfect; at speeds above synchronism, the commutation becomes worse, so that when revolving at double synchronism the plain repulsion motor sparks badly. He then described what he termed the series-repulsion motor, in which controller connections are employed which make it a repulsion motor at low speeds and a series motor with compensating field coils to improve commutation at high speeds. To illustrate the circuit connections at high speed he used the accompanying circuit diagram, in which *A* is the armature of a series motor, *F* the field coils and *C* the compensating coils for securing good commutation. *T* is the secondary of a transformer supplying energy to the motor. *V* is a variable connec-

tion, by which a larger or smaller proportion of the total voltage of the transformer can be impressed on the compensating field coils.

As to desirable frequencies for railway motors, Dr. Steinmetz said that motors of from 75 to 200 horse-power can be made to commutate in a satisfactory manner at speeds between 600 and 1600 r. p. m. on 25-cycle circuits. This answers the practical requirements. On 15-cycle circuits motors commutate well at speeds as low as 360 r. p. m. A 25-cycle installation would be superior in total economy for small motors. For very heavy locomotives the case possibly may be different, but he questioned whether a frequency of 25 cycles is not a low enough frequency for all purposes.

CURRENT NEWS AND NOTES.

ELECTRICAL FITTINGS.—The Underwriters' National Electric Association has just issued the October list of electrical fittings that have been examined and approved for use under the rules and requirements of the National Board of Underwriters.

ILLUMINATING ENGINEERS.—The next monthly meeting of the New York section of the Illuminating Engineering Society will be held in the United Engineering Societies' Building, on Dec. 12, when Mr. Bassett Jones, Jr., will read an illustrated paper on the "Relation of Architectural Principles to Illuminating Engineering Practice."

COLORADO SPRINGS ELECTRIC LIGHTING LITIGATION.—The history of the celebrated Colorado Springs electric lighting controversy is to be issued in book form, the text to be edited by Mr. Henry Floy, one of the board of arbitrators. The book will give verbatim the testimony of the large number of experts on lighting and illuminating questions who appeared before the board, and a summary of the legal arguments and citations in the case.

CHICAGO DRAINAGE CANAL POWER.—The new power plant on the Chicago Drainage Canal at Lockport, Ill., is now ready for service, the formal opening having been made Nov. 26. The transmission to Chicago is over a 44,000-volt aluminum line. The provisions made in the Chicago municipal electric lighting plants for utilizing this power have been already described in the Electrical World. Besides supplying the city of Chicago, the West Park Board, the town of Cicero and the village of Morgan Park will purchase energy. About 16,000 horse-power has been so far developed.

THE NEW YORK SUBWAY.—Mr. Bion J. Arnold, as expert for the Public Service Commission, has filed a preliminary report as to improving conditions under which the crush is now developed morning and night, limiting speed and the number of trains. He advocates various changes in loading and starting, and favors side doors as a means of relieving the end doors. His report discusses in an admirable and most impartial manner the many difficulties of the problem—difficulties that in reality must await the construction of the other subways, before the crowds on the existing one can be lessened.

THE NOBEL PRIZE.—In accordance with cable dispatches noted recently, the State Department at Washington has been advised by the American minister at Stockholm, Mr. Graves, that Prof. A. A. Michelson, of Chicago, is to be awarded the Nobel prize for physics. Professor Michelson was born in Germany, but came to this country at an early age, and was appointed a midshipman at the Naval Academy. He was graduated in 1873, but resigned his commission in 1881, and is at present professor of physics at the University of Chicago. His work there as to the velocity of light, etc., has made him known throughout the world. The Nobel chemical prize is to be awarded to Sir William Crookes, the distinguished English physicist and inventor.

FEDERAL EMPLOYEES.—The U. S. Bureau of the Census has just sent to press the official register of federal employees. There are no fewer than 306,000. The total number of names included in Volume I is 125,805; the total number of names in the Postal Service in Volume II is 166,444, and in the Railway Mail Service is 13,892. The aggregate, therefore, of names presented in the Official Register for 1907 is thus 306,141. Volume I enumerates 1100 occupations followed by the servants of Uncle Sam. In the District of Columbia there are 28,947 government civil employees, with an aggregate compensation of $31,541,225.

LUMINOUS ARCS FOR CHICAGO.—The association formed to improve Dearborn Street, in Chicago, has voted to adopt the luminous arc lamp for the special lighting of that important down-town thoroughfare. Full details of the installation have not been worked out. If present plans are not changed, these luminous arc lamps will be placed about 25 ft. high on extensions of the street railway poles. Every other street railway pole will carry a lamp, the lamps being alternated. The diagonal distance from one lamp to another under this arrangement will average about 117 ft. As the luminous arc lamp throws so much of its light downward immediately around the pole, this spacing, if the ordinary globes were used, would result in areas between poles which would appear to be in darkness by comparison with the areas near the poles. The present plan is, therefore, to work out some scheme for spreading the downward light from the luminous arc so as to illuminate a larger street area.

A. S. M. E.—The American Society of Mechanical Engineers has been holding, this week, at the Engineering Societies' Building in New York City, its twenty-eighth annual meeting. President Hutton delivered an address on "The Mechanical Engineer and the Function of the Engineering Society" on Tuesday, and professional sessions were planned for the three following days, with a reception in the building, with dancing, etc., on Thursday evening. The visits and trips of inspection during the week include the Hudson Companies' tunnels under the North River, the Pennsylvania crosstown tunnel, the Watson-Stillman 300-hp gas producer and engine, and the new reinforced-concrete building of the McGraw Publishing Company, the home of the Electrical World. On Tuesday night, new officers were elected as follows: M. L. Holman, of St. Louis, president; L. P. Breckenridge, of Urbana, Ill.; Fred J. Miller, and Arthur West, of Pittsburg, vice-presidents, and W. L. Abbott, Alexander C. Humphries and Henry G. Stott, managers.

CHICAGO ELECTRICAL SHOW.—At a recent meeting of the stockholders of the Electrical Trades Exposition, which conducts the Chicago electrical show in January, a large picture was exhibited showing the design of the decorative lighting of the Coliseum, which is to be the distinctive feature of the Chicago electrical show this year. This design has been worked out by D. H. Burnham & Company, the noted Chicago architects. The general scheme comprises a row of mammoth decorative chandeliers the length of the center line of the building and festoons of lamps hung from the arches. The booths will be of uniform design, this design being also made by the architects. The erection of booths and supply of furniture is in the hands of the exposition company, so that the exhibitor has only to move in his exhibit, thus saving a lot of trouble and annoyance to the exhibitor and producing a much better general effect. As a spectacular display, the coming show will undoubtedly offer the finest thing of the kind ever shown in the Coliseum. The dates of the show are Jan. 13 to 25, 1908. Mr. Homer E. Niesz, Monadnock Block, Chicago, is managing director.

THE DEBT OF BOSTON.—On the present showing, Boston is not likely to indulge in much municipal ownership. An official report has just been filed by a commission, showing the city debt to be $111,848,735 instead of $68,821,350 as reported by the city auditor. The commission states that there has been an increase in the net debt of the city of 111 per cent within the past 12 years, and it now amounts to 8½ per cent of the assessors' valuation of property subject to taxation, and to $183 per capita of the estimated population of the city for this year.

ALWAYS ON DUTY.—The Pittsburg Railways Company, operating all the local street car lines, has served notice on its employees that it will rigidly enforce the rule against the use of cigarettes or liquor while the men are either off or on duty. A number of men have recently been discharged, the company being able now, for the first time in years, to secure all the men it needs. J. J. Thorpe, business agent of the street car employees' union, called on President J. D. Callery, of the company, and protested against the discharge of the men, claiming that the company had no right to dictate to its employees when they were off duty. President Callery declared that he would stand by his order, and there is some strike talk among the employees.

DRIVING GERMAN LOOMS.—U. S. Consul George A. Bucklin, Jr., of Glauchau, reports that a master weaver of that German district has just put into successful operation his invention by means of which hand looms may be driven by electrical energy, a description of which follows: "It is so contrived that all of the parts of the old loom may be used except the 'frame.' The loom so made over answers all of the requirements of a power loom, and even works much more quietly, since the blow is given by a spring which is compressed by an eccentric. The power for such a loom is said to be inexpensive, the cost of the electricity consumed amounting to about 28 cents per week. The operation of the loom is so simple that it can be directed by a child. The invention is one that promises to be of great value to this region, as of late years there have been hundreds of looms crowded almost or entirely out of operation by the more rapid and labor-saving power loom. A preliminary patent has already been granted."

MOTOR vs. GAS ENGINE POWER.—The *West Ham Electrical Bulletin*—an excellent quarterly publication issued by the municipal electric light plant of West Ham, England—prints in the current issue the following comparative statement of cost of electricity and gas, in the form of a communication from a customer who operates a dyeing and cleaning establishment:

	£	s.	d.
Gas bill for engine from June, 1905, to June, 1906	43	18	4
Oil for gas engine	4	16	0
Total	48	14	4
Bill for energy for electric motors, June, 1906, to June, 1907	24	7	11
Oil for motors		6	0
Total	24	13	11

If the cost of renewals, repairs, and wear and tear were considered, the showing would be still more in favor of the electric motor.

CITY TUNNEL OWNERSHIP.—It is stated that a plan has been advanced by those interested in seeing the Belmont tunnel between Manhattan and Long Island City opened to the public, and is now being seriously considered, which contemplates the acquisition of the property by the city and what would amount to a partnership in its operation between the city and the interests now owning the tunnel. It was learned yesterday that it is by no means improbable that the plan will come before the Public Service Commission within a short time. The plan is that the city shall buy the tunnel, as it stands, for what it cost to construct it, with interest to date; shall pay for it with city bonds instead of cash, and shall enter into a contract with the Belmont interests whereby those interests shall operate the line in connection with the Queens County surface lines, the net earnings to be equally divided between the city and the Belmont people, and the city to apply its share of the proceeds to the payment of the interest on the bonds.

AMERICAN MANUFACTURES.—Fifteen billions of dollars represent the value of the production of manufactures in the United States in the year ended June 30, as shown in the annual report of Col. John M. Carson, Chief of the Bureau of Manufactures. Last year the aggregate value of domestic merchandise exported was $1,854,000,000, an increase of nearly $136,000,000 over the preceding year. In this classification "manufactures ready for consumption" are credited with $480,000,000, and "food-stuffs partly or wholly manufactured" and "manufactures for further use in manufacturing," aggregating $606,000,000, are grouped, making the aggregate value of manufactures exported $1,086,000,000. Special significance is attached to the increase of nearly $20,000,000 in the exports of completed manufactures, in view of the fact that the exports of cotton cloths declined more than $21,000,000 because of the loss in the cotton trade with China. The success attending investigation by experts sent abroad has led to the adoption of the policy of specializing investigations of trade conditions in foreign markets. One of the obstacles to the enlargement of export trade is the uncertainty of transit between places of production and the seaboard. Merchants in the Orient especially complain that calculation cannot be made as to when goods ordered in the United States will be delivered, and in consequence orders go to European houses that should come to those of this country. The bureau has been in correspondence with managers of railway and ocean steamship companies with a view to obtaining more reliable and rapid transit for merchandise destined to foreign countries.

POWER FOR JAPAN.—Extensive plans are proposed for electrical development in Japan. In a preliminary report on the subject, Julius M. Howells states that the outlook for cheap water power in Japan is very favorable. In the case of one power site on the Tashiragawa the construction of a tunnel 3½ miles long would, it is stated, secure about 66,000 horse-power, and at another power site by means of some 10 miles of tunnel and a certain amount of open canal construction 150,000 horse-power could, it is reported, be secured. In the first instance there is a good reservoir site for purposes of storage, while in the second instance advantage would be taken of natural lakes. These sites, and others which have been surveyed, are in the Fujiyama district. Additional sources of power are near Nikko, where Lake Chuenji would form the storage reservoir, and where, with 4 miles of tunneling, a fall of 2000 ft. could be secured; also in the Lake Inawashiro district, where the construction of 4 miles of tunneling would provide upwards of 50,000 horse-power. An inspection of the principal sites and a study of the rainfall statistics over many years point to the probability of the initial plants giving, even during periods of drought, 300,000 horse-power. A favorable feature of the scheme is that the power sites provisionally selected are located within a comparatively short distance of Tokio, where at the outset the bulk of the power would be taken. Between the capital and the sites referred to, there is a minimum transmission distance of 80 miles and a maximum of 150 miles. It is estimated that the present requirements of Tokio represent 48,000 horse-power, and that plants which will call for an additional 20,000 horse-power are in process of erection. These figures do not, however, include the electric road from Tokio to Yokohama, or the elevated road which is being constructed by the government in Tokio. One of the chief power sites is within 135 miles of the old capital, Kioto, and Osaka, the Manchester of Japan, is only 160 miles distant.

Electric Generating Equipment of the New Orleans Railway & Light Co.

THE work of eliminating smaller and less economical generating stations, and centralizing the production of energy in large stations, having been completed by the New Orleans Railway & Light Company, it is believed that a description of the changes introduced will prove of interest.

The plan of concentrating all equipment in a single station was not adopted, for the reason that it would have necessitated the abandonment of two modern generating stations, and because in some areas the distribution of the railway load made it more economical to generate direct current near the points of heavy consumption rather than to produce alternating current in one central station with high-tension transmission and conversion to direct current in sub-stations located at the points of consumption. The lesser likelihood of complete shutdowns in cases of station troubles was another consideration.

The system as reconstructed comprises one direct-current commercial lighting station and one direct-current railway station in the congested districts, and one large alternating-current station to feed the balance of the territory and the outlying districts. This station also contains 6000 kilowatts of direct-current generators for feeding the railway lines in its vicinity. The three stations have an aggregate rating of 25,000 kilowatts. As the load increases and the system is extended involved heavy expense for frequency-changing apparatus for the large amount of the service requiring 60 cycles, and the unsuitability of 25 cycles for the operation of incandescent and arc lamps. By using only one frequency the load factor on

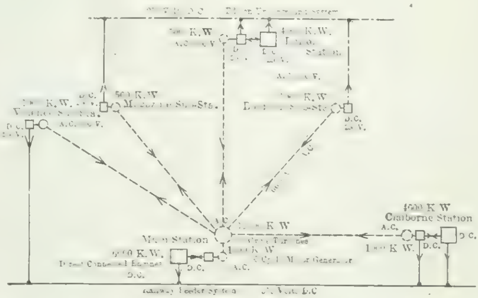


FIG. 1.—ELECTRICAL CONNECTIONS OF STEAM STATIONS AND GENERATING SUB-STATIONS.

the station and on the generating units was much improved, with resulting large savings in the cost of generated energy, and the idle investment in reserve apparatus was minimized. The large sub-station energy loss which would have resulted from the use of such frequency changers as would have been

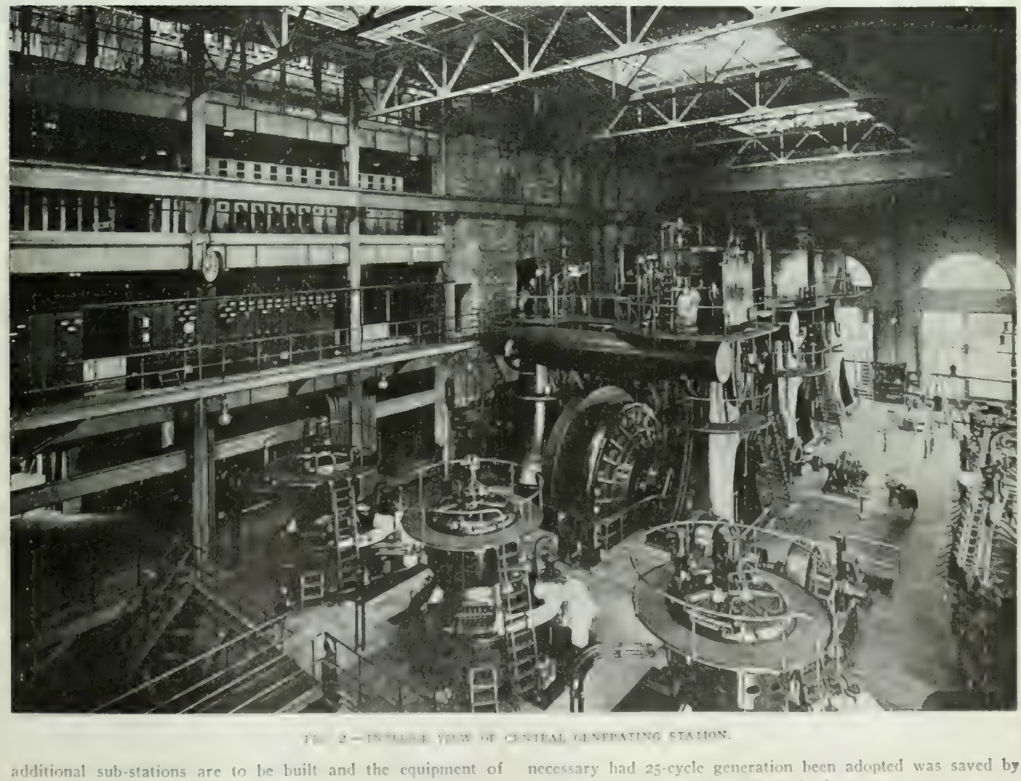


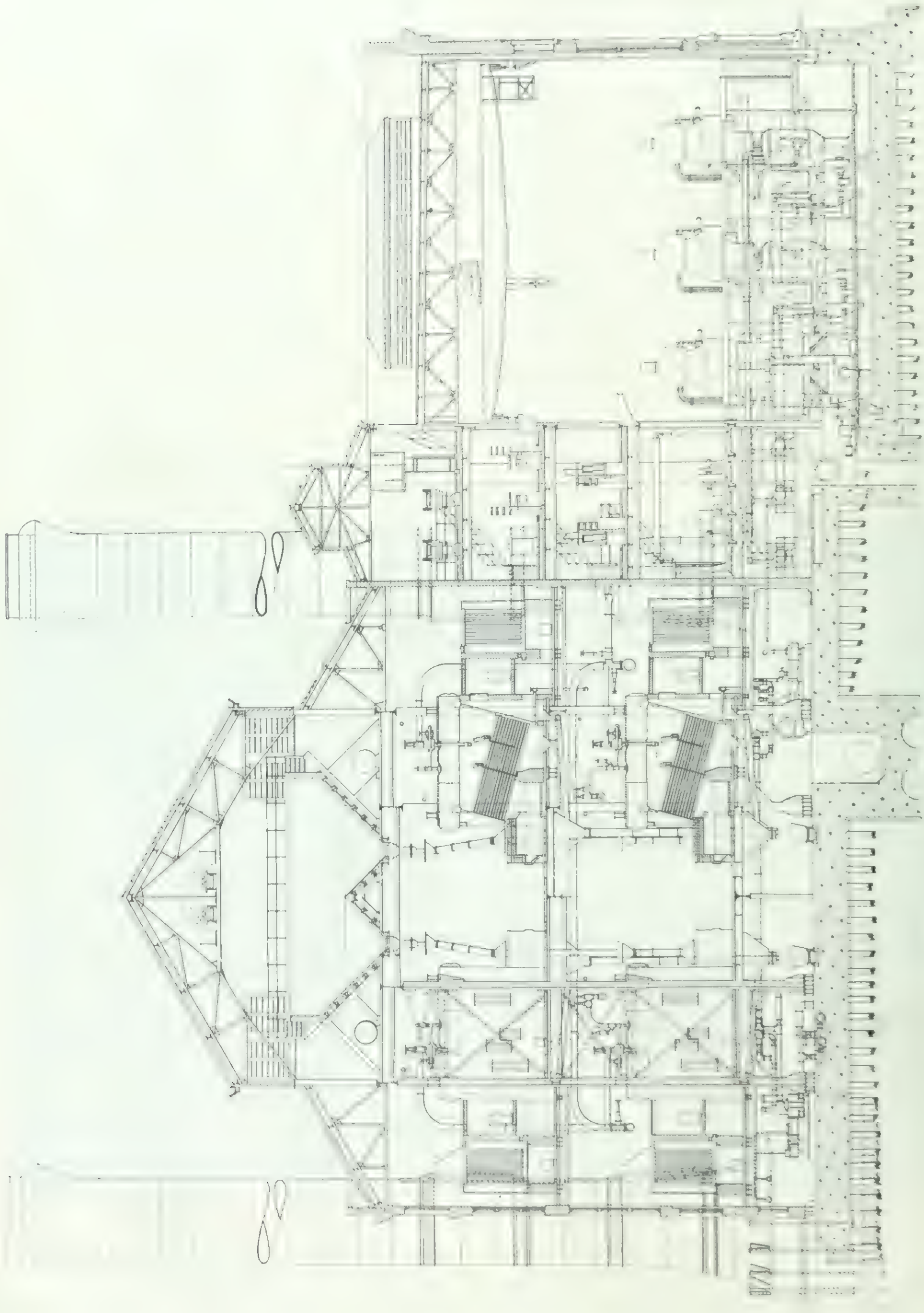
FIG. 2.—INTERIOR VIEW OF CENTRAL GENERATING STATION.

additional sub-stations are to be built and the equipment of the main or alternating-current power station is to be increased up to 50,000 kilowatts. It is not necessary that new generating stations be built until the output indicated is reached.

A frequency of 60 cycles had been adopted as standard for all generators. [illegible]

necessary had 25-cycle generation been adopted was saved by the adoption of a uniform 60-cycle frequency

It is believed that the higher frequency standard more nearly satisfies all of the present and future requirements and that it will show a decidedly higher all-around efficiency, everything [illegible]



largely dependent upon adopting a system which will involve the least first cost of installation to the consumer. The lesser cost of 60-cycle motors constitutes an important factor viewed from the standpoint of the operating company.

A voltage of 6600 was adopted as being a thoroughly stand-

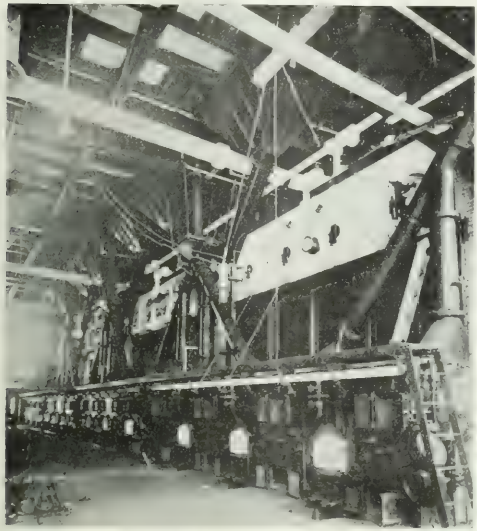


FIG. 4.—BOILER ROOM OF MAIN STATION.

ardized commercial voltage, for which motor generator sets of 500 kw and upwards could be readily wound, thus eliminating sub-station transformers. The transmission distances, being relatively short, did not call for a voltage higher than 6600, which would permit sending the maximum desired amount of power through any individual feeder with small loss. The frequent flooding of the underground conduits by heavy rains, which, for short periods, may overtax the drainage system, ren-

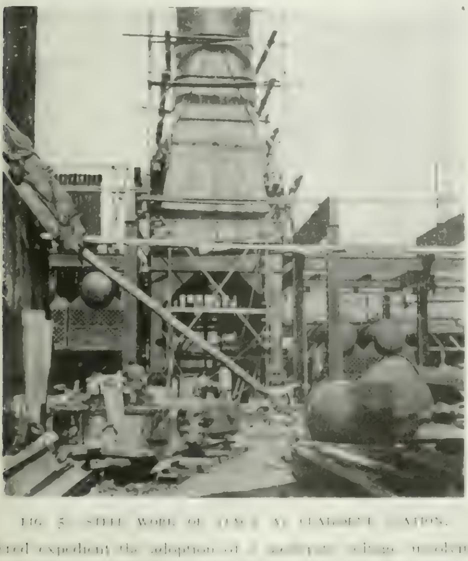


FIG. 5.—STEEL WORK OF [illegible] AT [illegible] STATION.

dered expedient the adoption of [illegible] voltage [illegible] no particular difficulties for insulation under these conditions.

The recent work has [illegible] the construction of practically an entirely new station at [illegible] and [illegible] Peter Streets, on the Mississippi River, about two miles upstream from the business center of the city. The station now contains 17,800 kilowatts and will have an ultimate output of 50,000 kilowatts.

THE MAIN STATION.

The new station building is a brick, steel and concrete structure, 122 ft. in height, with a ground area of 181 ft. by 212 ft. It is supported on approximately 4000 round piles driven on about 3-ft. centers. The piles are 50 ft. long and some were set 30 ft. below the surface or were driven to a total penetration of 80 ft. The average load over the entire foundation is somewhat less than 2000 lbs. per sq. ft., but at points the load is concentrated and is very much more. At such points twisted steel rods were used to reinforce the concrete mat.

TURBO-GENERATORS.

In the new portion of the generator room there are installed three 1500-kw, three-phase, 60-cycle, 2300-volt Curtis turbo-generators. A 3000-kw and a 500-kw, 6600-volt turbo-generators of the same make are also provided in the initial building, the former now being in operation and the latter under construction.

One common oiling system with one accumulator supplies oil to the step bearings of the three smaller turbines. A sep-

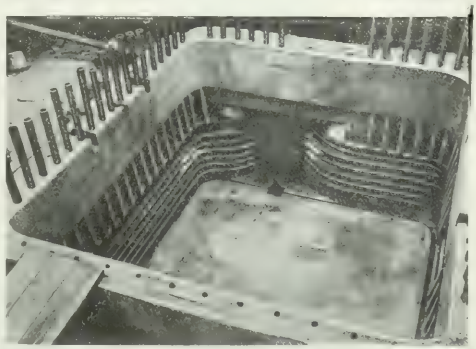


FIG. 6.—BASEMENT OF HOWARD AVENUE TERMINAL HOUSE.

arate oiling system with an accumulator is provided for the two larger turbines. The oil pumps and other auxiliary apparatus except the exciters are located in the basement.

MOTOR-GENERATORS.

Three motor-generator sets now operating on other service, each consisting of a 500-kw, 2300-volt synchronous motor and a 600-volt direct-current generator, are to be installed on the main floor alongside the exciters under the bus structures and will permit transferring 1500 kilowatts from either the alternating-current or the direct-current portion of the station.

EXCITERS.

The equipment already installed consists of an 80-kw induction motor-driven exciter and a 75-kw exciter driven by a two-stage horizontal Curtis turbine. The exciters are connected to a double bus system, and voltage regulation is effected by a Tirrill regulator built for four exciters. Plans provide for two additional 150-kw exciter sets which will be installed near those already in operation on the main floor.

[illegible] APPARATUS.

The switchboard proper is located on an overhanging balcony at the same height as the second floor of that section of the building between the boiler and generator room. From his position on the balcony the operator has a general view of the entire operating floor. Behind the switchboard are the generator switch and bus structures. On the floor above are similar structures for feeder busses and switches and there is also located on the floor 2300-volt regulators for the commercial feeder circuits. On the fourth or top floor is an arc lamp substation. All main and high-tension switches are of the oil-break type controlled from the main switchboard by [illegible]

switches. Both the generator and the feeder bus-bars are in duplicate, and all may be sectionalized.

The bus and cell structures are built in groups with the main and auxiliary bus structures flanking a common passageway on the second floor and the feeder bus structures similarly arranged on the third floor. The structures are of concrete with the exception that the tops and bottoms of the generator and sectionalizing switch compartments are of Alberene stone. The structures are reinforced by iron rods running through the barriers from top to bottom. The generator leads are carried down under the generator room floor from the generator terminals to junction boxes and then up the building columns in brass conduit direct to the generator switches of the main generator and auxiliary busses. A group switch connects the 2300-volt main generator bus to a main feeder bus on the floor above and a similar switch connects the generator auxiliary bus with an emergency feeder bus. The 6600-volt generator and auxiliary busses are permanently connected to extensions of these busses in structures on the floor above and from which the feeders are taken off. The 6600-volt and the 2300-volt bus systems are connected by two 1500-kw oil-insulated, water-cooled, three-phase transformers, located in the basement.

CONTROL PANELS.

The generator control panels are located at the west end of the initial switchboard, the plans providing for the installation of 6600-volt feeder panels west thereof, so that they will be centrally located with respect to the ultimate switchboard. To the east of the generator panels are exciter and house service panels and space for three synchronous motor and three railway generator panels.

FEEDERS.

The construction permits feeders leaving the station in underground conduits. They now leave overhead connecting with pole lines, those for the down-town district continuing overhead to a terminal house located about a mile distant from the station at the edge of the underground district.

From the feeder busses the arc lamp lines pass to the constant-current alternating-current arc regulators on the top floor, there being provision for 22 feeders in the sub-station. The 2300-volt feeders for the commercial lighting load pass through oil-insulated, water-cooled regulators.

THE BOILER HOUSE.

The present building provides for sixteen 900-hp boilers. Twelve such units of the Babcock & Wilcox water-tube type are now installed. They are located on two decks in double rows facing each other and parallel to the generator room wall. They are constructed for 200 lbs. pressure and are fitted with bent tube superheaters designed for 150 deg. superheat. Behind them are Sturtevant economizers, there being one economizer with 4900 sq. ft. of heating surface to each two boilers. The scrapers of the economizers are driven by induction motors. The boiler plant is equipped with thirty-six 300-hp Murphy smokeless furnaces and stokers, set three in a battery under each boiler. Coal is fed to the furnaces through down spouts extending from the overhead bunkers. Ashes from the furnaces fall direct into a hopper underneath, while the fine ashes drawn over the bridge wall and the soot accumulation are carried into such hopper by a motor-driven screw conveyor.

FEED WATER.

Boiler feed water is obtained from two 750-ft. wells, one 6 and 8 ins. in diameter, having a combined output of over 1800 gals. per minute. Water is raised with air furnished by two Ingersoll-Sergeant air compressors installed in a compressor room in the boiler room basement. The water is discharged either into tanks in the basement of the boiler room or into a stand pipe holding 60,000 gals. located near the building. The boilers are fed by a steam turbine-driven centrifugal pump and three Epping Carpenter pumps. These pumps are of the pot valve type with outside end packed plungers and are fitted with automatic pressure regulating governors. Connections are arranged so that the water may be forced either through the economizers or direct into the boilers.

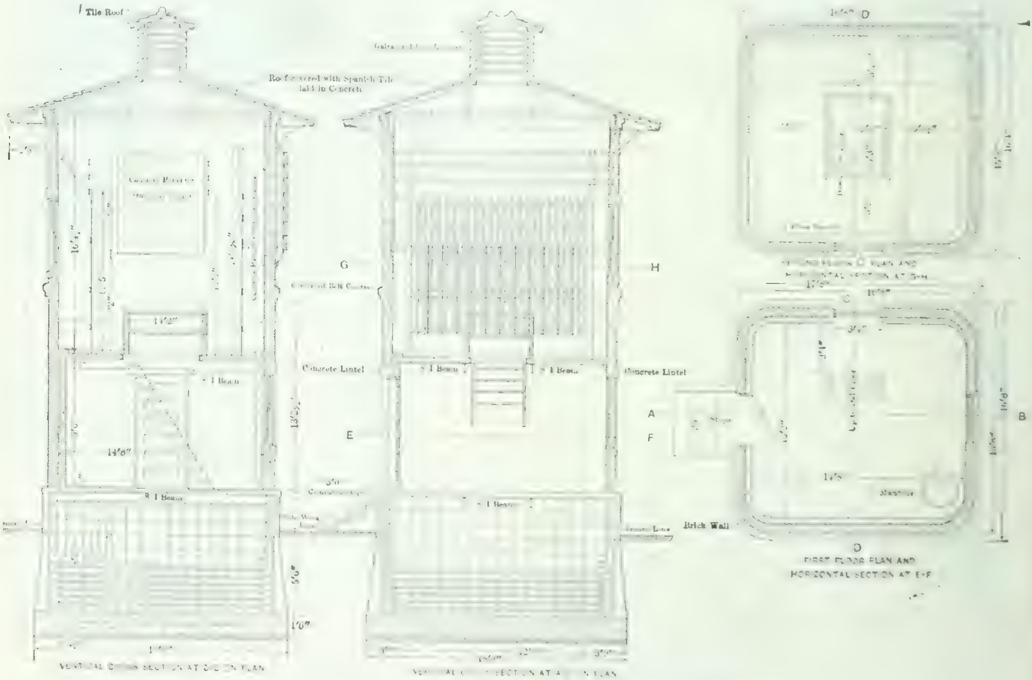
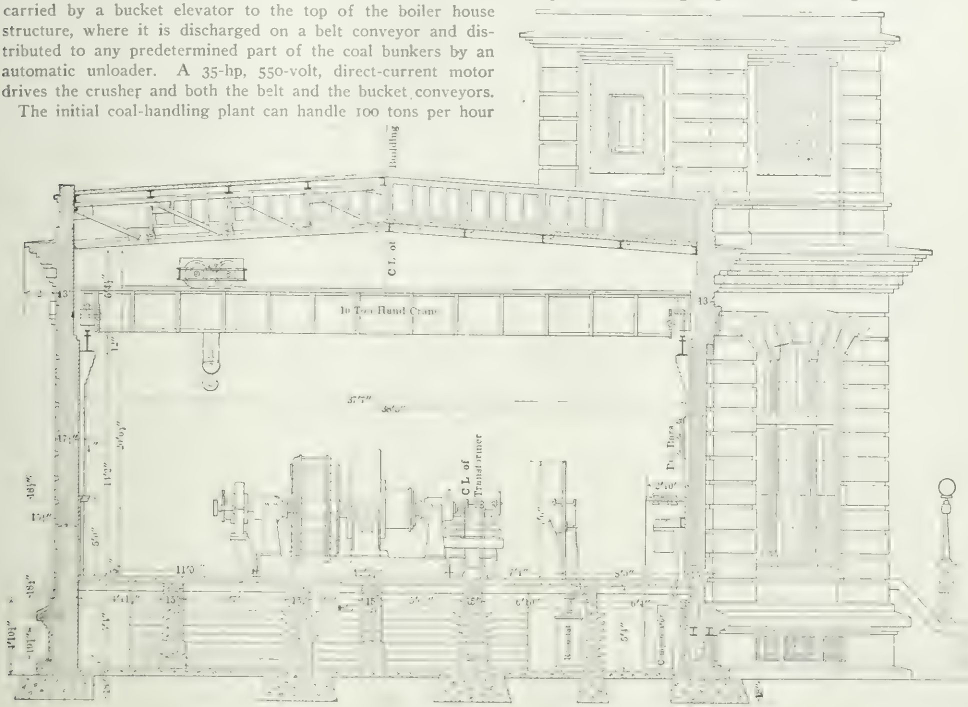


FIG. 7.—PLANS AND SECTIONS OF HOWARD AVENUE TERMINAL HOUSE.

COAL-HANDLING APPARATUS.

A switch extending along the east end of the station contains a 100-ton track scale and all cars are weighed before and after being unloaded. The cars are run on a sheltered track under the ash bunker at the end of the boiler house and unloaded into a hopper beneath the track. After passing through a crusher provided with an adjustable positive feed the coal is carried by a bucket elevator to the top of the boiler house structure, where it is discharged on a belt conveyor and distributed to any predetermined part of the coal bunkers by an automatic unloader. A 35-hp, 550-volt, direct-current motor drives the crusher and both the belt and the bucket conveyors. The initial coal-handling plant can handle 100 tons per hour and the plans provide for a duplicate equipment of equal rating. The initial coal bunkers hold 2000 tons and those of the ultimate building will store about 5000 tons. Additional storage space is provided in a vacant lot near the station, coal being conveyed to and from this space in electric cars. Dock privileges have been obtained from the city and a portion of the plant for unloading river coal from boats has been erected. This has been designed to handle 200 tons per hour.



SECTION THROUGH LINE A-B-C-D FLOOR PLAN

FIG. 8.—ARRANGEMENT OF APPARATUS AT THE VALENCE SUB-STATION.

ASH-HANDLING PLANT.

Small side-dump cars operating on tracks in the basement underneath the ash hoppers convey the contents of these hoppers to the east end of the building where the ashes are dumped into an automatic skip. This skip bucket, holding 60 cu. ft., hoists the ashes to the top of the boiler room and dumps them into a bunker built over the coal switch. Ashes are discharged by gravity from the bunker direct into steam or electric cars and conveyed to the suburbs to be used in track construction or filling.

THE CLAIBORNE STATION.

The Claiborne station is located at Elysian Fields Street and the river, about two miles below the Main or Market Street station. It is essentially a direct-current station. The original portion, built about nine years ago, contains two 300-kw and one 850-kw General Electric railway generators direct connected to Allis Chalmers compound engines and four 350-hp Edgemoor boilers. A new station has been built in line with the original station, the old plant reconstructed and 3000 kilowatts of engine-driven, direct-current railway units, 1000 kilowatts of railway motor-generator sets, with the requisite switchboard and steam generating plant, have been newly installed.

ELECTRICAL MACHINERY.

The two 1200-kw generating units installed in the new portion of the building consist of Filer & Stowell horizontal cross-compound condensing engines and Westinghouse 600-volt generators. The 800-kw unit is an Allis-Chalmers cross-compound engine with a General Electric 600-volt generator. Plans provide for the installation of an additional 800-kw unit. The station is tied electrically to the other stations of the system through two 500-kw motor-generator sets consisting of 6600-volt synchronous motors and 600-volt direct-current generators.

THE BOILER ROOM.

The boilers are installed in one row parallel to the engine room wall. For ventilation the wall opposite the furnaces is open to a point 9 ft. above the floor. Each of the four 600-hp Heine boilers is equipped with two 6-ft. by 8-ft. Murphy smokeless furnaces and stokers of a design similar to those in the main station. The concrete bunkers located above the open space in front of the boilers hold 100 tons per boiler. Over the rear of the boilers in the new section are installed four Sturtevant economizers. They are so set and piped that a boiler and an economizer constitute a single unit, but the flue connections are such that any one economizer may be cut out without interfering with the use of the corresponding boiler. When one is cut out the water for all of the boilers may be passed through those economizers remaining in service. The economizers are cut out by means of an interlocking mechanism operated by a lever from the boiler room floor. The coal-handling equipment is similar to that at the main station.

THE STACK.

The method adopted for supporting the one steel stack which extends through the central portion of the room was

considerable additional floor space in the boiler room. The stack is supported on four steel columns, which extend from the boiler room floor to the base of the stack at about the height of the top of the boilers. The columns are stiffened with concrete, and those portions in the engine room are arched over with brick. The stack is of steel 11 ft. in diameter and 175 ft. high. The base is square and is constructed without a base ring. The side sheets are riveted directly between channel framing at the base.

BARONNE STREET STATION.

Practically the only important changes made in the old direct-current station, known as the Baronne Street station, has been to equip the boilers with Murphy furnaces and mechanical stokers. In order to provide sufficient stoker equipment it was found necessary to install three stokers under each battery of two boilers, and this required that a portion of the center wall between the boilers be specially supported from the boiler room girders.

VALENCE SUB-STATION.

This is the first recently constructed permanent sub-station, and the only one yet finished outside of those in the power stations. It is located in the western portion of the city, at Valence and Franklin Streets, and about three miles northwest of the Market Street station. It is a combination arc lighting and railway sub-station, and at present contains six 110-lamp constant-current transformers and two 500-kw motor-generator sets. Provision is also made for its future use as a commercial lighting sub-station.

MAGAZINE STREET SUB-STATION.

A temporary sub-station for commercial lighting has been installed in an existing building on Magazine Street, near Poydras. This sub-station contains a 500-kw motor-generator set, consisting of a 6600-volt synchronous motor and a 250-volt generator, which feeds across the outside wires of the direct-current, three-wire system covering the downtown district.

BOURBON SUB-STATION.

There is now being installed in this sub-station a 1000-kw synchronous motor generator set, 6600 volts alternating to 250 volts direct, for supplying energy to a section of the underground system. The present sub-station building is temporary, but the foundations and sub-grade work is of permanent character, and will constitute a part of the ultimate sub-station construction aggregating some 5000 kilowatts capacity.

DRYADES SUB-STATION.

This sub-station is an installation containing constant-current transformers having an aggregate rating for 600 arc lamps and one 500-kw motor-generator set which operates in conjunction with the steam-driven generator in the Baronne Street station.

CONDUIT SYSTEM.

In the downtown district the high-tension connections between all the power stations and sub-stations are underground. The recent work has included the construction of about 600,000 duct-feet of conduit, and approximately 150 manholes. This was necessitated by the extension of the underground district to about double its former area.

The ducts are of 3-in. fiber conduit laid with 1 in. of gravel concrete between ducts, and with approximately 4 ins. on all sides. The larger portion of the system was constructed of four duct runs and ranged up to thirty-six ducts.

The manholes are usually located at street corners, but additional ones were occasionally built in the middle of long blocks. The manholes are made largely of molded concrete blocks, which, in addition to forming walls, carry projections which serve as shelves for the cables, and act as barriers between adjacent cables.

THE TERMINAL HOUSE.

The overhead lines from the main generating station, extending into the underground district, are carried into a terminal house about one mile from such station. This is a two-story and basement fireproof brick and concrete structure 15 ft. 8 ins. square. The overhead lines enter the upper room, on the walls of which disconnecting knife switches are installed on frames with slate barriers between them.

The above described improvements in New Orleans have been designed and executed by the engineering and construction organization of Sanderson & Porter, New York. Their New Orleans office—W. A. Haller, resident engineer—has substantially completed all the work herein described and the installation of the initial equipment, in such manner as will readily permit of enlargements from time to time, as required by the growth of the city.

The work has benefited greatly by the cordial co-operation which has existed between the representatives of the constructors and the officials of the New Orleans Railway & Light Company, the latter, particularly, including E. C. Foster, president; J. H. DeGrange, vice-president; A. L. Black, engineer, and E. B. M. Kn[illegible], superintendent of power.

Characteristics of the Magnetite Arc.

By G. M. Dyott.

On account of the great interest that is being taken at the present time in the development of the flaming arc lamp, and in illumination in general, the result of some investigations conducted by the writer with metallic arcs might be of interest to those who are making a study of the more recent methods of lighting. From time to time articles have been published concerning the magnetite arc, but they have dealt more with the lamp in general and its commercial aspect rather than with the peculiarities of the arc itself and the effect upon its behavior of certain substances incorporated in the electrodes.

The magnetite arc presents many very attractive features which especially recommend its use for series street lighting. The light has great carrying capacity, the distribution is good, the maximum being between 20 deg. and the horizontal, while the total light emitted by a 300-watt arc is approximately twice as great as that from an alternating-current series enclosed carbon lamp consuming 450 watts. The life of the electrodes also compares very favorably with that of the latter, 200 hours or more being allowed between trimmings. The magnetite arc differs from the carbon arc in practically every respect. It can only be maintained on a direct-current circuit and should be used in conjunction with a metallic positive in order to secure the best results. Should a magnetite be used for the positive as well as the negative electrode the arc loses some of its brilliancy, and its efficiency is thereby impaired; moreover, the positive electrode, which when metallic lasts 2000 hours or more, is consumed fairly rapidly. On alternating-current circuits it is impossible to maintain an arc, unless a specially prepared electrode is used.

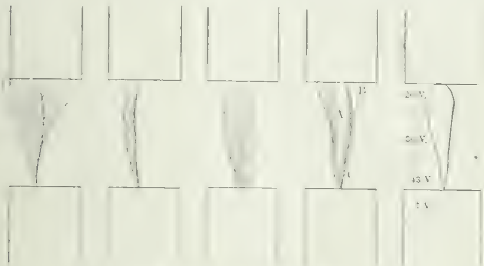
The magnetite electrode must in all cases form the negative, and is, as a rule, placed in the lower holder of the lamp. It is the more important of the two, as the character of the arc is dependent on its composition. The size of the positive has little effect on the behavior of the arc, so that while studying its characteristics it will be assumed to be made of a heavy copper rod 1 in. in diameter.

It has been found that a very satisfactory negative electrode for experimental purposes can be made out of the following materials: magnetic iron ore, Fe_3O_4, chrome iron ore, $FeCr_2O_4$, titanium oxide, TiO_2. For commercial work it is necessary to add other substances such as arc-steadying compounds. The bulk of the electrodes consists of magnetite, the percentage used varying over a wide range like the other ingredients, according to the conditions under which the final mixture must subsequently be used. Its most important function is to act as a carrier in the arc. The slag formed by it is a conductor when cold, and hence difficulties encountered in starting the arc are eliminated. Its high luminous efficiency also makes it a very desirable substance to use. Ordinary magnetite is much too impure to prove satisfactory, and special arrangements should be made to obtain it free from all silica, lime, magnesia, etc. An arc maintained between electrodes of pure magnetite

is very rich in blue and ultra-violet rays. It issues from the negative at a point and spreads out like a fan toward the positive although the anode spot itself is small. The central cone is slightly more luminous than the outer sheath, as is shown in Fig. 1. The arc itself is unstable and emits copious fumes.

In order to neutralize the excessive blue rays emitted by the iron arc alone, and at the same time to increase its efficiency, titanium oxide is added in varying proportions according to the percentage of the other materials forming the electrode. The arc produced between electrodes of this oxide alone is very brilliant; it is pure white in color, gives off fumes and forms an insulating slag when cold; it is also very unstable and assumes a shape such as shown in Fig. 2. If only magnetite and titanium oxide were used the unstability of the arc would be so great as to render it unsuitable for any practical application, so in order to overcome this defect and at the same time increase the life of the electrodes either oxide of chromium or chrome iron ore, called chromite, is added, the latter being perhaps the better of the two.

The arc of the oxide of chromium is of a dull greenish-yellow color and burns steadily, but its luminous efficiency is low. It forms an insulating slag when cold, consumes very slowly and gives off hardly any fumes. It is not pointed at its lower



FIGS. 1 TO 5.—MAGNETITE ARC.

extremity, but assumes the shape shown in Fig. 3. The shape and general character of the composite arc can be judged by reference to Fig. 4. It will be seen that the center is composed of a narrow band *A*, its brilliancy and thickness being dependent on the amount of TiO_2 present; the greater this percentage the narrower this band becomes. When TiO_2 is absent the central cone can hardly be perceived. The outer sheath *B* is composed of fumes and gives but little light; it is more important the higher the percentages of magnetite used. The lower portion of the cone *C* is characteristic of the quantity of chromium present. Should the point be very sharp and unstable, this quantity is low, but as it is raised the sharpness becomes less and less apparent. On further increasing the percentage, the arc becomes more and more steady and ceases to wander about the surface of the electrode; in an extreme case it becomes greenish-yellow, and loses all of its clearly defined outline. If impurities are present in any quantity they will be indicated by the behavior of this point.

As previously stated the arc appears to issue from the surface of the negative as a high-velocity blast impinging on the copper positive, and since the majority of the light is emitted at the negative end of the vapor bridge a reflector should be used in order to secure the best results.

From this it is evident that considerable gain in efficiency can be secured by burning the arc reversed; that is to say, with the negative in the upper holder of the lamp. Heretofore this arrangement has been beset with so many mechanical difficulties that it has received very little consideration despite its many attractive features, but in a lamp recently put on the market this type of construction has been used with remarkable results.

The voltage drop across a 1-in. magnetite arc consuming 5 amperes at 100 volts is shown in Fig. 5. It will be observed that the greatest drop [illegible] from the [illegible] of the negative to about ¼ in. away from the lower tip of arc.

Should the direction of the current be reversed, the whole character of the arc is changed; it loses all of its striking brilliancy and becomes a flaming arc in the true sense of the word, having a dull yellowish color.

While the characteristics of the arc are dependent on the negative electrode, it is around the positive that most of the difficulties center. They may be briefly stated as follows: (1) After continuous service fumes are deposited on the positive electrode, which adhere to it and hang down over the arc, sometimes entirely cutting off the light; (2) materials used for the positive are liable to oxidize owing to the heat of arc and form oxides which are insulators when cold; the arc is thereby prevented from starting; (3) globules of molten matter are taken up by the positive from the negative, which affects somewhat the burning of the arc.

As far as the result of experiment goes the choice of material for the positive seems to be limited to copper, iron, alloys or mechanical combinations of these metals. Copper scales off under great heat and its surface has a very rough appearance, due to the copper oxide scales which cause the scales to adhere to it. Iron by itself consumes too rapidly. Brass appears to be very satisfactory; it always has a clean, smooth surface, and any globules that may adhere to it at its lower extremity crack off and fall into the pan below when the light is extinguished. Further experiments, however, might disclose objections to its use. Attempts have been made to use laminated electrodes, consisting of metals and alloys in successive layers, with encouraging results. Of course, the expense of making such electrodes might prevent their commercial use.

The Infringement of Patents.

BY JOHN EDSON BRADY.

When a patent is issued, three exclusive rights are secured by it to the patentee, namely, the right to make the patented article, process or whatever it may be; the right to use it, and the right to sell or lease it to others. Broadly speaking, it is an infringement to invade any one of these three rights. A patent for a process is infringed by him who, without ownership or license, uses substantially the process which the patent claims, whether or not he uses substantially the apparatus which the patent describes, and whether he uses the materials prescribed by the patent, or uses equivalents therefor. Infringement of a process patent may occur even where precise identity does not exist between the process claimed by the patent and that used by the infringer.

The patent in the case of Mowry vs. Whitney, 14 Wallace 620 (1871), covered a process which consists in taking cast-iron car wheels from their molds as soon as they become solid enough to retain their shape, and in immediately placing the wheels in a furnace or chamber, previously heated to about the temperature of the wheels when taken from the molds, reheating the wheels therein, and then in finally causing them to cool with a great degree of slowness. The infringer's process consisted in taking the wheels red hot from the molds, putting them in an unheated chamber, interlaying them with charcoal, covering the whole with a perforated metal plate, then causing the charcoal to burn so as to reheat the wheels to an indefinitely high temperature, and so adjusting the draft as to make the charcoal burn out, and the wheels, consequently, to cool down with a great degree of slowness. The Supreme Court of the United States found that all of the steps of the complainant's process were included in the defendant's method, though confessedly the reheating was done by different means and the slow cooling regulated on different principles from those which controlled the corresponding parts of the complainant's process.

The fact that the infringer did not know of the existence of the infringed patent [illegible] relied upon as a defense to an action brought by the patentee. The general rule is that the motive or intent with which the act of infringement is committed is material and that a person may invade the rights of a patentee without intending, or even without being

aware of the existence of the patent; but he is none the less an infringer. Parker vs. Hulme, 1 Fish. Pat. Cases, 44. A person may act in the best of faith and under the protection of supposedly valid patents, but if he thereby infringes a prior patent, his ignorance or good faith will not avail him as a defense. The owner of the prior patent is entitled to restrain the infringement and to collect damages, and his right to do so does not depend upon the infringer's ignorance or knowledge. Timkin vs. Olin, 41 Fed. Rep. 169. One sufficient reason why ignorance of the existence of a patent is no excuse to the infringer, against whom suit is brought, is that a patent is a public record, of which all persons are bound to take notice. Bate Refrigerating Company vs. Gillett, 31 Fed. Rep. 809. However, the fact that one who is charged as an infringer has secured a patent upon the alleged infringing device is always entitled to weight in determining whether or not there has been an infringement. For the issue of a patent follows the decision of official experts specially appointed and qualified to examine and pass upon the claimed invention for which the patent is sought. And by the act of granting the patent they express their opinion that it does not conflict or interfere with patents previously granted. Of course, a valid patent is not to be overthrown by the issue of a subsequent patent to another person for the same thing; but when the question of infringement is at issue, and expert testimony is necessary, the action of the official experts on the subject calls for consideration, especially where doubt exists.

Obviously, there can be no great variety of fact in those defenses to an action for infringement which are based upon lack of knowledge on the part of the infringer. The unfortunate invader of the rights of the patentee can simply say that he knew nothing of the patent and that he acted unwittingly. In Thompson vs. Busnell Company, 96 Fed. Rep. 238, an action to restrain the infringement of a patent covering a saw intended for cutting metal and other hard substances, the defense was that the saws were "accidentally made and unintentionally sold by the defendant." But it was held that the patentee was entitled to protection against accidental infringemens and against the possible repetition of such accidents. The defendant in this instance advanced another equally weak defense, which was to the effect that the patented saw was impracticable and defective. Upon this point the judge, before whom the trial was had, made the following observation: "If, as they now contend, the saw of the patent in suit is impracticable and the defectiveness which results from the invention of the patent in suit is a disadvantage, the defendant will not suffer from the effect of an injunction which will operate to prevent its making such defective saws in the future, accidentally or otherwise."

The use of a thing not claimed by the patentee does not constitute an infringement. When the language of the specification, which defines the patented article, shows exactly what the patentee desires to secure as a monopoly, nothing that does not fall within the terms, which the patentee has thus chosen to express his invention, can be held to be an infringement. But a slight or immaterial change made for the purpose of avoiding the exact wording of the claim will not avail to avoid infringement. And, on the other hand, if the alleged infringement differs in principle from the patented device, it is not an infringement, although it may be within the letter of the claim of the patent. In every patent the language of the claim, specification and grant should be so clear, distinct and positive as to leave no question as to what was asked and granted, nor should it require a careful and labored investigation to ascertain whether one may not have trespassed upon the rights of the patentee. It is the duty of an inventor to use language sufficiently plain and explicit in his application for a patent to denote clearly what he asks for; and where he fails to do so, and the language of the grant of letters patent follows that of the application, and is thereby misleading to the general public, he should gain no profit from such defective statement of that to which he considers he is entitled. Thus, where an inventor applies for a patent upon "an improvement in burglar-proof safes," and his patent is granted in those terms, he cannot thereafter claim that his patent is infringed by a locking device intended for use in jail cages. Gerard vs. Diebold Safe & Lock Company, 61 Fed. Rep. 209. It is possible that the chief distinction between the two devices was that one was intended to keep out persons intent upon taking that which does not belong to them, while the object of the other was to keep them in, but the reason of the decision was that the patentee had not made the language describing his patent broad enough. If the inventor here had asked for a patent "upon an improvement in a locking device for safes, jails and other similar structures," he might have been in a position to successfully claim infringement. In White vs. Dunbar, 119 U. S. 47, it was said, in somewhat mixed metaphor: "Some persons seem to suppose that a claim in a patent is like a nose of wax, which may be turned and twisted in any direction, by merely referring to the specifications, so as to make it include something more than, or something different from what its words express."

Nothing is better settled in the law of patents than that the patentee may claim the whole or only a part of his invention, and that if he only describes and claims a part, he is presumed to have abandoned the residue to the public. The object of the patent law in requiring the patentee to "particularly point out and distinctly claim the part, improvement or combination which he claims as his invention or discovery," is not only to secure to him all to which he is entitled, but to apprise the public of what is still open to them. The owner of a patent for a sweat-pad for horse collars, fitted with a double spring so arranged as to be capable of clasping the collar and thus holding the pad in place, was held to have no grievance which the law would recognize, against one who manufactured similar pads upon which a curved hook performed the function of the double spring. The patentee had limited himself, perhaps unnecessarily, to the double spring arrangement; and, while he was undoubtedly unfortunate in the language which he had chosen to define his invention, the court was not at liberty to construe his patent to include anything more than the language of his claim fairly imported.

If a slight or immaterial variation is introduced into a patented article for the purpose of avoiding the consequences of infringement, and this can be shown or is apparent from the facts, the infringer will not be allowed to rely upon the variation as a defense to an action for infringement. In Devlin vs. Paynter, 64 Fed. 398, the patent covered a union for steam pipes, one of the members of which was fitted with an internal seat of soft metal, the face of which was made concave, the opposing member being fitted with a convex end, so as to conform to the concavity of the seat and form a perfectly tight joint therewith. The device overcame the difficulty arising from want of exact axial alignment. In the device which the patentee claimed to be an infringement of his rights, the position of the soft metal face was transposed to the convex side of the union. This transportation was held to be mere subterfuge, and, although not strictly within the letter of the patent, was declared to be an infringement. Devlin vs. Paynter, 64 Fed. Rep. 398.

Except where the patent covers merely a particular combination of elements, it is an infringement to use any part of the invention embraced within the patent. So also where a patent covers several new and independent machines working to a common end, the use of one alone is an infringement, although each is capable of independent use. In Wyeth vs. Stone, 1 Story, 273, the patent was for a new and useful improvement in the method of cutting ice, together with the necessary machinery and apparatus for cutting by the new method. To accomplish the cutting there were used two different devices, a cutter and a saw. The saw had been abandoned by the patentee as unnecesary or superfluous. In an action for infringement, the patent was held not to be invalid because double, and to have been infringed by the use of the cutter alone.

In an action for the infringement of a patent for a castor and bearings it was held to be an infringement of the patent to make and vend the bearings alone. Blake vs. Smith, 3 Fed.

Cas. 1502. An infringement of a patent for a machine takes place when a party avails himself of the invention of the patentee without such variation as will constitute a new discovery. It is not necessary that the defendant should use the entire machine, for the fact that the patentee claims an entire machine does not deprive him of his rights to the various parts of the machine, and it is an infringement if any one of the parts claimed is used in substantially the same manner and in similar machines. Foss vs. Herbert, 1 Bissel's Rep. 121.

Inventions pertaining to machines may, for the purpose of considering the law of infringement, be divided into four classes. First, where the invention embraces the entire machine, as, for instance, a car for a railway, or a sewing machine. Such inventions are seldom made, but when made, and duly patented, any person is an infringer who, without license, makes or uses any portion of the machine. Under such a patent the patentee holds the exclusive right to make, use and vend to others to be used, the entire machine; and if another, without license, makes, uses or vends any portion of it, he invades the right of the patentee. The second class of machines is that which embraces one or more of the elements of the machine, but not the machine in its entirety, as, for instance, the coulter of the plough, or the divider of the reaping machine. In patents of that class any person may make use or vend all other parts of the machine or implement, and he may employ a coulter or divider in the machine mentioned, provided it be substantially different from that embraced in the patent. The third class of machines is that which includes both a new element and a new combination of elements previously used and well known. The property in the patent in such a case consists in the new element, and in the new combination. No one can lawfully make, use or vend a machine containing the patented part or combination. They may make free use of the machine without the patented parts if it is capable of use; but they cannot use the improvements without making themselves liable as infringers. The fourth class of machines is that in which all of the elements used are old and where the invention consists in a new combination of those old elements, whereby a new and useful result is obtained.

Modern inventions of machines of utility and pronounced value belong to the fourth class, in which the invention consists solely in a new combination. Inventions of this class are just as meritorious as those of any other class, and the property of the inventor is entitled to the same protection. Such an invention, however, is but an improvement on an old machine and consequently the patentee cannot treat another as an infringer who has improved the original machine, by the use of a substantially different combination, although the machine may produce the same result. Union Sugar Refinery vs. Mathiesson, 24 Fed. Cas. 14,399.

The unauthorized application of a patented machine or device, or a colorable evasion thereof, to a new use, without varying the principle or means, is an infringement. Thus, it is no defense to a suit for infringement of a patent that a patented machine is used solely for sewing leather and the infringing device for sewing paper, when either machine might be used indifferently on either material, as a patent covers the exclusive right to use the patented machine for all purposes. Thompson vs. Gildersleeve, 34 Fed. Rep. [illegible]

In a patented machine the substitution, for one of the parts, of the equivalent of that part, does not avert an infringement. The term equivalent, as used in the patent law, has two meanings, one relating to the results produced by the invention, and the other to the devices or means by which the result is produced, and where used in this connection, it is to be given the latter meaning.

For the purpose of determining whether or not an infringement has occurred, if the patent mentions a specific mode of effecting the prescribed result, the substitution of any one or more mechanical equivalents for those specially mentioned will none the less work an infringement. Whoever adopts the patentee's plan and works out the same results by merely substituting for one or more mechanical devices their mechanical equivalents is just as guilty of infringement as if he servilely copies the patentee's device in all its parts. One thing to be the equivalent of another must perform the same functions as that other, and the function must be performed in substantially the same way. This substantial sameness of way is not necessarily an identity of merit, nor a theoretical scientific sameness. In a purely scientific sense, a screw always performs its function in a substantially different manner from a lever, and in substantially the same way as a wedge. Screws and wedges are equally inclined planes, while a lever is an entirely different elementary power. But screws and levers can practically be substituted for each other in a larger number of machines than screws and wedges can be similarly substituted. When a lever and a screw can be interchanged in a patented machine and still perform the same function with a result that is beneficially the same, they are said to perform the same function in substantially the same way. One thing, however, may be an equivalent for another in one environment, and not such an equivalent in another situation. For instance, springs and weights are generally equivalents; but where the environment is such that a spring will operate successfully while a weight will not so operate, they are not equivalents. In one case the Supreme Court has gone to the extent of holding that a confined column of water in a cylinder, worked by a pump and working a piston, is an equivalent of a combination of a vibrating arm, toggle joint and other mechanical devices, when used to transmit vibratory power. Walker on Patents, 311.

Direct-Current Motors, Their Action and Control—II.

By F. B. Crocker and M. Arendt

Shunt Motor Problems

The following data of three standard sizes of shunt motors are given, so that the various features of these machines may be studied and the efficiency, effect of temperature, speed regulation, etc., calculated:

Results of Actual Tests

1 HP Machine.	10 HP Machine	1[illegible] HP Machine
Rated Voltage [illegible]	230	230
Rated Current [illegible]	38 amps.	384. Amps.
Arm. Current at Rated Load Ia [illegible] Amps.	37 Amps.	380.7 Amps.
Shunt Field Current [illegible] Amps.	1 Amp.	3.3 Amps.
Arm. Resist "Hot," [illegible]	.28 ohms.	.0104 ohms.
Arm. Resist "Cold," $R'a$=2 ohms	[illegible]	.009 ohms.
Field Resistance "Hot," Rsh=1506 ohm.	230 ohms.	70.2 ohms.
No load armature current, Ia=.4 amps.	2.3 Amps.	14.21 Amps.
Speed at rated load R.p.m. 1250	825.	585.
Speed at no load R.p.m.f=1310	[illegible]	595.
Brush Contact Area, Ab=3 sq. cm.	12 sq. cm.	72 sq. cm.
Current Density of Brushes at rated load Sb=1.28	3.08	5.3
Current Density of Brushes at no load Sb=.126	.19	[illegible]
Drop due to brush contacts at rated load, Db=1.05 Volts.	1.4 Volts.	1.86 Volts.
Drop due to brush contacts at no load [illegible] Volts.	.84 volts.	.84 volts

The voltage drops due to the brush contacts have been taken from the curve herewith, which gives the results of actual tests made with a number of brushes similar to those employed in the three sizes of motor specified above.

Calculation of Speed Regulation [illegible] Motor.

It was shown that the speed of a motor is directly proportional to the c. e. m. f. at any instant, other quantities such as field current and flux being constant, hence the ratio between rated load speed and no-load speed (*i. e.*, free) is:

$$r.\ p.\ m. : r.\ p.\ m._f :: c.\ e.\ m.\ f. : c.\ e.\ m.\ f._f \qquad \text{VIII}$$

From equation VII c. e. m. f. = $V - (I_aR_a + D_b)$ in which we substitute the values of V, I_aR_a and D_b as given in the data sheet and obtain c. e. m. f. $= 230 - (3.85 \times 3.08 + 1.05) = 217.1$ volts at rated load, and c. e. m. f. $= V - (I'_aR'_a + D'_b) = 230 - [(.4 \times 2.7) + .83] = 228.10$ volts at no-load. Substituting these values of c. e. m. f. and the rated motor speed in equation VIII, we have $1250 : r.\ p.\ m._f :: 217.1 : 228.1$, $r.\ p.\ m._f = 1314$ r. p. m., which is within .3 per cent of the data value 1310 r. p. m. for the no-load speed.

[illegible]

C. e. m. f. $= V - (I_aR_a + D_b) = 230 - (37 \times .28 + 1.4) =$ [illegible] $(2.3 \times .244 + .84) = 228.6$. The rated speed is 825 r. p. m., and by substituting in equation VIII, we have 825 : r. p. m.$_f$: : 218.2 : 228.6; whence r. p. m.$_f = 863$, which is within .3 per cent of the data sheet value, 865 r. p. m., for the no-load speed.

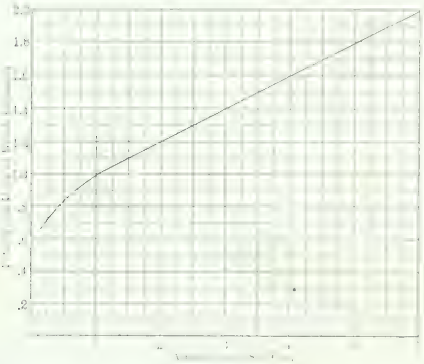
[illegible]

[illegible] $(3.807 \times .0103 + 1.86) = 224.2$ volts.

C. e. m. f. $= V - (I_aR_a + D_b) = 230 - (14.20 \times .09 + 84)$ $= 229$ volts, and from equation VIII, 585 : r. p. m.$_f$: : 224.2 : 229 or r. p. m.$_f = 597$, within .3 per cent of the no-load speed as given on the data sheet.

Determination of Efficiency of Motor at Rated Speed and Load.

The efficiency of a motor can be obtained approximately from its name-plate data or it can be determined absolutely from the



[illegible]

values obtained by test and given in the data sheet; usually the two results agree very closely.

The standardization rules of the A. I. E. E. (paragraph 313) state: "All electrical apparatus should be provided with a name-plate giving the manufacturer's name, the voltage and the current in amperes for which it is designed. Where practicable, the kw-capacity, character of current, speed, frequency, type designation, and serial number should also be stated." From the data thus given the approximate or "name-plate efficiency" of a motor can be determined as follows:

From Name-Plate of 1-hp Motor.

Input at rated load $= 230 \times 4 = 920$ watts. Output at rated load = 1 horse-power = 746 watts.

Hence efficiency being the ratio between input and output, the name-plate efficiency of the 1-hp motor $= 746 \div 920 = 81$ per cent.

Calculation of Efficiency, Using Data Sheet Values.

In determining the efficiency of a motor by calculation, we first obtain the motor input from the name-plate and then calculate the stray-power and copper losses, using the values given on the data sheet. The difference between input and the total losses gives the output, hence the ratio of input minus losses to input gives the motor efficiency.

The stray power losses of the 1-hp motor running free = armature input at no-load — the armature no-load copper losses; that is, [illegible] $I'_a - (I'^2_aR'_a + I'_aD'_b) = 230 \times .4 - (.4 \times 2.68 + .4 \times .83) = 91.2$ watts.

The remaining losses at rated load are

$$I_{sh}V = .153 \times 230 = 35.46$$
$$I_a^2R_a = 3.85^2 \times 3.08 = 45.64$$
$$I_aD_a = 3.85 \times 1.05 = 4.04$$
$$85.14$$

If to this we add the no-load stray power loss of 91.2 watts, the total loss is $85.14 + 91.2$ or 176.3 watts. The motor output being equal to the input minus losses $= 920 - 176.3 = 743.7$ watts and the efficiency by definition $= \frac{[illegible]}{920} = 81.0$ per cent; hence the efficiency by calculation is equal to that by name-plate determination.

The assumption that the stray power losses at no-load are equal to those at rated load is not absolutely correct, since they will be lower at rated speed, which is from 2 to 5 per cent less than with motor running free, but the error introduced by this assumption is practically negligible, as will be proven in the case of the 10-hp motor.

Determination of Efficiency of 10-hp Motor.

Name-plate efficiency $= \frac{\text{Output from name-plate}}{\text{Input from name-plate}} = \frac{10 \times 746}{[illegible]} = \frac{[illegible]}{8740} = 85.3$ per cent.

Efficiency by Calculation, Using Data Sheet Values.

First determine the various I^2R losses as follows:

$$I^2_aR_a = 37^2 \times .28 = 383.3$$
$$I_{sh}V = 1 \times 230 = 230.$$
$$I_aD = 37 \times 1.4 = 51.8$$

Total I^2R losses $= 665.1$ watts.

The stray power loss with motor running free (*i. e.*, at 865 r. p. m.) is equal to the no-load armature input minus the no-load armature copper loss; that is:

Stray power at no-load $= 230 \times 2.3 - (2.3^2 \times .244 + 2.3 \times .84)$ $= 526$ watts. At rated load the motor is running at a slightly lower speed of 825 r. p. m., hence the stray power loss will be less because the eddy current constituent varies as the square of the speed and the several losses due to hysteresis, windage and friction vary directly as the speed. In standard machines of this size the stray power losses are usually divided as follows: 50 per cent due to windage and friction, 25 per cent due to hysteresis and 25 per cent due to eddy currents. Hence, 75 per cent of the stray power losses vary as the speed, and 25 per cent vary as the square of the speed. The stray power loss corrected for change in speed from 865 to 825 r. p. m. or 4½ per cent will be $(.955 \times .75 \times 526) + (.955^2 \times .25 \times 526) = 495$ watts. If the stray power loss had been assumed to have the same value at no-load speed and at rated load speed the error introduced would therefore be $526 - 495 = 31$ watts, or about .4 per cent of 8740 watts the rated input. This difference is so small that it may be neglected in most practical problems..

The total motor losses employing the corrected stray power value are $495 + 665 = 1160$ watts. Hence the output is $230 \times$ [illegible]

The efficiency is, therefore, $7580 \div 8740 = 86.8$ per cent. A comparison of calculated output (7580 watts) and rated output $(10 \times 746 = 7460)$ shows that the former is 136 watts greater; so that the manufacturer is on the safe side when the motor is rated to give 10 horse-power, and this is as it should be, overrating of machinery being bad practice.

Effect of Armature Resistance Upon Speed Shunt Motors.

The principal and instantaneous cause of shunt motor speed variation with changing loads is the varying armature current and consequent varying armature drop $(= I_aR_a)$; hence the reason for making the resistance of the armature (R_a) as low as possible. This cause of speed change is shown by a consideration of the 10-hp motor, data for which have already been given. Assume its armature to be "hot" (75 degs. C.) and let us determine the speed change due to variations of armature current alone. From the data sheet we have $R_a = .28$ ohms, brush drop at no-load .84 volts, at rated load 1.4 volts, and speed at rated load 825 r. p. m., with armature current I_a of 37 amperes and terminal voltage V of 230.

The c. e. m. f. at rated load with armature "hot," but running

free is $230 - (.28 \times 2.3 + .84) = 228.5$ volts. Hence from equation VIII $\text{r. p. m.}_f = \frac{228.5}{218.2} \times 825 = 864$, that is the speed changes from 825 to 864 or 39 r. p. m., amounting to 4½ per cent. Thus a speed rise of 4½ per cent results on account of armature drop alone, when the load is removed from this 10-hp motor.

Effect of Temperature Changes Upon Speed of Shunt Motors.

Heating of armature affects the speed only to a slight extent, and may be practically neglected. For example, in the case of the 10-hp motor, the cold armature resistance is .244 ohms; the hot armature resistance with a temperature change from 25° to 75° C. (*i. e.*, 50° C. rise being permissible), is 15 per cent greater (see Section 6) or .28 ohm. The speed change at rated load due to this heating is determined as follows:

C. e. m. f. with armature cold at rated load $= 230 - (37 \times .244 + 1.4) = 219.7$ volts, the c. e. m. f. with armature hot and at rated load being 218.2 volts; hence the speed at rated load and with armature cold is $219.7 \div 218.2 \times 825 = 830$ r. p. m. instead of 825 r. p. m. when the armature is hot, an increase of .6 per cent, which is not material in most practical cases, the change due to varying load being 4½ per cent as shown above.

Change of Speed Due to Heating of Field Circuit.

The allowable temperature rise in the field winding is 50° C., causing a 19 per cent increase in the resistance, or cold resistance is $\frac{R_{sh}}{1.19} = \frac{230}{1.19} = 193.3$ ohms.

$$\text{Current in field (hot) } I_{sh} = \frac{R_{sh}}{V} = \frac{230}{230} = 1 \text{ ampere.}$$

$$\text{Current in field (cold) } I_{sh} \frac{V}{R'_{sh}} = \frac{230}{193.3} = 1.19 \text{ amperes.}$$

Hence the current in the coils cold is 19 per cent greater than when the latter are hot; and from magnetization curves of standard types of shunt motors a rise of 19 per cent in field m. m. f. causes an increase of about 4 or 5 per cent in the flux, or the field is this amount stronger "cold" than "hot." With other conditions (such as n, V, I_a, p *and* b) constant the speed (N) will vary inversely with the flux as proven in the following:

$$e = \frac{\phi n N 2p}{10^8 \times 60 \times b} \text{ or } N = \frac{e \times 10^8 \times 60 \times b}{\phi n 2p}$$

Hence with the flux 4 per cent to 5 per cent stronger with field winding cold, than with it hot, the speed is 4 per cent to 5 per cent lower. This variation of speed with heating of the field winding is a weak point of the ordinary shunt motor for work requiring almost perfectly constant speed, such as weaving It can be overcome by employing so highly saturated a field that a moderate change in field current produces only negligible flux variation; or a field winding with a zero temperature coefficient wire would secure a like result, but both methods are, however, too costly.

Effect of Armature Reaction Upon Speed of Shunt Motors.

The counter m. m. f. due to armature current decreases the field flux and the value of these back-ampere-turns varies somewhat with different designs. In fact some designers have suggested that armature reaction be employed to offset the effect of armature drop ($I_a R_a$) and thus cause the motor to maintain an almost constant speed from no load to full load. The objection to this design would be, under usual conditions, as follows:

1. Excessive armature reaction at starting under load, weakened field and resulting sparking.

2. Inability of machine to run well on continued or even momentary overloads due to weakened field and sparking.

3. Heating caused by the above stated sparking.

In the usual design of standard single-speed shunt motors the ratio of back ampere-turns to field ampere-turns at rated load seldom exceeds 8 per cent to 10 per cent, hence the rise in speed due to armature reaction would correspond to a change of only 1 per cent to 2 per cent in flux, depending upon the flux density at which the machine is operated. However, by designing the armature winding so that there will be few turns of wire per section, with a very high flux density in the teeth and high resistance brushes, the above difficulties do not occur when armature reaction is depended upon for speed regulation.

Collecting these various causes of speed variation of this standard 10-hp motor, we obtain the following table:

Cause.	Armature Drop (inclusive of brush drop).	Armature Reaction.	Armature Heating	Field Heating.
Per cent Speed change	—4½	+1½	— .6	+4 to 5

In the case of larger motors armature drop is slightly smaller, the field heating effects being also slightly less while the other factors remain about the same. It is important to note that the effects of armature drop and armature reaction are instantaneous, whereas heating requires several hours to reach its maximum effect. Hence the immediate effect of applying rated load to a motor is to reduce its speed ($-4.5 + 1.5 = -3\%$), after which as the machine heats up the speed slowly rises to about the original value ($+4.5 - .6 = +3.9\%$).

Construction of Joint Pole Lines.

In a paper delivered before the Western Association of Electrical Inspectors at its third annual meeting, held at St. Paul. Minn., on Oct. 23, Mr. H. B. Gear gives some information on the joint pole line arrangements in effect in Chicago between the various operating companies.

The lighting wires are carried on the top of the pole with a clearance of five feet between the lower cross arm of the lighting company and the upper cross arm of the telephone company. The lighting company's transformer is allowed to encroach on the clearance space, provided that at least 3½ ft is maintained between the bottom of the transformer and the top telephone wire. Ground wires on secondary lines and lightning arresters are covered by a half-round wood molding for the protection of linemen as well as to prevent the possibility of any stray current being communicated from the ground wire to the telephone system.

The telephone company limits its open-wire equipment to two cross-arms and a service buck arm in outlying districts, and to one-cross arm in the more congested districts. Cables are used for the transmission up to within a block or two of the location of the telephone served. This avoids the necessity of extra cross-arms for through lines and greatly reduces the possibility of crosses with lighting services or high-tension wires A clearance of 2 ft. is maintained on the sides of buildings between lighting and telephone services. Where underground lighting cables are brought up a pole, the iron pipe is extended to the top of the clearance space.

The major portion of the distributing systems of the lighting and telephone companies in Chicago is carried in alleys which makes it unnecessary to utilize the streets except for through lines. The latter are in many cases carried underground on the streets with lateral connections at the alley intersections for the distributing lines.

There is some advantage to both companies in joint pole arrangements from the standpoint of investment. The operating advantages are, however, considered such by the Chicago companies that old lines are reconstructed in preference to erecting a second line on the opposite side of the thoroughfare.

The use of joint pole lines has, however, some objections which may not be overlooked. The service of each company is likely to be interfered with by the employees of the other company. It is, therefore, essential that the relation between the employees interested should be friendly and a spirit of forbearance must exist at all times.

The arrangement in effect in Chicago may be outlined briefly as follows: Each company, when it proposes to make any extensions of its lines, notifies the other company by letter of

its intention, giving a description of the number, size and location of poles, which it intends to erect. Several copies of these letters are passed between the companies so that each situation may be looked over by the foreman or inspector, who makes a recommendation as to whether or not he considers it advisable for his company to take an interest in the poles which are to be set. If the foreman of the other company desires larger poles he may ask for the same, and they will be set as requested by the other company. Payment is then made on the basis of the number of gain spaces reserved for the use of each company.

If the other company does not feel that it will require space on the poles within a reasonable time, it reserves the privilege of refusing to take an interest in the poles which are to be erected.

In case one company wishes to extend its lines where the other company already has a line, it will ask for space on the existing poles if they are high enough, and will attach its equipment after agreeing to purchase from the other company an interest in the poles concerned. In case the poles in the existing line are not tall enough for the equipment of both companies, the incoming company replaces the existing poles at its own expense, taking the old poles as salvage and paying the other company the expense incurred by it in transferring its equipment from the old to the new poles. The new poles are then jointly owned by the two companies.

The expense of maintenance of joint poles is shared by the two companies in proportion to their interest in the pole.

In cases involving work where separate parallel lines exist representatives of each company agree upon a suitable arrangement for the consolidation of the existing lines into one joint line.

In general, the lighting company is apt to bear the greater portion of the expense, owing to the fact that it must pay for the lowering of the other company's equipment and also because the lighting lines are usually preceded by telephone lines so far that the lighting company cannot forecast its requirements with sufficient accuracy to derive the benefit of taking an interest in the poles when they are originally set.

The safety of the lives of employees and the public, as well as the diminished fire risk, are well established by the fact that hardly a single serious case of trouble has occurred in seven years of operation of joint lines. This record has been made on lighting and telephone systems which have been rapidly extended until there are at the present time about 25,000 poles jointly occupied by the wires of the Chicago Lighting Company and the Bell Telephone Company.

Joint arrangements are also in effect on about 2500 poles with the city telegraph and street railway companies. In addition to this, the city of Chicago has the privilege of attaching its wires for electric light, fire alarm and police telephone systems. In general, all signaling systems are kept on the telephone company's portion of the pole and all lighting or traction systems on the lighting company's portion of the pole.

Cases of triple occupation, in which the city is the third party, are numerous, but triple occupation with other companies is not frequent.

The author realizes that methods which can be applied in metropolitan work are not always suitable for smaller cities on account of the limited resources of the companies involved. In cities where the main runs cannot be carried underground, separate routes on high poles should be established for these by each company and the distributing lines may be carried well below the through lines. As far as possible the through lines of the telephone company should be carried in aerial cable.

The presence of two sets of telephone distributing systems is at best a deplorable condition from either standpoint and joint construction of the three companies involved in such situations is not practical under existing conditions, though entirely feasible from a construction standpoint. Conditions can be somewhat improved by the encouragement of one of the telephone companies to operate jointly with the lighting company.

The Malden Electric Company's Laboratory.

An interesting central station laboratory is in service at the present time at the plant of the Malden (Mass.) Electric Company. The value of a laboratory or special testing department in central station work is greater to-day than ever before, on account of the greater range of service supplied by electric light and power companies and the increased importance of being able to determine accurately the errors of meters and the candle-powers of disputed lamps. In these days of anti-corporation agitation on the part of the public, the maintenance of a standardizing laboratory at or near the central station can be made a valuable demonstration of a company's intentions in the way of fairness in supplying metered service. Perhaps no question is more an issue between lighting companies and their consumers than the accuracy of meters, and the provision of complete testing facilities in a special room set apart for investigation work alone is a wise policy for an operating company to adopt. Tests on the consumers' premises are useful, but if anything is radically wrong with the equipment, the laboratory offers much better facilities for the removal of trouble.

A general view of the Malden laboratory is shown herewith in Fig. 1. The department occupies two rooms on the second floor of the storehouse adjoining the main station at Malden. The main laboratory is about 33 ft. long by 23 ft. wide in extreme dimensions, and the second room, which is a section of the main laboratory partitioned off into a space about 13 ft. by 7 ft., is used as a photometric laboratory. The laboratory

FIG. 1.—GENERAL VIEW OF LABORATORY.

is provided with windows on three sides and is wired for all the regular tests which have to be made on apparatus which has fallen under suspicion. Almost all the work done is of a special nature as contrasted with the routine testing in a manufacturer's laboratory, where the product passes through inspection and test continuously. The same tests are repeated often at Malden, but they are almost entirely for the purpose of settling disputed points, following up the value of special schemes in apparatus arrangement, and testing the condition of apparatus which has been brought in for repairs or adjustment.

The scope of the regular work at Malden includes tests of arc and incandescent lamps, tests of meter accuracy, transformer insulation, and occasional efficiency, heating and insulation tests of small motors up to about 5 horse-power. Defective flat irons, fuses and other small appliances are tested when necessary, and the laboratory is available for any special studies or comparisons which the officials of the company desire to have made. In the practice of the Malden Electric Company very little new and guaranteed apparatus is tested as it is received, but any trouble showing itself in service is promptly investigated. The laboratory is not open at all hours of the day, as the staff are regularly occupied part of the time in motor and meter tests in the territory served by the company.

Figs. 2 to 6 illustrate in diagramatic form the principal testing circuits in the laboratory. As the entire distribution system of the Malden Company is operated at 2300 volts, single-

phase, or 550 volts, three-phase, no direct-current lines enter the laboratory. In one corner of the room, however, is installed a Holtzer-Cabot motor-generator set consisting of ½-hp, 104-volt motor direct-connected to a 30-volt, 8-ampere generator making 1800 r. p. m. This is ordinarily used for charging the sparking batteries used in automobile work, and can be turned to account for other purposes if desired. The principal supply circuits are a 104-volt, single-phase line for testing single-phase meters; a 2300-volt, single-phase line for arc lamp tests, and a 550-volt, three-phase circuit for testing meters. The frequency is 60 cycles.

All the laboratory apparatus is kept well out of the center of the room, being located on or beneath benches, suspended from special brackets or supported on stands carrying it above the floor and out of casual reach. The 2300-volt circuit for testing series enclosed-arc lamps enters the room at one side, and as shown in Fig. 3, passes through the plug switches, fuses and an ammeter to a constant current transformer mounted about 5 ft. above the floor. This ammeter is permanently retained in the primary circuit, as it gives a constant cautionary indication of the condition of the circuit. Provision has been made for testing seven arc lamps at once if desired. The lamps are hung from a special platform attached to the ceiling by four iron rods, and at one side space is provided for testing two multiple enclosed arc lamps, one at a time, as the circuits are now arranged. The circuit of the series lamp test contains an ammeter jack, and the multiple test circuit is also fitted with a jack, the same ammeter and voltmeter being used on both classes of work. The arc lamp tests include a 1000-volt insulation breakdown trial, test for open circuits, operation of contacts, feeding and pick-up mechanism, working of dash pots and weight adjustment. Comparative life and quality tests have been made here, and recently a series of tests was made on the life of an aluminum [illegible] globes, which worked out favorably in point of [illegible]. The series lamps used on the Malden circuits take 6.6 amperes each and are sent out of the laboratory calibrated to [illegible] volts across the arc. The 1000-volt arc lamp insulation test is made by a current supplied from a small transformer located under one of the benches in the corner of the laboratory nearest the suspended arc-lamp base board. A rheostat is inserted in the primary circuit and an ammeter in the secondary circuit of this transformer to enable the current to be held below the fusing point in case of a ground in the lamp mechanism. By adjusting this rheostat a small ground can be burned off if desired. A ¼-hp Emerson motor wound for 104 volts is used for polishing work.

Insulation tests on transformers are made by a General Electric high-potential 500-volt outfit mounted in an oil bath and located in a recess cut into one of the benches near the floor level. This transformer is wound for either 50 or 100 volts primary and 10,000 volts secondary, and is provided with a micrometer spark gap with terminals for the testing lines and a water rheostat for control of the primary current. When the cover of the spark gap is removed, the primary circuit is broken, as a safety precaution. All defective or doubtful transformers are tested at a potential of 10,000 volts for 5 minutes between primary and secondary, with the secondary grounded to the core and case. A voltmeter is provided in the primary circuit as a check on the spark gap, the latter varying in its reading with variations in the atmospheric conditions.

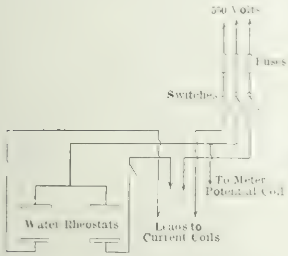


FIG. 2.—THREE-PHASE METER TEST.

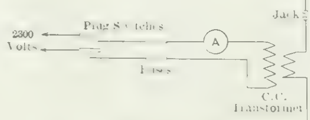


FIG. 3.—SERIES ARC TEST.

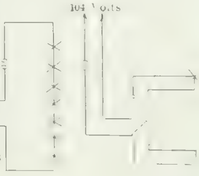


FIG. 4.—MULTIPLE ARC TEST.

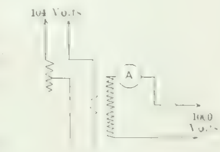


FIG. 5.—1000 VOLT INSULATION TEST.

All meters are made correct to within one-half of one per cent before they are returned to service. The usual stop-watch calibration of accuracy in the number of revolutions with definite constant loads is employed in all meter tests. When necessary artificial loads are secured by the use of series transformers. The standard connections of the laboratory for testing meters under load are shown in Fig. 2. A three-phase, 550-volt circuit is carried through fuses and a switch to the meter under test, the current coils of which are respectively connected to the outside and inside pairs of wires marked "leads to current coils." The middle phase wire is carried past the meter, with a potential tap taken off, to the center of a jumper wire connecting two corresponding water rheostat plates. Two rheostats are located in tanks supported on insulators mounted on a platform outside the laboratory window, the platform being enclosed with a hinged cover adjustable from the inside of the window. The plates farthest away from the window have a potential difference of 550 volts between them and the end plates in each tank are likewise at different potentials. This brings the plates nearest the window and joined by the jumper to the same potential and makes a shock impossible in moving them in and out. The plates are hung by insulators from a cross bar carried by rollers, small brass rods being used as rails lengthwise of the rheostat tanks. According to the amount of chlorine given off, the rheostats may be completely shut in or opened to the outside air. The maximum capacity of the outfit is about 50 amperes per phase.

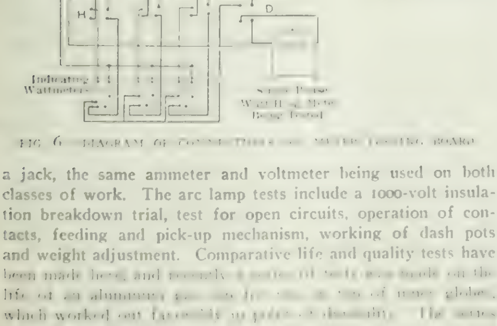


FIG. 6.—DIAGRAM OF CONNECTIONS OF METER TESTING BOARD

Fig. 6 shows in detail the testing circuits for calibrating single-phase watt-hour meters. Current enters the laboratory at 104 volts for this purpose. Attached to the ceiling over the testing bench is a lamp bank composed of some 90 incandescents arranged in rows. Five of these lamps are "Meridians," the balance being 16-cp units, arranged to form an adjustable resistance and controlled by small single-pole, vertical-throw knife switches mounted on a panel within convenient reach of the tester. Three standard indicating wattmeters are provided for comparison of different sizes of meters, the scales reading to 500, 1500 and 7500 watts, respectively. The meter to be tested is placed in circuit at *K* and the horizontal, double-pole knife switch *H* supplies the indicating meter which is to be

used for checking. The tested meter is controlled by the switch *D*. One side of the supply circuit passes to a bus-bar on the lamp bank, and after the current is passed through the lamp resistance and switch which makes the desired combination, it passes through the particular switch *H* selected and then through the standard and tested meters back to the line. Besides the single-pole knife switches, which produce broad changes in the lamp bank connections, rheostats are inserted in the circuits to permit gradual adjustment of the load, the handles being located close to the testing stand. By means of series transformers artificial loads of 75 to 100 amperes can be tested on large meters; but the normal capacity of the testing circuits covers meters of from 5 to 50 amperes. The company keeps at the laboratory for exact comparison of the standard meters a precision dynamometer which is calibrated once a year at the factory and also a precision wattmeter and ammeter. The 0.500 indicating wattmeter is so frequently used that it is mounted on a stand on top of the test bench; the other two meters are on a swinging bracket which is located beneath the bench when not in use.

The photometer room contains a Queen photometer with motor-driven lamp stand adjustable for different degrees of angular rotation, with permanent ammeter, voltmeter and rheostat connections. The precision instruments are kept in this room together with Queen standard incandescent lamps used in photometric comparisons.

Electric Power Application in Small Sewage Pumping Plants.

At a recent meeting of the sanitary section of the Boston Society of Civil Engineers a discussion was held following the reading of a paper on "Small Pumping Plants for Sewage," by Mr. Irving T. Farnham, of Newton, Mass. During this discussion the problems of electric power application to small sewerage pumping plants were very frankly handled, and in view of the increasing importance of this kind of load for central stations a résumé of the electrical portion of the discussion is given below.

Mr. Frank A. Barbour pointed out that the great argument against pumping in the case of small installations has been the labor charge. With steam pumping local attendance at each station is required and a storage capacity limiting the pump run to certain hours is necessary. To localize the labor at one point compressed air is of considerable value, but of doubtful economy and limited usefulness. The more nearly continuously a pumping plant can be made to operate at a uniform rate, the more economical is the result, provided the labor account does not offset the saving in the decreased storage capacity, lessened size of force main and reduced friction head thus made possible. With a steam plant a reservoir large enough to hold the sewage during the hours the pumps are not running, and a force main adapted to the pump rate, are required. If the amount of sewage to be handled could be accurately predicted and a pumping unit with a capacity equal the average daily discharge adopted, then a reservoir only large enough to equalize the hourly variation would be necessary. This cannot practically be done, and the nearest approach to uniform discharge is obtained by dividing the plant into such a number of units as will most nearly approximate in their capacity the rate of inflow; that is, by dividing the total power into units best capable of handling the load curve. With such an arrangement, the reservoir can be reduced to a size only sufficient to prevent too frequent a starting and stopping of the units, and the force main designed on the basis of the maximum rate of inflow for the period in the future which it is economical to consider. This continuous discharge is often extremely desirable in disposal work where either purification is effected or the sewage disposed of by dilution.

Such frequent starting and stopping practically necessitates automatic arrangements, and for this electric motors are practically the best adapted. Such plants can be electrically operated with practically no attendance except for oiling and examination of switches.

The plant at Saratoga, N. Y., is of the type above described, consisting of three units of 20-hp induction motors, direct-connected by vertical shafts to three 6-in. centrifugal pumps, the pumps being submerged in three separate wells, with floats in these wells arranged to stop and start the motors by the rise and fall of the sewage. The capacity of each unit is 1500 gals. per minute with one pump working against a head of 28 ft.; 1200 gals. per minute with two pumps working against 38 ft., and 1000 gals per minute with all three pumps against a head of 42 ft. The combined efficiency of pumps and motors was by test proved to be about 35 per cent. The capacity of the pump well is 10,000 gals., or only sufficient to balance the operation of the machinery. The amount of sewage varies daily from 1,500,000 to 3,000,000 gals. The cost of the plant was $5,400, including pumps, motors, automatic starting apparatus and all interior piping and valves.

At Hudson, Mass., two 15-hp, three-phase, 60-cycle induction motors, direct-connected to 5-in. centrifugal pumps by verical shaft, serve to lift the sewage to the elevation of the disposal plant. The current is supplied at 500 volts through transformers. In this case the pumps are set in dry wells at an elevation below the height to which the liquid rises in the adjoining sewage well, with suctions laid through the dividing wall into this collecting well. The pumps are therefore dry and accessible for use, ready primed with each rise of sewage in the collecting well. The normal capacity of the pumps is 500 gals. each when two units are working against a total head of 35 ft. The combined efficiency is a little over 42 per cent. The cost was $3,600 complete, including motors, pumps, piping and control.

Wherever vertical shafts are used, the division of the moving parts of the motor and impeller thrusts by a slip coupling is desirable. The thrust bearing for the vertical shaft is an important element in the design. At Saratoga, where a bearing of several inches in diameter with alternate loose rings of brass and steel submerged in oil, was employed, considerable trouble was encountered because of heating. At Hudson a regular marine propeller bearing, with an oil-collecting pan, and the oil lifted and circulated by centrifugal force, was used with entire success. In both the Hudson and Saratoga installations time limit relays have been installed, which automatically cut out the current in case of stoppage of the motors or burning of the switches. The floats are so set that the first pump starts with the sewage at a certain level, and if the inflow is greater than the capacity of this pump, the sewage rises to the level where it operates the float governing the second pump. This second pump, coupled to an alternating-current motor, runs at constant speed, and starting against a closed check with no discharge, develops the necessary pressure to lift the check and begin pumping. Where energy is drawn from a lighting circuit the starting current of the motor may dip the lights for a fraction of a second unless special apparatus is inserted in the line to prevent this action. Alternating-current motors started and stopped automatically, cannot be varied in speed with success. With a certain frequency and number of poles a practically fixed number of revolutions per minute results. The variable factor in obtaining the desired pump capacity is in the radius of the impeller. Motors with a multiple number of poles can, however, be obtained, the number being changed by the attendant so as to change the speed in inverse ratio to the poles in use. With direct current the series-parallel method of control can be utilized to vary automatically the speed in such a way as to adapt discharge to inflow within certain limits. Where direct current is used, the motors cannot safely be subjected to the same overload as with alternating motors, and in order to prevent commutator difficulties under the torque developed in starting centrifugal pumps, large relative motor capacity must be provided.

At Fredericton, N. B., a plant consisting of two 15-hp motors direct-connected by vertical shafts to two 5-in. centrifugal pumps, is being installed to pump the sewage during such

period as the river is above the elevation of the outlet of the sewer. The plant is designed to discharge 500 gals. per minute against the maximum height of water in the river. This height varies 20 ft., and with the short force main, is the governing factor in determining the load. In this case, however, with constant circumferential speed, it is found that the maximum load on the motor occurs not with the maximum head, but with a lower head. This is because of the fact that with a centrifugal pump the discharge increases in greater inverse ratio than the reducing head, and the maximum load occurs at some intermediate point between maximum and minimum head, the exact point depending upon the pump characteristic, which depends upon the curve given to the impeller. Each centrifugal pump has its own characteristic and a breaking-down point beyond which the discharge will not increase beyond the inverse ratio of the head. This is a phase of the problem which must be taken into account wherever the load is liable to change, either because of a varying difference between source of supply and point of discharge, or in the case of a force main which may empty because of reduced friction head at the time of starting the pumps. Unless care is taken in the selection of the impeller curve it is possible under reduced head to bring such a load on the motor as to burn out the windings. The cost of the Fredericton plant was $4,000 and the guaranteed efficiency 52 per cent. It should be noted that high efficiency in handling sewage sometimes increases the tendency to clogging of the pumps because of the decreased impeller clearance necessary, and it is sometimes better to adopt a pump of lower efficiency or one requiring less screening.

One of the advantages of electric pumping is the possibility of placing the entire pump outfit below the ground surface, and without the building. In Atlantic City, because of the flat character of the country and because of the small elevation of the streets above tidal level, several pumping stations are installed. These are placed below the streets or sidewalk, the stations being lighted through the roof with glass sidewalk lights. The plans provide for the raising of the screens for clearing by hydraulic lift above the elevation of the ground in a manner similar to the sidewalk elevator.

At West Chester, Pa., the peculiar topography of the city renders impossible the collection of sewage at one point, making it necessary to install two stations. These are similar to the Hudson and Saratoga plants, but use single-phase current.

Where a number of small plants are to be installed, widely distributed in location, and where energy can be obtained at a reasonable cost, the automatic possibilities of electric operation usually render the electrical method the most economical and advisable. At Saratoga, where energy is obtained from Spiers Falls, there is no doubt that in actual cost of energy this plant is far more economical than would be possible under any other method. At Hudson the energy is in greatest demand for pumping at the hours when the lighting load is at a minimum, which serves to smooth out the load line. In such a case a rate of 2 or 3 cents per kw-hour is possible. The possibility of small, artistic stations, odorless and noiseless, without chimney or exhaust pipe, is a feature to be counted in favor of electric pumping, particularly in summer resorts or high-class residential districts. Electric pumping is thus sometimes made possible where steam or gas-engine plants would not be tolerated.

Mr. F. H. Hayes referred to a motor-driven sewerage plant at Pittsfield, Mass. This is a triplex, horizontal pump; it handles 3500 gals. per minute, and delivers this amount of sewage through 2400 ft. of 24-in. pipe. Energy is supplied by the local central station for an 8-hour day-time run at a very reasonable price, and if a larger run is required, an extra charge is made. The plant has been in operation 5 years, and an 8,000,000-gal. triplex pump was recently ordered to extend the installation. Mr. Hayes emphasized the desirability of inspecting smaller plants every 3 or 4 hours.

Mr. Bertram Brewer cited a new plant under construction at Waltham, Mass., which consists of two 5-in. pumps and two 15-hp motors of [illegible] type, working against about 40 ft. maximum head. Mr. Brewer stated that there is room for improvement in automatic starters, it being an extra expense where heat is needed to keep water from freezing or oil from congealing. Mr. A. J. Garrett also contributed a brief description of a plant at Plainfield, N. J., consisting of two 10-in. x 6-in. Ingersoll-Rand air compressors, driven by two 7.5-hp Wagner motors, with a Fairbanks-Morse gasoline engine as a reserve, and two air-operated displacement pumps. The plant is guaranteed to handle 250,000 gals. in 16 hours against a static head of 13 ft. and cost $4,655, exclusive of the concrete operating chamber.

Coil Insulation in Electrical Apparatus.

At the sixteenth meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers, Mr. J. A. Jacobs presented a paper with the above title which contains much of interest to the operating engineer. The first cost of a machine for a given output depends largely upon its rating, and that depends, in turn, on the allowable temperature rise in the coils, and thus upon the temperature which the insulation of the coils will stand without rapid deterioration. From this it follows that the quality of the insulation is of prime importance to users and manufacturers of electrical apparatus.

For convenience, the subject is divided into three classes: First, the insulation on the wire; second, what might be termed the internal insulation of the coil, the insulation which fills in between the turns of insulated wire, usually after the coil is wound; third, the external insulation, which goes over the outside of the coil and insulates it from the metal of the machine and prevents the grounding of the coil.

The first class of insulation, namely, the insulation on the wire, is a very important part of the insulation of the coil. Mechanically, it should be hard, tough, elastic and uniform in thickness. It should be chemically inert, non-hydroscopic and not affected by high temperatures. At the present time there are several materials to choose from, all of which have been used more or less, and each of which is satisfactory for certain classes of work. There is no material, however, which fully satisfies all of the requirements.

The materials most commonly used at the present time for covering wire are cotton, silk, asbestos and enamel. The most serious defect of cotton is the rapidity with which it deteriorates at temperatures above 125 deg. C. It is also a poor insulator, very hydroscopic, and not strong mechanically. The cotton covering really acts more as a spacer for the wire than as an insulator. In spite of these defects, if reinforced with compounds and varnishes, cotton gives satisfactory results when the temperature is well below 100 deg. C.

Silk is better than cotton in that it takes less space in the coil, and is often used on coils where the space factor is a more important consideration than the extra cost of the silk.

Asbestos covering for wire is being used quite extensively where ability to withstand high temperatures is the prime consideration. Asbestos is poor mechanically, is very hydroscopic, not a very good insulator, and is expensive, but wherever outside limitations make it difficult or impossible to prevent excessive temperature rise the use of asbestos wire is often justified.

Enameled wire is a material which is coming into use quite rapidly and will probably eventually supersede cotton or silk-covered wire for most purposes. Theoretically, enamel is very well adapted for insulating wire. While already enameled wire has been brought to a high degree of perfection it will doubtless be still further perfected. Enamel has a high insulation, is non-hydroscopic, and will withstand a higher temperature than cotton or silk, and, most important of all, in some classes of work, it takes up much less room than other materials used for insulating wire, even less than silk, and is thus very valuable in coils wound with a large number of turns of small wire. With enameled wire it is often possible to give a machine a higher rating, or to allow greater overloads, and thus effect considerable saving in the construction of the

machine. The danger in enamel wire lies in its tendency to crack when bent around small turns, especially in large-sized wire, and also in its tendency to become brittle.

For the great mass of work, such as the field coils on direct-current machines, armature coils, and, in fact, most of the coils used in dynamo-electrical apparatus, cotton-covered wire is used at the present time. In the future, as enameled wire becomes more and more perfected, it is quite certain to supersede cotton on field coils, especially where small space factor is of great importance.

For arc lamp coils, induction coils, for a large part of the coils used in telephone work, and, in fact, nearly all coils wound with very fine wire, enamel will be found to be most satisfactory, provided the wire is properly covered.

In street railway coils asbestos is being used to a considerable extent, on account of its ability to withstand the higher temperatures due to the severe conditions surrounding this class of work.

For transformer work, cotton-covered wire is still very largely used, although enamel wire has been used to some extent with fairly satisfactory results.

For the internal insulation of coils solid compounds, known as impregnating compounds, paints, varnishes and sometimes sheet material, such as paper or mica or varnish cloth, which separates the different layers of wire, are used. The material must have good insulating qualities and its mechanical properties should be such as to cement the coil into a solid mass and prevent the rubbing and vibration of the wire in the coil. The material should not become brittle and powder under heat and vibration, should be oil and moisture proof, and of such a nature as to help conduct the heat from the interior of the coil to the surface. It should be chemically inert so as not to attack the copper; should be non-hydroscopic to prevent the absorption of moisture in the coil, and should be oil proof, if possible, so that it will not be dissolved by the lubricating oils which are nearly always present. Above all, it should not be affected by the heat at the ordinary operating temperature of the coil, and it must be of such a nature that it can be applied to the coil in a satisfactory manner without too great a delay in time or too great an expense.

The materials available include varnishes of different characteristics, including baking, air-drying and paraffin compounds, papers, mica and solid impregnating compounds, both oil and waterproof.

For the internal insulation of stationary coils the best method is to fill the space entirely with a solid impregnating compound by means of the vacuum drying and substituting process. This method has not proved very satisfactory for use on coils which revolve at high speed, as there is a tendency for the compound to soften under high temperature and be thrown outward by centrifugal force.

In the insulation of transformer coils this method of treating with the solid compounds is very satisfactory, if the proper compound is used. As most of the transformers used at the present time are oil-insulated, it is very essential that the compound used should not be affected by the oil in the transformer. If the compound is absolutely oil-proof and has the other necessary characteristics, then the coil produced by this method is much better than can be produced by any other method of insulating.

In addition to the solid compounds, the materials most commonly used for internal insulation are paraffin compounds and oil varnishes. Paraffin is a good insulator, and is very good in preventing the absorption of moisture. Paraffin compounds are defective in that they are very poor mechanically, that they soften up under heat, that they are very soluble in mineral oils, and do not have very high insulating qualities. Paraffin compounds are being used to some extent for the insulation of armature coils and field coils, but on account of their defects they have never been a serious rival of the more commonly used classes of varnishes known as oil varnishes.

One great defect in the use of all varnishes is the fact that volatile thinners, such as benzine, naphtha, etc., are used to a considerable extent. These thinners will penetrate into the coils and when the coils are baked they are driven off, leaving the inside of the coil more or less porous, and this space allows more or less moisture or other injurious substances to enter the coil. To remedy this defect there has recently been placed on the market a line of insulating compounds which contain no benzine or naphtha or other volatile thinners. These may be used in conjunction with the vacuum drying process or they may be used in the way similar to insulating varnishes, with the exception that the insulating compound should be kept warm in order to give it the proper fluidity and penetrating qualities. Not only do these materials fill the coil more solidly and give a better insulated coil, but they also do away with the danger of fire or explosion in the dipping room, which is always present where volatile thinners are used. Also by avoiding the use of volatile thinners quite a saving is effected, as all volatile thinners used in varnishes pass off in the baking of the coil or evaporate from the surface of the tank in which the varnish is contained. In the use of oil varnishes the question of drying out the coils thoroughly before and after dipping in the varnish is very important. For best results, it is preferable to use a flexible baking varnish, and give it a thorough baking in a good oven.

The internal insulation of a coil is often reinforced by paper or mica strips, which are placed between the layers of wire. This practice is very common, especially in transformers and wherever the voltage between layers is greater than the insulation of the wire alone will safely withstand.

The external insulation of a coil includes that part of the insulation which is wound on the coil, usually after the coil is taken from the former. This insulation is sometimes separate from the coil, as in the case of slot insulation used in a direct-current motor armature winding. Also in transformer work the external insulation is often strengthened by means of heavy paper or mica insulation, which goes on the outside of the coil between the coil and the iron. In field coils the external insulation is now largely wound on the outside of the coil, usually in the form of cloth or paper or asbestos tape, or a combination of the three and all thoroughly covered with varnish.

There are a large number of materials which are satisfactory for external insulation, including heavy canvas tape, cotton tapes, asbestos tapes, different preparations of paper or mica, also fibers, etc., all of which may be used in the external insulation of the coil. These materials also should be reinforced with a good baking insulating varnish or, at least, a varnish which is oil and moisture-proof, and which has good insulating qualities.

The great limitation to the improvement of the coil insulation is due to the temperature limits necessitated by the nature of the wire insulation. If materials could be obtained which would be satisfactory in all other respects and would not be injured at a temperature of, say, 250 or 300 degs. C. or higher, then a much higher operating temperature could be allowed in electrical machinery and thus give the machines much higher ratings and allow heavier overloads. This would mean a large saving in the cost of electrical apparatus for a certain output. In order to make any great advance the cotton covering for wire must be discarded, and at present one of the most promising outlooks is in the direction of some form of enameled wire. The enameled wire which is on the market at the present time will withstand a considerably higher temperature than cotton, and thus a higher temperature limit may be allowed. As yet, however, enameled wire has not been sufficiently perfected so that it can be safely used in all classes of work, especially in armature work, so that the old temperature limits which were in force when cotton was used exclusively are yet in force. The time may come when a coil can be produced which will be as indestructible as reinforced concrete and satisfactory in every other respect. When that time comes, as it surely must, apparatus can be built which will be practically indestructible, and the old trouble of burnt-out coils will be largely done away with. This is the problem of the insulation engineer—to build a well insulated, indestructible coil at a reasonable cost.

Operating a Small Electric Plant.

By W. H. Wakeman.

Twelve years ago I was in charge of a steam power and heating plant in which electricity was not used. About that time the idea of using electric lights was agitated and the subject was interesting, because the dynamo would be put in the engine room in case it was decided to install one. Under such conditions there is a choice of two courses open to the engineer. One is to show intelligent interest in the matter, pointing out the advantages of certain machines, and favoring the best plan for installing the same. The other is to take no interest in the subject, and then after the machine is installed, growl and find fault because he was not consulted in regard to what ought to be done, and the best way to secure the desired results. Choosing to adopt the former, I secured the kind of a machine that I wanted, it was installed in the place that I favored, and my plan for the details was adopted. This part of the subject is important, as it frequently makes all of the difference between a contented and a dissatisfied engineer. As the machine has always been ready for service when wanted, and numerous small failures in the lighting system have been repaired without serious trouble, expense or interruption to the service, it seems as if a few suggestions prompted by this experience ought to be valuable to other engineers of small steam plants in which dynamos are in use or may be installed in the near future.

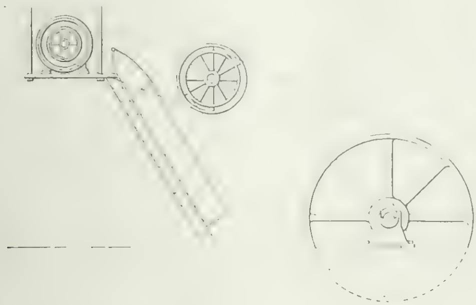


FIG. 1.—DYNAMO ON ELEVATED PLATFORM.

In such a case the engineer feels alarmed if he is not familiar with electricity, because he may not be able to take care of the new machine and secure satisfactory results; hence he may be asked to resign in order that a more competent man may have the situation. As a general rule, to which there may be a few exceptions, this apprehension is unnecessary, because a man who knows enough intelligently to care for a steam plant, can easily learn how to operate an electric lighting system in connection with it. People who are either directly or indirectly interested in the sale of electrical machinery, sometimes claim that it requires no more intelligence to operate a dynamo than it does to run a grindstone. This is evidently a mistake, as the man who has run a grindstone for a long time and is then obliged to take care of a dynamo, will soon discover. Such statements are harmful, because they give too low an estimate of the service required; hence, if believed, they prevent an engineer from taking precautions to understand thoroughly the new duties and requirements, and such a course is a sure way to invite trouble and unsatisfactory results.

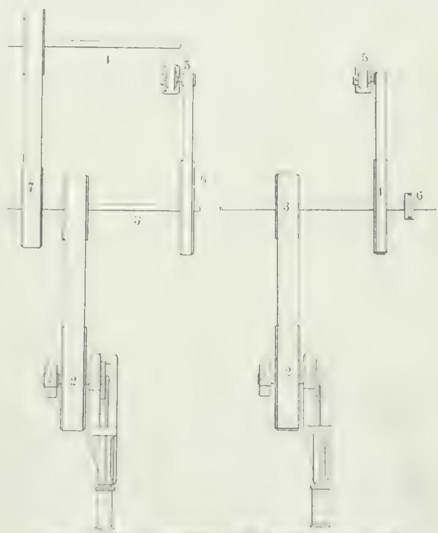
A compound-wound, four or six-pole dynamo will give satisfaction under average conditions, and is as good as any other kind for peculiar situations. When deciding on the place to locate such a machine, the coolest spot available should be selected. Where space is limited a dynamo is sometimes located on an elevated platform. (See Fig. 1.) Of course, it utilizes space that probably would [illegible] for other purposes, but heat rises and this fact [illegible] unless it is ventilated much better than the average engine room.

It is assumed that [illegible] belted dynamo driven at a speed of about 1,000 revolutions per [illegible]. A clutch pulley should be provided to drive it, so that it may be stopped at pleasure, and this pulley should be kept in good working order at all times. If it is thrown in and out frequently it will become loose in a few months, and, consequently, on some cloudy day when all of the lights are needed, it will slip and fail to carry the load. A clutch gives warning of this, but it is not always noticed by the engineer in time to save complete failure. When a clutch is properly adjusted, the lever goes in hard, but as time passes and the rubbing parts wear slightly, it goes in easier; the difference should be carefully noted and another adjustment made before it gets too loose to carry the load.

When plans are being made and considered for installing a dynamo, it often appears as if it might be driven by an ordinary pulley on a shaft that must always revolve when the engine is running; while this is possible it is not practicable, and hence is unworthy of adoption. If a clutch pulley is not adopted, then use a countershaft with a tight and loose pulley, but do not fail to provide some device for stopping the dynamo while the shafting is running. Furthermore, it is a good idea to provide means for running the dynamo while the mill shafting is at rest, as it will prove very convenient to have good lights in case it becomes necessary to change shafting or pulleys, or when other work must be done at night for which the shafting is not wanted. Fig. 2 illustrates this idea, as it shows an engine, 2, driving a jack shaft, 3, from which power is transmitted to the main shafting, 4.

The dynamo, 5, is driven from the jack shaft, 3, by a clutch pulley, 6, and therefore can be stopped at pleasure. When lights are wanted, and the shafting is not needed, 6 is kept in, but 7 is also a clutch pulley, and can be thrown out.

In some shops and mills there is no jack shaft, as the main belt transmits power direct to the shafting. This is illustrated in Fig. 3 in which 2 is the flywheel, 3 the main pulley, 4 a clutch pulley driving the dynamo 5; 6 is a cut-off coupling, and



FIGS. 2 AND 3.—METHODS OF BELTING DYNAMOS.

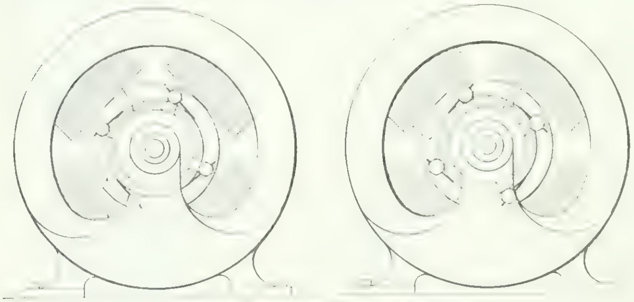
therefore the shafting beyond this point can be stopped at any time while the dynamo is still in use.

When the dynamo mentioned in the beginning of this article was delivered at my engine room I found that it was intended to run in the opposite direction from which it must revolve in this place. Fig. 4 shows how the carbon brushes were set, and the arrow indicates the direction of rotation. It could be used in this way with carbon brushes, but copper brushes would be ruined at once if an attempt was made to turn the commutator in this direction. However, it would never look right, and hence the brushes were [illegible] as shown in Fig. [illegible]

Before making an attempt to change brushes in this way, the engineer should note that each one bears on the commutator nearly opposite the center of a field coil; therefore, when they are reversed the combined brush holders should be turned by a handle provided for that purpose until each brush bears on nearly the same place as before. This is shown in Figs. 4 and 5. It is not proper to set them exactly in their former positions, but if put opposite the center of each field coil it will be near enough for trial, and the proper position can be determined by experiment after the dynamo has been installed and while running at full speed as follows: Suppose that 114 volts are wanted at the switchboard in order to secure 110 at the lamps, but the pointer indicates only 75, with the rheostat in the position shown in Fig. 6. Turning the indicator from right to left causes the voltage to rise, but it may have to be turned as far as it will go in order to secure 114 volts. This is not satisfactory, because under ordinary working conditions it ought not to be turned more than one-half way around, thus giving an opportunity to adjust it in either direction if necessary.

The above mentioned result shows that the brushes are not in the right place, and therefore they must be turned until the voltage is brought up. The direction in which they must go can be determined by experiment, and it will do no harm to turn them in the wrong direction by mistake, as it will only reduce the voltage. In a certain plant that I visited, the engineer cannot reduce his voltage below 114 under common working conditions, even with the rheostat turned in as far as it will go. This is not a good plan, for if the engine speed should be accidentally increased, it might increase the voltage to a damaging point. Of course the same thing would happen if the speed was suddenly increased while the rheostat is in the central position, provided the engineer was not there instantly to turn it down. As this has happened twice in my plant, on account of an engine that does not regulate closely under quick changes of load, and as the same conditions are sometimes found elsewhere, this is an important point.

If the carbon brushes are left square they form but slight contact with the commutator. This will do no harm provided it can be run with only a few lamps on for several hours, until the natural wear gives better contact between the two surfaces. If this is not practical it is a good idea to take a strip of sandpaper, as wide as the brush, put it between the brush and the commutator with the smooth side next to the latter and draw it back and forth until enough of the brush is removed to make a good fit.



FIGS. 4 AND 5.—LOCATION OF BRUSHES.

FIG. 6.—SWITCHBOARD.

An effort should be made to arrange matters so that the new dynamo may be run with a light load for at least two or three days, and care should be taken to know that the bearings are well lubricated during this time; for if they are not perfectly smooth when first used they may heat, and if not given an abundance of oil at this time the babbitting may be disturbed sufficiently to cause trouble afterward by always running warm. This is not only annoying, but is also dangerous because the armature should never become warmer than 90 deg. F. (50 deg. C.) above the temperature of the room, and cool bearings assist in keeping the armature temperature down. Furthermore, when such bearings really begin to heat they quickly reach the melting point; hence, if the outer parts are comparatively cool in regular service, it gives the engineer a better chance to discover the cause of trouble and provide a remedy than if the bearing was always warm and must only become a few degrees warmer in order to melt the babbitting.

After a dynamo has run cool for a month or more it is only natural for the engineer to expect it to continue to do so, especially if it is fitted with oil reservoirs and ring oilers. These are excellent devices, which save much trouble and care, but they should not be neglected. It does not take long to remove a brass plug or lift a cast iron cap to ascertain if there is oil in a reservoir, or if the ring oiler is revolving properly, but failure to do it has caused more than one hot box. I have known a reservoir to remain nearly full of oil for six months, then to become nearly empty without apparent cause. In view of this it is plain that safety lies in daily inspection of these parts.

When a dynamo is overloaded, or in other words, when more load is put on than the machine was designed for, it will cause the brushes and armature to heat, and after a reasonable time this heat will be transmitted to the frame.

If an overload is the real cause of trouble it can be determined by comparing the ammeter readings with the rated capacity of the dynamo. For illustration, I have a 15-kw belted dynamo to which there are nearly 400 incandescent lamps connected; and as each one requires about one-half ampere, it would require about 200 amperes to carry them all. Since this machine is good for 15,000 watts, and by dividing this by the voltage, or 112, we find the amperes to be 134. The actual load is frequently 140 amperes and it has risen to 150 for two hours or more without serious trouble, but if more than this is put on, one switch is pulled out to prevent damage to the dynamo.

When the brushes and frame begin to heat, the engineer may conclude that too much friction is caused by contact of the revolving armature and the stationary brushes, and consequently he proceeds to lubricate the commutator. This, however, is not always necessary, and sometimes it is harmful. A poor grade of oil is occasionally applied by means of a piece of waste, but it is useless, and the burnt sediment left behind it is detrimental to good service. A piece of the waste may be caught on the commutator and carried under the brushes, thus making it necessary to stop the dynamo and remove the cause of trouble.

Only a little lubrication is ever necessary at this point, and some of the lubricants prepared and sold for this purpose should be sparingly used, if anything is really needed. Keep the commutator bright and clean, and little else will be required. Use a medium grade of sandpaper for this purpose (never emery cloth), and always put it on the inside of a block of wood that is fitted to the curve of the commutator.

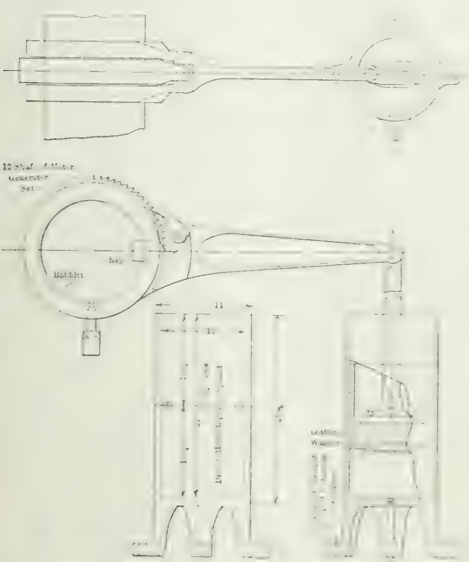
After the brushes have been used a long time they will be

worn down so that each one will cover two bars in the commutator. It is a good idea to take them out and file them until the point of contact is not more than one-eighth inch wide.

Use a pair of small hand bellows to blow dust out of the coils of wire, and keep the remainder wiped clean with good waste. Provision is usually made for moving a dynamo forward to take up slackness of the belt, which may therefore be made endless, requiring no laced joint. This is important, because the lamps will show variation of energy every time that a laced joint passes over the dynamo pulley. After shutting down at night, loosen the belt to give it a chance to relax.

Jack for Starting Motor-Generators.

The Edison Illuminating Company of Detroit has a direct-current sub-station located in a factory district in the northern part of the city, which district is somewhat isolated from the company's direct-current network. The starting of a 1500-kw motor-generator set recently installed in this sub-station would require, under ordinary conditions, such a large volume of current to overcome the initial friction of the bearings as to interfere seriously with the voltage regulation, and overload the machinery already running because of the small capacity of the other apparatus in the sub-station and the insufficiency of the feeders connecting this network with the principal direct-current district. The motor-generator set receives 4600-volt,



PNEUMATIC JACK FOR STARTING MOTOR-GENERATOR.

three-phase, 60-cycle current from the principal power plant at Delray and gives 110 and 220-volt direct current. The starting is accomplished by direct-current with a rheostat in series with the direct-current armature. To help in starting this motor-generator a pneumatic jack was designed, the construction and general principle of which are shown herewith. It consists of an air cylinder with a piston connected to an arm, this arm having a pawl engaging a ratchet on the armature shaft. The idea is to have this jack give the armature a single impulse or kick to overcome the standing bearing friction, which is considerably higher than the running friction of any plain bearing, and also to overcome some of the inertia of the rotating parts. It is found by the use of this device that the machine can be started with a maximum current of 500 or 600 amperes, as against 1500 amperes when it is started in the usual manner from standstill.

Wiring a Room Having Walls of Panel Work.

By T. W. POPPE.

Often after a room is wainscoted, the owner desires to place incandescent electric lamps in the center of different panels. It is imperative that no damage be done to the wood or finish and as the panels are often fastened with glue, it is next to impossible to remove them without injuring them to a certain extent. The marks made with the tools will readily be seen and are objectionable. It is therefore a problem to the wireman in charge how to do the work satisfactorily. The following explains how a paneled room was wired in a perfectly satisfactory manner.

A wainscoted room was oblong in shape and had four large panels on each side and two small panels and one large panel on one end; the door taking the place of the large panel on the other end of the room. A plan of the room is shown herewith. The panel frames were fastened to furring which caused the frame to set away from the wall seven-eighths of an inch. This is done in nearly every case, as it forms an air chamber between the panels and wall protecting the wood from moisture and also preventing dry-rot.

As the owner desired the lamps to be controlled by switches near the door an oblong opening, large enough to accommodate a three-gang switch-box, was made in the panel work near the door jamb. One switch was to control four three-lamp brackets on one side of the room; another was to control the four three-lamp brackets on the opposite side of the room, and the remaining switch was to control a three-lamp bracket on the end of the room opposite the door.

After cutting the opening mentioned, nine circular holes were drilled in the panels where the brackets were to be located. These holes were made five inches in diameter. A stiff steel "snake" was then pushed from the switchbox outlet behind the panels toward the corner of the room, and from the

PLAN VIEW OF ROOM, SHOWING LOCATION OF OUTLETS.

nearest opening on the adjoining side wall was pushed another snake. It was necessary to "fish" with the second snake. To achieve this result it was found necessary to fasten to the first snake sufficient strong cord to form several loops and to form a small hook on the end of the other snake. This hook readily caught in one of the cord loops on the end of the first snake and the latter was pulled out at the first bracket outlet opening. To this snake was then attached a sash cord which was pulled out at the switch-box opening. Here a two-wire steel-armored cable was attached to the cord and another sash cord. The two were then pulled out at the bracket outlet, "humoring" them as they made the turn at the corner of the room. Humoring consists of gently pulling at the cord and pushing the armored cable at the same time so as not to disconnect the "pulling" sash cord from the cable by too strong a pull. When the armored cable was pulled out at the bracket opening a sash

cord was connected to the one drawn in with the cable as was another armored cable. These were drawn to the switch-box opening. Then the sash cord already in was attached to a third armored cable and drawn to the bracket outlet. The purpose of drawing in the extra sash cord each time was to avoid excessive fishing.

The process was continued to the fourth outlet where one armored cable was dropped. The second cable was continued to the fifth opening, and the third cable was continued to the last opening. When the armored cables were all drawn in the outlet boxes were set and fastened to the brick-work behind the panels with expansion screws. The switch-box was likewise fastened with expansion screws. Six or eight inches of the steel armor of the cable was removed and the regular connector and outlet bushing applied. The wires should be tested with a magneto or bell and battery for continuity. If this is not done a defect which will cause some trouble to remedy afterwards may escape detection.

As the boxes did not fill the space at the bracket outlet, a "mat" one-quarter of an inch thick was colored the same as the woodwork and glued to the panel. This mat was made of veneer. It was circular in form, slightly larger than the opening and had holes for the passage of the wires and the supporting end of the bracket. The mat for the switch-box was made oblong and had an oblong opening large enough to accommodate the three switches.

Wiring for Direct-Current and Alternating-Current Motors.

By Louis J. [illegible]

The installation of electric motors is an important and profitable branch of the contractor's business, and if the number of orders is sufficient, the installation work should be in charge of a special and competent foreman.

Direct-current motors for ordinary work, are either shunt-wound or compound-wound. For regular work the shunt-wound motor is usually furnished, and it has installed with it an automatic-release, starting box.

Motors should be installed in dry locations, and not in dirty or dusty places or near inflammable gases. If location in a dusty place is unavoidable, the motor should be housed in a dust-proof sheathing, or an enclosed type of motor should be used. Enclosed motors, owing to the temperature rise due to lack of ventilation, have a lower rating, size for size, than regular motors.

In some localities motors are required to be mounted on drip pans, as illustrated in Fig. 1. Sliding rails are used in connection with belted motors, so as to take up the slack of the belt.

A good plan is to fasten motors on the ceiling. This method saves considerable floor space and eliminates the danger of the running belt. To hoist the motor in position, remove the flooring directly over the place where the motor is to hang, and mount the tackle on the ceiling of the next floor or on a support. The motor can then be easily aligned and bolted in position. In mounting a motor on the ceiling, the bearings must be turned so as to bring the oil cups in their proper position.

The automatic or no-voltage release starter must be mounted on a slate or marble backing, and the form of the starter should be such as to allow of the fullest air circulation on all sides. A good plan is to mount the switch with its fuses and circuit breaker on the same panel with the starter. Such panels are on the market and are neat as well as substantial.

Wiring to motors should preferably be run in iron conduits, especially where motors are located on floors, but other approved methods of wiring answer as well if properly installed. Fig. 2 illustrates a conduit wiring scheme using terminal fittings which spread the wires.

If motors are to be used to run elevators, in connection with automatic or solenoid starters, or if they are required to start under a load, a compound-wound motor should be installed.

To change the direction of rotation of a shunt-wound motor reverse the brushes and interchange the field leads as shown in Fig. 3. The direction of rotation of compound-wound motors may be reversed in a similar manner.

Motor connections should be carefully made and tested before the machine is switched into the circuit, as a motor is very easily damaged by starting under improper conditions. It is

FIG. 1.—MOTOR MOUNTED WITH DRIP PAN.

of primary importance that the resistance is in series with the armature circuit. This is necessary to prevent excessive current in the armature, which has a low resistance and would consequently be destroyed. As soon as the armature is speeded up the counter e. m. f. generated increases, and the resultant e. m. f. produces a less current in the armature circuit.

The no-voltage or automatic release on the starting box is a very important adjunct. Without it, should the circuit be momentarily interrupted and then closed again, the excessive current through the armature, starting with no resistance in circuit, would either burn out the armature or blow the fuses.

FIG. 2—APPROVED WIRING [illegible]

In wiring motors in connection with automatic starting devices the diagrams and instructions furnished by the manufacturer should be followed. The ordinary wireman frequently makes errors, especially in making connections from diagrams. A good plan is to tag the motor terminals and special device

terminals in the following manner: A to A-1, B to B-1, etc., putting proper tags on each terminal.

For varying the speed of motors many methods are used. In connection with some motors a resistor is used with considerable resistance in the main circuit. Another plan is to insert

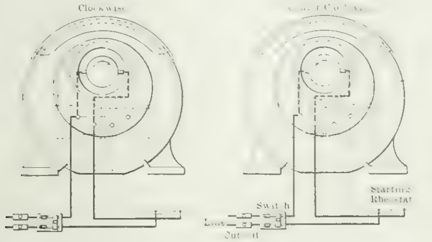


FIG. 3.—SHUNT-WOUND MOTOR CONNECTIONS.

a resistor of variable resistance in the field circuit, whence by varying the strength of the field the speed is naturally changed. There is a great variety of special variable-speed motors on the market. In wiring these motors in circuit the diagrams and instruction blanks furnished by the builder should be carefully followed.

As the current initially taken by a motor is considerably greater in value than the normal running current, the fuses or

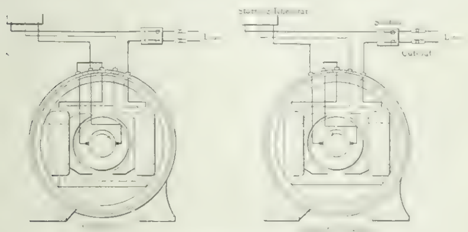


FIG. 4.—COMPOUND-WOUND MOTOR CONNECTIONS.

other safety devices, such as a circuit-breaker, should be sufficiently large to take care of this initial rush. Table I gives the rating of various motors, showing their normal full-load current and the rated capacity of fuses to use.

Circuit breakers are sometimes used in place of a switch and fuses, and though the initial cost is greater, their use, where

TABLE I.—FUSES REQUIRED FOR VARIOUS MOTORS.

Horse-Power of Motor	Full Load Current at 115 Volts	Ampere Rating of Fuses Required	Full Load Current at [illegible] Volts	Ampere Rating of Fuses Required	Full Load Current at 550 Volts	Ampere Rating of Fuses Required
2	[illegible]	[illegible]	[illegible]	20	3½	10
3	24	35	12	25	5	15
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20
7½	57	75	[illegible]	50	12	25
10	75	100	[illegible]	[illegible]	[illegible]	30
[illegible]	[illegible]	[illegible]	[illegible]	75	[illegible]	[illegible]
20	[illegible]	175	74	100	[illegible]	[illegible]
25	[illegible]	225	92	125	[illegible]	[illegible]
30	[illegible]	275	[illegible]	150	36	60
[illegible]	300	350	[illegible]	[illegible]	[illegible]	80
50	[illegible]	450	185	225	[illegible]	[illegible]

permitted, is cheaper in the end, as there are no renewals required as when fuses are used. The code requirements, however, call for fuses in connection with circuit breakers, except on main switchboards.

In selecting a direct-current motor for a customer consideration for future requirements should be taken into account. If belted or geared to a [illegible] the [illegible] should [illegible] nearest standard size relative to the load. A standard motor operates at its maximum efficiency at or near full load, and the efficiency is reduced when operating under partial load. If the motor is belted to a line of shafting driving a number of machines, the average load should be taken, plus a reasonable allowance for additions.

Motors geared direct to machinery make an ideal drive. Geared motors should be run at as low a speed as possible. Motors of a certain horse-power rating may be obtained with two or three speeds. The motor having the lowest speed should be used for geared work. The pinion on the motor should be made of rawhide, so as to minimize the noise and wear on the gearing. A silent chain-drive may also be used to advantage with geared motors. In calculating the size of gears required for various speeds, the same formulas apply to the silent chain-drive as to gears.

$$\frac{\text{number of teeth} \times \text{speed of gear}}{\text{number of teeth in pinion}} = \text{speed of pinion}$$

$$\frac{\text{number of teeth} \times \text{speed of pinion}}{\text{number of teeth in gear}} = \text{speed of gears.}$$

$$\frac{\text{number of teeth} \times \text{speed of gear}}{\text{speed of pinion}} = \text{number of teeth in pinion.}$$

$$\frac{\text{number of teeth} \times \text{speed of pinion}}{\text{speed of gear}} = \text{number of teeth in gear.}$$

The following formulas may be used for determining the size of pulleys required for various speeds:

$$\frac{\text{diameter} \times \text{speed of driven pulley}}{\text{speed of driver}} = \text{diameter of driver.}$$

$$\frac{\text{diameter} \times \text{speed of driving pulley}}{\text{speed of driven pulley}} = \text{diameter of driven pulley.}$$

$$\frac{\text{diameter of driver} \times \text{speed}}{\text{diameter of driven pulley}} = \text{speed of driven pulley.}$$

It is a good plan to install devices for stopping the motor from a number of distant points in a factory. Such a device will often prevent a serious accident when an employee is caught in belting or gearing. Numerous commercial devices fitted with push-button control are manufactured for this purpose. Fig. 5 illustrates a home-made device which has been found to be reliable, as well as inexpensive. It can readily be assembled by any carpenter. An ordinary electric door opener is mounted as shown, in connection with a knife-switch of proper size. A weight sliding on a rod, and having a trigger, is released when the magnet of the door opener is energized. This weight in falling strikes the switch handle and consequently opens the circuit. Any number of push buttons connected in multiple can be used to operate this device. Two or three ordinary dry cells are used to operate the door-opener circuit. Fig. 6 illustrates a good type of circuit closer for emergency use.

Automatic solenoid starters are used when motors are to be started or stopped automatically or from a distance. One of the most frequently used applications of this type of starter is in connection with belt-driven elevators. Fig. 7 shows a type of starter suitable for such use. A "belt switch" is required to close the solenoid circuit. This belt switch is connected as indicated and the outfit makes a very satisfactory installation.

The alternating-current motors on the market may be divided into two classes, single-phase and polyphase. Single-phase motors are of the induction and series types, and the polyphase motors are of the induction and synchronous types. Polyphase motors include both two-phase and three-phase machines. Motors of the induction type are provided with auto-starters or with variable secondary resistance for starting. Synchronous motors are sometimes made self-starting, but more often they are provided with an induction motor for bringing them up to speed or are brought up to speed from some other source of motion through a clutch or belt. A compensator starter may also be used.

Single phase motors [illegible] up to 15 horse-power and in providing fuses and circuit breaker, the size of the fuses

should be such as to take care of the initial current, which is about twice the normal full-load current. In starting the single-phase motor, the double-throw switch on the starter is first thrown to the starting position, and after the motor has attained full speed, the switch is thrown to the running position.

On two-phase and three-phase circuits, induction motors are usually used. For large installations where 50 or more horse-power is required, synchronous motors are frequently used, as they diminish line disturbance and voltage fluctuations. The contractor seldom is required to install the synchronous motor, and if called on to connect up such a motor he should follow the manufacturer's instructions and diagrams.

The induction motor when required to operate at a constant speed in a given direction has many advantages over the direct-current motor. Its disadvantages are that the speed controller and reversing apparatus required for special work is complicated and expensive.

Induction motors of the squirrel-cage type are very simple and reliable, and have no commutators or brushes. An overload will tend to reduce the speed of the motor when it may drop out of step and stop.

In calculating the size of a motor to perform certain work, it is advisable to overload the induction motor slightly, instead of underloading it. An induction motor runs with a higher power-factor at a small overload, whereas the power-factor on underload is very low.

In deciding what type of induction motor to use, the conditions under which the motor is required to operate must be carefully considered.

Where motors are used in connection with a single machine and are frequently started and stopped, the auto-starter type will be found the most serviceable. This is due to the fact that even should the operator carelessly start the motor by throwing the switch over to the running position without going through the intermediate steps, no damage to the apparatus will result. Such procedure, however, should be rigorously discouraged.

In installations where the motor is started and stopped only once or twice a day by a careful attendant, the type of motor with an internal starting resistance should be used. This type of motor draws less starting current than the other type, and for that reason some electric light companies insist on an induction motor with self-contained resistance being used. The induction auto-starter motor frequently requires four to five times the normal running current at starting. Table II gives the starting and full-load current of three-phase induction motors.

The enormous difference which exists between the size of wires would satisfactorily and safely carry current for operating an induction motor, and the size of wires which would be required by a strict and narrow interpretation of the Code has been the cause of bitter argument many times between electrical inspectors and contractors. A wire of such size as to be protected properly by the large fuses required in starting is an unnecessary expense, and a fuse large enough to permit the motor to be started is no protection to the motor after it is running, as it would not blow on anything less than a short-circuit. It is customary, therefore, to provide two sets of fuses for induction motors requiring excessive current in starting: those on the starting side being larger than those on the running side of the switching circuit. In this way it is possible to start the induction motor without blowing the fuses, and after the motor

FIG. 5.—EMERGENCY STOP.

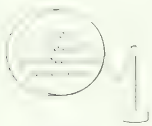


FIG. 6.

FIG. 7.—BELT SWITCH AND CONTROLLER.

FIG. 8.—SINGLE-PHASE MOTOR.

TABLE II.—CURRENT TAKEN BY THREE-PHASE INDUCTION MOTORS AT 110 VOLTS. †

Horse-Power of Motor	Full Load Current	[illegible] Full Load Torque	Starting Current at Full Load Torque
1	6.3	19	
2	12	[illegible]	
3	18	[illegible]	
5	[illegible]	42*	28
10	[illegible]	70*	54
15	81	120*	[illegible]
20	112	167*	112
30	168	252*	168
50	268	400*	268
75	390	585*	390
100	[illegible]	825*	550

* [illegible]

† On 220-volt circuits the current is approximately one-half of that given in the table.

FIG. 9.—THREE-PHASE MOTOR WITH INTERNAL STARTING RESISTANCE.

is running it is properly protected by the smaller fuses. Oftentimes conditions of operation are such that the time element of the fuses is sufficient to permit the motor to be started with smaller fuses, especially if the motor comes up to speed quickly. Motors taking less than full-load current when starting need only the running fuses.

Nearly all of the manufacturers of alternating-current motors supply starting devices also, together with complete instructions

FIG. 10.—THREE-PHASE MOTOR WITH STARTING COMPENSATOR.

for connecting them in circuit. In motors rated less than 5 horse-power no auto-starters are required; the knife switch connects the motor directly with the line.

In wiring two-phase motors, three wires, as well as four wires, are used. If three wires are used, the third conductor should have approximately one and one-half times the sectional area of either of the other two. In four-wire, two-phase systems motors of one horse-power and under are usually of the single-phase type, and these are connected across one of the two phases of the system.

Notes on Superheated Steam Fittings from the Detroit Edison Company's Practice.

The Delray plant of the Detroit Edison Company has now been in operation about three years. As this is a steam-turbine plant operating with steam superheated 200 deg. at 210 lbs. boiler pressure, some notes on the experiences with steam fittings in this station are of interest.

It is found that cast-iron pipe fittings develop some remarkable tendencies under high temperatures and pressures. Cast iron seems to "grow" under such pressures. For example, a 36-in. cast-iron fitting has been known to increase in length ¼ in. on one side more than on the other. In other words, it positively warped. Bonnets and valve chests also warp and develop star cracks. These troubles took from one to two years to develop. It was not realized what the trouble was at first when cast iron fittings were taken out of a pipe line and could not be replaced without a great deal of trouble. Finally it was found out by measurement that they had warped. As a result of these experiences, cast fittings are made symmetrical whenever possible, as an unsymmetrical fitting is much more likely to warp. Experiments are being made with valves of reduced area, in order to reduce the size of fittings. This will partially reduce warping tendencies. Cast steel and welded parts are being substituted for cast iron wherever possible.

Boilers have been connected to headers by means of 30-ft. bends of 8-in. pipe. The boilers are rated at 520 horse-power each. It has been found that for steam-turbine practice where there is a steady flow of steam, a 5-in. pipe is sufficient to carry the steam from a 520-hp boiler; and by making these bends of 5-in. pipe, it is much easier to connect and disconnect them from the pipe line, on account of the greater flexibility of a 5-in. as compared with an 8-in. pipe. The gaskets used are of very thin copper.

The station, as originally piped and described in the ELECTRICAL WORLD, Feb. 4 and 11, 1905, had provision for flooding the superheaters with which each Stirling boiler is equipped so that the turbines could be operated with saturated steam. This provision has been found unnecessary, as there are practically no conditions where saturated steam is wanted for the turbines. Saturated steam is, of course, used for the auxiliaries, and on the boilers supplying the auxiliaries a separate connection is made for this.

No trouble has been experienced with rubbing of turbine blades during the rapid expansion of parts when a turbine is started suddenly. These Curtis turbines, which are rated at 3000 kilowatts, can be started from rest in 90 seconds. Practically the only thing that limits the rapidity with which a turbine may be put into service is the time required to start the auxiliaries.

The five 3000-kw turbo-generators in the Delray plant being now fully loaded, a second plant has been started adjoining the first. The second plant will have 8000-kw turbine units.

Steam Auxiliary to Hydro-Electric Station.

BY WM. LEE CHURCH.

The subject of steam auxiliary to a hydro-electric plant needs representation in a somewhat different light from that in which it is generally understood. Hitherto a steam auxiliary has largely been considered a necessary evil, seldom having a part in the original scheme of development and usually installed in a more or less make-shift fashion when pressing necessity requires. When a hydro-electric proposition is presented to financial interests about the first question is: "How much power is this river good for?" "Well, it is good for a minimum of 20,000 horse-power." "Do you mean that this is the absolute minimum in the lowest flow of the dryest recorded year?" "Probably not—in the extreme low water of an occasional year you might require 5000 horse-power of steam aux"—— Up go the hands in horror and the deal is off. "We want a water-power plant, we don't want a steam-power plant!"

Now, all this is very natural. Like most engineering evolution, the idea of an auxiliary steam plant as a thing to be avoided took its origin in supposed and seemingly obvious facts. Experience, however, on the commercial side of propositions of this character has slowly let in a dawning light on the situation. Engineers and investors have begun to investigate the actual conditions of the problems by balancing cost, operation, maintenance, etc., against increased revenue. It is for the purpose of bringing out this by no means new, but, at the same time, somewhat cloudy view, that this article is written.

For the sake of more convincing illustration consider an actual case that has come within the writer's practice. A study of the recorded flow of a certain river indicated that it would produce 10,000 to 12,000 horse-power even in the extreme low-water years. The market demand, however, was such that 20,000 horse-power could be utilized if it could be continuously guaranteed. The 10,000 horse-power could not be absolutely guaranteed for every day of every year, but the shortage was so slight and so infrequent that a 10,000-hp development was perfectly justifiable, and with the storage value of the lake itself it was even possible to expect 12,000 horse-power. The class of users for this power was such that occasional slight shortages at rare intervals would be condoned, but the market which demanded the maximum of 20,000 horse-power was of such a nature that no shortage whatever at any time could be considered.

To get at this problem recourse was had to the available data from six years of government records, namely, from 1901 to 1906, inclusive. 1901 was a wet year and the natural flow of the river on the lowest day would have yielded 24,000 horse-power; 1906 was almost a duplicate, the minimum flow being 23,000 horse-power. (In all cases the power is considered as 24-hour continuous power.) The years 1902 to 1905, inclusive, were quite variable in rainfall, and fortunately included the year 1904, which was the dryest year on record for that entire section of the country.

Taking the year 1902, the flow was computed in terms of horse-power and tabulated. It was found that there were three

days in that period in which the flow ran down to 6900 horse-power; 20 days to 8350 horse-power; 30 days to exactly 10,000 horse-power; 34 days to 12,000 horse-power; 27 days to 14,000 horse-power; 18 days to 16,250 horse-power; 16 days to 18,650 horse-power, a total of 148 days of varying shortage on the 20,000 horse-power basis. There was no considerable storage, so that these various shortages have been grouped together and the resulting "curve" plotted to scale as the zigzag dotted line shown in the accompanying illustration. Now, right here is where somebody will say: "Why, there you are, running 148 days, or nearly half your time, by steam!" Well, we shall see.

A similar study of 1903 gave somewhat better results, which are plotted in the broken line on the chart; 1904 was the extreme year and gave the heavy line; 1905 was a fairly good year that would have yielded 12,000 horse-power on the flow of the stream, and its shortage resulted in the light full line on the chart.

As a basis for this chart a rectangle was constructed of which the vertical ordinates represented power and the base represented time. The area, therefore, of the complete rectangle

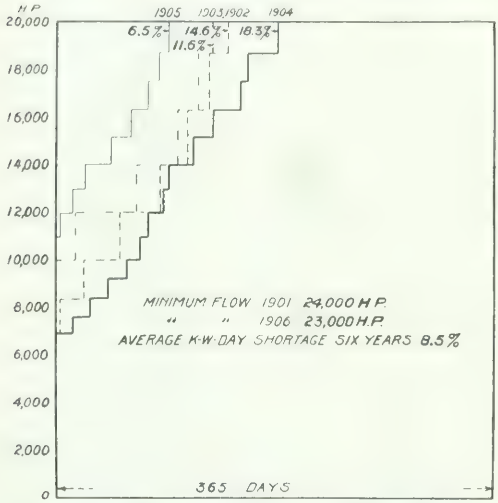


CHART SHOWING ENERGY SHORTAGE THROUGHOUT THE YEAR

represented the energy demand, or 20,000 horse-power for 365 days, equal to 7,300,000 hp-days.

The point now to be observed is that the triangular areas in the corner of the diagram, bounded by the two sides of the rectangle and the zigzag line for each year, show the actual energy shortage in terms of hp-days.

Counting on the diagram the respective small squares included in these triangles gave the following results in percentages, obtained by dividing the hp-days of shortage by the total hp-days representing total energy, or full power for the total year:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Adding the shortages and dividing by the total hp-days for the six-pear period, the total shortage in hp-days for that whole period was 8.5 per cent. It is, therefore, apparent that without auxiliary resources of some sort this river was strictly an 8000 horse-power proposition, or on a commercial basis, say, 10,000 horse-power; whereas if 8.5 per cent of auxiliary energy can be added in some form the river immediately becomes a 20,000 horse-power proposition.

Stated concisely in terms of dollars, the securing of 8.5 per cent of reserve energy would double the income. (Of course, this surplus should be supplied, if possible, by reserve storage of water, but many rivers fail to yield sufficient storage space owing to their natural formation.)

Now the misapprehension in the past has been that the power rating of the steam plant in relation to the total power rating of the hydro-plant was the measure of the shortage, whereas the measure of the shortage is really the product of the varying steam load into the proportional time run; in other words, the energy percentage. The rating of the steam plant expressed in horse-power bears no relation whatever to the earning capacity of the development as a whole, except in so far as is represented by interest and depreciation on its cost—and, of course, its extra operating charge.

Turn again to the chart and note that had power rating been the true measure of relative value, the so-called shortage in the years 1903 and 1905 would have been practically 10,000 horse-power, and in the years 1902 and 1904 the shortage would have been 13,000 horse-power, scaling down from the top of the chart. The tendency hitherto has been to say, "This development is one-half to two-thirds steam and we don't want anything to do with it." I hope it has been shown that the true expression would be, "This development requires only 8 per cent of steam energy to double the income and, therefore, is worth looking into."

To turn the matter around once more, so as to get it in still another practical light, it appears that this development should have been equipped with about one-half its rating as a steam auxiliary. This would take care of the years 1903 and 1905, and with the usual margin allowable for overload, would have pulled through the lowest years of 1902 and 1904. The effect of this additional investment would be to double the gross income of the plant as a whole.

Now it is at once seen that good engineering would dictate the installation of a steam auxiliary not along the line of refined economy at all. Expensive boilers, economizers, compound engines and economy adjuncts generally should be rigorously excluded in such a plant. Some rugged form of engine capable of "standing grief" under overload would be the proper type. It might be single-expansion, while a condenser and a heater would be about the only allowable economy adjuncts. Just where this line should be drawn would only appear in the study of each individual case, but the governing principle is that inasmuch as the time of service in a period of years is so insignificant, the value of the coal saved by compounding, etc., must be balanced against interest and depreciation on the plant and the extra space required. It is the province of the engineer to determine this question closely in connection with each proposition and on its merits.

Having led up to this point, it becomes self-evident that so far from a steam auxiliary being a burden upon and a detriment to the commercial proposition, it may, instead, be the largest earning factor in it. The hydraulic development and the land are fixed items, and are usually one of the largest elemefits in the total cost of development. Now in this particular case this part of the investment would have yielded an income due to only 10,000 horse-power, whereas, aided by steam auxiliary, it would have yielded 20,000 horse-power. As a rough statement, and in other words, to develop only 10,000 horse-power the total investment would have been, say, $175 per horse-power. By adding the cost of a plain steam plant of the simplest character, the whole proposition is raised to 20,000 horse-power on an earning basis, and the investment cost is dropped to, say, $125 per horse-power.

This summation is really all there is to the subject. Proper consideration will lead, it is hoped, to a more careful investigation of every hydraulic development on the basis of its energy output value over a series of years, when aided by a steam auxiliary (storage assumed as unavailable), and in the light of the total investment per horse-power: and, second, to a more intelligent designing of the auxiliary steam plants, considered, not as a monument to the engineer, but as an investment, held rigidly down to those lines which will produce the largest net returns to the owners on the equipment as a whole.

LETTERS ON PRACTICAL SUBJECTS.

COMMERCIAL FEATURES OF SINGLE-PHASE INDUCTION MOTORS.

Single-phase induction motors are used in small sizes on the lines of every alternating-current system. The numerous small energy consumers, such as butchers, ice-cream makers, druggists, etc., want small motors rated at 5 horse-power or less, and due to reasons to be herein discussed, a single-phase induction machine is usually installed.

There are in general two types of single-phase induction motors in common use; that is, the machine which starts up from rest due to a phase-splitting coil, and the one which starts as a repulsion motor.

The split-phase starting motor is very satisfactory for operating individual sewing machines, buffing machinery, wood lathes, etc. This type of motor was the first and easiest solution to the problem of rendering a single-phase induction motor self-starting. The motor is a polyphase induction machine which is supplied with two currents differing in phase, which produce a starting torque. To apply this machine to loads which are hard to start, such as a loaded line shaft or other heavy starting load, another ingenious device was brought to bear. A pulley was designed which at standstill or low speeds is loose on the shaft, but under sufficiently high speeds is gripped to the shaft by a centrifugally operated clutch. This latter device enabled the motor to attain almost synchronous speed before the load was started, giving it work at or near the maximum of its torque characteristic. Thus fully prepared by "curative medicines," the machine was built and advocated by engineers because there seemed no better solution to the problem. To those men and engineers who understand the limitations of the machine and use it in the proper places, surprisingly satisfactory performance is attained.

The split-phase motor is on the market to-day in large numbers, and is supported by some of the best companies.

Other engineers were at work, however, at about the same time on the alternating-current motor of the repulsion type. The characteristics of the repulsion motor are practically the same as those of the direct-current series motor, so that a combination of repulsion motor for speeds from zero to synchronism or thereabouts, with a single-phase induction motor for normal near synchronous speed operation has proved advantageous. Thus, high starting torque is obtained together with small speed variation from full-load to no-load. The latter machine finds its peculiar field in driving water pumps, printing presses, machine tools of all types, and, while covering the entire field of small energy users, its operating characteristics are such as to adapt it especially to all classes of loads where high starting torque is necessary.

Operators of direct-current machinery are accustomed to believe that heavy overloads of from 50 to 100 per cent for short intervals are not to be feared. Single-phase machines will not meet the demands for overload outlined above, and it is customary to install motors of slightly larger rating when replacing direct-current motors with either of the above types of single-phase induction motors.

The small ability for overload possessed by the single-phase machine is not inherently due to the design nor to the special features necessary in producing a self-starting motor. Motors are usually rated and designed to give the maximum efficiency at full load. Moreover, the maximum power-factor occurs at approximately full load. [illegible] materially the internal copper losses of the machine due to the larger load current. The load losses are greater, due to lower speed, or greater slip, and, what is more vital, there is no longer a uniform rotating field, further decreasing the torque and output. The repulsion-starting single-phase machine has its limitations, however, for which allowance must be made. [illegible] ideal solution to the problem. [illegible] suggests troubles from sparking, brush setting and the need of close attention. This is the point which is attacked by engineers and central-station men, the point which, theoretically at least, lowers the value of the motor.

Practically, the manufacturers of the repulsion-starting motor place the commutator so as to discourage any attention, expert or mediocre, and with the result that the motors are operating satisfactorily in pump houses, grist mills and laundries with infrequent attention even from the oil can.

All single-phase induction motors have the advantage over direct-current machines in that they may be started by simply closing the switch. The rush of current at starting ranges from two to three times the full-load current with a torque at starting equal to the full-load torque. Here is where the repulsion-starting type has the advantage. At starting it can exert five times the full-load torque, and its torque characteristic closely resembles that of a direct-current cumulative compound motor. Since a starting device is unnecessary, these motors are practically "fool proof," and may be placed in the hands of any one who can throw a switch. The small energy user prefers such a machine. The central station man prefers the motor for this reason, and also for others; he can install one transformer to take care of it, thereby reducing the all-day iron losses, a less expensive meter, and much less extensive wiring than would be possible if a polyphase motor were supplied. It goes without saying that for a single-phase supply circuit these motors must be used. For installation of over 5 horse-power on polyphase lines, polyphase induction motors are installed. In some cases single-phase induction motors are allowed, and recommended when rheostats are used to limit the starting torque to 100 per cent of the full-load intake.

A flagrant case of misinformed salesman engineering came to the writer's notice during the past few months, which illustrates the troubles a man well acquainted with direct-current machinery may find on the alternating-current side. A direct-current 4-hp motor was successfully driving a small pump which required frequent starting and stopping. It became necessary to replace this machine with a single-phase motor. A representative of a well-known company recommended a certain single-phase motor, and took the order for a 4-hp machine. The motor duly arrived, was installed and shortly afterward burned out. A representative of a rival company guaranteed his motor to do the work and replaced the last machine with a new 4-hp motor. It required only a few hours to put the latter motor on the "burned-out list," and being guaranteed the salesman replaced it with a 5-hp motor of the same type; the latter lasted only slightly longer than either of the former motors. It is needless to point out that these machines were split-phase motors, and as such did not have sufficient starting torque to start the pump without drawing large current for a long time.

An engineer who recognized the differences between the various single-phase motors commended the use of a repulsion-starting type of motor. The central station manager in that town knows more about alternating-current motors now, but his experience was costly.

[illegible] [illegible]

[illegible]

From time to time I have noticed requests for information on substances suitable for repairing the burnt insulation between commutator bars. The answers usually recommend powdered mica and some shellac or other insulating varnish as a binder. No doubt this mixture should give almost as good results as the original mica itself. I have never tried it, however, and hence cannot say how good the results might be. It may be interesting, however, to give the composition of another insulating compound that I have tried and which gave good results. The burned insulation between the commutator bars must first be dug out and the cavity thoroughly cleaned. Then a thin paste of litharge and glycerine is poured into the cavity. [illegible]

used to heat the mixture until it is thoroughly baked. When the compound has hardened sufficiently it may be filed down smooth and even with the commutator surface. It might be well before applying the paste to test the bars to make certain that the short circuit has been removed. Holes plugged with this mixture have never given any trouble since.

SYRACUSE, N. Y. H. B. BAKER.

THE CARE OF COMMUTATORS.

If maximum efficiency in the running of direct-current machinery is to be obtained with the minimum of expense, the maintenance of commutators and brushes must be given due consideration. It is no longer considered good policy to wait until there is a fine display of pyrotechnics before giving the commutator or brushes attention. It is also quite inconvenient to take out an armature from a motor or dynamo to send it away for the purpose of turning down the commutator; and it is the purpose of the writer to describe some home-made and some commercial devices for keeping the commutator in condition and for repairing it without removing the armature shaft from its bearings. It is taken for granted that the brushes are in their proper position and they have been carefully fitted to the commutator by means of sandpaper in the usual manner. A good running commutator should present a dark, glossy appearance, free from scratches. Too much attention cannot be given to the commutator and brushes, and their proper or improper condition is an index of the competency or incompetency of the attendants. The habit of caring properly for a commutator is easily acquired by any careful man, and it is well to remember that prevention is much better than cure for troubles of this kind. The attendant should make certain that the armature oscillates in its bearings while running, as this will greatly lengthen the life of both the commutator and bearings. In large machines mechanical oscillators are sometimes provided for this purpose so as to prevent the brushes from wearing grooves in the commutator.

FIGS. 1 AND 2.—COMMUTATOR CLEANERS.

FIG. 3.—DEVICE FOR SANDPAPERING COMMUTATOR.

The commutator should be cleaned regularly with a cloth slightly moistened with light mineral oil. A touch of vaseline may also be applied from time to time for lubrication purposes. Where the commutator has become quite dirty or slightly roughened, it may be smoothed by using sandpaper. This may best be applied by means of some handy device. A useful tool may be made up of a piece of well-seasoned pine shaped to fit the commutator and provided with a handle. The sandpaper is fastened to the wood by tacking it to the ends, and should be bent up along the edge of the wood for this purpose.

Another useful device for this purpose is shown in Fig. 1 herewith. One end of the sandpaper or polishing cloth is inserted under the clip at the front end and the cloth is then turned back under the flexible backing and applied to the commutator. The flexible backing is made in such a manner that it easily adapts itself to the curve of the commutator, but will not fall into depressions on the surface. Thus, the whole surface is evenly scoured and afterwards polished.

A novel appliance for sandpapering a commutator which is designed to avoid the necessity of holding a piece of sandpaper against the commutator by hand, which is a very tiresome operation, is shown in Fig. 3. The device consists of a bracket of wrought-iron ⅜ in. thick, held against the pillow block by four lag screws. Inside this bracket a long iron bar with forged lever and a slot running almost its entire length is held by means of a bolt. The sandpaper is fastened to a wooden block at the end of this bar. The method of holding the bar in the bracket keeps the sandpaper in a plane at right-angles to the diameter of the commutator so that the surface will always be flat. At the same time the pressure can be easily regulated by the handle.

FIG. 4.—HOLYSTONE FOR COMMUTATOR.

Frequently a commutator which appears so rough as to require turning may be placed in satisfactory condition by stoning. A holystone can be placed in a holder of convenient shape and size as shown in Fig. 4, and one of the long surfaces made to fit the curvature of the commutator. The handle of this holder should be arranged so that the attendant who uses it can hold it with comfort and safety. A stone of this kind is preferable to sandpaper, as it will not dip into all the low places of the commutator and will usually reduce high bars and avoid the use of the turning tool. If the sandstone is rather coarse, it may be desirable in finishing the surface of the commutator, to line the rubbing surface of the stone with a sheet of fine sandpaper. The commutator may be given a buff finish by simply turning the sandpaper over. The use of a commutator turning tool will decrease the radial depth of the commutator appreciably, while the holystone will wear the commutator much less. The process of stoning, sandpapering, etc., sets free a large amount of grit and dust so that the windings and leads should be protected as far as possible. A cloth head may be placed over the commutator leads and bound securely to the commutator and to the edge of the armature. A long-hair, stiff bristle brush or duster may be used to dislodge the dust and dirt, or, better still, a bellows or a jet of compressed air.

FIG. 5.—COMMUTATOR WITH GROOVED MICA.

A particularly effective way of treating flat or blackened commutators is to use an ordinary three-cornered file and file out the mica between bars until the file touches on both bars as indicated in Fig. 5. A commutator treated in this way will usually wear true and bright, and will give less trouble from short-circuiting than one in which the mica is left in the usual condition. The dust does not stay in the slot, and as the sur-

face of the mica will measure about twice as much as in the usual way, the insulation between bars is higher. An explanation of this may be that many commutators are assembled with too hard a grade of mica, and the copper wearing faster than the mica causes the surface to become uneven, hence the flashing and bucking which flatten the commutator. This method of treating commutators is especially recommended in cases where motors or generators have more than one coil per slot in the armature.

Fig. 2 shows a device for cleaning commutators. It consists of a wooden base having affixed at one end a tightening device and on the other end is a recess containing a dust box for collecting the copper dust. The grinding cloth, preferably of carborundum, rests on an elastic cushion and can be easily removed and renewed by releasing it from the tightening device. The dust box is provided with a strip of rubber which impinges on the commutator so as to rub off the dust which clings to it, and it is further enforced by a brush placed directly in back of it. The rubber is housed in a wooden batten somewhat similar to a weather strip. A long, pivoted handle is provided so that the device may be fulcrumed at some convenient point in order to obtain sufficient pressure to bear on the commutator surface.

FIG. 6.—COMMUTATOR GRINDER.

A commutator which has become eccentric, or has high or low bars, or in which the insulation between segments projects beyond the surface of the bars should be turned or ground down until the inequalities of the surface have been removed. This may be done by means of many special commutator tools which enable one to turn down or grind down the commutator without removing the armature from the frame. Some of the devices use files for this purpose; but the writer does not favor the use of a file except in extreme cases. Many of the grinding tools also use emery wheels, but these are open to objection because the emery is apt to injure the insulation between the segments. Carborundum is to be preferred for this purpose, as it is a non-conductor and possesses better cutting or grinding qualities than emery. The writer is not very conversant with the turning tool attachments, of which there are many, and so will confine himself to some of the grinding tools.

Fig. 6 shows one of the simplest commutator truers, which is applied by hand. The abrasive surfaces are self-adjusting to any radius, the outer blocks are fixed while the center block is movable by the hand lever so as to adapt itself to any curve. The abrasive substance contains no emery and having three points of bearing, it necessarily cuts true. Fig. 7 shows a commutator truing machine in which the grinding wheel spindle is driven by means of a round belt passing around the commutator or shaft. The grinding wheel spindle is slotted to allow of lateral movement of the wheel across the face of the commutator. The feed is controlled by hand, the depth of cut being set by means of an eccentric gear. The grinding wheel is of carborundum, and the device is provided with suitable clamps for affixing it to the rocker journal or framework of the generator or motor. Another machine having a clamp arrangement for attaching it to the brush-rocker journal is shown in Fig. 8. Where no rockers are used, the machine is fastened to the nose of the outer bearing. Distance rings of different sizes are used when necessary to fit various sizes of rockers. In working, the grinding spindle is driven direct by means of a specially prepared rubber friction wheel running on the commutator. The grinding wheel moves to and fro across the face of the commutator and in all except the hand-feed machines is automatically reversed at each end, being so constructed that stops can be set as in a planing machine, grinding the surface right up to the connecting wires and back to the edge. The grinder runs in a direction opposite to that of the commutator.

FIG. 7.—COMMUTATOR TRUING DEVICE.

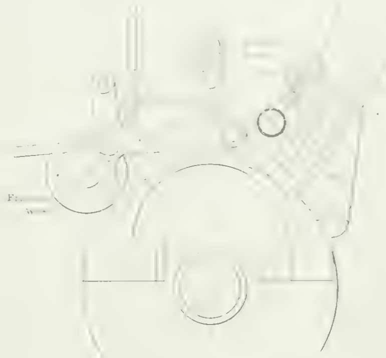


FIG. 8.—COMMUTATOR GRINDING MACHINE.

Brooklyn, N. Y. C. J. Thomas.

A NOVELTY IN ELECTROLIERS.

An interesting novelty in electric standards and fixtures is shown herewith. In the device a certain portion of the fixture moves to another position as the lamp lights, thus causing the electrolier to assume a different aspect, according to whether the lamp is lighted or extinguished.

The movement is accomplished by means of a small solenoid *A* suitably arranged, which is controlled by the lamp switch, so that the action is entirely automatic; the movable member resuming its position as soon as the lamp switch is turned to extinguish the lamp.

The artistic effects which may be obtained from this simple movement are innumerable. A button is pressed and the bronze hall figure of a sturdy yeoman swiftly, yet without vibration or shock, swings a lighted lantern high above his head, where it remains until the switch is again operated, when the extinguished lantern is returned to his side. In this case the arm is pivoted at the shoulder. A short shaft extends inwardly and is fitted with a yoke. To this is fastened the solenoid core and the counterweight. In this instance a dashpot is used to regulate the action, and in all of the various applications of the device the weight of the movable member is counteracted by weights or springs.

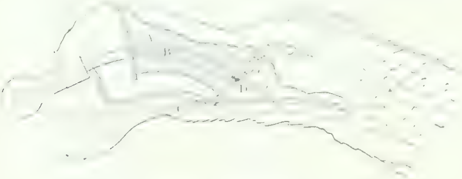
A tasteful urn or vase is fitted with lamps and the solenoid auxiliary. When a switch is turned, the upper portion of the urn rises some 3 ins., forming the shade of a very attractive electrolier. The drooping petals covering a single lamp in its socket expand as the electricity is turned on, forming an excellent shade. The mouth of a dragon or griffin opens as a switch is turned and a lamp protrudes. Similarly the doors of

a quaint English inn open when a button is pressed and a damsel appears with a cheerful light upraised.

Though its adaptation to ornamental standards and newels has thus far received most attention, the device has other advantages.

In desk fixtures or on walls where space is limited, it may be so arranged that the lamp emerges from a recess when the switch is turned and automatically recedes when turned off. A shade designed to cover the opening leaves the wall flush.

The mechanism is in all cases very simple and the additional energy required is kept at a minimum. Where solenoids of



NOVEL ELECTROLIER.

considerable size are used, these are arranged to cut off automatically when the action is complete and the core is held in place while the lamp is burning by a small retaining magnet. In the illustration the letters have the following significance: *A* is the solenoid; *B* is the core; *C* is a pivot; *D* is the connection of lower jaw to core; *E* is an iron counterweight; *F* are the wires; *G* shows the connections to the solenoids, and *N* is a spring.

QUINCY, MASS. R. P. IRVING.

NOVEL CONDENSING EQUIPMENT.

A very complete and somewhat unusual system is in use in this city for condensing the exhaust from the engines and for cooling the condensing water, the supply being taken from the river. There are five units in the engine room, three of 1300 horse-power and two of 2400 horse-power. Admiralty jet condensers are used in connection with the three small units and for the two large engines condensers with a capacity of 60,000 lbs. of steam per hour are installed. A third condenser of the same size is connected so that it may be used on one of the large engines or any of the small engines. Before the installation of the present system, much trouble was experienced when the river was muddy, with the sand cutting out the condensers. The new arrangement, with one large condenser constantly in reserve, will provide against any possibility of shut down from sand troubles. An intake reservoir 12 ft. wide and 24 ft. long is carried down 24 ft to bed rock and is provided with screens on the river side and on one end, through which water enters from the adjoining sand formation. A settling basin 8 ft. x 5 ft. adjoins the reservoir and is carried down to bed rock. Water that is drawn directly from the river has a chance to settle in this basin, and is then carried into the intake reservoir through a gate. A centrifugal pump with a capacity of 2500 gals. per minute pumps the sand and sediment from the basin into the river. From the reservoir the water flows naturally through a concrete conduit 6 ft. wide x 14 ft. high, resting on bed rock, to the side of the boiler room basement. From that point three 14-in. pipes carry the condensing water to the engine room, to the large condensers. The small condensers are connected separately by 10-in. pipes with a 14-ft. x 14-ft. reservoir. The discharge from these three small condensers is carried through a pipe of increasing size and empties in a 30-in. pipe that also receives the discharge from one of the large engines and the reserve condenser when it is in use. This reserve condenser is connected directly with the small condensers by means of 16-in. pipes through an 18-in. and a 20-in. header. The 30-in. pipe and a 20-in. pipe from the condenser of the other large engine empty into an open hot-water reservoir outside the building that is 8 ft. wide and 10 ft. deep. From this reservoir the hot water is raised by centrifugal pumps to the cooling tower and discharged into a 4-ft. brick conduit and cast-iron pipe, or by opening a gateway passes directly into the 4-ft. pipe. In this pipe the water flows by gravity to the river or may be diverted by a gate into a 6-in. conduit to the reservoir connecting with the small condensers and from these it runs to the intake reservoir, thus completing the circuit. By this arrangement when the river is clean and suitable for condensing purposes, the cooling tower may be cut out and the water permitted to discharge into the river. In case the sand and dirt in the river make the water unsuitable for condensing purposes the cooling tower may be brought into service and the same water circulated continuously. The cooling tower has a capacity of 15,000 gals per minute. It is 50 ft. high and has a base dimension of 20 ft. by 90 ft. Across the lower portion of the tower and staggered in position are arranged over 300 planks. These are set 6 ins. apart, with 8-in. vertical spaces. Each plank consists virtually of nine 3/4-in. x 6-in. wooden strips, fastened with end and intermediate 2-in. x 4-in. cross pieces, so that five of the strips form the top of the plank and four the bottom. Two-inch pieces are provided between the strips and the top and bottom spaces are staggered. The hot water from the condensers is raised to the top of the tower and falling onto the planks, is broken into a fine spray by the time it drops from plank to plank and reaches the bottom. The water heats the air in the top portion of the tower and thus creates a natural draft upward, cool air entering at the bottom and passing up through the descending water spray. The water thus passes out at the bottom comparatively cool. The tower is built entirely of wood, except the covering for the sides, which consists of corrugated iron. The two centrifugal pumps used to force the water to the top of the tower are electrically driven.

DENVER, COL. J. F. LOGAN.

[illegible]

The town of Willoughby, Ohio, will soon find itself in trouble unless it immediately proceeds to put in adequate waterworks and electric light service, both of which are at present owned by the corporation of Willoughby.

Some time since it was voted to sewer the village and an elaborate system of double sewerage is now in course of installation; a storm sewer of large pipe being run along most of the streets and a sanitary sewer being placed immediately adjacent to the storm sewer. The sanitary sewer is of smaller pipe and both sewers have a common outlet a mile or two long, at some distance below the village.

The sewer system is approaching completion, buildings are being connected, and soon the system will be ready for use, but here the first part of the problem presents itself as follows: The location of the streets of the village is such that almost every one of the sewers terminates in a dead-end of pipe, and almost every sewer-branch requires an automatic flush tank for the proper flushing or washing out of that particular sewer. The amount of water required daily by each flush-tank is comparatively small, but the entire number of flush-tanks make necessary an additional daily supply of 10,000 gals. of water for their proper operation.

The connection of the houses with the sewer system, the opening of many new bathrooms, wash basins and other water-using devices will result in the citizens of Willoughby using considerably more water. At a mass meeting of the citizens, on Nov. 2, the attorney of the village corporation told the citizens flatly that the present municipal water pumping and electric installation "would not supply enough water to extinguish a brush-heap, much less to meet the demands of a serious fire." The electric installation is operated far beyond its rating and may break down at any moment, leaving the town in darkness.

The present water supply is obtained from a river which flows through an alluvial valley lined with mostly clay and soft shale. The condition of the water during a storm must be seen to be appreciated. A gravity system is used, and the storage reservoir is supplied by a 10-in. pump which [illegible]

nected to an 8 in. supply pipe, both having been in service 15 years. All the pumping must be done in the day time, as at night the boilers must be used for furnishing steam for driving the electric light plant.

The electric generator is an old-timer, and has, according to the report of examining engineers, an efficiency of only 45 per cent to 48 per cent, and is overloaded all the time. In fact, it is impossible to obtain any energy for lamps for new houses or for electric signs on account of the overload already upon the generator.

In the very immediate future it will be absolutely necessary to build a new power plant which shall be able to run both the water and electric installations at the same time, though usually a night and a day turn of each in succession will suffice. A filtering plant will also be necessary. The electric plant must be large enough to handle a fast-growing business, for at this time there is not even a fan motor on the circuits.

Estimates have been made upon the cost of a combined pumping and electric plant, and the figures, including the filter plant, are $27,000, but the citizens are horror-stricken at the idea of spending so much money. Some of the people want to patch up the plant for $9,000 or $10,000 to do the necessary work, and others talk of selling the outfit to the Cleveland, Painesville & Eastern Railway, an electric transportation line which passes through the city of Willoughby; the water and electricity to be furnished by that company.

There is a field for a large plant in place of the one described, and some enterprising electric man may do good business by getting next to the city officials and devising some means of installing the needed machinery for a price within the reach of the citizens. It may be added, to illustrate the loose methods now in use, that the city lamps, a number of arcs, and 25 to 35 incandescents, are lighted with never a cent's worth of credit from the city, but their cost is charged to expense of maintaining the plant.

In addition, there is a lack of proper management all along the line. The lamps and circuits are in the tender care of the police force, the chief of the fire department—a business man, by the way, and a very good man, though he is no mechanic, has chief care of the pumping and electric plant. At present there is no engineer or mechanical man upon the board of public works, and it is not to be wondered at that the plants in question are in the condition described above. Some electric light man might succeed in obtaining the plant upon a franchise of several years' duration. Action of some sort must be taken at once, for the time is ripe and the necessity for more water and electricity will be a vital one before another year has gone.

Willoughby, Ohio. James F. Hobart.

OPEN AIR SECTIONALIZING SWITCH.

An open air high-tension switch which is primarily a line-sectionalizing switch and is not intended to take the place of oil switches in power houses or sub-stations has been in operation at the Roanoke sub-station of the Fort Wayne & Wabash Valley Traction Company. This was designed, I believe, by Mr. M. J. Kehoe, the company's engineer, and serves to sectionalize the lines in the event of trouble. The switch has the advantage over the usual forms of high-tension switches in that the insulation of the line is maintained. The wires are, in fact, carried through it and the terminals are supported on standard line insulators. The high-tension wires of one side of the line are lead over top cross-arms and down to three [illegible] The wires of the other side of the line terminate in three brass rods, mounted on insulators, which are themselves carried on a [illegible]

high-tension lines diverge after having been carried on one pole line for several miles. When trouble occurs on one of the lines beyond the junction, it is frequently necessary to shut off the circuit at the station from all paralleling lines before repairs can be made. With the switch described a lineman finding trouble on the line can break the circuit at the nearest switch and make repairs without delay. The danger of misunderstanding whether or not the switches are thrown off in the station is avoided, as the man making the repairs can see for himself that the switch is open. Although used on a railway line, the device is of service to electric light men, since it is applicable to high-tension lines feeding lighting systems, and for that reason your readers might be interested in it.

Columbus, Ohio. R. C. Gordon.

SWITCHBOARD INSTRUMENTS.

Too much cannot be written about the care and accuracy of central-station switchboard instruments. It is taken for granted, too often, that the meters are correct when a little testing might reveal the opposite to be the case. Usually instruments of such capacity are installed, that, under normal working conditions, the needle of an indicating instrument will hover about the middle of the scale. By this means overloads are provided for and the meters are sufficiently accurate for light loads. The watt-hour meters, however, should be of such size that under normal conditions they will be fully loaded and one with a rapidly moving train is preferable to one with a slowly moving train. The chief causes of inaccuracy in meters are stray fields and blunted jewels. There are many switchboards where to the writer's knowledge the effect of stray fields renders the meters very inaccurate and this is more apt to affect alternating-current instruments than direct-current instruments. The stray fields are in almost all cases due to faulty switchboard design and to careless connection of feeders, especially where these are brought to the board from above. Blunted jewels are in most cases due to careless handling of the instruments and a lack of appreciation of the delicacy of parts of the mechanism. It is not uncommon to see instruments dropped on a table or placed on the board while hammering is going on in the immediate vicinity sufficient to jar the instrument and damage the jewels. Now no one expects that the same care will be taken of switchboard instruments that is taken of laboratory instruments or that their accuracy would be as great, because conditions do not permit it; but if a correct impression is to be obtained of the operating efficiency of the station, the instruments should be calibrated about every other month, and suitable arangements should be made for conveniently doing the work. In some cases the switchboard builders, if requested to do so, will provide testing plugs on the panels both for the current coils and for the potential coils of the instruments so that it is a comparatively easy matter to connect a portable testing meter in order to calibrate the instruments. On polyphase circuits two independent wattmeters are easier to calibrate than a polyphase meter. The instruments should be properly installed and for this purpose it would be best to follow the manufacturer's instructions and diagrams. On alternating-current switchboards there are, of course, many instruments which might tend to confuse the attendant. Some of these might be omitted in some installations, as, for instance, on a three-phase circuit feeding synchronous machinery, two wattmeters could be replaced by a power-factor indicator. With the increasing use of transformers for switchboard instruments, checking of instruments is not so difficult and inconvenient as heretofore. The potential transformers are quite reliable and in fact more accurate than is ordinarily supposed. Any errors of the series transformer may be compensated for by adjusting the meter and the added convenience of these more than compensate for any slight errors which they might introduce. The chief point is to have [illegible] them so.

[illegible]

QUESTIONS AND ANSWERS.

Does oil affect the insulating properties of mica appreciably? A. S. W.

Yes. This is one of the chief causes of commutator troubles. A sheet of mica that would resist an e. m. f. of 10,000 volts for an unlimited time in air has been known to break down instantly under oil at an e. m. f. of 5000 volts.

Would it be profitable to install mechanical stokers in a station having a rated output of 1500 kilowatts? D. J. B.

It depends on the fuel used, character of the load and other items too numerous to mention, whether or not mechanical stokers would be profitable in a station having such an output.

Can a rotary converter be run inverted; that is, can it be made to give alternating current at one time and direct current at another? S. E. F.

Rotary converters are run inverted in a number of stations which supply both alternating current and direct current apparatus. Motor-generators are, however, used more often for this purpose.

How may carbon brushes be tested? We have recently had a number of commutator troubles which we believe are due to the brushes. J. B. C.

To determine whether the brush is homogenous and free from laminations and hard specks which scratch the commutator, break the brush and the fracture will usually show the grain and any imperfections in homogeneity.

Can boilers using buckwheat coal for fuel be as easily forced as others burning a better grade of fuel? B. Q.

Boilers using the low grade anthracites can be more easily forced than those using the better grades of fuel, as it is always possible to enrich the fuel by mixing with it bituminous coal. In fact this is the usual way of taking care of the peak load in a great many stations using buckwheat coal.

Should watt-hour meters be placed on the front of the switchboard or behind it? I find that there seems to be no standard rule since both front and back mountings are used indiscriminately. D. P.

The switchboard attendant should have before him only such instruments and such apparatus as he must necessarily use, and although it is quite common to see watt-hour meters mounted on the face of the board, this practice is waning. There may be good reasons for placing watt-hour meters on the front of the board other than for show; but ordinarily there are not.

Will a single-phase watt-hour meter record the energy consumed by a two-phase motor, if a constant of 2 be used? W. C. D.

If the phases are perfectly balanced, a single-phase watt-hour meter connected in one phase will record one-half of the energy consumed by the motor. Such a condition, however, is not usual and it would be preferable to install a polyphase watt-hour meter or a single-phase meter in each phase. In the latter case the sum of the watt-hour meter readings gives the total energy consumed.

How is ozone produced electrically? R. B. B.

There are many forms of apparatus devised for the electrolytic production of ozone. The general principle underlying the construction of all of them is to pass a stream of dry air between two conducting surfaces which are close to each other. The conductors are subjected to differences of potential which are rapidly varied in amount over wide limits. The high tension of electrostatic machines, induction coils, or transformers are used. Disruptive discharges may be employed for producing the rapid change of potential difference.

When installing a two-phase motor, is it better to supply it with energy from two single-phase transformers or from a polyphase transformer? T. O. M.

While the polyphase transformer is more compact and cheaper, the general practice is to install two single-phase transformers because of the advantages of simplification of the system, applicability of the single-phase transformer to either lighting or motor loads, and the convenience with which repairs can be made in case one transformer has been destroyed; since it is usually possible to find another single-phase transformer. In ordinary central-station work, polyphase transformers could not to be so easily replaced, as they are not usually carried in stock.

A number of our commutators are troubled with loose leads due to the solder coming out, and although the leads have been resoldered a number of times, the trouble does not seem to lessen. How can this be remedied? F. G.

The probabilities are that the commutator becomes quite hot in operation and that the solder used in fastening the leads is not suitable for the work because of its low fusing point. It is important where motors are operated under load and heat up considerably that some account be taken of this condition. This is very often overlooked, and where the temperature during operation becomes quite high, only commercially pure tin solder should be used. This has a high fusing point, and in connection with it, it might be well to use an alcoholic solution of resin as a flux rather than a flux containing acid.

How may iron be preserved from rust? J. K.

Melt a lump of camphor in some lard, using a pound of the latter to an ounce of the former, and color the mixture with black lead till it resembles the color of iron. Clean away all rust that is causing difficulty or clean up the iron parts that it is desired to treat, and then rub on this mixture. After it has remained for a day, the parts should be cleaned up again with a cloth. A mixture of common rosin with pure olive oil and spirits of turpentine forms another material which will act very well towards preserving iron from oxidizing. It is always better and easier to keep the iron parts clean and clear from rust formation than it is to remove the rust once it has gotten a start.

A 3-hp compound-wound motor in starting blew a 35-ampere fuse with the handle of the starting box on the second notch and when under only a light load. The fuse was replaced by another, and the motor started without load, when it ran all right until a normal load was put on it. It then speeded up to over normal speed and the fuse blew. Kindly let me know the cause of this. W. H.

From the information supplied we are led to believe that the terminals for the series field winding are reversed from the proper position. That is to say, it is probable that the machine is connected in circuit in such a way that the series field coil opposes the shunt field coil in its magnetizing action. It would be well to reverse the connections to the series field coil, leaving all other connections as they are. If this change does not overcome the difficulties, it is probable that the starting rheostat is improperly connected in the circuit. However, we are unable to determine all the possible inaccuracies from the limited information supplied.

Why is it that in railway switchboard practice the equalizer is connected on the negative side, while in lighting switchboard practice the equalizer is invariably connected on the positive side? B. T. F.

Not all railways connect the equalizer to the negative side of the system; but there are good reasons for so doing. With the equalizer connected to the negative side, the possibilities of short circuits between the equalizer and ground are reduced, as there is a very small difference of potential between them. Complication on the board is also reduced as one switch only is required instead of two or three which are needed when the equalizer is on the positive side. The instruments can also be connected more directly and the arrangement of lightning arresters is also much simplified. It is, of course, understood that in railway practice, the negative is grounded and the equalizer is not placed on the switchboard, but under the floor, and the equalizer switch is mounted on a panel in front of the generators. With rotary converters, equalizing on the negative side simplifies the switchboard wiring and this is usually done except where the rotary is called upon to work in parallel with direct-current generators in the same sub-station.

CENTRAL STATION SALE OF CURRENT.

How to Make Newspaper Advertising Pay Central Stations.

By WILLIAM D. MCJUNKIN.

It is only during the last few years that central-station managers have been dealing seriously with the problem of selling energy. Production has monopolized their attention. And during these few years a wonderful impulse has been given to newspaper publicity as a means of getting new business. Whatever may be said theoretically about the relative merits of sending out advertising material by mail, the overwhelming verdict of central stations from actual practice has been in favor of newspapers.

In a long advertising experience I have become more and more convinced of the relative inefficiency of mail matter in getting results, unless newspapers are used in conjunction. The mail is overcrowded with circulars. People get so many stereotyped appeals of this sort that they become indifferent to them, if they open them at all. The busy man has little time for third-class mail.

Newspaper advertising has a number of distinctive advantages. It is inevitably read. It makes a persistent appeal. No man is too busy to read his newspaper. No up-to-date woman neglects the advertising pages. Whatever may be imagined to the contrary, there is a deep-seated confidence in the press on the part of most people. They believe its announcements more readily than a printed circular mailed by the advertiser himself.

Another point of advantage not always realized by the public service corporation is the incipient good will engendered by systematic advertising in the press. People like to follow an interesting campaign. They are favorably influenced by it. Housewives look for the announcements for the information afforded. Everybody enjoys good pictures and clever type arrangements.

This makes it all the more incumbent upon central-station advertisers to print only the best. Newspapers afford wide and persistent publicity. Your message is in the limelight. A poor impression goes broadcast and does harm. Inferiority is as fatal as the slovenly appearance of a salesman in selling his goods.

In looking over central-station advertising in the daily press coming to my office from all parts of the country I have been struck by the crudeness of so much of it, often inferior to the local department store announcements appearing alongside. Stiff, makeshift designs offer an impassable barrier to the reader's attention. Jumbled type bodies distract it. And the copy is often limp and confused. The impression is weak. The space wasted.

A number of the larger companies even advertise spasmodically, taking a half-page or full-page now and then, with worst possible effect. It is seldom possible to fill a half-page with live, interesting matter. The space must inevitably be wasted or stuffed with unwieldy looking type. There is no value in such an appeal. It looks like blackmail to intelligent readers, as if the newspaper were being bribed. Without a systematic schedule of insertions, no effective interest can be aroused. People forget an isolated advertisement. They are not in any receptive frame of mind for the next one or the next solicitor who happens along. The shot has been wasted.

FIGS. 1, 2 AND 3.—NEWSPAPER ADVERTISEMENTS OF THE CHICAGO EDISON AND COMMONWEALTH ELECTRIC COMPANIES.

This backward condition of electric light advertising is, of course, due to inexperience in the field and the employment of inferior syndicate services because they are cheap. Such false economy is being rapidly realized by a number of the larger and more progressive central stations, who to-day are spending liberally for profitable advertising.

What is good advertising and what should it aim to accomplish? This is, perhaps, too broad a question for one man to answer dogmatically, and I shall confine suggestions to my own experience in central station publicity.

The difficulty in getting results out of a protracted newspaper campaign for any public service corporation is in maintaining

for sensationalism or levity. A straightforward business tone must be maintained, and still an interesting story must be told. To overcome this dilemma unfailing ingenuity must be exercised in introducing variety in set-ups and designs, as far as appearance goes, and in affording valuable information, as far as copy is concerned. The merely fanciful will not do. The humorous still less. People are serious when they do business. They do not care to be entertained.

To scrimp on outlays for art work is mighty poor economy. This is a very common mistake among the inexperienced. The cost of space is a big item, after all, and should be made to pay for itself handsomely with handsome material. Cheap drawings are useless, and cheap cuts will spoil the cleverest idea. For house lighting a decorative artist can with profit be employed to draw exquisite interiors—bedrooms, living rooms, bath rooms, etc., illustrating most daintily the artistic and hygienic possibilities of electricity in the home. For cooking and heating advertisements the use of models is desirable, dramatically photographed in the very act of handling the various apparatus. The lifelike reproduction of a womanly personality in such announcements has much to do with winning feminine favor for electric cooking. With the electric devices thus vividly represented in the hands of a pleasing demonstrator, the total impression made by the design is inviting and homelike.

In advertising electricity to manufacturers a very different course is called for. The illustrations of machinery and power plants should be made with mechanical nicety and truth, and where vigorous pictures are needed, the bold impressionistic work of a sketch artist will make the argument emphatic. Simple type advertisements are effective for power advertising. Heavy, clean cut headlines arouse interest and lead directly into terse argument. Business men have no time for frills. They must be caught on the wing by type bodies set up in strong, clear contrast, throwing the salient points of a convincing argument into relief.

The skilful massing of type effects is an art few advertisers understand and makes a vast difference in the impression produced. The human mind is normally lazy and does not readily attack involved composition. You must catch the eye with beauty and boldness both in the headlines and type bodies, and then the full force of your argument is free from obstruction. Shots from a sighted gun are far more effective than a whole broadside at random.

The "interview" form of copy has been tried very successfully. Verbatim statements of motor users, regarding effectiveness, cost, increased output, cleanliness, etc., have been massed into short paragraphs and printed with quotations, the material being obtained at first hand from engineers and proprietors in the plant. Sometimes names may be given identifying the plant, care being always taken to preserve as much as possible the vivid expressiveness of the talkers in their statements.

On the higher plane of professional work newspaper advertising becomes the most potent means central stations can employ for getting new business. It is especially valuable in promoting anything as new as electricity in the household. People are strangely ignorant of the real advantages of electric light over any other form of illumination. They know practically nothing of electric devices for cooking and heating. Electric flat irons, curling irons, coffee percolators, toasters, ovens, vibrators, fans, dim-a-lites, hylos, heating pans, etc., conveniences without limit, are eagerly wanted by a prosperous community when rightly understood. Walking into the office of a large metropolitan daily a few months ago I was surprised to learn from the advertising manager that he did not know exactly how an electric flat iron looked—how heavy it was—whether it cost $2 or $10—whether it was practical or not—or any of its advantages. If keen-witted business men are thus unaware of the commonest of electric devices for the home, where would the great army of housewives come in—the people who need an electric flat iron?

Electric Light in New England.

[illegible]

In the smaller cities throughout New England electric lighting takes the smaller portion of the central station load, motor business taking the greater share. The number of gas consumers is overwhelmingly greater than the users of the electricity. This state of affairs can be accounted for by the fact that the cities and towns of New England are manufacturing centers, having about three-quarters of their population employed in the factories and mills with an income capable of allowing only oil or gas to be used as an illuminant. Then, again, the stores are open only one or two evenings each week.

The central station managers have found that the lighting business, if any was to be obtained, is commercial lighting, and in the majority of the cities low and attractive rates are offered for this class of business. Sign and outdoor lighting especially have been favored with exceptionally advantageous offers. For instance, in the city of Danbury the sign rate is 5 cents per kw-hour, the regular lighting rate being 12 cents per kw-hour, and the same can be said of Derby, where the sign rate is very low, the regular lighting rate being 12 cents.

In one of the cities a proposition was made to a storekeeper doing a moderate amount of business to install a number of incandescent lamps in his windows and keep them burning on the evenings he was closed until 11 or 12 o'clock. After some hesitation, he finally agreed to go ahead in the matter and await results. The show windows were attractively dressed, and when lighted at night stood out prominently along the thoroughfare, a bright spot in the dark. The storekeeper watched the number of people who stopped and looked at the windows, and found that it was good advertising. The neighboring storekeepers were all approached and the proposition laid before them; they were skeptical, and while some of them were induced to install signs, these were only burned on the nights the stores were open. This company then let the matter drop for some time. A little later a large company operating stores throughout the country opened a store in this city. They, as was their custom, wired the store so that the windows could be used for night display. They not only kept the windows lighted, but maintained a display as attractive as it was possible, changing it every week. In a short time some of the other stores ventured on lighting their premises during the night.

In another city the electric light company thought by doing the wiring at cost and allowing the consumer to pay for it as he chose, it would be an inducement; after a year's trial it found that this was not entirely satisfactory in that it attracted a class of consumers who were most likely to allow their bills to run too long or never pay them. A new scheme was then tried, that of giving heating and cooking appliances to small residential consumers, and signs to the commercial consumers. The company also did additional wiring free for all commercial consumers, providing the additional equipment was not too large and was likely to bring some return on the investment. This, after a trial, showed good results, but after the company gets a good foothold it will drop this plan and hopes to gain the rest of the possible lighting by straight soliciting methods.

This same company started at one time a thorough canvass of its territory. It sent solicitors to every house and building in the city, obtaining information concerning each call, which was reported on a card and turned into the office each night. The data the card called for were the address, the name, business and nature of premises, owner, owner's address, light used inside, light used in windows, sign used, if any, kind of power used, whether premises are wired, date and name of solicitor. On the reverse side of this card a space was ruled off, asking for a report in detail with reason for not wanting, also a space for wants. When a complete canvass was made the cards were sorted according to streets and street number and filed away. All cards that showed a report which would give a chance for a return call from the solicitor were noted and the solicitor paid another visitor. A great many of the cards bore requests for

estimates. This request was attended to with caution in this way: It was found that a prospective consumer generally wanted to know what it was going to cost him to wire the premises, and if good judgment was not used it was found that the price would amount to too much. Once having him satisfied on the wiring cost it was comparatively easy for the company to have him sign. The cards were all kept in order and a year later were all gone over again, and the additional information and data obtained were added. A different solicitor was used in each district on the second call. The company found in this second canvass considerable changes and also quite a number of new buildings and enterprises. This card is used quite often for reference, and is now kept up to date.

In New Bedford a good opportunity was presented to get unusual public attention focused upon electric lighting. During September a one-week carnival was given by the citizens during "Old Home Week." This was advertised around extensively for some time beforehand, and various committees were formed to carry out the different details. Among the most important was that of the electric lighting of the streets, public buildings and landmarks. The New Bedford company went into the matter whole-hearted. They agreed to furnish free of charge all the electric energy during "Old Home Week" to anybody who would furnish a special electric equipment for the occasion. This generous offer was readily accepted by the citizens, and the newspapers were filled with comments upon the public spirit of the electric light company. The route of the carnival procession and the abutting buildings were bathed in a flood of electric light each night, and everybody was loud in his praise of the electrical demonstration. Upon the roof of the City Hall was outlined with colored electric lamps of 16 candle-power a large spouting whale, emblematic of the principal industry of early New Bedford. This display created a great deal of discussion, which is still continued, especially concerning the way in which the whale spouted. The whale was constructed so that a double row of green colored lamps represented the whale spouting in a direction away from his head. Immediately the next morning an old whaling master called at the office of the electric company and stated that a whale spouted over his head in the opposite direction from the one on the City Hall. The company applied for information on the subject to the newspapers, which, after looking the matter up, had a free-for-all discussion in their columns as to the direction the spout of the whale should have taken. Six old whalers were found to agree on one way and another six were as determined that it should have been the opposite way. Owing to this discussion, everybody came to see and discuss the electric whale.

The New Bedford company states that it has obtained a considerable amount of lighting business as a result of "Old Home Week." A great many of the special equipments have remained permanent and the storekeepers have found that there is a benefit from night illumination. The New Bedford stores keep open only two nights a week.

Many New England companies depend upon flatirons and some other of the heating appliances to introduce electric energy in a house. One manager stated that as the direct result of the operation of a heating pad in a serious case of illness, he had secured six new consumers without any canvassing. The New London Gas & Electric Company has made a specialty of flatirons. A large sign over its handsome office reads, "Electric Irons." The company employed a lady, who went from house to house making a thorough canvass, and as she was very well known, she gained a ready entrance. A brief talk upon the advantages of the iron and an invitation to the office with several friends, where it could be easily demonstrated, was extended. Irons have been placed in a great many houses of the old consumers and have also proved an entering wedge where electricity has never been installed. At the office no trouble has ever been spared to demonstrate the various uses to which electric energy can be put. If a person after having read of some new labor-saving device made inquiry and the company did not have the article, it immediately looked it up, and if it could possibly be brought to the city for a demonstration it was done and at no cost to the person interested. Everything electrically, old or new, is kept on hand in a very neat and attractive showroom, where, from time to time, public demonstrations are given of some one thing. This helping-hand policy has gradually become well known throughout the city and has placed the company on a good basis in the public opinion.

Central-Station Commercial Development at Detroit.

About three years ago the Detroit Edison Company began the operation of a new power plant located at Delray, on the outskirts of the city. The commercial expansion of the company had previous to that time been somewhat hampered by lack of adequate generating plants for economically taking care of the large motor load. The completion of the Delray plant was the beginning of a new era in the company's development. With it in operation, plans were immediately laid and carried out to increase the company's motor load so as to supply at very low rates the numerous large and small factories of the city. Detroit is an important manufacturing center. The distributing system and power plant of the Detroit companies was described in the ELECTRICAL WORLD AND ENGINEER for Feb. 4 and Feb. 11, 1905.

It is the purpose of the present article not to take up the enlargements and changes in this distributing and generating

FIG. 1.—LOAD CURVE, OCT. 13, 1905.

system so much as to review the commercial development and commercial methods which have made this increase in equipment necessary. It may be incidentally mentioned, however, that the load connected to the Delray power plant which was started about three years ago now requires the combined output of five 3000-kw turbo-generators; and a second power plant close to the first is now under way in which 8000-kw turbo-generator units will be installed. This growth has been due partly, of course, to the natural development of the city during prosperous times. It is not by any means entirely due to this, however. A correct commercial policy toward motor users has brought about some of the most valuable increases. Figs. 1, 2 and 3 show typical load curves for corresponding days in October, 1905, 1906 and 1907. In 1905 an important growth along the lines indicated had already been started, the Delray plant having been in operation about a year. The peak load on Oct. 13, 1905, was 6700 kilowatts, while that for Oct. 14, 1907, was 15,600 kilowatts. In these load curves the uppermost curve represents the total power generated by the 4600-volt, three-phase, turbine units. The curve marked "alternating current converted" represents the amount of power converted from alternating to direct by motor-generator sets for use in the direct-current distributing district. The curve marked [illegible]

explanatory. The sum of the two lower curves is not equal to the total load curve of the station for three reasons: First, the line losses between generating station and sub-stations are not accounted for; second, some power used at 600 volts in railway service is not included; third, some large motors are connected to trunk and tie lines between the generating station and sub-

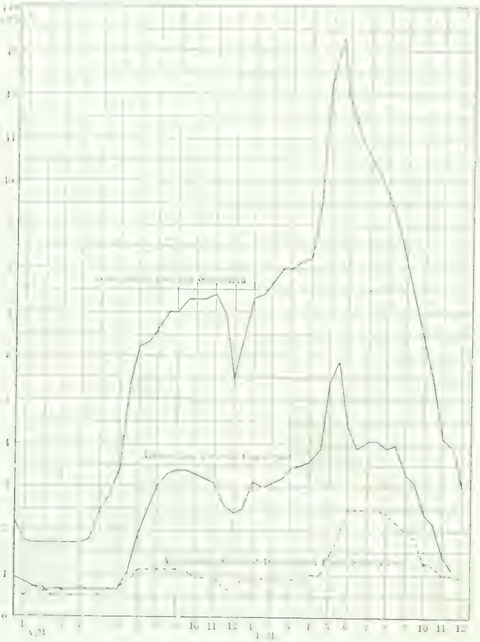


FIG. 2.—LOAD CURVE, OCT. 15, 1906.

stations, so that there is no record of their consumption. In the total generated load curve for Oct. 14, 1907, the average load was 8150 kilowatts and the load factor for the day 52.5 per cent. It must be considered in connection with the questions of peak and load factor, however, that there are a few steam stations which carry a small amount of load during the peak and have a steam heating load during the winter season.

RATES.

As the policy of a company as to rates has a vital bearing on its development in a commercial way, the very logical system of rates which has been adopted at Detroit will be of interest. All rates are published, and the system of rates is comprehensive enough to take care of practically all conditions.

Taking up first the forms of contracts there is one termed the "Electric Energy Contract" which recites that the company undertakes to reserve for the use of the customer its machinery, apparatus and lines to an extent sufficient to deliver to him at his premises electric energy at the rate of a given number of kilowatts continuously night and day, Sundays and legal holidays excepted. The customer agrees that he will not at any time take energy from the lines of the company at a rate greater than the specified number of kilowatts without notice given to the company, and that he will report to the company from time to time or will allow the company as its option to determine by measurement his actual maximum demand or rate of using electric energy. For the reservation of equipment provided for in the foregoing, the customer agrees to pay the company $4.50 per rated kilowatt of equipment contracted for per month. In addition to such payment for reservation the consumer agrees to pay 1 cent per kw-hour for energy used. Discounts, for payment within 10 days, are 5 per cent on bills up to $100 and 10 per cent for excess over $100. In case of the failure of the company to maintain its supply as before provided, the customer shall notify the company by telephone and by writing of the duration of such interruption and claim rebates at the rate of 10 cents per kilowatt of equipment per hour of such delay, this to be deducted from the gross amount of the next monthly bill before deducting the discount; but the customer cannot claim more than $4.50 rebate per kilowatt. As the hourly rebate provided is greater than a pro rata rebate would be, the company retains the privilege upon notice given the preceding day, of interrupting the supply at night or on Sundays or holidays or at such other times as will not interfere with the regular conduct of the customer's business, for short periods for the purpose of making repairs or changes of its lines or apparatus. Under this contract, the customer is not permitted to sell energy to a second party without the written consent of the company, nor does the company furnish or maintain any apparatus beyond the point of entrance of the lines to the customer's premises, nor are any lamps, lamp renewals, fuses or the service of repair men or inspectors furnished free. This contract is, of course, intended for the largest wholesale customers, and is made for three years.

Customers not wishing such a contract may obtain energy on an open order, which may be cancelled at any time. On an open order contract, the customer simply pays 4 cents per kw-hour, with discounts for prompt payment, as in the case of the three-year energy contract.

The company also has a special non-peak form of contract which is similar to the energy contract described, except that the customer pays only $3 instead of $4.50 per month per kilowatt of maximum demand or kilowatt capacity "reserved"

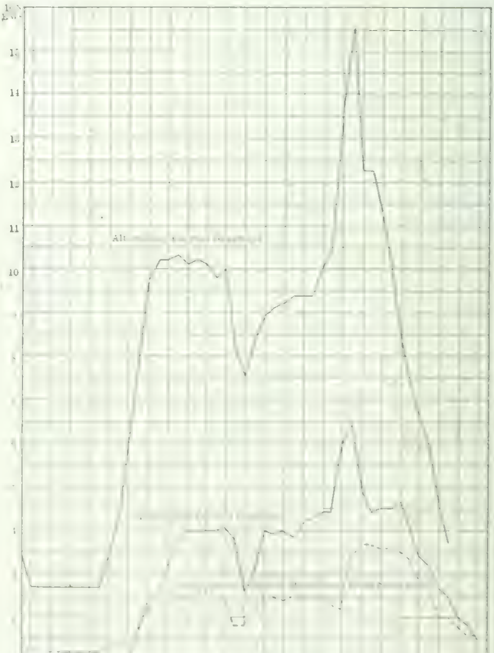


FIG. 3.—LOAD CURVE, OCT. 14, 1907.

as the Detroit contracts are worded. Not many customers have been taken on non-peak contracts as yet, and the making of such contracts has not been pushed to any extent, but the company's condition just now is such as to make it advisable to push the non-peak contract, the load being nearly up to the station's maximum output.

Residence lighting is taken on an open order contract which can be discontinued at any time, or on a one year contract. Under the open order contract the customer pays 16 cents per kw-hour up to the point where the energy consumed is equivalent to 60 hours' use per month of what the company reckons his maximum demand. For all energy over that he pays 4 cents per kw-hour. The minimum bill under an open order contract is 50 cents per month. The discount for prompt payment is 10 per cent.

The company's method of estimating the maximum demand in a residence is to count all the rooms of the house except kitchen, laundry, store-rooms and three bedrooms. Multiplying this number by 2 kw-hours gives the amount which is charged for at the high rate.

Commercial lighting is taken under a one year contract with a maximum-demand meter, unless the maximum demand is the same as the connected load; in which case no demand meter is necessary. Under this contract the customer pays 16 cents per kw-hour for the equivalent of 30 hours' use of the maximum demand and 4 cents for all above that, with a 10 per cent discount for prompt payment on bills of less than $50, 15 per cent on bills of $50 to $100, and 20 per cent on bills of $100 or more. Such an agreement is not written for a monthly bill less than $2.40. Free lamp renewals and free trimming and repair of arc lamps are included and original installations of lamps, both incandescent and arc. If the customer consumes less energy than would be equivalent to 30 hours' use of the maximum demand, he pays for the full 30 hours' use at 16 cents, as a readiness-to-serve charge.

The company furnishes free incandescent lamp renewals. It also furnishes and maintains 3-glower Nernst lamps, of which there are about 2000 in use. The maintenance cost on these lamps is about ½ cent per kw-hour. Free renewals are furnished on all larger sizes of Gem lamps, the customer purchasing the reflectors.

No flat-rate service sign contracts are made, but the company furnishes free renewals for 2-cp sign lamps, and this seems to have been a great stimulus to the sign business in Detroit, judging from the appearance of the down-town streets at night. Aside from furnishing these free renewals of 2-cp lamps, the company has made no effort to get sign business. This speaks well for the efficiency of the 2-cp sign lamp as a business getter. It allows customers with small signs to make a much better showing than they could if 4-cp lamps were the only ones supplied.

The contract department is in charge of Miss Sarah M. Sheridan. Ten solicitors are employed outside of the office, of whom four are on motor work. Besides these, there is one general motor-contract engineer who handles the most difficult engineering problems coming up in connection with the contract department. The six lighting solicitors divide the city by districts and also solicit for any small motor users of 10 horse-power or less. The solicitors for motor load are assigned cases largely according to their previous experience. These solicitors are gradually becoming specialists in handling various classes of customers. One of the lighting men devotes his time mainly to isolated plants. Fifteen isolated plants were closed down in 1907 and 12 in each of the two preceding years. About six isolated plants take summer service from the company and operate during the winter.

An interesting development in connection with isolated plants is what is called a throw-over service. Two meters are placed on the central-station service wires to the isolated plant. One of these meters is thrown on by a Hartford time switch between 1:30 to 6:30 p. m. At 6:30 the time switch throws the circuit to the other meter, where it remains until 1:30 p. m. the following day, and so on. All energy consumed between 1:30 and 6:30 p. m. is paid for at 16 cents per kw-hour; energy consumed at other times is charged for at the rate of 4 cents per kw-hour. The time switch is wound once a week. There are 55 such connections in the city. The minimum bill for this throw-over service is $1 per rated kilowatt of equipment per month up to $25. This is only in the direct-current districts where no special transformer capacity is required, and up to transformer rating in the alternating-current district.

There are over 3000 electric flatirons in use. Between 200 and 300 a month are sold from the company's display room during the summer and about 100 in winter. There are also about 250 electrically operated washing machines connected. The one used most is the "1900 Washer." From the display room the company sells nothing but heating appliances and sewing-machine motors. The sales from this room altogether amount to $600 per month. Electric irons are sold at $3.50 each and sewing-machine motors at $15.

The total connected load on Sept. 30 amounted to the equivalent of 741,849 50-watt lamps and the motor load alone equalled 252,075 lamps.

The Detroit Edison Company and the various companies through which the energy it generates is distributed are under the management of Mr. Alex Dow, vice-president and general manager.

Luminous Arc Service in Cleveland.

The Cleveland, Ohio, Electric Illuminating Company has recently started a luminous arc lamp service which, being one of the first of its kind in the country, is of considerable interest to central-station companies. The company contracts to supply energy for outdoor luminous arc lamps at the rate of $6.25 per lamp per month, and agrees to operate these lamps from dusk to 11 p. m. daily. Lamps are furnished by the company. A Hartford time switch wound once a week, also furnished by the company, turns on each pair of lamps at dusk and turns it off at 11 p. m. For the trimming and maintenance of these lamps the customer must, at the same time that he contracts with the company, enter into a contract with the Flaming Arc Maintenance Company to trim and maintain the lamp and time switch for $2.75 per month. The total cost to the customer is therefore $9 per lamp per month. The Flaming Arc Maintenance Company is practically a Cleveland maintenance branch of the Excello Arc Lamp Company. The trimmer for the Flaming Arc Maintenance Company reports to the head trimmer of the Cleveland Electric Illuminating Company, but is employed by the maintenance company and devotes his time to flaming arc lamp maintenance. All troubles on luminous arc lamps are reported direct to the luminous arc trimmer. The rate obtained by the illuminating company is about equal to the regular meter rate. Luminous arc lamps for outdoor advertising purposes are, therefore, coming into use rapidly in Cleveland. Their principal application is for lighting store fronts—a field hitherto extensively occupied by gas arc lamps burning very cheap natural gas. The luminous arc lamp so far surpasses any gas arc lamp in candle-power that, for spectacular work of this kind, gas arc lamps are left far in the rear. These luminous arc lamps are also coming into use to some extent for factory lighting in Cleveland.

Tungsten Lamps for Street Lighting.

An interesting street lighting installation, using series tungsten lamps, has recently been made at Grosse Point Farms, a suburb of Detroit. This lighting is done under contract by the Peninsular Electric Light Company, of Detroit, and for the particulars regarding it we are indebted to Mr. E. F. Philipps, in charge of the suburban properties of that company. As will be seen from Figs. 1 and 2, the latter a view of the street, the lamp post used has two goose-necks, each of which carries a radial wave reflector with a 16-cp, 5.5-ampere tungsten lamp. The length of the street so lighted is 11,500 ft., and there are 42 lamp posts placed at somewhat irregular distances apart, owing to the fact that some portions of the street have more trees than other portions and also because some portions are not as well built up as others. Where the roadway is straight and not built up as thickly, the distance between lamps is

greatest. The average distance between posts is 280 ft., although there are some places where they are 450 ft. to 500 ft. apart, and the company may some time be called upon to put in an extra post here and there.

The tungsten lamps are of the regular type for series street-lighting circuits made by the General Electric Company, and each lamp requires 5.5 amperes at a potential of 14.7 volts or 81 watts. The radial wave reflector is a fluted enameled steel reflector made for street lighting, and is of sufficient size to reflect in useful directions a large percentage of the light usually wasted above the horizontal.

FIG. 1.—LAMP POST.

The street-lighting results obtained with this arrangement are excellent. On a visit by the writer to the street recently on a rainy night, it was noticed in one or two places where only one lamp was burning on each of two adjacent poles the lighting was still much better than is common on suburban streets.

The lamps are arranged in two circuits, and energy is supplied to them through No. 10 stranded single-conductor rubber and lead-covered cable from a constant-current tub transformer supplied from a 2300-volt single-phase circuit. The circuits are all underground. In the underground construction 3-in. fiber conduit was used. The trench for the conduit was dug just inside of the curb, to obviate the necessity of disturbing the roadway. An extra duct was laid in the trench with the street-lighting conduit to provide for any future call for commercial lighting on piers, boat-houses and grounds. The street thus lighted (Jefferson Avenue) is located along the lake front. In the conduit opposite each lamp post was located a brick hand-hole, with a cast-iron top 18 ins. in diameter. These hand-holes are 3 ft. from the lamp post. From the hand-holes a 36-in. 90-deg. pipe bend 2 ins. in diameter was run. Two-in. pipe was used for this bend because the slot in the base of the poles was not large enough to pass the 3-in. bend.

The illumination of this street is an excellent example of the

FIG. 2.—JEFFERSON AVENUE, [illegible] FARM.

economy obtainable in street lighting with tungsten lamps. Even better distribution of light would, of course, have been secured with twice as many posts, and with but one lamp on each post; but the construction expense would have been much greater. From an inspection of this street at night, it can be said safely that the majority of suburban streets would be lighted better than they are at present with poles located as far apart as they are in this instance and with but one 60-cp lamp per post. This would call for a very reasonable expenditure of power; only about 81 watts for every 280 ft. A part of the improved results obtained are due to the reflector employed, though, of course, the tungsten lamp is responsible for most of the improvement over existing methods.

Main Street, Dayton, Ohio, at Night.

The accompanying engraving, made from a night photograph of Main Street, Dayton, Ohio, shows what the enterprising central-station interests there are doing to produce an attractive appearance on that city's principal down-town thoroughfares. Main is among the notably lighted streets for cities of

MAIN STREET, DAYTON, OHIO, AT NIGHT.

this size. As will be seen, there is considerable sign and display lighting. Very rapid progress is being made in the introduction of sign and display effects in Dayton, and no doubt by the holidays the attractive appearance shown will even be improved. The Dayton Lighting Company has changed considerably the illumination of this street since the present ownership took hold.

Letter to the Editors.

Height of Lamps and Lighting Efficiency.

To the Editors of Electrical World:

SIRS:—It is a matter of common knowledge that the illumination obtained from a single lamp usually varies approximately inversely as the square of the distance. Even the most unscientific mind fully realizes that the nearer the reading page is held to the lamp, the more the light received on it. For this reason it may be somewhat difficult for those who have not watched recent illuminating engineering practice closely to realize that in some classes of lighting increasing the height of the lamps above the plane to be illuminated does not necessarily decrease the illumination. This is not due to any miraculous contravention of the law of inverse squares, but due to some long-unrecognized facts in connection with flux of light and reflection. In the case of a large interior like a store, where many lamps are giving light on the plane of the counters, it must be evident that the total light received on the plane of the counters is that coming directly from the lamps plus that which strikes the ceiling and walls and is reflected to the plane of the counters. Modern illuminating engineering practice would attempt, in a case of this kind, by the use of properly designed reflectors and reflecting surfaces, to throw as large a percentage of the total light generated by the lamps on the plane of the counters as is consistent with a well-lighted ceiling. A comparatively small percentage of the light given out is sufficient to light the ceilings and sidewalls, so that most of the light can safely be directed toward the plane of the counters.

Now if the lamps are hung low in very concentrating reflectors, each lamp will have a large percentage of its flux delivered over a small area under the lamp, and if there are sufficient lamps the entire area of the working plane will be covered.

If, now, these lamps be raised much higher than before, they will still have a large part of their light flux directed toward the working plane, but each lamp will cover a larger area. The total flux of light toward the counters being approximately the same, the illumination as measured on the counters would be the same, but with the difference that any given point on the counters would be receiving light from a greater number of lamps. Stated another way, the decrease in illumination due to the raising of any particular lamp is compensated for by the fact that the area lighted by that particular lamp will be also lighted by a number of other lamps when the lamps are raised from the lower to the higher position.

The correctness of this theory has now been well established by various tests. It is indeed fortunate that such is the case, for it permits of placing the light sources high out of the ordinary range of vision. This improves the apparent as well as the actual illumination, and in practice the apparent illumination to the casual observer is fully as important as the actual illumination in foot-candles measured by testing instruments. It is important to note, however, that unless proper reflectors are used which direct a large percentage of the light flux of the lamp toward the working plane under consideration, the height of the lamps has a great deal to do with the efficiency. The whole question simmers down to one of sending in useful directions a large proportion of the light coming from the lamp.

PHILADELPHIA, PA. CHAS. T. BLAKE.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Carbon Brushes.—An account of a very extended test of various commercial carbon brushes. Brushes of hard, medium-hard and soft carbon made by five different manufacturers were tested. The following properties were investigated: Apparent density, real denstiy, tensile strength, compressibility, wear and tear as a function of the speed, behavior as anode in electrolysis, specific electric resistance and its variation with a temperature, contact resistance and friction, content of ash, etc.; microscopic examinations of the carbons were also made. The values for the specific resistance in microhms-cm. vary between 8496 and 1494, while those for the temperature coefficient vary between —0.000842 and —0.000088.—*Bull. Soc. Internat. des Elec.*, August, September, October; abstracted in *L'Industrie Electrique*, Oct. 25.

Lamps and Lighting.

Incandescent Lamps.—TEICHMUELLER.—In different European countries there are now national bureaus for testing incandescent lamps. For these tests exact regulations have been formulated; for instance, in Germany by the buying bureau of the Association of Central Stations and by the selling bureau of the Syndicate of Lamp Manufacturers. A summary is given of the requirements in the different countries. Each lamp must be marked with the candle-power, the normal e. m. f. to produce this illumination (called the "test voltage"), and the mark A, B or C, where A means low specific power consumption and short life, B medium power consumption and medium life, and C high power consumption and long life. The useful life is 300 hours for A, 600 hours for B, and 800 hours for C. For instance, the mark 112 B 16 means a 16-cp, 112-volt lamp with a useful life of 600 hours. The e. m. f. for which the lamps are ordered ("the order voltage") may differ from the "test voltage" by the following amounts:

[illegible]	[illegible]
[illegible]	[illegible]
at [illegible] to [illegible] volt	[illegible] volt
at [illegible] to [illegible] volt	[illegible] volt
at [illegible] to [illegible] volt	[illegible] volt
at 240 to 250 volt	+ 6 volt — 5 volt

The above requirements are about the same in Germany, Austria and Switzerland. In England there are two standard e. m. f.'s, namely, 110 and 220 volts, and two standard figures for useful life, namely, 400 and 800 hours. For tests in Germany it is required that not more than 10 per cent of all lamps shall reach the limits given above for the voltage. However, for 5 per cent a further limit of 1 per cent is allowed. In Switzerland not more than 20 per cent of the lamps of each type and each size are permitted to reach the limits given above. Special figures are given for the specific power consumption required. For 16-cp lamps the figures are as follows:

	A	B	C
45 to [illegible] volts	[illegible]	[illegible]	[illegible]
116 to [illegible] volts	[illegible]	[illegible]	[illegible]
1[illegible]6 to [illegible] volts	[illegible]	[illegible]	[illegible]

The figures represent specific consumption in watts per hefner candle. It will be seen that for the higher supply voltages the lamps become less efficient, and that for the long-life lamps (C) a considerably higher power consumption is permitted. The specific power consumption is determined at the "test voltage." In Austria a discrepancy of 4 per cent from the above values is permitted, in Switzerland 6 per cent, in Germany from 5 to 8 per cent, according to the difference between the test e. m. f. and the order e. m. f. The corresponding table, which is valid in England, is also given. In Germany the specific consumption test is made with at least 30 lamps of each type, and, if the manufacturer desires, 2½ per cent of the whole shipment must be tested. The shipment may be refused if 10 per cent of the tested lamps do not fulfill the conditions; or if all the lamps were tested for candle-power and consumption, all those which do not fulfill the conditions may be refused. The useful life is defined as the life in which the candle-power decreases to 80 per cent of the candle-power marked on the lamp (not the real original candle-power). In the life test the lamps are used at the test voltage. The lamps are refused in Germany if 10 per cent of the tested lamps do not fulfill the life test; in Switzerland if 20 per cent of the tested lamps do not fulfill the conditions, and in Austria if two successive tests of 15 per cent do not fulfill the conditions. The lamp manufacturers complain that many of the conditions are too stringent. As the unit of light the mean horizontal candle-power is used in each case. In England there is the further requirement that the ratio of the mean spherical candle-power to the mean horizontal candle power be at least 0.8.—*Elek. Zeit.*, Oct. 17.

Alternating-Current Arc Lamps.—J. SOHLMANN.—In order to render the operation of alternating-current arc lamps more economical, inductance coils instead of resistors should be used in series with them. Further advantages may be obtained by using a homogeneous carbon for the lower electrode and a cored carbon for the upper electrode. The e. m. f. of the lamp is thereby raised from 28 to 38 volts, and an apparent phase-difference occurs between current and e. m. f., due to the variable arc resistance, simultaneously with strong hissing. The author endeavors to flatten out the distorted current and e. m. f. curves by the use of the inductance coils so as to get a quiet arc. He states that his experiments were completely successful. On the assumption that in alternating-current arc lamps 40 per cent of the light thrown upwards is turned downwards by the reflector, the author finds the following figures for lamps consuming 360 watts, including the loss in the series resistor. A lower hemispherical candle-power of 490 hefner candles with one cored and one homogeneous carbon electrode and alternating-current, 332 hefner candles with two cored carbon electrodes and alternating-current, and 440 hefner candles with a cored and a homogeneous carbon electrode and direct current.—From *Jahrb. f. [illegible] und Verhandlungen* 1906, abstracted in *Elek. Zeit.*, Nov. 7.

[illegible] Lamp.—An illustrated description of a new mod[illegible]

fication of the "Juno" flame arc lamp made by a British company. The lamp is at present made in only one size, taking 450 watts and suitable for connecting four lamps in series on a 200-volt supply. The carbons, C_1, C_2, in Fig. 1, are clamped in holders attached to a cross slide, *S*, along which the holders can move as the convergence of the carbons requires. One carbon always rests at its lower end on an abutment piece, *A*, so that as it burns away the two electrodes are caused to descend by gravity together with the cross slide. The abutment piece is simply a bent copper bar, which has to be renewed through burning away only once every three months or so. The magnet for striking the arc is placed at the top of the case. A rod, *W*, attached to its armature rests upon a projection of the striking lever, *F*. When the lamp is not burning, the

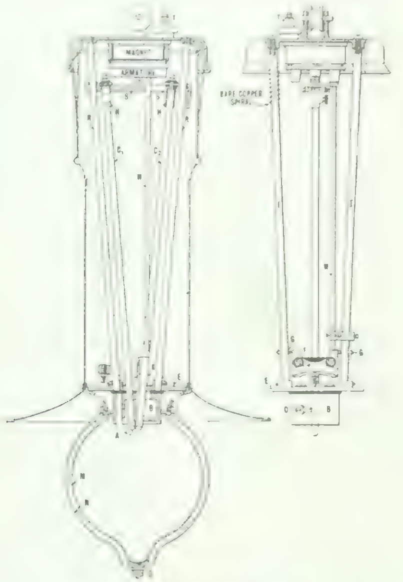


FIG. 1.—FLAME ARC LAMP.

weight of the armature and rod keeps the striker in the position shown, and the collar, *K*, attached to it keeps the carbons pressed together. When the circuit is completed, the armature is attracted, and the weighted striking lever moves and causes the carbons to separate, thus starting the arc. The necessary magnetic flux to "blow out" the arc is obtained by means of the two iron side rods, *I*, which are wound with a helix of wire carrying the main current. With the type of carbon without a metal case recommended for these lamps, it is claimed that practically no fumes are given off and remarkably little ash is found in the globe.—Lond. *Elec. Eng'ing*, Nov. 7.

Luminescence.—E. L. Nichols and E. Merritt.—The eighth paper of their serial on studies in luminescence. The present paper deals with the influence of the red and infra-red rays upon the photoluminescence of Sidot blende.—*Phy. Rev.*, Nov.

Power.

Electric Power Along a Canal.—L. Pasching.—An illustrated article on the electricity plants of the Rheintalishe Binnenkanal in Switzerland. Three water powers were available with distances of about 3 miles between two succeeding ones. In view of the location of the three water powers with respect to the area to be supplied with energy it was not possible to let each station supply energy to its own area. On the other hand, operation in parallel of three distant plants was somewhat difficult. It was then decided to use the following novel system. Only one plant was equipped with synchronous generators, while the two other plants were equipped with non-synchronous generators; that is, induction motors running above synchronism. The first cost of this system is less than for three synchronous generator stations, while the cost of operation is very much less, since no skilled labor is required in the two stations equipped with non-synchronous generators. The operation is quite satisfactory.—*Elek. Zeit.*, Oct. 17 and 24.

Water Power in Italy.—An illustrated article on the utilization of water power for industrial purposes in central Italy. The Abruzzi Mountains, which was one of the most primitive regions in Italy hardly a generation ago, has now become an industrial center with many electric lighting and power plants. This is due to the abundance of water power. Various electrochemical and electrometallurgical plants are in this region.—Lond. *Electrical Review*, Nov. 8.

Rhine.—J. Reyval.—An article, illustrated by maps, on the water power available along the River Rhine in Switzerland.—*L'Eclairage Elec.*, Oct. 5.

Electric Equipment of Flour Mill.—W. O. Horsnaill.—An illustrated description of the equipment of a flour mill which is partly electrically driven, although rope-driving has been adopted for such parts of the mill as contain continuously running interdependent machinery.—Lond. *Elec. Eng'ing*, Nov. 7.

Electric Power in Mines.—Notes on the general introduction of electric working in mines in New South Wales, where the more advanced collieries are adopting electric power. Opposition has been made from the miners, and has assumed the form of strikes or threatened strikes. Some notes are given on the prevention of explosions.—*Australian Mining Standard*, Oct. 2; abstracted in Lond. *Elec. Eng'ing*, Nov. 7.

Internal Combustion Engines.—The full issue is devoted to articles on internal combustion engines. H. H. Suplee gives a historical review of the development of the internal combustion engine; B. H. Thwaite discusses the blast furnace as a center of power production; E. F. Adams the development of the large gas engine in America; H. A. Humphrey by-product recovery gas-producer plants; L. Greiner the utilization of the waste gases of blast furnaces and of coke ovens in metallurgical works; C. T. Wilkinson, the utilization of low-grade fuels in the gas producer; F. E. Junge, the gas-power situation in Germany; G. M. S. Tait, producer gas composition and its influence on the performance of suction-producer plants; W. H. Booth, large gas and steam engines; F. J. Rowan, the suction-gas producer; E. A. Harvey, the production of engine gas from bituminous coal, and C. E. Lucke, energy transmission by producer gas. The portrait of Dr. N. A. Otto is given as frontispiece.—*Cassier's Magazine*, November.

Gas Power.—An article with reference to a recent paper by Mathot on modern gas producer and gas engine practice.—Lond. *Electrical Review*, Nov. 8.

Smoke Nuisance.—An account of a recent London police court prosecution of the Westminster City Council against the Underground Electric Railways Company of London for causing a nuisance by emitting black smoke from its power house. The case has been decided in favor of the company. The magistrate held that the smoke was brown and not black, and that all reasonable care was exercised by the company to prevent any nuisance.—Lond. *Elec. Eng'ing*, Nov. 7.

Installations, Systems and Appliances.

Earthing the Neutral Point.—E. V. Shaw.—The neutral of a three-phase system should be earthed at one point only, and that through a suitable resistance. In a large power station containing a number of three-phase machines running in parallel, only one should be earthed in its neutral point. The author has devised an automatic switch for this purpose. This automatic earth switch, shown in Fig. 2, is made up of two parts—the earth switch proper and the supplementary or motor-control switch by which it is operated. The earth switch itself consists of a slate base, on which are mounted one ring contact—which is connected directly to the earth resistor—and, concentrically with this, the same number of contacts as there are machines in the station, each of these contacts being connected to the neutral point of one machine. A brush carried on a shaft connects this ring to one contact at a time; this is coupled by worm-gearing to a 1-hp motor, which is capable of revolv-

ing the brush at the rate of 2 r. p. m. The supplementary switch is similar to the main switch, but is much lighter in construction; its revolving brush is carried on the same shaft as the main brush, and these two brushes are on the opposite ends of the shaft, which is geared in the middle to the motor. The ring contact of this supplementary switch is connected to the

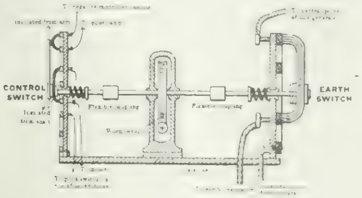


FIG. 2.—GENERAL ARRANGEMENT OF EARTH SWITCH.

negative side of the switch motor, and each of the small contacts corresponding to the neutral point contacts on the earth switch, is connected to the "off position" of the pilot switch on the main oil switch for that generator. (Fig. 3.) It will be seen that while the earth switch is connecting the neutral point of a generator, which is switched on to the bus-bars to earth, the motor circuit is broken at the pilot switch, but immediately the oil switch of this generator is opened the pilot switch comes over to the "off position" and closes the motor circuit. The motor then drives the revolving brushes until the main brush connects the neutral point of the next machine, which is switched on to the bus-bars, to earth. When it reaches this

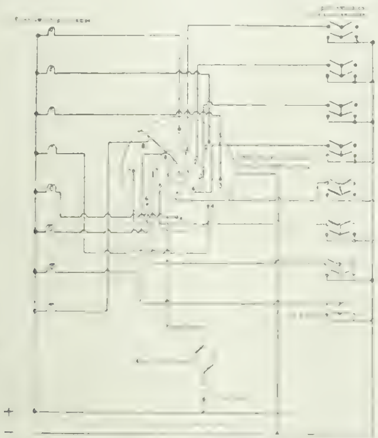


FIG. 3.—CONNECTIONS OF MOTOR CONTROL SWITCH.

position, the brush on the supplementary switch being in a corresponding position, the motor circuit is now opened at the pilot switch on the oil switch of this generator. It is arranged for the earth switch to travel in a clockwise direction. The small single-pole switch in the motor circuit is provided for opening this circuit when all the generators are off the bus-bars, so as to prevent the motor from driving the switch round and round, searching for a generator to earth. In addition to this, on a particular switch designed by the author, a pilot switch has been added similar in construction to the motor-control switch, the brush arm of this switch being likewise driven by the common shaft. This is shown in the two illustrations. This pilot switch closes the circuit for the "earth-switch pilot lamp" corresponding to the generator which is earthed.—Lond. *Elec. Review*, Oct. 18.

Three-Wire Direct-Current System.—W. A. Toppin.—An article in which the author states that in Great Britain out of a total number of 428 central stations, 280 distribute by means of the three-wire system, 81 stations by means of two-wire direct current, and only 67 give a purely alternating-current supply. The majority of the two-wire direct-current stations will change over to the three-wire system as they increase in size. The author describes a method of L. R. Lee for locating faults. The only apparatus required is a voltmeter and a coil of lightly insulated small wire. The most suitable voltmeter is a very sensitive one, having two scales, one reading from 0.01 to 1 volt and the other 1 to 100 volts. One terminal of the voltmeter is connected to as good an earth as can be obtained; there is generally a terminal connected to an earth plate in each feeder and distributing pillar. A water-pipe or even a gas-pipe has been found to give excellent results. The other terminal of the voltmeter is connected to a screwdriver or metal plate. The earth in the vicinity of the fault is raised to a pressure above the normal, and it is this pressure that it is desired to measure. The fault will be found immediately below the spot where the highest reading is obtained. As it is essential that the leakage should be taking place during the test, it is advisable to have four lamps in series across the outers, with the middle point earthed; these can be connected up at the nearest pillar, and thus save the rouble of telephonic inquiries to the station.—Lond. *Electrical Review*, Oct. 25.

Circuit-Interrupting Devices.—F. W. Harris.—The first of a serial of articles on switches, fuses and circuit-breakers. The author discusses the general appearance of their design. Fig. 4

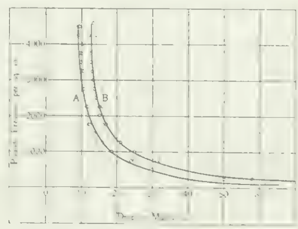


FIG. 4.—CURVES OF VOLTAGE DROP.

shows typical curves of voltage drop between two contacts, the current being maintained constant and the pressure varied. The drop across the contacts decreases rapidly with pressure up to a certain critical pressure. To prevent an arc in interruping a circuit it is necessary to prevent the formation of low-resistance vapor or to successfully counteract its effect. To extinguish arcs, four commercial methods are used: Oil magnetic blow-out, expulsion and enclosure. Finally, the quickness of break is discussed.—*Electrical Journal*, November.

Electricity Supply Development.—An illustrated article on the development of the electricity supply undertaking of the St. Marylebone Borough Council, which is the largest municipal system in London. It was one of the first to apply organized methods to the commercial development of the business. The publicity department has done considerable work. A very complete system of curves and book records of the progress of the undertaking is kept up by the department. Slot meters are in use, but at present no free wiring or higher schemes are in operation, though they are being contemplated.—Lond. *Electrical Review*, Oct. 25.

Sub-Stations.—Idelberger.—The first part of a description of the sub-station Krummestrasse of the Berlin electric elevated and subway. It is supplied with three-phase currents, which are changed in five 660-kw converters to direct current. The article is profusely illustrated.—*Elek. Zeit.*, Oct. 31, Nov. 7.

Berlin.—K. Wilkens.—The conclusion of his long illustrated article on the Berlin Electricity Works at the beginning of 1907. The concluding installment deals with the storage battery equipment.—*Elek. Zeit.*, Oct. 24.

Wires, Wiring and Conduits.

Losses in Alternating-Current Cables.—E. Stirnimann.—In tests of large alternating-current cables the ratio of the apparent alternating-current resistance to the calculated direct-current resistance was found in several cases as high as two or three. The large additional resistance cannot be explained by the ordi-

[illegible] of the increased apparent resistance, there is still another cause. An ordinary stranded cable consists of a central wire around which one or more layers of smaller wires are laid spirally. The current has two ways open to itself, first, along the spiral-wound conductors, and, secondly, in straight direction passing from one wire to the next. The first path has resistance and inductance. The second path has only ohmic resistance. This explanation was found, indeed, to be satisfactory. The conclusions arrived at by the author are that for normal alternating-current systems ordinary cables can be safely used up to cross-sections of 100 sq. mm, but above this the cables should be sub-divided into a number of segmental or circular cables, insulated lightly from one another, and stranded together, and of not more than 70 sq. mm section each. "Specifications for alternating-current cables should also contain a clause fixing the conductivity for alternating current at, say, 95 per cent for 50 cycles, and 98 per cent for 30 cycles or less—the latter being the ordinary direct-current specification."—Lond. *Elec. Review,* Oct. 11.

Determining Voltage Drop.—T. L. Kolkin.—An illustrated article giving graphical methods for determining the voltage drop in energy distribution systems.—Lond. *Elec. Review,* Oct. 11.

Electrophysics and Magnetism.

[illegible] Precht, Tamm, Evers, Warburg and others with respect to spark potentials are greatly at variance, often differing by 1000 volts. The present author points out that results equally variable can be obtained with one and the same apparatus. They apparently depend upon a number of imperfectly known conditions. One of these conditions is, no doubt, the temperature of the spark-gap and terminals, and this the author subjects to a careful scrutiny, using a gold cylinder and a platinum point charged to a positive or negative potential. The whole spark-gap and leads were heated by an electric oven. The author found that the negative minimum potential is inconsistent when the point is new, but soon acquires a constant value which returns on returning to the original conditions of temperature, illumination, etc. By heating to a red heat under constant density, the negative minimum potential is reduced to an amount which suffers no further reduction on heating further. The positive spark potential is affected only slightly by heat. The current density increases rapidly on heating the negative point above 500 deg. C. The phenomena are qualitatively the same in air as in nitrogen.—*Ann. d. Physik.,* No. 11; abstracted in Lond. *Elec. Eng'ing,* Nov. 7.

Electrochemistry and Batteries.

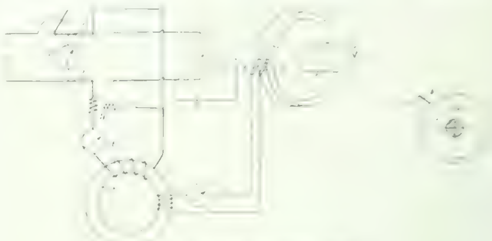
Disinfection.—At Poplar the Hermite electrolytic process of making hypochlorite is in use. Formerly carbolic fluid and powder disinfectants were used. It is shown that the use of the electrolytic hypochlorite disinfectant has reduced the cost to about one-half, and that this saving has already paid for the initial outlay for the plant. In the future a still greater saving is expected, since the system is now in working order, and the expenditure for wages, batteries, etc., will be smaller.—Lond. *Electrician,* Nov. 8.

Induction Furnace.—V. Englehardt.—The first two parts of a long illustrated serial on electric induction furnaces and their application in the iron and steel industry.—*Elek. Zeit.,* Oct. 31, Nov. 7.

Electrometallurgy.—J. B. C. Kershaw.—An illustrated summary of some recent developments in the electrometallurgy of ferro-alloys, steel, lead, tin and zinc.—*Eng'ing Magazine,* November.

Units, Measurements and Instruments.

[illegible] the German Association of Electrical Engineers on a method of determining the iron losses as a function of the induced maximum flux. The body of iron to be tested is indicated by E in Fig. 5. The losses are measured by means of the wattmeter W, the effective value of the alternating current which magnetizes the iron core E, is measured by means of the ammeter A. The voltmeter V, serves for controlling the e. m. f. of the alternator, which supplies the energy. By means of the switch U, it is possible to connect the magnetizing windings of E, the ammeter A and the current coil of the wattmeter W, either with the alternator or with a Wheatstone bridge. In this way it is possible to measure first the iron losses and then to determine immediately afterward the resistance of the circuit, so that the copper losses may be found and deducted from the loss determined with the wattmeter. During the resistance



[illegible]

measurement the voltage-coil circuit of the wattmeter must be open. For testing the field in the core E a secondary coil is provided, which is connected to the galvanometer G, and a contact device, C. The latter is placed either directly on the axle of the alternator or on the axle of a synchronous motor. The contact device operates so that the galvanometer circuit is closed during one half period and open during the next half period. There are two brushes, b_1 b_2, of which b_1 slides on a complete circular brass ring. On the other hand, the brush b_2 slides on a disc constructed as shown in the right-hand diagram. This disc is made of hard rubber and has two sectors of copper inserted on the surface at opposite places as shown in the diagram. These copper sectors are firmly connected with the complete copper ring of the other disc. In order to obtain good results it is very important that the brushes do not vibrate and that the contact surface is clean. Under proper conditions the needle of the milliammeter G does not vibrate in any way. The indication of this needle gives the current which, when multiplied with a constant value, gives the flux in E. If the object is to determine the iron losses as a function of the maximum flux, the position of the brushes must be so adjusted that the deflection of the galvanometer G becomes a maximum. The results of a test of a certain kind of iron are given. In this case it was found that with constant flux the hysteresis loss per period increased with increasing frequency. A special arrangement for testing sheet steel is also described.—*Elek. Zeit.,* Oct. 10; *Elek. und Masch.,* Oct. 20.

Variable Mutual Inductances.—A. Campbell.—An abstract of a (British) Physical Society paper on the use of variable mutual conductances. In connection with wireless telegraphy the measurement of small inductances and capacities is of importance; one of the methods described has special reference to small self-inductances. Mutual inductances can be more easily dealt with than self-inductances, for the former can be (1) more accurately calculated from dimensions, (2) are less affected by change of frequency, and (3) when variable, can be made to pass through zero value. A convenient form of variable mutual inductance consists of a continuously variable part and a series of steps. The first consists of two equal parallel coils with a third coil moving parallel to their planes round an axis eccentric to the fixed coils. The scale thus obtained is very open near zero (which is an advantage) and the graduation is done by experiment. The steps are obtained by means of another fixed coil of standard wire, each strand giving an equal sub-division. The model shown had two ranges, from 0.01 to 200 and 2000 microhenries. A variable mutual inductance of this type has a number of applications. It is obviously convenient for calibrating ballistic galvanometers. By means of it mutual inductances of all values can be readily measured.

By several methods it can be used to measure capacities, and the formulas required are mostly very simple. Its most important application, however, appears to be the measurement of small self-inductances as follows: Let the variable mutual inductance be called W. With a source of intermittent or alternating current and any convenient detector (vibration galvanometer, telephone, etc.), a bridge with corners, A, B, C, D, is formed, in which BD and DC are equal non-inductive arms, AB is the fixed secondary of W and AC has resistance and self-inductance equal to those in AB. The detector is across BD, while the source is applied at D and also through the primary of W connected to A. When W is set to zero reading a balance is obtained. An unknown self-inductance, N, is now inserted in AC, and the balance restored by adding resistance in AB and adjusting the mutual inductance W. The reading of W when doubled gives directly the value of the unknown N. The method is really a differential one and can also be used to give very accurate measurements of the difference between two nearly equal large self-inductances.—Lond. *Electrician*, Nov. 8.

Measuring Insulation Resistance.—D. SHIRT.—An illustrated description of a method of testing direct-current networks for insulation resistance during working. It may be applied with advantage to the neutral of a three-wire or a five-wire system, because the earth connection need not be interrupted. It is customary in many generating stations to make the resistance of the neutral earth connection as small as possible, but to provide some means of introducing a known resistance, either by means of a switch, which normally short-circuits it, or by means of a rheostat, so that, in the event of a fault occurring on one of the "outers," the "leakage" current may be controlled. The test consists simply in measuring the leakage current through the earth connection for two different values of the resistance of the latter. If these resistances are R_1 and R_2 ohms, and if the corresponding leakage current is I_1 and I_2, then the insulation of the system to earth in ohms is $(I_2R_2 - I_1R_1) \div (I_1 - I_2)$. It is convenient to let R_1 be the normal resistance of the earth connection and it may in some cases be so small as to be negligible.—Lond. *Elec. Review*, Oct. 11.

Sensitiveness of Photometers.—L. W. WILD.—An account of some experiments in which the author endeavored to determine comparative figures for the sensitiveness of photometers. Eleven different photometers were tested, and different sources of light were used so as to determine the effect of difference in color. On sources giving the same color of light, flicker photometers are not so good as the best of stationary photometers, but as soon as the color difference is at all appreciable, such as is met with even in the photometry of carbon-filament lamps, against a carbon-filament standard, both of the flicker photometers tested were found superior in sensitiveness to any other form of photometer.—Lond. *Electrician*, Nov. 8.

Magnetic Tests.—E. HAUPT.—An illustrated description of a magnetometer for iron tests, which is not disturbed by external magnetic fields. It is specially suitable for making magnetic tests of short and thin pieces of iron, such as relay armatures and other small iron pieces of telegraph apparatus.—*Elek. Zeit.*, Oct. 31.

Testing Machine.—C. E. LARARD.—A paper read before the (British) Institution of Mechanical Engineers on a new single-lever testing machine and some torsion tests. The special feature is the good control which is obtained by electrical means. This method is described and illustrated.—Lond. *Electrician*, Nov. 8.

Telegraphy, Telephony and Signals.

Wireless Telephony.—C. SCHAPIRA AND S. LOEWE.—An illustrated description of a method of wireless telephony used by a German company and stated to give satisfactory results in practice over a distance of from 18 to 24 miles. While Poulsen uses the Duddell arrangement of a capacity-inductance circuit in shunt with an arc burning in an atmosphere of hydrogen and in a strong magnetic field with artificially cooled electrodes, the present method employs neither a hydrogen atmosphere nor a magnetic field. The fundamental source is a multiply subdivided arc lamp, the arc occurring between two electrodes of the form shown in Fig. 6, where A is a solid carbon electrode (30 mm in diameter), and B is a hollow copper electrode filled with water (45 mm diameter). Six such arcs are used in series on a 220-volt supply and 12 on a 440-volt supply. When the arcs have been lighted by removing one set of the electrodes from the other set by means of a common lever, further regu-

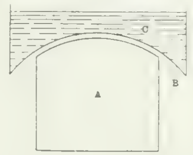
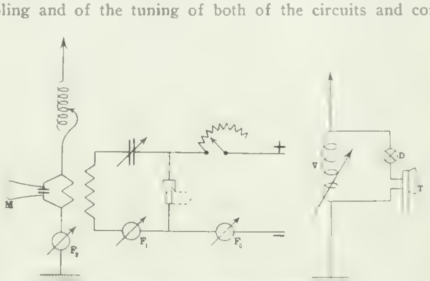


FIG. 6.—WIRELESS TELEPHONY.

lation is unnecessary, since the rate of burning of the carbon is very trifling. The cooling water must be renewed at intervals of from eight to ten hours. The transmitting apparatus is shown in Fig. 7. In accordance with the alterations of the resistance of the microphone there will be variations of the coupling and of the tuning of both of the circuits and corre-



FIGS. 7 AND 8.—WIRELESS TELEPHONY.

spondingly of the energy output from the antenna. F_2 is a hot wire ammeter included in the antenna circuit; this instrument shows how the output of the radiation from the antenna is effected by speaking into the microphone. The receiving apparatus is shown in Fig. 8, where V is a variable self-induction in shunt with the detector D and the telephone T.—Lond. *Elec. Eng'ing*, Nov. 7.

Miscellaneous.

Electrostatic Separation.—F. ESSER.—An account of an experimental investigation of the possibilities of electrostatic ore separation. This is found to be applicable with good success only when the ore has been reduced to particles of a size between certain limits. Sizes downward from 1 mm to a certain minimum were found most suitable; above 1 mm the results were less satisfactory, while the finest powder could not be separated electrostatically. To be successful, it is necessary that all of the particles to be separated consist of the same material; any impregnation with foreign materials acts as a disturbing factor. For instance, an ore in which zinc blende is very intimately united or impregnated with pyrite is not suitable for electrostatic separation. Thus zinc blendes, which are poor in iron, are most suitable. These conclusions are valid only for countries with the same climate as Germany. In districts high above sea level and with a dry climate, as in Chili and Colombia, the conditions are much more favorable to electrostatic separation—*Metalurgie*, Sept. 8 and 22; abstracted in *Electrochem. and Met. Ind.*, November.

Teaching.—A. SCHWARTZ.—An address to technical teachers with the title "The New Technology." The author emphasizes that the aim of the school should be to impart a thorough understanding of the principles underlying the branch of technology concerned, to inculcate habits of observation and logical thought, and to train the student in the lines of thought and modes of attack employed in mathematics, physics, chemistry, engineering or other technological subjects, and in the interpre-

tation of results. The method of teaching should be rather by experience than by facts. It is all wrong to give the student a certain number of concentrated doses of pre-digested information. Further, there should be some curtailment of the method of examination. Some notes are given on what can be done in day courses and evening courses.—Lond. *Electrician*, Nov. 8.

BOOK REVIEWS.

MATHEMATICAL HANDBOOK. By Prof. Edwin P. Seaver. New York: McGraw Publishing Company. 279 pages. Price, $2.50 net.

This book is intended solely for reference, various formulas being given without explanation as to their derivation. It contains the chief formulas of algebra, trignometry, circular and hyperbolic functions, differential and integral calculus, and analytical geometry, together with mathematical tables. The tables comprise the squares and cubes of numbers up to 1000; the square-root and cube-root of these numbers to the seventh decimal place, and the cube-root of the square and the reciprocal of the same numbers to the seventh significant figure. The tables of logarithms relate to numbers up to 999, logarithms to base 10 being expressed in five figures, and those to base ϵ being carried to the third significant figure of the number itself. Tables are also given of circular and hyperbolic functions, and the logarithms of the values. An unusual table is one relating to the velocity of bodies falling from various heights. The book is of convenient size, 5 in. x 8 in., and contains a large amount of information in compact form for ready reference by the mathematician and engineer.

HARPER'S ELECTRICITY BOOK FOR BOYS. By Joseph H. Adams and Joseph B. Baker. New York: Harper & Brothers. Illustrated, 407 pages.

This is one of a series of practical handy books for the rising generation, and is destined to have a very wide circulation. It is distinctly of the "How to Make" character, not the least merit being the extremely clear and precise drawings of parts and details of all the classes of electrical apparatus it includes. This is an electrical age, and a great many boys of inquiring minds and of mechanical ability will find immense usefulness in the simple, straightforward instructions of this volume. In fact, the book may well be employed as a test of youthful enthusiasm. Lots of boys think they would like to be electricians, and pictures of themselves as future "wizards" float hazily before their minds. But the very first application of reality, the very first effort to read a serious book on the subject, or work out a circuit or a piece of apparatus, puts the novice "out of business." The boy who goes through this admirable book with vim and zest stands an excellent chance of making a good electrical engineer in the long run. We commend it at this season to every anxious, forecasting parent.

The greatest part of the book is due to Mr. Adams, the last chapter, on the uses of electricity all around us, having been added by Mr. Baker. It will be succeeded by a companion book of slightly advanced, yet popular nature, "How to Understand Electrical Work."

ELECTRIC RAILWAYS. Vol. II. Engineering Preliminaries and Direct-Current Sub-Stations. By Sydney W. Ashe. New York: D. Van Nostrand Company. 282 pages, 145 illustrations. Price, $2.50.

The treatment employed in this book is both theoretical and practical. There are ten chapters dealing with preliminary considerations concerning the probable income from passengers, determination of the required motor equipment, schedule and load diagrams, power house and sub-station location, rotary converter sub-stations, the rotary converter, the transformer, insulating oils, and auxiliary sub-station apparatus. With the exception of the part dealing with the so-called "electrical features" connected with the selection of the motor equipment, the matter is largely descriptive of present practice, the information having been compiled from various sources.

The book suffers from a lack of consistent editing. For example, no attempt seems to have been made to render the symbols uniform throughout. Thus, V is used both for e. m. f. and for speed; speed, however, is also represented by S, while S is used for distance, and distance is denoted by D, and also by L. In view of the strong intimation on page 225 that transformers can be used only when connected either "delta" or "mesh," one is not surprised to find on page 224 an illustration of a partially completed one-phase, shell-type transformer designated as the "core of a three-phase transformer." Probably the lack of care in details is the cause for the statements on page 219 that the "drop in the transformer coils" is I^2R, and that eddy currents depend upon the "reluctivity" of the iron, and the intimation on page 217 that the losses in a transformer may sometimes be considered as "negative." By far the best part of the book is found in chapters II, III and IV on "Electrical Features," which contains much useful information presented in a logical manner. In fact, it may be stated that the intrinsic value of these chapters is sufficient to counterbalance the errors of carelessness found elsewhere in the book.

Relay Type of Recording Meter.

By M. C. RYPINSKI AND H. W. YOUNG.

There are in general use two types of recording meters, which may be designated as the "direct-swing" type, in which the recording pen is directly actuated by the measuring element, and the "relay" type, in which the recording pen is actuated or driven by a separate source of power, the measuring element simply opening and closing a local circuit. In external appearance, commercial relay recording wattmeters, voltmeters, ammeters, frequency meters and power-factor meters differ immaterially. Moreover, the operating principles are very similar. The quantity being measured tends to move a dynamometer arm in a certain direction. The movement is opposed by a spring whose tension likewise depends upon the quantity being measured. When the arm is in an equilibrium position, the elongation of the spring is an indication of the quantity.

The principle of operation can readily be described in connection with the circuit diagram of Fig. 2, which relates to a recording voltmeter. The various elements of the meter are designated as follows: *A, B, C, D,* fixed coils; *E, F,* movable coils mounted on supporting structure pivoted at *G; G,* pivoted support of *E, F; H,* upper adjustable relay contact connected to *L; I,* lower adjustable relay contact connected to *K; J,* movable relay contact attached to movable element *E-F; K,* pen actuating electromagnet (left hand); *K'* iron core of *K; L,* pen actuating electromagnet (right hand); *L',* iron core of *L; M,* arm supporting iron cores pivoted at *N* and connected to *O* by pin bearing *P; N,* pivoted bearing for *M; O,* pen arm connected to *M* by pin bearing *P*, and provided with guide slot at the upper end, which bears on stationary guide pin *R; P,* pin bearing connecting *M* and *O; R,* stationary guide pin for *O; S,* recording pen arranged to pass across a suitable moving record paper, *T; U,* helical spring connecting movable coil system and movable pivoted supporting arm, *M*.

The meter operates upon the Kelvin balance principle, combined with a modified form of the "Siemens dynamometer" control. The coils are so arranged that when current exists in them the left-hand coil, *E*, is repelled by *A* and attracted by *B*, the right-hand coil, *F*, being repelled by *D* and attracted by *C*. Assuming the recording pen to be at the zero position on the chart and connection made to the relay and the measuring circuits, it will be seen that the movable system will take up a position which will force contact *J* against contact *I*. A circuit will thus be completed through the right-hand solenoid, *L*, and the electromagnetic attraction will cause the core *L'* to move downward, which movement will turn *M* about its axis and through its connection with *O* cause the pen to move across the chart toward the full-scale position. This movement of *M* places tension on the spring, *U*, and continues increasing this tension until the core has traveled a sufficient distance to place

such a tension on U that it balances the torque of the movable measuring system, E-F, and draws the contact, J, away from I. The entire moving system, including the solenoids, pen arm and measuring coils, remains in the position last assumed when the circuit was broken and the pen continues to draw a line which represents the voltage of the circuit.

It will be noted that the spring U is now under tension, and the position of the contact J between contacts H and I represents a balance, or state of equilibrium, between the actuating and restraining forces. This can readily be compared to the action of a Siemens dynamometer in which the knurled thumb nut has been turned until the torsion of the control spring has drawn the pointer attached to the movable coils back to zero and the pointer operated by the knurled thumb nut will indicate the circuit voltage. The zero reading pointer of the dynamometer can thus be likened to the movable contact J of the recording meter and the manually operated pointer of the dynamometer may be likened to the solenoid operated pen of the recording meter. It will be seen, therefore, that the manual operation of the dynamometer's indicating pointer is replaced by electrical operation of the graphic meter's recording pointer.

If the voltage increases, the movable contact is again deflected downward until it makes contact with the lower fixed contact and the right-hand solenoid again causes the recording pen to move across the chart until the increased tension of the spring balances the increased torque of the measuring element, drawing the movable contact J away from I and again opening the solenoid circuit. The recording system again remains stationary until the voltage of the supply circuit changes.

If the voltage decreases the contact J rises and making con-

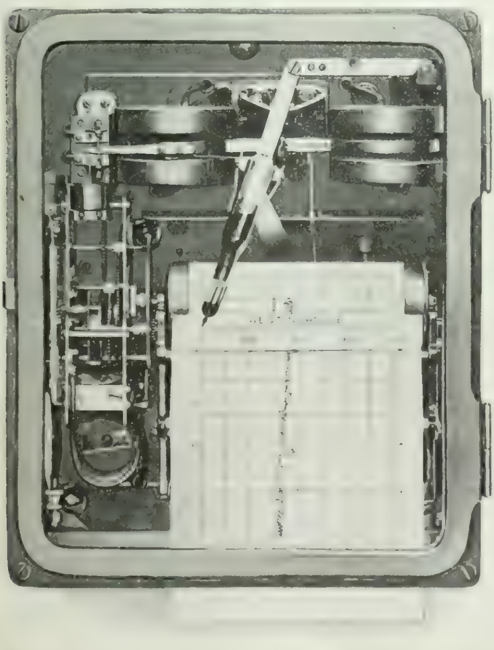
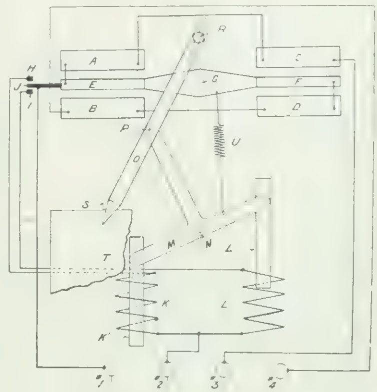


FIG. 1.—ELECTRICAL AND MECHANICAL [illegible] OF RECORDING METER.

tact with H energizes the left-hand solenoid, K, which, drawing down its core, causes the pen to move down the scale toward zero, and as this movement continues the arm, M, moves up sufficiently to relieve the tension on U and restore the balance between the actuating forces of the measuring system and the spring, when the contact, J, will leave H and open the control circuit through K.

It will thus be seen that as the voltage varies the contact J moves up and down, completing the circuit through one or the other control solenoids, causing the recording pen to move across the chart, and this gives a record of the variations.

The sensibility and damping can be altered readily to suit local conditions; for instance, on a badly fluctuating voltage, in order to obtain satisfactory records, it would be necessary to



CIRCUIT DIAGRAM OF RELAY TYPE OF RECORDING VOLTMETER.

employ a meter of different damping period than on a circuit on which the voltage was constant. Attached to the moving coils is a piston suspended in a small dash pot, and this dampens the movement of the moving system by absorbing its excess momentum. The magnitude of this action is variable by changing the oil density, a heavy oil giving greater damping and *vice versa*.

By varying the distance between the contacts H and I, the sensibility may be controlled. When the contacts are close together, the slightest variation in the voltage will be recorded, giving, in some cases, a very irregular line. By increasing the space between the contacts, the meter will not record such small changes and the curve will be more regular, but large variations will be recorded with equal accuracy.

The quickness of action can be controlled by the adjustment of the main dash-pot pistons. Cylinders are provided having an adjustable leakage slot, and by increasing the width of this slot the pen action may be quickened. For extreme slowness, on badly flucuating e. m. f.'s, a heavier oil may be used, and where a quick response to change is desired a light grade of oil will give the desired result.

The recording pen is constructed of glass so formed as to provide an ink reservoir of such size that one filling suffices for several months' use. The pen-point is drawn to a capillary tube of heavy wall and small bore, giving maximum strength with minimum width of line.

A specially calendered and ruled grade of paper is used and furnished in rolls of 244 ft. in length, being sufficient for two months' use at a speed of 2 ins. per hour, or a proportionately shorter time at 4 ins. or 8 ins. per hour. The paper is ruled longitudinally with a set of parallel lines, which represent the meter calibration, this ruling varying with the different types and ratings. At right-angles to the calibration lines are a set of parallel lines representing hours, varying in distance from each other with the particular rate of speed for which the paper is ruled.

The clock mechanism which drives the paper is of the electrically-wound pendulum type. It moves the paper under the recording pen at a uniform predetermined rate, synchronous with the time markings on the recording paper. Its electrically winding mechanism is operated from the same circuit as the pen-actuating electromagnets and it winds at intervals of one hour.

Gas Producer Generating Station of the Milwaukee Northern Railway.

A feature of the equipment of the Milwaukee Northern Railway which has attracted especial attention from the engineering public and users of electrical energy is the fact that the motive power of the road is furnished by gas-engine-driven electric generating units of a size heretofore unknown to the traction interests of this country.

The location of the main power plant is at Port Washington, on the harbor front, where the handling of coal is very economical and convenient. Two buildings comprise the power plant proper, one for the producers and one for the engines, generators, switchboards and protective apparatus. The gas supply main is run outside of and along the entire length of the power house from the producer plant.

The generating units are three in number, each of 1000 kilowatt rating, two of which are now installed; the third will be set up shortly. Each unit consists of a twin-tandem horizontal double-acting Allis-Chalmers gas engine direct connected to a 405-volt, 25-cycle Allis-Chalmers alternator. Although the rating of each unit is given as 1000 kilowatts, both engine and generator were designed with large overload margin, the engine being capable of developing upwards of 2000 horsepower and the generator having a corresponding overload range. Each engine has four cylinders, 32 ins. in diameter by 42 ins. stroke, and operates at 107 r. p. m.

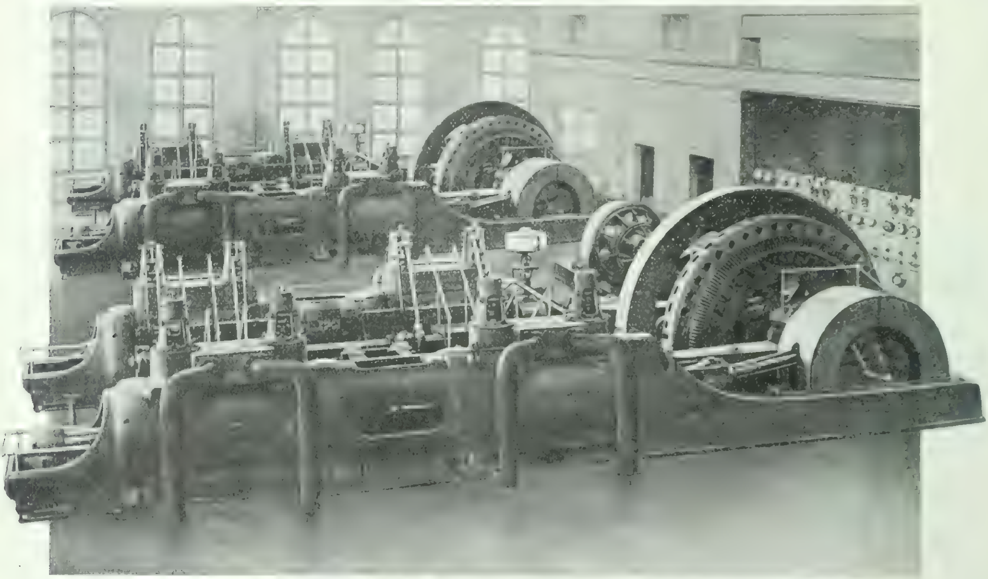


FIG. 1.—VIEW OF GAS ENGINES AND GENERATORS, POWER HOUSE, PORT WASHINGTON, WIS.

The valve gear is of the standard Allis-Chalmers cut-off type, and the engine operates with constant compression, thus tending to insure smooth running under the highly variable loads to which it is subjected. The inlet gear is extremely simple, consisting of a main inlet valve of the single-beat poppet type, eccentric operated, thus insuring long life and quiet running. The mixture of the air and gas is thoroughly effected before entering the cylinder by means of an annular mixing chamber located under the main inlet bonnet; the design and operation of this device is such that, at the instant of closing of the main inlet valve, there is practically no explosive mixture left outside the cylinder. The gas valve is of the double-beat poppet type controlled by a variable lift rolling lever operated by a single-link connection to the main inlet gear, the lift of the valve, and consequently the amount of gas admitted and the time of admission, being regulated by the governor. The exhaust gear is of the single-beat poppet valve type, eccentric operated, and is in this respect a duplicate of the main inlet gear. A distinctive feature of the Allis-Chalmers gas engine is the location of this exhaust bonnet with its valve at the bottom of the cylinder, where all the dirt is removed by the action of the exhaust gases and the provision of a substantial jack to lower the entire exhaust mechanism out of place to allow inspection and regrinding of the valve, and which also serves to swing the valve chamber, with the valve and its operating mechanism complete, out to one side where it can be reached by the crane hoist. The removal of one pin, either in the inlet or exhaust mechanism, is all that is necessary to allow the removal of either the inlet or exhaust bonnets, with their valves and entire operating mechanism, without disturbing any adjustment whatever.

The igniters are electrically controlled and so arranged that the time of ignition may be regulated by a single hand-wheel. Direct current at 60 volts is used in the ignition system. Duplicate igniters are provided at each end of the cylinder to insure prompt firing of low heat-value gases, and also to avoid the danger of shut-down due to short circuit. The entire ignition system, from the motor-generator set which furnishes the current to the electrically operated igniters, is very solidly built.

The air starting device consists of a small poppet inlet air valve at each end of each cylinder, with a main distributing valve operated by the layshaft. Air is admitted to each cylinder in turn at what would be the explosion stroke. As the high compression carried prevents the engine from stopping on the dead center, this arrangement insures the prompt starting of even a tandem engine without the use of a barring gear. The Port Washington engines being twin-tandem will, of course, start from any position.

The engines are exceptionally heavy and rigid, the weight being concentrated in the frame cylinders and tie-pieces in the direct line of the stresses to which an engine of this type is subjected. The engine frame is designed for a side crank in place of the double-throw crank which is the standard practice abroad. The stresses transmitted to the frame in a side-crank gas engine are very great, but, even in the largest sized gas engines, they are no greater than the Allis-Chalmers Company

has, for many years, successfully provided for in its steam engine practice. This is contrary to popular belief, but the stresses cared for in the engines operating the New York subway, for example, are as great as any that the gas engine is ordinarily called upon to sustain. The distinctive features of the engine are the extreme simplicity of design and the solidity of the construction and quiet operation.

The load at the present time is extremely variable, swinging from less than one-half to 50 per cent overload, with momentary peaks greatly in excess of this. It is only by a study of the switchboard instruments, however, that this is apparent, as the engine handles the maximum overloads as quietly and with the same freedom from vibration that characterizes its operation under normal conditions. To the observer there is no outward indication of the magnitude of the forces at work. The engine turns its centers as quietly as a slow-running Corliss engine, and is as indifferent to the rapid changes in load, impressing one with the tremendous reserve power in each unit.

All wearing surfaces, including the main bearings, slides, crank and cross-head pins, are arranged for a continuous oiling system, and the cylinders are lubricated by carefully timed admission of the cylinder oil, Richardson's sight-feed oil pumps being used.

The water cooling system includes ample provision for cooling the cylinder walls, cylinder heads, pistons, piston rods, exhaust valves and exhaust bonnets. Water is circulated by means of two Morris and two Deming pumps, each driven by an Allis-Chalmers induction motor.

The gas for the engine is furnished by producers operating on the Loomis-Pettibone system. The present installation comprises two generating units, each consisting of a pair of gas producers connected to a common economizer, wet scrubber and exhaust. The gas is delivered into a 30,000-cu. ft. holder. The normal rating of the present plant is 4000 horse-power, and it can carry 5000 horse-power for five hours' duration. Hocking Valley bituminous slack coal, containing about 11,500 B. t. u. per pound, is the fuel ordinarily used.

The plant is operated on the down-draft principle, the air being admitted through the charging door at the top of each producer, and the necessary suction being caused by an exhauster located beyond the wet scrubber. By this method the volatile matter and distillates are drawn through the deep bed of incandescent fuel and gasified, thus avoiding any tar extracting machinery, and enabling the system to produce gas obtaining 80 per cent of the heat units possessed by the fuel used.

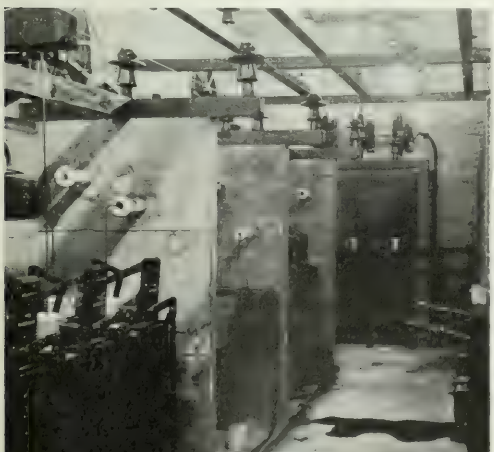


FIG. 2.—HIGH TENSION SWITCHES IN CEDARBURG SUB-STATION.

Reverse runs of steam, generated by the gas passing through the economizer, or waste heat boiler, are occasionally made for the purpose of breaking up the fuel bed. The water gas made by this process mixes with the producer gas in the holder and slightly enriches it. The average calorific value of the gas as delivered from the holder is 125 B. t. u. per cu. ft.

The revolving field cores of the generator are of special construction. The field poles, which are of solid cast-steel, are bolted to a heavy cast-iron spider; they can, therefore, be readily removed in case it is necessary to get at a field coil. The field windings are held in place partly by the projecting pole tips and partly by brass rings running completely around the rotor on each side and fastened to the tip of the poles by long brass screws. This construction, combined with the solid poles, gives a large damping effect, prevents hunting and aids in securing parallel operation.

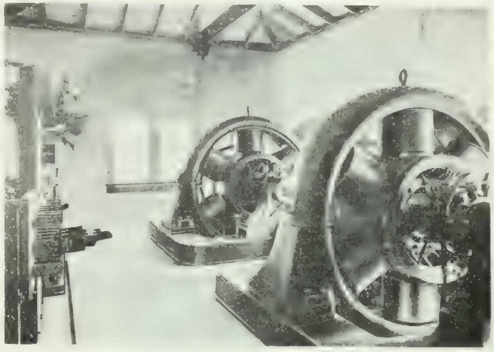


FIG. 3.—ROTARY CONVERTERS IN CEDARBURG SUB-STATION.

Direct current for excitation is furnished by two 50-kw, 120-volt generators driven by vertical gas engines, the complete units being of Allis-Chalmers Company's build.

The current from the main generators is delivered to a six-panel switchboard, from which it is led to the step-up transformers and also to a rotary converter switchboard. There are seven Allis-Chalmers 500-kw transformers arranged in two banks of three each, with one held as a reserve. These transformers raise the e. m. f. from 405 volts to a maximum of 22,000 volts, with intermediate tap to allow the e. m. f. to be varied, if desired. The current from each bank of transformers passes to the high-tension bus through three 40-ampere oil switches in each circuit; in addition to plug switches at each transformer to allow for speedily cutting out any transformer in case of break-down. The station apparatus is protected from lightning by means of an equipment of low-equivalent lightning arresters and oil-immersed choke coils connected to the high-tension bus.

For supplying energy to nearby portions of the line two 300-kw rotary converters are provided in the main station. These, like all other rotary converters on the system, are of standard Allis-Chalmers design. They have six poles and run at 500 r. p. m., taking three-phase alternating current at 405 volts and delivering direct current at 650 volts.

There are eight sub-stations located along the right of way, two of which have two 400-kw, 650-volt rotary converters. Each of the remaining six sub-stations has two 300-kw rotary converters.

The present rolling stock consists of eight heavy interurban cars of the type known as the Semi-Empire Pullman, built by the Niles Car Manufacturing Company, of Niles, Ohio. Each car weighs, including trucks and motors, 70,000 lbs., and there are two 75-hp motors on each truck. The schedule speed is 25 miles per hour, including stops, with a possible maximum speed of 54 miles per hour. The cars are equipped with straight air-brake equipments manufactured by the Allis-Chalmers Company.

Polyphase Induction Motors.

The Triumph Electric Company, Cincinnati, Ohio, has placed upon the market a line of polyphase induction motors which embody the best features found in motors of European design. As will be noted from Fig. 1, ample openings are provided for the free circulation of air around the stator core and stator windings; the good ventilation thus obtained allows the active material to be fully utilized and an inexpensive motor is the result. By the use of partially closed clots and a shallow air gap the power-factor has been kept high—varying from 92 in a 2-hp motor to 94 in a 20-hp motor. The bearings are liberally proportioned and the construction throughout is extremely rigid.

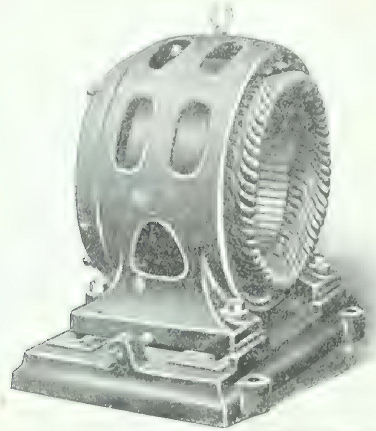


FIG. 1.—STATOR WITH END BELL REMOVED.

The standard motors are provided with squirrel-cage secondary windings on the rotor, and they possess the extreme of simplicity. With this type of secondary, the drop in speed from no load to full load will not be more than 6 per cent in the smallest size, and it will be less in the larger sizes. For variable-speed work the motors are equipped with coil-wound rotors with slip-rings for the insertion of resistance in the secondary circuit. These motors operate at an efficiency which reaches .83 in a 2-hp rating and .865 in a 20-hp rating. In no case does the temperature-rise at full load exceed 40 deg. C.

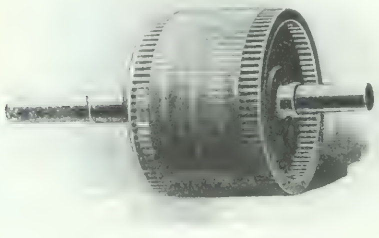
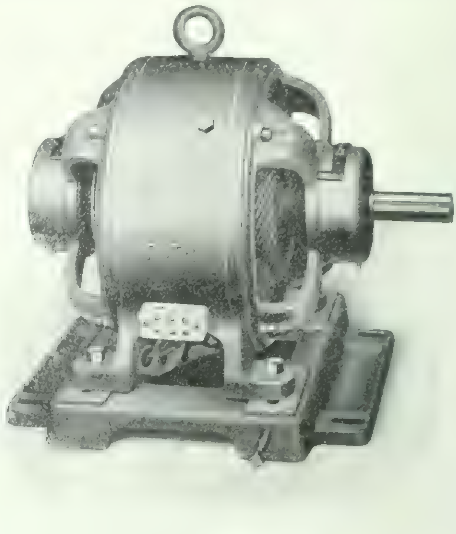


FIG. 2.—ROTOR COMPLETELY WOUND.

Medium Size Direct-Current Motor.

The accompanying cut illustrates the new type "S" design recently put on the market by Roth Bros. & Company, of Chicago. This design is the result of a broad experience of the firm dating back to the early days of the electric motor. There is not a single point in the entire design which is so unusual that its value can be questioned. The design of each part has been made according to the accepted standards of construction that have proven themselves by long continued use. At the same time, by selecting properly the most suitable types of construction and combining them a more harmonious complete design is realized.

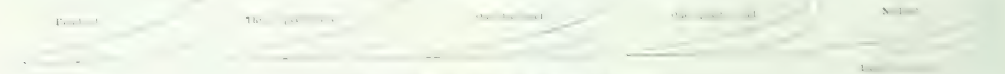
The frames are of cast steel finished all the way around inside. The poles are of laminated iron. The commutator is of large diameter with a large number of segments. The brush holders are supported from the rocker ring moving in a finished way on the frame. There are no band wires on the armature core. All windings are impregnated with water-proof and oil-proof gum. Effective safeguards are employed for preventing the oil from the bearings reaching the windings or the commutator. A 35-deg. C. rise is noted for continuous service.



DIRECT-CURRENT MOTOR

Tests of Alcohol-Engine Generator Set.

Denatured alcohol as fuel for internal-combustion engines has so much to commend it that the following account of a test made on an alcohol-engine generator set marketed by Mr. August Mietz, of New York City, will doubtless be interesting. The engine used in the test was an 8-hp Mietz & Weiss three-port, two-cylinder, two-stroke cycle machine, which was direct-connected to a 5¾-kw generator, and the tests were made to determine the output and fuel consumption as well as to obtain curves showing variations of speed and load, port timing and comparative indicator diagrams. A standard oil engine was used, the only difference being in the compression and in the fuel, which was composed of the following ingredients: 100 parts by volume of grain alcohol, 10 parts of wood alcohol and one-half of a part of approved benzine. The denatured alcohol had a specific density of .83.



INDICATOR DIAGRAMS OF ALCOHOL ENGINE

The pressure diagrams were taken by means of the Hospitalier-Carpentier manograph. These show conditions at full

load, three-quarter load, one-half load, one-quarter load and no load. The mean effective pressure at full load was 38.24 lbs., which represents 9.88 indicated horse-power. At the time the card was taken the engine was developing 7.6 brake horse-power, the difference, 2.28 horse-power, being expended in running the engine and generator.

It was noticed that when the valve was opened to take the indicator cards, the clearance in the instrument and connections resulted in a drop of about 15 r. p. m. and the ammeter showed a drop of two to three amperes. The compression used was 100 lbs. and the piston displacement was 206.75 cu. ins. The fuel used at the various loads was as follows:

	Pints Per Brake Horse-Power
Full load	[illegible]
Three-quarter load	[illegible]
One-half load	2.86
One-quarter load	[illegible]

The maximum speed variation was within 3 per cent from no-load to full-load, the speed varying from 519 r. p. m. to 505 r. p. m. A test run made with a constant load of 40 amperes showed a voltage variation of less than 1 per cent.

Automatic Controllers for Direct-Current Elevator Motors.

The controllers illustrated herewith possess the unique feature of causing the actual motion of the motor itself to vary the conditions of the control circuits. That is to say, the rheostat

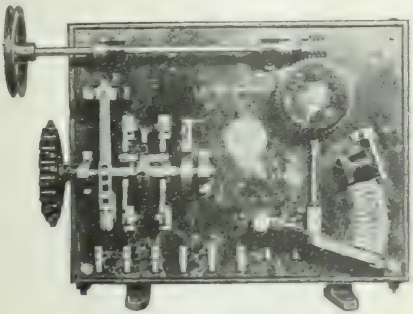


FIG. 1.—DIRECT-CURRENT ELEVATOR CONTROLLER.

arm moves at a speed depending solely upon the speed of the motor and in a direction variable at the will of the operator.

Fig. 1 shows a motor-driven controller for manually operated direct-current elevators. This controller provides absolute protection against overloading of the motor, and it parallels the

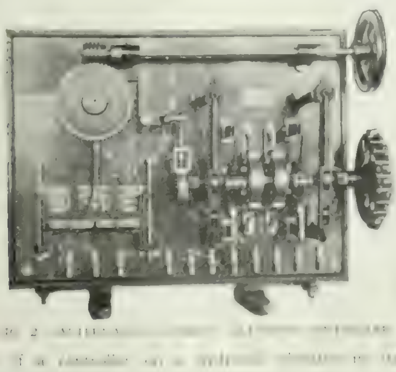


FIG. 2.—[illegible]

action [illegible]. There are no points on the entire controller where an arc can [illegible] butt contacts are used; these contacts being cheaply renewable, the [illegible]

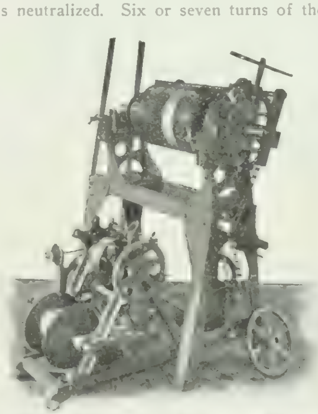
interrupts both the positive and the negative sides of the lines when opened.

Fig. 2 illustrates a motor-driven non-magnetic controller for polyphase induction motors with exterior secondary resistance. This controller is intended for use where the control of the car is mechanical. The device is set on the motor, the switch being connected to the shipper shaft by a standard sprocket chain to provide a throw of about 120 deg. either way from center. When the switch is thrown in either direction the eccentric on the extreme end of the switch shaft applies a mechanical clutch to the revolving worm wheel, so as to pull up the resistance arm as the motor accelerates, thus mechanically cutting out the resistance in series with the collector rings at a speed proportional to the load on the motor. When the switch is centered, the clutching effect being disengaged through the movement of the eccentric, the resistance arm will fall by gravity, thus reinstating the resistance.

These controllers are designed and built by the Automatic Switch Company, 131 Liberty Street, New York.

Combined Tension and Banding Machine.

The Device Improvement Company, of Hanover, Pa., has designed a machine along new lines for the exclusive purpose of banding armatures and winding field and armature coils. In connection with this is a machine for giving an accurate and uniform tension to the band wire. The latter machine consists of two side frames mounted on angle-steel sills and casters. The lower shaft runs in babbitted bearings, and one end carries the brake pulley. On the other end is a pinion which engages with the gear on the upper shaft, this ratio being 3 to 1. On the gear is mounted a large drum for the insulated wire and on the shaft the tapered, flanged band-wire drum. The taper is so designed that the tendency of the wire to crawl up is neutralized. Six or seven turns of the band wire



COMBINED TENSION AND BANDING MACHINE.

on this drum will hold any tension desired. At the front end of the frame is mounted the cast-iron band wire spool, with the small retarding brake, as shown. The band wire passes off the spool to the grooved lead on the pulley, thence to the drum, around the drum to the grooved lead-off pulley and thence to the armature to be banded. The tension index with which the machine is provided has ten divisions, each of which corresponds to a different tension.

The banding machine consists of two cast-iron legs bolted to a steel bed, the legs containing the babbitted bearings for the shafts and belt shifter. The left-hand head is bolted to the bed; but the right-hand head is adjustable to accommodate armatures of different lengths. The armature shaft revolves in each head on two brass rollers. The outer bearings are adjustable. Each head carries an inwardly-projecting arm, to [illegible]

ened. The rod can be adjusted to suit the operator. The feed rod is of steel, threaded its entire length to receive the feed wheel, which carries on its hub the independently revolving grooved wheel for guiding the band wire. The armature is driven by a clutch sprocket wheel and a detachable link chain. The clutch jaws are self-centering on the shaft in one direction and the shaft need only be approximately centered by the eye in the other direction, as any discrepancy due to the sprocket not being centered is taken up by the slack in the chain and in the idler. Power is transmitted direct from the line shaft by a belt, but the machine can easily be adapted for individual motor drive. The speed of the armature may be increased or reduced by changing the speed of the driving shaft, and this requires but the time necessary to remove one gear and substitute another. The stopping and starting of the machine is controlled by a foot lever, which when depressed applies the brake, locks the driving shaft and shifts the belt to the loose pulley. To start the machine, the lever is disengaged from the dog screwed to the floor, and the springs on the outside of the belt-shifting rod automatically pull the belt to the tight pulley and release the brake. The method of control is quick, positive and sensitive, it being possible to move the armature ½ in. or less. The hands of the operator are also free to perform banding, soldering and other operations. The banding and winding machine is separate from the wire tension machine; but the combination is very useful for repair work or for doing the original banding work, and in the case of the tension machine for winding coils.

Portable Lamps and Fixtures for Christmas Trade.

The Central Electric Company of Fifth Avenue, Chicago, has prepared and sent out a very attractive and interesting folder intended to reach and help Christmas trade.

Portable lamps and fixtures have been given very little attention by electrical supply houses, at least in the West, whereas they are devoting considerable effort to pushing heating apparatus and central-station supplies. The Central Electric Company has devoted considerable attention to the electric fixture line and has a very handsome show room for this class of

PORTABLE LAMP

material, fitted up at a considerable expense, where central-station managers feel that they can send their customers, when visiting the city, to select something in the fixture line. It is really surprising to see the number of calls from out of town visitors who are sent in by central-station men to make selections. There seems to have been a very large demand for electric lamps during the past two years and the lighting effects which are secured by means of art glass shades are each year becoming more elaborate. The folder illustrates a number of artistic portables and fixtures, one of which is shown herewith.

Universal Insulator Supports.

The accompanying illustrations show applications of the universal insulator supports marketed by the Electric Controller & Supply Company, of Cleveland, Ohio. It has long been recognized that the most difficult part of a wiring job in steel frame mill and factory work has been in obtaining a secure support

FIG. 1.—INSULATOR SUPPORTS.

for the insulators. Expensive and special work is usually the result and no two jobs are done in the same way. The universal support shown in the illustrations can be used in any position on the flanges of any known rolled-steel structural shape: beams, angles, channels, Z-bars, round, square and flat bars, gas and water pipes, edges of tanks, plates, etc. By this means

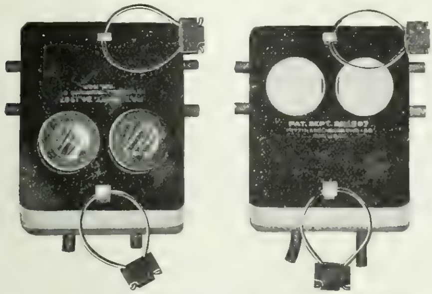
FIG. 2.—INSULATOR SUPPORTS.

it is possible to avoid all preliminary work as well as the expense and vexation connected with it. No woodwork is required, so that the element of danger from fire or loosening of supports due to shrinkage is eliminated. No holes need be drilled, and the use of cup-pointed hardened set screws and a clamp form of great strength prevent the supports working loose, even under severe vibration. The set screws cut into the metal and are securely anchored. The clamps are made of malleable iron and are suitable for light or heavy work.

Fuse Block Cover.

The accompanying illustrations show applications of the "O. K." fuse-block cover made by the Pettingell-Andrews Company, of Boston, Mass. The device is primarily intended to prevent theft of energy by sealing all live parts of the circuit, but allowing access to the fuses except in cases of discontinued service, when by a reversal of the steel face-plate no service connection is possible without breaking the seals. In apartment-house wiring and in similar classes of service, where several customers have meters, it is desirable that all conductors to the meter be so covered that it is impossible to leave the wiring in such condition that any unauthorized work would not be apparent upon inspection. It is also desirable in cases of discontinued service to be able to seal the branch block so that it is impossible to insert fuses or make any illegal connection without breaking

a seal. These results are said to be accomplished by the use of the fuse-block cover shown. This consists of a porcelain canopy and steel face-plate that completely enclose the fuse block. The porcelain canopy is held by the screws which fasten the fuse block in place and the screws are covered by

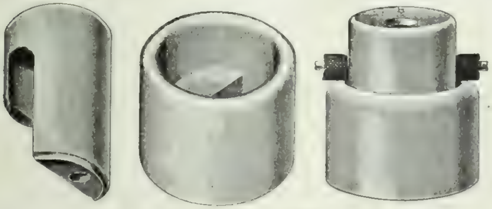


FIGS. 1 AND 2.—SERVICE CONNECTED AND DISCONNECTED.

the face-plate which is itself held in place by the seals. The latter are attached to metal posts that form part of the porcelain canopy. The canopies fit all branch blocks for Edison plug fuses and a screw-driver is the only tool needed to install the device on existing services equipped with Edison plug cut-outs.

Porcelain Insulator.

The latest type of confining insulator designed to get rid of the tie wire is shown herewith. The insulator is made in two parts by the Star Porcelain Company, of Trenton, N. J. As shown in the engraving, the upper part of the insulator is made



PORCELAIN INSULATOR.

to straddle the wire and the projection of the lower portion, on which the wire rests, is so shaped that when the upper part is fastened in place, the wire is curved slightly and thus resists any slipping or pulling action. The wire is thereby not only safely insulated, but securely fastened. A screw passing through one side of the top part, and also through the lower part, serves to hold the insulator in place. Between the screw and the wire is a wall of porcelain, so that contact between them is not possible. The insulator is said to meet all the requirements of the fire underwriters.

Fireproof Insulation.

During the past few years materials possessing both insulating and fire-resisting qualities have been used for arc lamp coils and also for the insulation of motor field coils, especially in railway motors, where, because of location and operating conditions, insulating material not possessing fire-resisting qualities is short lived. Asbestos has been used and is now being used in one form or another as the insulating substance because of its well-known fire-resisting qualities. The commercial asbestos, however, contains various other substances, such as salts of iron, magnesia, etc., which rather detract from its efficacy as an insulating material. The Green Insulation Company, of Cleveland, Ohio, has brought out a fire-resisting material which also possesses marked insulating properties. By combining various other substances with the silica of asbestos so as to remove the impurities, the company has produced a fibrous quartz. This mineral is claimed to be non-carbonizing, non-disintegrating, indestructible, and from its nature is said to possess greater utility than like substances and to conduct heat readily.

The quartz is spun into cord, incorporated in sheets, rubber compound, porcelain, etc., for various electrical uses, increasing many times the insulating qualities of paper, fibre, etc., in which asbestos has been hitherto incorporated. Insulation tests of fibrous quartz paper, that is, paper made with an inner layer of manila paper for imparting strength, have given the following results:

Condition	Thickness, Mils	Volts Per Mil
Normal	10.8	175
Baked	10.8	182
Burned	10.8	183
Wet	10.8	99

In these tests the fibrous quartz paper was baked at a temperature of 200 deg. F. for four hours; was burned in the flame of a bunsen burner, and was soaked in water, the surface water being removed with blotting paper.

The company is placing on the market a fibrous quartz paper and tape which can be used anywhere on electrical appliances. Wire as small as No. 18 gauge has been made with fibrous quartz as the insulating material.

Wire Coiling Reel for Counter Use.

The accompanying illustrations, which show a recently developed oiling reel in use and after forming a coil, are self-

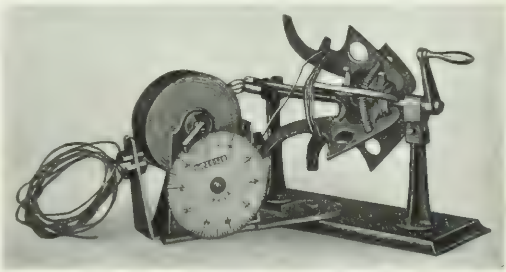


FIG. 1.—REEL OPEN AND IN USE.

explanatory. The reel is simple in detail and strong in construction, yet it occupies little counter room. It has been designed for coiling wire measuring not more than 5/16 in. in

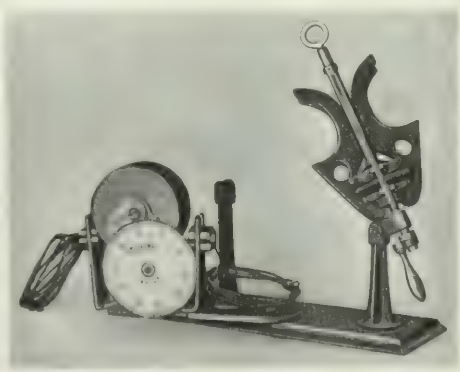


FIG. 2.—REEL COLLAPSED AFTER FORMING A COIL.

diameter. When desired, it can be equipped with a measuring attachment for showing the length of wire in each coil.

The above-described reel has been placed on the market by T. J. Cope, 3244 North Fifteenth Street, Philadelphia, Pa.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The improvement in financial matters gave a more cheerful tone to the whole situation. Trade, however, is still quiet throughout the country and new buying is small, while the industrial operations are still being restricted. With the more easy money situation has come a more liberal marketing of the country's products. Commodity prices were irregular, the cereals and cotton advancing, while provisions, meats and other food products declined. Railroad traffic was appreciably smaller than in many weeks past, and the car shortage trouble has disappeared. Large numbers of men employed in railway construction work have been laid off and building is apparently much less active. These two features, however, are not uncommon as the winter season approaches. In distributive trade conservatism was manifested in buying for immediate necessities, and a disposition shown to postpone future buying till later. Many manufacturers have aided in restoring confidence by giving notice that cancellations will not be accepted, though delivery may be delayed to suit conditions. On the other hand, there is no disposition to accumulate stocks, and factories are suspending or curtailing where necessary. Collections are still poor, with numerous extensions being asked for and in many cases granted. While the banking situation is improving, loans are not being made with any degree of freedom and rates are still prohibitive. There is a better feeling in the iron and steel trade as regards the future, but new business is light and curtailment of production continuous although it is reported that a few plants have resumed operations. Pig iron quotations are now from 14 to 29 per cent lower than they were at this time last year. Finished lines are dull, and outputs are being adjusted in keeping with the volume of specifications appearing. Wage reductions that average about 10 per cent are being made. The volume of new business in structural materials is small, and transactions in standard steel rails are dull. The demand for copper from domestic consumers was lighter than it has been at any time this year, but the market was firmer in sympathy with the advance in standard warrants at London. Exports for November are expected to score another new record. Prices were raised, but it is thought the advance was due to manipulation rather than to commercial conditions. The closing quotations were 13¾c. for Lake, 13½c. for electrolytic, and 13¼c. for casting. The liabilities of commercial failures reported for November are $12,208,092 against $6,809,601 for the same period last year. Of these failures $6,835,000 were of manufacturing concerns, $4,344,000 in trading, and $1,028,000 in other commercial lines. The failures during the week ending Nov. 28 as reported by *Bradstreet's* numbered 256 as against 265 in the preceding week and 174 in the corresponding week last year.

AMERICAN EXPORT TRADE.—The share which the United States supplies of the imports of the principal countries of the world is shown in a statement just published by the Bureau of Statistics of the Department of Commerce and Labor. It puts the total imports of merchandise into all countries of the world in the latest available year at 14,131 million dollars, speaking in round terms, and those of all countries other than the United States at 12,697 millions. Of this 12,697 million dollars' worth of merchandise imported by countries other than the United States, that from this country is set down at 1862 millions, or 14.7 per cent of the total imports of those countries as a whole. The largest importer of merchandise is the United Kingdom, and it also imports a much larger value of our merchandise than does any other country, its total imports being 2958 millions, and those from the United States 638 millions, forming 21.6 per cent of the total imports of that country. The second in importance in value of imports is Germany, whose total imports are set down at 1697 millions, and it also ranks second in the importations of merchandise from the United States, the total drawn from this country being 236 millions, forming 13.9 per cent of the total imports. The next in order of magnitude of imports is the United States, whose imports are given at 1434 millions. Then comes Netherlands with imports of 1031 millions, of which 97 millions is drawn from the United States, our merchandise forming only 9.4 per cent of the total imports. France is the remaining billion dollar country in the list so far as relates to imports, the total value of merchandise imported into France being 1009 million dollars, of which 100 millions, speaking in round terms, is drawn from the United States, and forming 9.9 per cent of the total imports.

PUBLIC SERVICE PRICES.—Mr. F. Rice, Jr., in an article in November *Moody's Magazine*, points to a probable increase in the charges for public service. He says: "Prices of various kinds of public service have remained stationary, or, in many instances have been decreased, during an era when all the other necessities of living have greatly advanced in cost. The citizen to-day can ride at least as far by trolley for 5 cents as he could ride ten years ago. Railroad fares are no higher; in some States they have been reduced, by action of hostile legislatures, below the point of yielding a fair profit. It costs more to send telegrams now than then. Telephone rates have frequently been reduced by the companies of the system which operates on a national scale, both at points where competition exists and where competition does not exist. Electric lighting has not, as a rule, become more expensive than it was. So that the average man with a fixed income, who complains because $1,000 or $2,000 seems to have hardly more than two-thirds its former purchasing value, has, at least, to be thankful that enhanced contributions to the coffers of public service corporations have not helped to contribute to his burden. Indications are not wanting that, in some instances, the limit of stability of service charges, during this period of high prices and prosperity, has about been reached. It is suspected that not a few American public service companies are face to face with the alternative either of raising their rates moderately, to compensate for the greatly increased cost of operating, or of incurring loss of dividend-paying power, or something worse. If anything like the present tension continues we shall not unlikely, within the next few months, see many a corporation compelled to revise its scale of rates."

ELECTRIC MOTORS IN ITALY.—U. S. Consul James E. Dunning, of Milan, reports that his office has received the official publication upon electrical power in Italy, in which the factory inspectors show the continued use of that form of power in the country. The consul says: "The consulate at Milan has frequently had occasion to comment on the rapid development of electrical energy as a motive power in Italy, and particularly in the northern provinces, where the manufacturing interests center. The report for 1906 shows that at Milan alone about one-quarter of the total new work was put into operation, while the development through the peninsula was general; 125 new electrical plants were built, and 114 extensions of existing plants were effected."

APPARATUS FOR SAN FRANCISCO.—The City Electric Company, of San Francisco, has closed a contract with the Westinghouse Machine and Westinghouse Electric & Manufacturing Company, of Pittsburg, for a 10,000-hp turbo-generator. This will be the largest machine of its kind in the world, and will cost $300,000. Two smaller generators of the same type are now in use by the City Electric Company and the large machine that has just been ordered will greatly increase the capacity of their power-house at Beach and Mason streets. The United Railroads expects to obtain from this company a large supply of power for running its cars, and the plant is being improved accordingly.

ELECTRIC CRANES.—The new power station of the Columbia Improvement Company, Seattle, Wash., will be served by a 50-ton, 3-motor electric Northern traveling crane, furnished by the Northern Engineering Works, Detroit, Mich. The United Engineering & Foundry Company, Pittsburg Plant, has recently installed a 10-ton, 60-ft. span electric Northern traveling crane.

PLANT FOR MARE ISLAND.—The navy department bureau of yards and docks asks $780,800 for improvements at

Mare Island next year. The principal item is $385,000 for a central power plant. The yard is now purchasing its power from a company.

HANDLING TROLLEY TRAFFIC.—Sir Clifton Robinson, of the surface and underground railway systems of London, prior to his departure for Japan on a trip around the world has devoted most of the time to observing the traffic conditions in the congested centers. "The order and precision," he said, "with which this dense volume of traffic adjusts itself to the local conditions is to me nothing short of marvelous. There seems to be an utter absence of even an attempt to control or shepherd the congested throng. We are obliged to have police to control our crowds in London. Usage and custom, as it were, turn them here into the channels which they follow automatically. The measure of the accommodations is limited only by the packing capacity. Tramways have grown to be an institution in New York, and are recognized as part and parcel of the daily life of its millions of busy workers. Their success was assured from the first by the adoption of a flat rate with one class and an utter absence of any difficulty in the way of caste prejudice. The people of New York are seeking to do away with straphanging while the masses in London, who are now beginning to realize the value of time, are trying to introduce it. The police there rigidily enforce the old stage coach laws, which were framed for animal not for electric traction. Passengers who are found standing in a car are fined $2.50, as well as the conductor, and besides, they have to waste half a day in court. This comes very hard on gallant men who get up to give their seats to ladies. This is a direct result of the closer connections between New York and London in the last few years. The Londoner has seen that he has an efficient street car and underground service, and it has induced him to travel, but it takes a long time to educate him. The solution of the traffic problem will be found when the public and the traffic men strike a happy mean. That is to say, that the public must recognize the authority and use their own common sense to alleviate the congestion when possible. For example: I have noticed that at terminal points like East Twenty-Third Street the people all crowd into one car when there are four or five empty cars in line, because they would sooner suffer discomfort than wait for even a moment. The company takes advantage of that weakness and holds a car until it is packed to its capacity. Much can be done to improve conditions here by the company organizing a service on the broadest and most complete lines with equitable fares, up to date equipment and intelligent officials."

ELECTRIC DRIVE IN COTTON MILLS.—In commenting upon the present prosperous conditions of English cotton and woolen mills, in which about 8,000,000 new spindles and 77,000 new looms have been added this year, a London trade paper remarks upon the great advancement in favor which has been recently made by electric drive in competition with steam and shaft drive. It is no less apparent that American cotton and woolen mills are as much alive to the advantages of electric drive as the English manufacturers and have been so for some time. The steadiness of driving securable by means of the electric motor brings a consequently greater and more perfect output of each machine. The independence of machines gives greater freedom from break downs, and less cost in running on light loads. The electric system enables a constant check to be made upon the power consumption of each department. It also simplifies matters, since it makes easy the lighting of the mill. Although in some cases it may be found more economical to purchase power, with the greater number of machines it pays to generate it at the mill itself and to drive the machinery in groups, each from high-speed shafts coupled direct to motors. The steam turbine alternator of the improved horizontal type, built by Allis-Chalmers Company, Milwaukee, has, within the past year, been received with favor by Eastern and Southern mills for the operation of this class of machinery. The Allis-Chalmers Company has received contracts for nine units within the past few months, aggregating in capacity many thousands of horse-power. They comprise installations in the following mills: Jamestown Woolen Mills, Jamestown, N. J.; Cherry Cotton Mills, Florence, Ala.; Lawton Spinning Company, Woonsocket, R. I.; Pacific Mills, Lawrence, Mass.; American Thread Company, Fall River, Mass.; Tremont and Suffolk Mills, Lawrence, Mass.

AMERICAN CONDITIONS.—M. Dupont, member of a well known Franco-American firm of bankers, Dupont & Furland, in a recent discussion of American conditions says: "With this American spirit of daring it is not surprising that much of the business of the country—and of the very best—rests to a great extent on credit. They forget too easily in America the relation which should exist between the working capital of a concern and the amount of business it tries to do. The American never anticipates hard times. For him American prosperity must go on without a halt. That is how it happens now and again that a company, at the height of its prosperity, must go into the hands of a receiver. Banks cannot go on renewing paper forever, be the paper of the best. I think that it can be said, therefore, without contradiction that the primary cause of the present crisis is the abuse of credit. Newspapers have also had much to say about speculation and overcapitalization. Overcapitalization exists in America, I must admit, just as it does in every other country of the world. But this view always supplies its own remedy. The company's earning power either makes good this excess of capitalization or the price of the stock shrinks until its real value is reached. In America, as more or less everywhere else, those who risk their money in founding a company are rewarded with shares of common stock —a tangible form of the company's hopes. This stock very often later on goes far above par. Is its real value decreased by the fact that the stock cost nothing in the first place? The stock exchanges of the world answer the question. Americans, temperamentally, are more inclined to speculate perhaps than some of their neighbors, but I do not think that speculation, any more than overcapitalization, can be considered as real factors in the crisis. They are contributory causes in a way, for they increase the need of ready money, but they are not the real causes, despite sensational charges to the contrary."

WHAT THE FARMS DO.—The annual report of the Department of Agriculture, just issued by Secretary James Wilson, says: "The value of the total farm productions in 1907 exceeded that of 1906, which was far above that of any preceding year. The total value for 1907 is $7,412,000,000, an amount 10 per cent greater than the total for 1906, 17 per cent greater than that of 1905, 20 per cent above that of 1904, and 55 per cent in excess of that for 1903, and 57 per cent greater than the total value for 1899. If we let 100 represent the total value for 1899, the value for 1903 would be represented by 125; that for 1904 by 131, for 1905 by 134, for 1906 by 143, and the total value for 1907 by 157. The animals sold from farms and those slaughtered on them in 1907 were worth about $1,270,000,000, or nearly twice as much as the cotton crop. During the fiscal year 1907 the exports of farm products exceeded the imports by $444,000,000, a balance that has been exceeded only four times—in 1898, 1899, 1901, and 1902. Our foreign credit is sustained mainly by our farmers. For eighteen years, beginning with 1890, the farmers have not failed to secure a favorable balance, the lowest being that of 1895—$193,000,000, and the grand aggregate of the balances of trade in farm products for the eighteen years is $6,500,000,000."

LARGE EUROPEAN PLANT.—One of the American consuls in Europe mentions the proposed construction of a private electrical generating plant of 100,000 horse-power, and suggests to the Department of Commerce and Labor that American manufacturers might like to bid on it, if the work is actually given out.

CRANES FOR IRON WORKS.—The new foundry of the Clyde Iron Works, Duluth, will be operated by alternating current motors and will be equipped with two 10-ton and one 15-ton electric traveling cranes of about 40-ft. span. These cranes are to be of the Northern type, furnished by the Northern Engineering Works, of Detroit, Mich.

POSTOFFICE FACILITIES are largely the subject of the admirable report of Postmaster-General Meyer. He renews his recommendations of postal savings banks, limiting deposits to $500 per individual, and urges strongly a parcels post. Mr. Meyer points out that under the present system a person mailing in any United States postoffice two parcels weighing 4 lbs. each must pay 64 cents for the one addressed to New York and only 48 cents for the one sent to a foreign country, which will usually pass through New York. If the New York package weighs more than 4 lbs. it will be denied the mails, but the package going abroad may weigh up to 11 lbs., according to the country of its destination. The postmaster-general recommends a rate of 12 cents a pound on domestic parcels and a weight

limit of 11 lbs. He also proposes the establishment of a special parcel post system on rural delivery routes for packages originating on a rural route at the rate of 5 cents for the first pound and 2 cents for each additional pound up to 11 lbs. Mr. Meyer argues that this will be a great boon to farmers, facilitate consumption and increase the business of the country merchant. "The retail merchants in cities," he says, "have found that they increased their trade by delivering goods to their customers. The parcel post on rural routes will enable the local country merchant to deliver goods to his buyers at an average cost of about 2 cents a pound, or 25 cents for 11 lbs., while the wholesale merchant, in order to reach these consumers by mail, will be compelled to pay 12 cents a pound, or $1.32 for 11 lbs. Therefore, to gain the benefit of the special rates on rural routes, they would find it necessary to ship by freight to the point of the rural routes and be obliged to establish many thousands of agencies and depots for handling. It is of incalculable importance that the country merchant should exist and prosper."

SMALLER BUSINESS FAILURES.—A very good sign of business improvement is seen in the reports of commercial failures in the United States for November, which, as compiled by Dun's Review, show a decrease of about $10,000,000 in the liabilities as compared with those of October. The actual failures, as reported, were 1180 in number and involved $17,637,011 of defaulted indebtedness. Although these figures show a heavy increase as compared with the same month last year, in which the total was only 885 failures, with liabilities of $11,980,782, they are smaller than for any monthly period since the financial and business situation became acute, and, in the amount of defaulted indebtedness, are smaller than September's showing. The returns indicate that the only noticeable increase of liabilities over the figures for the same month last year ocurred in the manufacturing class, though numerous small firms were forced to suspend among traders. "The mortality was greater than normal, owing to the strained monetary situation and not because of poor business, and a comparatively few large failures in the manufacturing division supplied the only increase above an average month's liabilities." Comparison with last year's figures at this time is much less significant than the great improvement that is shown over the losses of the preceding month. The Review says: "During November there were 30 suspensions of banks and other financial institutions, the liabilities thus far reported aggregating $9,144,225, but returns are not yet available in many cases. Most of these suspensions are of comparatively small concerns, and several of the institutions have resumed." The figures in detail show that "manufacturing failures were 305 in number and $10,927,598 in amount, compared with 212 defaults in the same month last year, when the amount involved was only $3,291,192. Trading failures were 840 in number and $5,640,065 in amount, against 647 failures last year, with liabilities of $4,390,415. There were 35 other commercial failures, including brokerage, real estate, insurance and similar concerns, with a defaulted indebtedness of $1,069,348, against 26 similar failures last year, when the amount involved was $4,299,175."

AMERICAN SCHOOL OF CORRESPONDENCE has recently erected a fine building for itself in Chicago on Washington Park and Midway Plaisance, near the University of Chicago. It is built of paving brick in two shades, with Bedford stone trimming and green tile roof. It is four stories and basement, enclosing on two sides an open court 60 ft. square, walled in the rear and entered through an arched driveway. . The interior woodwork is green quartered oak. The administrative offices of the school are on the second floor; the remainder of the building is used for the accommodation of the large staff of instructors, editors and other employees in charge of the various details of the work of the school. An interior telephone system connects all departments. To facilitate the work of the business office and mailing room, several of the latest electrical appliances have been installed, including adding machines, folding machines and envelope sealers—all operated by electric motor. In the basement are the stock room, the shipping room and the steam heating plant. The system of heating is known as the "direct-indirect;" the larger radiators are located in juxtaposition to cold-air ducts that lead from the outside through the walls and that supply an abundance of fresh air at all times. Electricity is used throughout for lighting purposes. The corridors and large rooms are equipped with Nernst lamps. Lavatories with hot and cold water are located on each floor. On the second floor are the lecture room, and the rest room for employees. The lecture room is used as a meeting place for the clubs that have been formed at the works of the Crane Company, the McCormick Harvester Company and other large manufacturing plants in and near Chicago. At these plants students of the American School have organized, appointed leaders from their own number, and found mutual assistance in studying together. From time to time they meet in the lecture room of the school, where they are provided with instructors, apparatus and—since most of them come direct from the shop to the school—with a substantial lunch, all for the usual tuition. The school also provides its employees with free coffee and lunch at noon time.

FOREIGN TRADE FIGURES.—Although the foreign trade of the year in the gross is much larger than last year, the difference in our favor is less. The business disturbances of the past two months are shown in the October statement of imports and exports, in which there is a combined increase of $17,456,000, compared with October, 1906. Among imports the heaviest decline is shown in the classes of commodities known as materials for manufacture, both crude and partially manufactured. These two together make a loss of $6,373,000. The only other item showing a decrease is foodstuffs, where the small total of $281,434 is noted. On the side of exports for October the most notable decrease was that in crude materials for use in manufactures, amounting to $12,558,765. These shrinkages are partly balanced by gains in exports of other foodstuffs and provisions, of semi-manufactures and of finished manufactures amounting in all to $9,025,000. Nevertheless the losses of the month are greater than the gains. For the ten months ending with October the increase in imports ran above last year by $153,602,000, while the export movement, both domestic and foreign, gained $86,821,000. The gains of imports are 45 per cent greater than those of exports. Comparing volumes of business, however, the export trade is still considerably in advance. The aggregates for the ten months are as follows:

	1907.	[illegible]	
Exports	[illegible]	[illegible]	[illegible]
Imports	[illegible]	[illegible]	[illegible]
Differences	$292,012,000	$358,793,000	Dec. $66,781,000

GREAT COPPER EXPORT.—The extent of foreign purchases of copper metal here last month, which ran prices up suddenly from 12 to 15 cents a pound, is shown by the publication of the export returns for November. Altogether, 33,787 tons of copper were shipped last month, establishing a new record, and bringing the total of 1907 to date to a figure only 1448 tons below last year's exports. The increase over October was 5001 tons, over November last year 15,336 tons. The following table shows the monthly comparison of our copper exports for the past four years:

	1906-7. Tons.	1905-6. Tons.	1904-5. Tons.	1903-4. Tons.
November	33,787	[illegible]	[illegible]	[illegible]
October	28,786	17,528	17,784	26,585
September	17,157	14,119	19,755	20,569
August	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]
June	16,193	18,634	22,096	16,279
May	[illegible]	[illegible]	[illegible]	[illegible]
April	17,263	16,330	24,121	13,383
March	13,006	16,433	21,073	22,852
February	9,072	15,801	17,508	17,073
January	17,089	15,307	21,245	29,085
December	[illegible]	[illegible]	[illegible]	[illegible]

The previous record was in January, 1904. Since Jan. 1, last, reports have been 189,167 tons, comparing with 190,615 tons in the same period last year.

AMERICAN INSTRUMENT COMPANY.—This company has received important orders for switchboard instruments to be installed in plants of the Philadelphia Electric Company, S. L. Allen & Company, Carnegie Steel Company, American Steel & Wire Company, National Tube Company, and the U. S. Steel Corporation at Gary, Ind.

Financial Intelligence.

THE WEEK IN WALL STREET.—Both sentiment and prices on the stock market tended to improve on the decreased money market pressure and the indications of a return to normal conditions in that respect. Much irregularity, however, prevailed and certain portions of the list, notably the Gould group, exhibited weakness and recorded new low-record prices in the face of a stronger tone elsewhere. Western Union also showed much unsteadiness and fell to 54⅛. There was likewise pressure in connection with Pennsylvania and New York Central. On the other hand, a variety of favorite trading stocks developed strength—Reading, Union Pacific, the Hill group and

Amalgamated Copper being prominent in the activity. United States Steel issues were irregular. Most of the electric and traction stocks made substantial gains during the week, the net advances being as follows: General Electric, 6 points; Westinghouse, 5¼ points; Mackay preferred, 3 points; American Telephone & Telegraph, 4¾ points, and Interborough Metropolitan preferred, 3½ points. Western Union declined 2⅝ points. On the Curb liquidation came to an end early in the week, and thereafter there was gradual improvement, the week ending with some noteworthy gains. Following are the closing quotations of Dec. 3:

NEW YORK.

	Nov. 25	Dec. 3		Nov. 25	Dec. 3
Allis-Chalmers Co......	4⅞	5⅞	General Electric	107	115¼
Allis-Chalmers Co. pfd.	12	15½	Hudson River Tel.....	—	—
Am. Dist. Tel.........	—	—	Interborough Met. com.	5⅝	7
American Locomotive...	35¼	36¾	Interborough Met. pfd..	15¾	18
Amer. Locomotive pfd .	85	86	Mackay Cos.	47½	50¾
American Tel. & Cable..	60	—	Mackay Cos. pfd......	53⅝	60
American Tel. & Tel....	—	100½	Marconi Tel.	—	—
Brooklyn Rapid Transit.	31½	35⅞	Metropolitan St. Ry....	—	—
Electric Boat	—	—	N. Y. & N. J. Tel.....	—	97½
Electric Boat pfd......	—	—	Western Union Tel....	60	58½
Electric Vehicle	—	—	Westinghouse com.....	36	46
Electric Vehicle pfd....	—	—	Westinghouse pfd.. ...	—	61

BOSTON.

	Nov. 25	Dec. 3		Nov. 25	Dec. 3
American Tel. & Tel...	96⅜	101½	Mass. Elec. Ry. pfd...	—	39
Cumberland Telephone..	—	—	Mexican Telephone....	1½	1¼
Edison Elec. Illum....	195¾	200	New England Telep....	99	99½
General Electric	—	116	Western Tel. & Tel....	—	—
Mass. Elec. Ry........	9½	9¼	West. Tel. & Tel pfd .	—	50

PHILADELPHIA.

	Nov. 25	Dec. 3		Nov. 25	Dec. 3
American Railways.....	44	44	Phila Electric	6¾	6⅜
Elec. Co. of America...	8	8⅛	Phila. Rapid Transit...	13	15¾
Elec. Storage Battery..	—	32½	Phila. Traction	82½	81
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Nov. 25	Dec. 3		Nov. 25	Dec. 3
Chicago City Ry..	150	150*	National Carbon	-	—
Commonwealth-Edison ..	—	78	National Carbon pfd..	-	—
Chicago Subway	—	14	Union Traction		—
Chicago Tel. Co.......	—	105	Union Traction pfd...	—	—
Metropolitan Elec. com.	19*	20*			

*Asked.

THE WESTINGHOUSE SITUATION.—The committee, acting at the request of certain creditors of the Westinghouse Electric & Manufacturing Company, has proposed the following plan for the extension of the company's debt: The holders of the floating debt of the company shall accept for their claims, including interest to Jan. 1, 1908, one-third in 5 per cent convertible bonds at 90, one-third in assenting stock of the company at par, and one-third in three 6 per cent notes of the company, in equal amounts, maturing respectively in one, two and three years from Jan. 1, 1908. The stock to be issued to creditors under this plan of extension shall be stock heretofore authorized by the stockholders of the company, and known as "assenting" stock. The convertible bonds to be issued under this agreement of extension are known as "convertible sinking fund 5 per cent gold bonds." They bear date of the thirtieth day of March, 1906, and the principal is payable Jan 1, 1931. The interest is at the rate of 5 per cent per annum, payable semi-annually on the first days of January and July in each year. They are issued under the provisions of a trust indenture bearing date of the thirtieth day of March, 1906, between the company and the Standard Trust Company of New York, as trustee. The trust indenture provides for the issue of bonds to the aggregate amount of $25,000,000, of which the sum of $1,969,000 is still reserved, to be issued only against the deposit of equal amounts of the outstanding 5 per cent debenture certificates issued by the Mercantile Trust Company; $22,345,000 of bonds have been certified by the Standard Trust Company, of which there are now outstanding $18,500,000, leaving $3,845,000 in the treasury and $686,000 yet subject to issue upon the payment into the treasury of the company of a like amount of money to be received from the sale of additional assenting stock. The notes to be issued will be in the form of ordinary notes, signed by the company and payable to the order of the depositors, and shall be dated Jan. 1, 1908, payable in one, two and three years from date, with interest at 6 per cent per annum, payable semi-annually, and shall have coupons attached representing said interest. While the depositors' claims are to be paid as aforesaid, one-third in stock, one-third in bonds and one-third in notes, it is understood and agreed that in cases where it is not possible to divide the depositors' claims into three equal amounts and to apportion the securities in precisely the proportion indicated, the committee shall have power to apportion stock, bonds and notes to the fractional part of the depositors' claims as the committee may deem best, providing for the extension of said fractional amounts in such a way as to approximate as closely as practicable to the scheme of this extension. The company agrees that as a condition to said plan becoming operative a majority of the members of its board of directors shall be persons approved in writing by the committee, and the company undertakes to cause the resignations of such of the present directors and the election of such new directors as shall be necessary to that end. It is stated from Pittsburg that developments indicate more strongly than ever that the receivers of the Westinghouse Electric & Manufacturing Company will be discharged in the near future, and that the company will be restored to the shareholders. The second plan for extending the debt of the company, it is expected, will be carried out. The details of the plan have not been made public as yet, but some announcement is anticipated in the near future. The shareholders are now co-operating with President Westinghouse and are working with the object of terminating the receivership as soon as possible.

A REVIEW OF WESTERN UNION.—With a longer unbroken dividend record behind it than any other security now active on the New York Stock Exchange, having paid not less than 5 per cent in any year since 1888 and dividends at a smaller rate even further back. Western Union has sold this week at a price to yield the buyer about 9 per cent. Last January it sold as high as 85; on Friday it sold at 54½. Its range in the year 1906 was from 94¼ to 83¾. There would seem to be, says the *Wall Street Journal*, a number of reasons for the reduced market position of the stock, apart from conditions affecting all investment securities at the present time. Coincidently with the declaration of the last quarterly dividend of 1¼ per cent, the company announced that it would discontinue quarterly statements of earnings. A great many people innocently inferred that the strike had made larger inroads upon the company's earnings than the management cared to acknowledge. Whether this inference was justified, only those having access to the accounts of the company can say. The weakness of the stock recently would tend, at all events, to confirm it, and to give rise at the same time to misgivings as to the dividend. Touching the condition of the company there have been no figures since those contained in the last annual report, as of June 30. They show that although the gross earnings for the fiscal year were the largest in the history of the company's business, and that the average receipts per message were the highest since 1884, the final result was a smaller aggregate of net earnings than for any year since 1900; net earnings last year, in fact, were smaller than in 1893 or in 1884. The average cost per message to the company was the highest since 1876. After dividends at the rate of 5 per cent on the stock, there was a surplus of income for the year amounting to $36,052. In November, 1906, $10,000,000 4 per cent convertible bonds (part of an authorized issue of $25,000,000) were offered to stockholders at 87½. On June 30, last, there had been issued of these new bonds $7,200,000, representing an increase of $288,000 a year in fixed charges. The income account, however, shows an increase in bond interest of only $92,086. That is approximately four months' interest on the new bonds, instead of eight. The bonds were dated Nov. 1, 1906. If the full interest for eight months had been deducted from income there would have been a deficit after dividends instead of a surplus of $36,052. The company has an accumulated surplus of $16,884,781, but it is not a cash surplus. It represents the excess of assets over liabilities in a bookkeeping sense. On June 30 it had $3,164,615 cash, and carried among its assets $2,889,799 sundry accounts receivable, an increase of $1,331,192 in that item for the year. On the other side of the balance sheet it showed bills payable, including the July dividend, amounting to $3,764,414.

WESTINGHOUSE ELECTRIC.—The receivers of the Westinghouse Electric & Manufacturing Company have issued a balance sheet as of Oct. 23, which shows a surplus of $11,610,756. They announce that they have taken pains to figure the assets down to a basis as conservative as possible. Their valuation of the total assets of the company is $82,817,923. Compared with a statement issued last spring, this is an increase of $10,600,000 in the value of the assets as shown in the annual report. The receivers believe that the assets are worth $10,600,000 more now than in March last. A large portion of the increase is explained by the increase in the value of the investments. In March the investments, including stocks and bonds in subsidiary companies throughout the world, were valued at $22,296,806. The receivers' valuations of these assets are now $29,490,614, an increase of about $7,200,000 since the panic began. On March 31, when the balance sheet was struck, the

company had a surplus of $12,595,151. According to the receivers' statement, the balance sheet as of Oct. 23 shows a surplus of $11,610,756. The business of the company continues on a very large scale, with a maintained percentage of profit.

NORTH SHORE ELECTRIC.—The annual report of the North Shore Electric Company, of Chicago, of which Samuel Insull is president, was issued a few days ago. After all charges, including $41,740 for depreciation, the balance of $85,024 was equal to 2.6 per cent on the outstanding capital stock. The financial statements follow:

	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Special depreciation reserve	41,740	
Balance	$85,024	
Previous surplus	169,100	
[illegible]	[illegible]	
Less 6 per cent stock dividend	150,000	
[illegible]	[illegible]	

President Insull, in his report to the shareholders, said among other things: "The growth of the company's business during the year, necessitating further enlargement of its distribution system, as well as the construction of additional substations, has called for an increase in the capital stock of $750,000 and in the outstanding first mortgage bonds of $604,000. Your directors are pleased to report that of the underlying bonds shown in the last annual report those which existed against the property acquired from the Calumet Lighting Company, amounting to $200,000, have been paid off and canceled. The operation of the contracts for furnishing power to street and interurban electric railways, which the company has recently made, is proving satisfactory, and there is reason to expect that this branch of the company's business will grow to large proportions. Your directors have deemed it wise to make a reduction of 10 per cent, effective Oct. 1, 1907, in the rates charged for residential lighting, and hope that the increase in the company's business will enable them in the future to make still further reductions."

STREET RAILWAY RECEIVERS.—Justice Seabury, of the New York Supreme Court, has appointed Paul Fuller, J. Hampden Dougherty and Melvin G. Palliser receivers of the New York City Railway Company and of the Metropolitan Street Railway Company, for which receivers had already been appointed in the Federal Court. The new receivers were appointed in actions brought by Attorney-General Jackson to dissolve the former corporation, and for an accounting of the official conduct of the directors of the Metropolitan Street Railway Company. The plan of the attorney-general is to fight the federal receivership to the United States Supreme Court if necessary. The three receivers are to be qualified in the sum of $100,000 each. Herbert R. Limburg has been appointed as their counsel. It is the intention of the receivers, as well as that of the attorney-general, to assert the jurisdiction of the state court as against the federal court, and by such action it is hoped a precedent will be set, and a final decision of the higher court obtained as to which of the courts, federal or state, may properly exercise jurisdiction. The ground on which the attorney-general seeks to dissolve the New York City Railway Company, by which it will forfeit its corporate rights, privileges and franchises, is that the company has been insolvent for at least a year. In regard to the Metropolitan Street Railway Company, the attorney-general demands an accounting from the directors for their official conduct from the year 1898 to the present time, including their alleged neglect or failure to perform their duties in the management and disposition of the property of the company. He also asks that they be directed to pay to the company all the money and the value of the property lost or wasted by or through their alleged neglect. The attorney-general in addition asks that the directors be suspended from exercising their office and that a new election of directors be held.

SAFETY INSULATED WIRE.—It was announced last week that Mr. H. E. Huntington has acquired a controlling interest in the $1,500,000 capital stock and $1,228,000 outstanding bonds of the Safety Insulated Wire & Cable Company, a subsidiary of the National Steel & Wire Company, which went into a receiver's hands some time ago. C. E. Graham, Mr. Huntington's personal representative in New York, has been elected vice-president of the Safety Insulated Wire & Cable Company. The company has a very large business and has sold vast quantities of cable to the United States Government.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company's statement of earnings for October and ten months compares as follows:

	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Charges and taxes	37,998	35,726	28,924
[illegible]	[illegible]	[illegible]	[illegible]
Ten months' gross	4,854,036	4,416,256	3,796,456
Expenses	3,019,867	2,773,914	2,340,614
[illegible]	[illegible]	[illegible]	[illegible]
Charges and taxes	364,945	314,203	233,611
[illegible]	[illegible]	[illegible]	[illegible]

ELECTRICAL INVESTMENTS.—Stone & Webster, of Boston, have published opportunely a list of preferred stocks netting from 6 to 8 per cent, in well-established, dividend-paying public service corporations under their own management, for safe investment, and have issued a manual of electric traction, lighting and power properties, which will be mailed upon request to prospective investors. A good deal of similar work could be done advantageously at this time for other properties in getting the small investor interested in them and in getting their hoarded money into circulation.

NOT DUE TO BANKS.—President George Westinghouse, of the Westinghouse Electric Manufacturing Company, now in receivers' hands, has denied the published reports that the company's financial difficulties had been precipitated by big banking interests in New York. The appointment of the receivers, he stated, was an emergency measure taken on the advice of the Pittsburg Clearing House for the protection of all interests, the banks there being unable because of the financial stringency to co-operate with strong financial interests in New York, which had been prepared to extend the monetary aid needed.

FEWER NEW ENTERPRISES.—Capitalization of new companies incorporated with $1,000,000 capital and upwards in Maine, New Jersey, New York, Delaware and Massachusetts during November, according to the New York *Commercial*, was $42,000,000, compared with $52,050,000 in October and $184,900,000 in November, 1906. November incorporations were the lowest with one exception of any month in the last 15 years. There now appears to be a revival of activity in this direction, which will also be stimulated in the new year by the greater cheapness of money.

BELL TELEPHONE CONSOLIDATION.—At Philadelphia, on Dec. 3, at a special meeting of the Bell Telephone Company of Philadelphia it was decided to purchase the Pennsylvania Telephone Company and the Delaware & Atlantic Telegraph & Telephone Company of Pennsylvania. It was also decided to increase the capital stock of the Philadelphia Bell Company from $30,000,000 to $60,000,000, of which a sufficient amount will be issued necessary for the exchange of stock of the two companies acquired.

HUDSON RIVER POWER.—The Hudson River Electric Power Company reports income and expenditures for October as follows:

	1907.	1906.	CHANGES
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Net	[illegible]	[illegible]	[illegible]

WIRELESS TELEPHONES.—An allotment of $25,000 for the purchase by the chief signal office of one or more dirigible balloons has been made by the board of ordnance and fortifications. An allotment of $3,000 also has been made for wireless telephones.

PAWTUCKET CONSOLIDATION.—A consolidation of the Pawtucket Electric Company, the Pawtucket Gas Company, and the Woonsocket Gas and Electric Companies, all of Rhode Island, is being carried out under the guidance of Stone & Webster, of Boston.

DIVIDENDS.—Directors of Canadian General Electric Company have declared the regular quarterly dividend of 2½ per cent. Directors of the Mackay Companies have declared the regular quarterly dividends of 1 per cent on the preferred and common stocks, payable Jan. 2.

GENERAL NEWS

Construction News.

TOMBSTONE, ARIZ.—The Adams Telephone & Telegraph Company, which was recently formed, will build a telephone line from Wilcox to Bowie, and west from Wilcox via Fort Grant and Bonita to the Klondike Camp.

CAMDEN, ARK.—The Camden Ice & Light Company has been organized by R. L. Moore and others.

HOT SPRINGS, ARK.—A resolution dissolving the corporate existence of the Southern Telephone & Telegraph Company, of this city, has been filed with the Secretary of State. The stockholders of the company are: H. J. Pettingill, J. E. Farnsworth, T. L. Powell, P. K. Baker, F. B. DeShon and W. J. Terry.

SULPHUR SPRINGS, ARK.—The Kihlberg Company, of which E. Bee Guthrey is secretary, will install an electric light plant. Smith & Powers, engineers, will have charge of the work.

GILROY, CAL.—The Union Construction Company, for the Stanislaus Electric Light & Power Company, is shipping material for the construction of transmission towers near the line of the Southern Pacific Company's tracks, the objective point being the cement works at San Juan, which it has contracted to reach by July 1, 1908.

HANFORD, CAL.—F. S. Granger has placed an order with the H. W. Johns-Manville Company, of San Francisco, for overhead equipment for 17 miles of electric railway.

KELSEYVILLE, CAL.—The Lake County Power Company has been organized for the purpose of taking over the old corporation formed two years ago to provide the city with electricity for lighting and gas for fuel. The company expects to have both plants in operation within 45 days. It has secured quarters at Lakeport; and later will establish a sub-station in that city. The men interested in the new company are George P. Low, of San Francisco; G. S. Cutler, of Calistoga; Robert Polk, of Upper Lake; M. S. Sayre and B. H. Henderson, of Lakeport. The men who relinquished their interest in the old company were W. M. Nobles, Joseph McLaughlin, Dr. W. B. Prather, Lewis Henderson, W. H. Renfro and L. H. [illegible]

LODI, CAL.—Henry E. Adams, manager of the Stockton Gas & Electric Company, states that the corporation of which his company is a part, will build a transmission line from Sacramento to Stockton, passing through Lodi, Acampo, Galt, Elk Grove and Florin, and will furnish electricity in competition with the American River Electric Company. This new line, while extending the service to a new field, will constitute a third main to supply power to Stockton should the other two lines be disabled.

LOS ANGELES, CAL.—Incorporation papers for the Los Angeles Gas & Electric Company are now being prepared. The capital stock will be $200,000. H. F. Lenkfield is the originator. It is proposed to expend [illegible] in the northeastern part of the city.

LOS ANGELES, CAL.—The Kings River Power Company has given notice of the appropriation of 25,000 miners' inches of water from the Kings River for the generation of electricity, the power house to be located on Section 35-12-28. The company will transmit electricity to Fresno, San Francisco and Los Angeles.

LOS ANGELES, CAL.—L. C. Brand asks the city of Glendale to pay $21,000 for his entire electric light and power system. The plant is said to be on a paying basis, but in order to give service wherever required it would be necessary to make considerable additions to the lines. It would probably require a bond issue of $40,000 to purchase the plant and make the needed extensions.

LOS ANGELES, CAL.—We are informed that the Los Angeles & Owens Valley Railroad Company, which proposes to construct a railway to connect Los Angeles, Randsburg, Independence and Bishop, will begin work on the construction [illegible] mines along the route. The officers of the company are S. P. Jewett, president; George Chaffey, vice-president, and A. M. Chaffey, secretary and treasurer.

SAN BERNARDINO, CAL.—[illegible] Ana Canyon belonging to the Edison Power Company have been put out of [illegible] mountain, besides wrecking flumes and water pipes.

SAN FRANCISCO, CAL.—[illegible] that the Big Creek [illegible] (Cal.) national forest and a right of way for a pipe line. The company proposes to generate electric power. A permit has also been granted the North Mountain Power Company [illegible] national forest.

SAN FRANCISCO, CAL.—The City Electric Company, which is about ready to place in operation a new light and power plant in San Francisco, has closed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for a 10,000-hp turbo-generator. Two smaller generators of the same type are now in use by the company. The United Railroads expects to obtain power from this company for running its cars, and the capacity of the plant is being increased for that purpose.

VALLEJO, CAL.—The Vallejo & Northern Railway Company is making arrangements to begin construction work in the spring of 1908 on its electric railway, which is to connect Vallejo, Napa Junction, Creston, Cordelia, Sinsun, Fairfield, Cement, Vacaville, Winters, Woodland and Sacramento. All franchises and terminal sites and a large portion of the right of way have already been secured. The road will be about 130 miles long. Energy will be obtained from the Bay Counties Power Company, and both third-rail and overhead trolley will be used. The officers of the company are Melville Dozier, of Oakland, president and engineer; C. F. Kinsey, of Oakland, vice-president; T. T. C. Gregory, of Fairfield, secretary, and George S. Lockie, of Oakland, treasurer.

DENVER, COL.—A. E. Wilson, of this city, is interested in a project to build a large power plant on the South Platte River, a short distance south of Denver. It is proposed to develop 20,000 horse-power. The cost of the plant will be about $1,000,000.

WATERBURY, CONN.—John H. Cassidy, secretary of the Waterbury & Milldale Tramway Company, states that the company will award the contract for the construction of the road as soon as the capital is raised. The proposed railway will be operated by electricity and will connect Waterbury, Southington and Meriden. The line will be about eight miles long. The officers of the company are Charles H. Clark, of Milldale, president; John H. Cassidy, of Waterbury, secretary, and Edwin S. Todd, of Milldale, treasurer.

WASHINGTON, D. C.—Announcement has been made that the Washington, Spa Springs & Gretta Electric Railway Company will commence construction work in January, 1908. The railway will connect Washington, Bladensburg and Branchville and will be about eight miles long. The power station will be built at Beverly, Md. S. S. Yoder, of Washington, is vice-president and general manager.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 17, to furnish at the Navy Yard, Mare Island, Cal., naval supplies and a motor as per Schedule 488. Applications for proposals should designate the schedule desired by number. Blank proposals will be furnished upon application to the Navy Yard Pay Office, San Francisco, or to the bureau. E. P. Rogers is paymaster-general, U. S. N.

WASHINGTON, D. C.—Rear Admiral R. C. Hollyday, chief of Bureau of Yards and Docks, in his annual report recommends an appropriation of $985,047 for the Washington Navy Yard, which includes rewiring of certain yard buildings, at a cost of $21,500; machinery for power plant extension, $12,000; extension of underground conduit system, $10,000; extension to electric light plant, $5,000; extension and improvement to electric fire alarm and telephone systems, $4,000; complete switchboard in power plant in building No. 118, $2,500. The report also asks for $786,800 for improvements at the Mare Island Navy Yard, which includes $385,000 for the installation of a central power plant. The yard is now purchasing its power from an outside company.

JACKSONVILLE, FLA.—Bids will be received by the Lester Clay Company for constructing an electric light plant, which will furnish from [illegible] to [illegible] lamps.

LEESBURG, FLA.—The question of holding an election to vote on the proposition of issuing bonds to establish an electric light plant is now under consideration.

BARNESVILLE, GA.—An election will be held Dec. 31 to vote on the proposition of issuing $4,000 in bonds to enlarge the municipal electric light plant.

BLUE RIDGE, GA.—[illegible] bonds for improvements to the electric light plant and water works system.

COLUMBUS, GA.—The [illegible], which will soon be placed in operation will be operated by electricity transmitted from a dam on the Chattahoochee River, owned by the Columbus Power Company.

MACON, GA.—The Citizens' Electric Company has withdrawn its application for a franchise to furnish electricity for lighting and power [illegible] new application later [illegible]

WALLERSVILLE, GA.—[illegible] for the organization of a company to furnish electricity for lighting the city. A committee has been appointed consisting of Dr. J. D. Nicodemus, Cephas M. Thomas, Newton A. Fulton and others.

ELK CITY, IDAHO.—[illegible] Jacob Schlosser, president of the Umatilla Mining Company, which owns

the Umatilla Mine, near Orogrande, is interested in the enterprise. Mr. [illegible] velop the water power, which will furnish electricity to run the Umatilla Mine, and also supply the Buffalo Hump, Orogrande and Elk City mining districts with electric power. The plant will have a maximum capacity of 10,000 horse-power and will cost about $140,000.

HAILEY, IDAHO.—The Idaho Consolidated Mines are contemplating the construction of an electric light and power plant to furnish electricity for the mines. Work has commenced on the construction of a dam across the Wood River. The cost of the plant is estimated at $[illegible]

CHICAGO, ILL.—The Dearborn Street Improvement Association will soon ask for bids for the installation of the new electric lighting system from Van Buren Street to the river.

DECATUR, ILL.—The Wabash Railway Company will install an electric plant for lighting the station and roundhouse, and will also furnish electricity for lighting in the city.

ROCKFORD, ILL.—Arrangements are being made by the Central Union Telephone Company to place its wires underground along certain streets in this city.

ROCKFORD, ILL.—The Rockford Edison Company has changed its name to the Rockford Electric Company, and increased the capital stock of the company from $350,000 to $1,000,000.

CONVERSE, IND.—It is reported that O. D. Ross, of Peru, and Philip H. Palmer, of Kokomo, have taken an inventory of the local lighting plant owned by Lewis Barger, and have placed the value of the plant at $14,404. F. Wilson, of Marion, has a claim against the plant for $10,000, and the property will be sold at sheriff's sale.

EVANSVILLE, IND.—The American Bell Telephone Company has been granted a franchise to remove its offices from the Outer First Avenue to a site within the city limits. The company has agreed to construct a building to cost $10,000 in which its exchange and offices will be installed.

EVANSVILLE, IND.—A movement is on foot in this city to secure a municipal electric lighting plant. Mayor Boehne in his fight for better gas and electric light service called the Merchants' Association to his aid and is advocating the establishment of a municipal plant. The Merchants' Association passed a resolution in support of the mayor's effort to secure better lighting service and also to secure a municipal plant.

INDIANAPOLIS, IND.—Official announcement has been made that arrangements have been made whereby the work on the Indianapolis, Newcastle & Toledo Traction Company's will be resumed at once and pushed to completion. It is stated that the work of installing machinery in the power house will begin early this month.

MODOC, IND.—The capital stock of the Modoc Telephone Company has been increased from $5,000 to $10,000. J. G. W. Beard is secretary of the company.

SOUTH BEND, IND.—The South Bend & Southern Michigan Railway Company and the Indiana & Michigan Electric Company have closed a deal whereby the latter company will furnish power to operate cars of the former between South Bend and St. Joseph, Mich. The contract will take effect as soon as the new dam on the St. Joseph River at Berrien Springs, Mich., is completed. This will mean the abandonment of the steam power station at Scottdale. Four sub-stations will be erected along the line of the railway.

DAVENPORT, IA.—The McCarthy Improvement Company has commenced work on the new electric light plant of the Independent Gas & Electric Company in West Davenport.

DIKE, IA.—The Corn Belt Telephone Exchange Company contemplates making improvements to the local exchange.

DOUGHERTY, IA.—The Rockwell Farmers' Telephone Company is contemplating the establishment of a local and rural telephone exchange.

HUMBOLDT, IA.—The Rural Union Telephone Company contemplates installing a new switchboard in the local telephone exchange.

IDA GROVE, IA.—At a special election held recently the citizens voted to grant a 15-year franchise to the Ida Grove Electric Company to maintain a lighting and heating plant. The company contemplates making many improvements and extensions to its plant next year.

KEOSAUQUA, IA.—We are informed that J. W. Andrews, 7 Pine Street, New York, N. Y., has been appointed engineer for the two dams to be constructed on the Des Moines River for power purposes, which will cost about $500,000. D. Fitzgerald, 80 Wall Street, New York, N. Y., is also interested in the enterprise.

MUSCATINE, IA.—The Mississippi Valley Telephone Company contemplates making improvements to the local system, including the construction of a new building next season.

STORM LAKE, IA.—The Northern Telephone Company contemplates making improvements to the local exchange to cost about $[illegible]

ALMA, KAN.—The Alma Light & Ice Company contemplates the installation of an electric light and ice plant and giving a 24-hour service. W. B. Wilson is manager.

LOUISVILLE, KY.—Contracts have been awarded to the General Electric Company by the Kentucky Electric Company for the construction [illegible] power. Donald McDonald is president of the Kentucky Electric Company.

FRANKLIN, [illegible] for the new electric plant which is expected to be completed and in operation by Jan. 1. All the principal streets will be lighted by arc lamps.

NEW ORLEANS, LA.—Plans and specifications have been prepared by J. W. T. Stephens, a civil engineer, for an electric railway to run from Algiers, New Orleans, to Grand Isle. Mr. Stephens proposes to organize a company and obtain a charter for the purpose of building and operating the line. The company is to be capitalized at $1,000,000.

PONCHATOULA, LA.—The Ponchatoula Electric Light Company is making arrangements to install a complete new plant by next January, the equipment of which will consist of a [illegible] engine and a boiler of 150 horse-power, and will also install transformers and arc lamps. S. Bowling is manager.

BANGOR, ME.—Construction work on the power transmission line from Ellsworth to Veazie, which has been under way at the Bangor end for some time, has been suspended until spring. The suspension of the work will in no way affect the preliminary work of surveys and obtaining right of way at the Ellsworth end of the line.

LEWISTON, ME.—The Libbey & Dingley Company has secured a 20-year lease of the water power at Littlesfield, on the Androscoggin River, near Auburn, known as the Damren & Leavitt power. The company proposes to build a concrete dam and install a power plant capable of developing 2000 horse-power. In addition to this a generator is to be placed at the power site above the Barker Mill dam, which will furnish about 500 horse-power additional for the company on the Little Androscoggin River.

PORTLAND, ME.—The City Council has authorized the renewal of the city's contract with the Portland Electric Light & Power Company for street lighting for a period of five years.

BOSTON, MASS.—An appropriation of $435,800 has been asked for by the Bureau of Yards and Docks for the Boston Navy Yard, which include extensions to the power plant, at $295,000; electric elevators, $17,000; underground conduit system, $30,800; telephone system extensions, $2,000. Rear Admiral Hollyday is chief of Bureau and Docks.

CHELMSFORD, MASS.—The Lowell Electric Light Corporation has applied to the Selectmen for permission to erect a transmission line from the north side of Princeton Street, near the city line, to Gay Street, near the mills of the Moore Spinning Company, in North Chelmsford. The company is making arrangements to furnish electricity to the Moore Spinning Company to operate its mills.

LEICESTER, MASS.—The Worcester Electric Light Company has purchased a site on Pleasant Street, where it will install an electric light station to operate its system in Leicester. The company will furnish a 24-hour service.

ESCANABA, MICH.—The Home Electric Company has been organized here by John H. Knutsen.

ESCANABA, MICH.—The City Council has accepted the proposition submitted by the Escanaba Electric Pulp & Power Company to furnish electricity to operate the municipal electric lighting plant for a term of 10 years.

FLINT, MICH.—The City Council has passed a resolution ordering the Valley Telephone Company to remove its wires from the streets and place them in underground conduits in the north end of the city, in accordance with a resolution passed by the Council in 1905. The telephone company has been given 15 days to start the work.

FLUSHING, MICH.—The Common Council has decided to purchase another engine for the municipal electric light plant.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company has commenced work on another large dam 8 miles north of the second dam at Croton. The new dam will have a 54-ft. head and develop 15,000 horse-power. The plant will be connected with the general system of the power company, which supplies Grand Rapids, Muskegon and other western Michigan cities with power. Work of construction is to begin at an early date. J. B. Foote is engineer.

GRAND HAVEN, MICH.—The city of Grand Haven must either spend about $15,000 in improving its lighting plant and extending the service or abandon the plant and purchase electricity to operate the municipal system. There is strong sentiment for buying power of the Grand Rapids-Muskegon Power Company.

JACKSON, MICH.—The Commonwealth Power Company contemplates the construction of a new dam across the Kalamazoo River just above Allegan. It will supplement the five dams already built at Allegan, Otsego, Trowbridge and Ceresco, and the new one at Webers, on the Grand River. In addition to these stations the company has smaller stations at Albion and Battle Creek, while at Jackson steam turbines furnish 6000 horse-power, and a steam plant generating [illegible] horse-power is being [illegible] at Battle Creek. The proposed new dam will generate 2500 horse-power, bringing the output up to approximately 17,000 horse-power.

KALAMAZOO, MICH.—The Kalamazoo Home Telephone Company is preparing to place its wires in underground conduits.

LANSING, MICH.—The Michigan Power Company contemplates extending its lines from Lansing to Charlotte, and will soon apply to the City Council of Charlotte for a franchise in the city. The company will erect a transmission line from its power plant in Dimondale to Charlotte, the cost of which is estimated at $75,000.

LUDINGTON, MICH.—The Pere Marquette Railroad Company, [illegible] an electric plant [illegible]

[illegible] at Ludington, at a cost of $[illegible], has sold the plant and will buy energy from the Stearns Lighting & Power Company.

TRENTON, MICH.—As soon as arrangements can be completed the Village Council will issue a call for a special election for the taxpayers to vote on the proposition to sell the village electric light plant and water works system to the Edison Illuminating Company, of Detroit, for $8,000. If it is decided to sell, the Council will give the company a ten-year contract for a water supply and for street lighting. The Edison company, it is said, plans to install an extensive electric lighting and power system between Trenton and Ypsilanti and will extend its transmission line from the Ypsilanti plant and supply all the towns on the route with electricity, and will extend the water works service to Grosse Isle.

ALEXANDRIA, MINN.—The question of making improvements to the municipal electric light plant is under consideration.

CANNON FALLS, MINN.—The new electric light plant, which is being erected to take the place of the plant burned about a year ago, is nearly completed and will soon be put in operation.

FARIBAULT, MINN.—Receiver S. F. Donaldson, of the First National Bank, has sold the plant of the Polar Star Electric Light Company in this city to F. C. Nelson, of St. Paul. The receiver of the bank received $1,000 for the bank's share in the plant. Mr. Nelson assumes the payment of $36,000 in bonds against the plant. It is said that he will make extensive improvements to the plant.

MINNEAPOLIS, MINN.—Joseph Kiichli, the local promoter of the Minnesota Power & Trolley Company, has relinquished his rights in the company to Archibald S. White, of New York, N. Y. The company proposes to build a dam on the Mississippi at Monticello and Otsego and generate electricity which will be transmitted to Minneapolis. The company recently received a franchise to distribute electricity for motors and heaters in this city. It is understood that Mr. White will begin active work in the spring. The charter is to be forfeited if the dam is not completed by Dec. 31, 1908.

WINONA, MINN.—The Winona Railway & Light Company is planning to install a 450-hp boiler.

BAY ST. LOUIS, MISS.—The local telephone exchange of the Cumberland Telephone Company was recently destroyed by fire.

HOUSTON, MISS.—The citizens are considering the question of increasing the capacity of the municipal electric light plant and will install a 120-kw, alternating-current, 60-cycle, 2200-volt generator direct connected. [illegible] Arnold is manager.

SEMINARY, MISS.—The People's Telephone Company has just completed the local telephone system and contemplates extending its lines to Hattiesburg, Collins and Mount Olive.

NEOSHO, MO.—The Neosho Electric Light Company contemplates the installation of a 500-hp water tube boiler in its plant. S. N. Carver is manager.

DILLON, MONT.—It is reported that the two electric light and power plants in Dillon have been consolidated.

GRAND ISLAND, NEB.—T. H. Fritts, manager of the Grand Island Electric Company, writes that the company is contemplating increasing the equipment of its plant by the installation of a 300-kw steam turbo-generator set, cooling tower [illegible]

YORK, NEB.—Owing to the increased demand for electricity the York Light & Pow[illegible] of its plant, and is install[illegible]

CARSON, NEV.—[illegible] Pacific Telephone & Telegraph [illegible] Nevada Consolidated Telephone & Telegraph Company, whereby the latter will take over the entire system of the [illegible] that it will operate [illegible] Manager [illegible] will be retained by the new company. Announcement has also been made that the new concern has purchased all the Alpine Telephone Company's lines, which extend over Douglas, Alpine and Mono Counties. J. F. Adams is president of the company and is arranging for the installation of [illegible]

ELY, NEV.—[illegible] Commissioners [illegible] the smelter and covering all the streets of the city of Ely.

GOLDFIELD, NEV.—A syndicate of Baltimore capitalists, headed by H. G. Merry, has recently acquired a group of copper properties in the [illegible] Mountains [illegible] Bonnie Claire station, on the Tonopah & Goldfield Railroad, to its mines. [illegible]

PORTSMOUTH, N. H.—[illegible] Bureau of Yards [illegible] Portsmouth Navy Yard during the next fiscal year which includes, extension of electric light plant [illegible]

MORRISTOWN, N. J.—[illegible] the lighting contract for Morris Township, in connection with the Morris & [illegible]

PRINCETON, N. J.—[illegible]

BERGEN, N. Y.—Temporary arrangements have been made for running of the electric light plant, which is owned by individuals who decline to run it longer, until the annual election, March 17. The Village Board has agreed to run it, provided enough money should be raised by subscription to make up the difference in the income from individuals and firms for light, plus the amount allowed by law for street lighting and the cost of running the plant, the estimated difference being about $40 a month. It is expected that the full amount will be raised. The streets have been lighted by electricity since July, 1901.

BROOKLYN, N. Y.—Bids will be received until Dec. 10 by John H. O'Brien, commissioner of water supply, gas and electricity, New York City, for furnishing from Jan. 1, to Dec. 31, 1908, in the borough of Brooklyn, electricity and maintaining electric lamps for lighting the streets, avenues, public buildings, parks and public places.

GOUVERNEUR, N. Y.—It is expected that the Tannawa Falls Electric Company will soon begin the work of extending its transmission lines within the village. The line from Hermon is completed. The company will be ready for business as soon as the sub-station is completed and the lines erected, which will be about Jan. 1.

LOCKPORT, N. Y.—The merger of the Lockport Gas & Electric Light Company and the Economy Light, Fuel & Power Company has been effected, and the new company, the Lockport Light, Heat & Power Company, will take over the properties on Jan. 1. Oliver M. Diall, present superintendent of the Lockport Gas & Electric Company, will be general manager of the new company.

NEW YORK, N. Y.—Bids will be received until Dec. 10 by John H. O'Brien, commissioner water supply, gas and electricity, New York City, to furnish to the boroughs of Manhattan, Bronx, Queens and Richmond from Jan. 1 to Dec. 31, 1908, inclusive, electricity and maintaining electric lamps for lighting streets, avenues, public buildings, parks and public places.

GASTONIA, N. C.—An appropriation of $2,000 has been made for improving the electric lighting system of the town.

KINGS MOUNTAIN, N. C.—Harkey & Page, electrical contractors, of Charlotte, have been awarded the contract for installing the new electric lighting system in this place. Electricity for operating the system will be supplied by the Southern Power Company, of Charlotte, N. C.

WASHBURN, N. D.—The Northwestern Telephone Company has been granted franchises for a telephone line through the towns of Martin, Mercer and Turtle Lake.

AKRON, OHIO.—Application has been made to the Secretary of State for a charter for the Akron & Youngstown Electric Railroad Company. The company has an authorized capital stock of $100,000 and is headed by Thomas L. Childs, of Akron.

ASHEVILLE, OHIO.—Bids will be received by W. P. Powell, village clerk, until Dec. 20, for furnishing all material, copper wire and arc lamps and constructing an electric street lighting system to be operated in connection with the sub-station of the Scioto Valley Traction Company. Specifications may be obtained from R. Fullerton, care of the Scioto Valley Traction Company, Columbus.

MANSFIELD, OHIO.—The directors of the Mansfield Railway, Light & Power Company have decided to increase the output at the power house to provide power for the Ashland line when completed. The cost of the work is estimated at $[illegible]

STEUBENVILLE, OHIO.—The County Commissioners have granted the Knoxville Rural Telephone Company a franchise for a right of way between Knoxville and Osage by the way of Toronto, Empire and New Somerset pikes.

TOLEDO, OHIO.—The Toledo Railways & Light Company has been granted a six-year franchise to operate a street railway on Holland Street and Oakdale Avenue, East Toledo.

XENIA, OHIO.—The Trustees of the Ohio Soldiers' and Sailors' Orphans' Home, in their annual report, ask for a special legislative appropriation of $100,000 to install a complete new power plant and sewerage system.

MEDFORD, ORE.—The Rogue River Electric Company has been formed to take over the plant and holdings of the Condor Water & Power Company, including the dam and power house at Gold Ray, and the light and power system extending through the Rogue Valley, supplying electricity to the towns of Grants Pass, Gold Hill, Central Point, Medford, Jacksonville and Ashland. The capital stock of the company is $700,000, and the incorporators are C. R. Ray, president; H. C. Stoddard, secretary [illegible]

PORTLAND, ORE.—The Portland Railway, Light & Power Company plans to develop the water power of Little White Salmon River in Washington and generate electricity to be transmitted to Portland, a distance [illegible] Railway Company and came into possession of the present company through the consolidation of the old companies. It is estimated that from [illegible]

HAZLETON, PA.—The Harwood Electric Power Company is extending [illegible] lighting the streets and residences of the villages and for operating the mines. Electric locomotives will be used for hauling coal, and later elec[illegible]

[illegible]

JOHNSTOWN, PA.—The City Council has granted the Johnstown Passenger Railway Company a franchise to operate its system on certain [illegible]

[illegible] way between this city and Beaver Falls, and it is said that work will [illegible] for the proposed line have been secured, one through Wampum, and the other for a spur from Wampum to Ellwood City. The New Castle & Wampum Company and the Wampum & Beaver Falls Company will be consolidated and will reach New Castle by the way of Mahoningtown, where connection will be made with local lines. Pittsburg, Ellwood City and Zelinople capitalists are interested in the proposed company.

PITTSBURG, PA.—The power house of the Pittsburg Malleable Iron Company, at Fourth and Smallman streets, was recently destroyed by fire, [illegible]

PITTSBURG, PA.—The Pennsylvania & Franklin Street Railway Company and the Electric Avenue Street Railway Company have been consolidated. The new company has a capital stock of $14,000, and is building an independent line between Wilkinsburg and East Pittsburg. Henry P. Haas is president and George H. Finn is secretary, all of Pittsburg.

SHAMOKIN, PA.—The Shamokin & Coal Township Light & Power Company has agreed to furnish electricity for operating the new Selinsgrove Electric Railway Company and will also furnish electricity to light the residences along the way. It is expected that work will soon commence on the erection of the lines. The local plant with the installation of new engines will be able to furnish power as far as Williamsport.

GREENVILLE, S. C.—The Greenville Interurban Company has commenced a survey of its proposed electric railway from Williamston to Greenville, and is now securing rights of way for another line, which it proposes to build from Greenville to Spartansburg. It is announced that the company has completed all arrangements for financing the enterprise. John C. Carey is president of the company.

SUMTER, S. C.—J. L. Alnut is reported to have petitioned the City Council for a franchise to operate a street railway and gas works.

FLANDREAU, S. D.—We are informed that the Flandreau Water Power Company is considering the question of constructing an electric light plant to be operated by water power. It is proposed to organize a stock company and a practical man is wanted to take stock in the company and look over the field and make an estimate of the cost of the plant.

MADISON, S. D.—Plans are now being considered for increasing the output of the municipal electric light plant, which will include the installation of two 80-hp tubular boilers; one 65-kw alternating-current generator with exciter, and also changes on the switchboard. W. A. Boyd is manager.

LIMESTONE, TENN.—W. N. Mitchell is contemplating the installation of an electric light plant to furnish electricity to light the town.

BEAUMONT, TEX.—The Southwestern Telephone & Telegraph Company has submitted a proposition to the City Council agreeing to install underground conduits and double metallic system in Beaumont, and to make extensive improvements in its local plant and exchange, provided the City Council will grant the company a new franchise for a term of 25 years, for which the company agrees to pay the city $250 per annum and will install a special conduit for the city fire alarm or police system.

SAN SABA, TEX.—The San Saba Light, Ice & Bottling Works Company is contemplating the installation of a gas producer engine or oil engine to operate its lighting plant. Frank B. Hall is manager.

SALT LAKE CITY, UTAH.—It is officially announced that the special lighting committee of the City Council, which has been considering the question of improving the present street lighting system, has accepted the proposition submitted by the Utah Light & Railway Company. The new lighting system will require new arc lamps to take the place of the old-fashion type now in use. Incandescent lamps will be used along the boulevard and on the north beach.

MIDDLEBURY, VT.—The Middlebury Electric Company is replacing its gasoline engine with a Westinghouse compound steam engine of 170 hp, which will be used in conjunction with the new turbine water wheel. When the improvements are completed the company will be in a position to meet all demands made upon it

AMHERST, VA.—O. V. Hauger, secretary of the Amherst Electric Light & Power Company, writes that the company has been organized to build an electric light plant and will in about ten days decide on the size of its proposed plant, etc. It is proposed to operate the plant by water power if possible.

NORFOLK, VA.—It is reported that the Portsmouth Marine Railway Company is negotiating for the purchase of the Dashell property in the Berkley Ward, and, if the deal is closed, will remove its plant, which is now located in Portsmouth, to Berkley, where it will be improved and enlarged

RICHMOND, VA.—The receiver of the Virginia Passenger & Power Company, under authority of the federal court, is preparing to spend $250,000 for improvements in its power station and for building a new sub-station to increase the output. The output of the power plant will [illegible] South, is provided for the Twelfth Street plant. The sub-station will be on Broad Street between Shaffer and Harrison Streets.

STAUNTON, VA.—The Blue Ridge Light & Power Company has placed on record a deed of trust to J. M. Perry, trustee, to secure an issue of $100,000 in bonds, the proceeds to be used to cover floating indebtedness.

TAZEVILLE, VA.—The local exchange of the Bluefield Telephone Company was recently destroyed by fire, causing a loss of $3,000.

BISMARCK, WASH.—The Bismarck Mill Company is contemplating installing a steam power plant for the generation of electricity to supply the suburbs of Tacoma.

CENTRALIA, WASH.—The City Council has granted the promoters of the Centralia-Chehalis Electric & Power Company an extension of 60 days in which to deposit the $1,000 guarantee money and to commence work. The delay has been caused by the recent financial flurry. The City Council of Chehalis has also granted the company an extension of time.

MONROE, WASH.—The Monroe Water & Light Company is contemplating extensive improvements to its system, and will install a new engine, boiler and generator in its power plant and erect about 4½ miles of line. R. V. Green is manager.

NORTH YAKIMA, WASH.—In addition to the large irrigation project on the Columbia River, at Priest Rapids, the Hanford Irrigation Company has completed surveys for an electric railway from Hanford to North Yakima to a point where it will connect with the Milwaukee Railway further west.

NORTH YAKIMA, WASH.—The new power plant of the Northwest Light & Water Company, about 12 miles from North Yakima, in the Naches River Valley, has been placed in operation, and is furnishing 3500 horse power with the present equipment, and is capable of developing 7000 horse power. With the opening of the new plant announcement has been made that the company will supply electricity for the Yakima Valley Transportation Company's lines when put in operation, and another sub-station will be built in this city. The company also proposes to furnish electrical energy for the various manufacturing plants near North Yakima and in the city, and will also extend its lighting system into the farming districts.

OLYMPIA, WASH.—The fire, light and water committee of the Council has been instructed to enter into a contract with the Olympia Light & Power Company to supply the city with electricity for street lighting for a term of three years.

PASCO, WASH.—William H. Perry has been appointed receiver of the Pasco Power & Light Company. Application for a receiver was made by F. T. Blunck, of Davenport, Ia., in his own behalf and that of other creditors, to protect and preserve the property of the company for the benefit of the creditors. He states that the company has unlimited resources, but cannot obtain funds to operate with on account of the stringency of the money market

SEATTLE, WASH.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 17 for naval supplies to be furnished at the navy yard, Puget Sound, Wash., as follows: Schedule 513—electric wire, conduit, switchboard cabinets; schedule 515—cable, steel, copper pipe, etc.; schedule 517—incandescent lamps, etc. Applications for proposals should designate the schedule desired by number. Blank proposals will be furnished upon application to the navy pay office, Seattle, Wash., or to the bureau. E. B. Rogers is paymaster general.

TOPPENISH, WASH.—Everett Bohannon, who has the franchise for installing an electric light plant in Toppenish, has placed orders for machinery and poles necessary for a lighting system. Work will commence on the system as soon as the material arrives.

ELKINS, W. VA.—C. C. Bosworth, superintendent of the Valley Improvement Company, writes that the Valley Improvement will reorganize under the name of the Elkins Power Company and will build an entirely new plant, reconstruct its lines, etc. The company has secured a new franchise for 50 years, and the city contract for lighting has been ex- [illegible] street lighting will be installed as soon as the plant is ready to furnish current. The present 110-volt, single-phase, 60-cycle system will be replaced with a 2200-volt, three-phase system. Either coal or natural gas will be used for fuel. The company at present is operating under the name of the Valley Improvement Company.

ASHLAND, WIS.—A. E. Appleyard, head of the Chippewa Valley Construction Company, who recently entered into an agreement with the Council for the construction of a new street lighting plant and the development of the Copper Falls water power, will complete the organization of his new company, which will be known as the Ashland Power Company. He states that he completed financial arrangements for the proposition.

LA CROSSE, WIS.—The Winona City Council has passed an ordinance giving the La Crosse Water Power Company permission to erect its transmission lines from the Hatfield dam into the city over the high wagon bridge.

MINERAL POINT, WIS.—The Mineral Point Electric Company has filed an amendment to its charter increasing its capital stock from $25,000 [illegible]

STANLEY, WIS.—The Northwestern Lumber Company has contracted with the city to furnish 26 electric lamps.

WITTENBERG, WIS.—[illegible] a proposition to the Village Council to furnish the village with a certain number of [illegible] proposition to the village of Eland to furnish electricity for lighting.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has purchased a charter from William Farrell, S. G. Faulkner and the estate of the late Dr. Lefeyre, giving it the right to build an electric railway between Vancouver and the international boundary line, at or in the vicinity of Blaine. The company has also secured an option of purchase of water rights on the Lillooet River, which were secured two years ago by Hermon & Burwell, engineers, of Vancouver.

BELLAIRE, ONT.—A committee has been appointed by the Board of Trade to interview the officials of the Grand Trunk Railway in regard to the construction of an electric railway to the cement works.

GODERICH, ONT.—The Ontario & West Shore Railway contemplates the construction of an electric railway between Goderich and Owen Sound. The townships along the line will submit by-laws in the near future guaranteeing their share of the bonds of the road to be voted on soon. The cost of the road is estimated at $20,000 a mile.

HAMILTON, ONT.—The Hamilton Electric Radial Railway Company will ask the next session of Parliament for power to extend its lines to Toronto.

HAMILTON, ONT.—Application will be made at the next session of Parliament for an act to incorporate the Ontario & Michigan Power Company with the right to acquire and operate water powers on the Nipigon River and the Pigeon River in the Thunder Bay district.

HAMILTON, ONT.—The City Council has decided to submit the by-law to the people for the issue of debentures to the amount of $225,000 for the purpose of installing a municipal electric light plant. The Council also passed the second reading of the by-law to issue $50,000 in debentures for electric pumps for the new water works at the Beach.

HAMILTON, ONT.—J. Reid Hyde, of the Colonial Engineering Company, Ltd., of Montreal, Que., has submitted a proposition to the City Council for furnishing electricity for lighting the city. The company agrees to install a producer gas engine plant and furnish arc lamps for street lighting for $30 per lamp per year, and to furnish electricity for lighting and power purposes from one and one-half cents to two and one-half cents per kw-hour. The company is now installing a plant at Chatham.

INGERSOLL, ONT.—The public utilities committee of the City Council has made arrangements with Ross & Holgate, electrical engineers, of Montreal, Que., to furnish the Council with a valuation of the plant of the Ingersoll Electric Power & Light Company. The Council contemplates purchasing the plant to be operated by the town.

PARRY SOUND, ONT.—The Ontario Railway and Municipal Board has been asked to approve a by-law of the town of Parry Sound providing for the issuance of debentures for the purpose of extending and improving the electric light and water works system of the town.

ST. THOMAS, ONT.—Estimates have been submitted to the City Council by the Hydro-Electric Power Commission providing for a distributing plant costing $42,493. The estimates provide for the construction of two branch lines through the city.

TORONTO, ONT.—It is stated that if the city decides to install a municipal electric light plant the Cataract Power Company will ask for an opportunity to bid for furnishing power for operating the system.

TORONTO, ONT.—The Board of Control of Toronto proposes to construct an electric spur railway from Cherry to Leslie Street to feed the industries at Ashbridge's marsh. The cost of the work is estimated at $90,000.

TORONTO, ONT.—The Colonial Engineering Company, of Montreal, Que., has submitted complete plans to furnish a complete electric light and power station and equipment including all exterior and interior [illegible] equip the plant and have it in successful operation within two years of [illegible]

TORONTO, ONT.—The City Council on Nov. 25 voted to submit the by-law to the people in January, to provide for the issue of $2,750,000 in bonds for the construction of a plant to distribute the electric power [illegible] Falls. The plant will provide for 1500 street lamps, power to be delivered to pumping stations and for lighting of the public buildings.

TORONTO, ONT.—[illegible] given by the Hydro-Electric Power Commission to the towns of Belleville, Kingston and Deseronto, which are outside of the Niagara power zone. The estimates presented are calculated on the basis of an offer of power made by the Northumberland Paper & Electric Company, of Campbellford. The prices are as follows for 24-hour service stepped down ready for distribution: For Belleville, a minimum of $30.44 to a [illegible]

Company Elections.

HOPKINSVILLE, KY.—[illegible] Home Telephone Company held recently, the following officers were elected for the following year: R. E. Cooper, president; W. T. Fowler, [illegible] counsel.

MURPHYSBORO, ILL.—The Murphysboro Electric Railway, Light, Heat & Power Company, which was recently organized to build an interurban railway between Murphysboro to Carbondale, has elected the following officers: P. H. Eisemeyer, president; W. C. Alexander, vice-president and manager; John G. Hardy, secretary and treasurer.

TRENTON, N. J.—At the annual meeting of the Interstate Telephone Company, held Nov. 25, the following officers were elected: H. R. Swartz, president; William S. Hancock, vice-president; Barker Gummere, secretary; C. W. Wright, treasurer, and F. A. Demarest, general superintendent.

New Industrial Companies.

AMBOS-CUDMORE COMPANY.—[illegible] Cleveland Electrical Supply Company, have incorporated the Ambos-Cudmore Company, with headquarters in the Citizens' Building, Cleveland. The new concern will act as selling agents for the Weston Electrical Instrument Company, the Bristol Company, W. H. Bristol, Condit Electrical Manufacturing Company, Steel City Electric Company, Enameled Metals Company, Machen & Mayer Electrical Manufacturing Company, Pass & Seymour, Duncan Electrical Manufacturing Company, Hartford Time Switch Company and the Detroit Insulated Wire Company. The firm will also handle switchboards.

THE CORNING MOTOR & ENGINE COMPANY, [illegible], N. Y., has filed articles of incorporation, with a capital stock of $50,000. The directors are: Charles C. Clark, Merrill S. Baker, of Corning, and Laverne [illegible], N. Y.

THE REX ROTARY GAS ENGINE COMPANY, of Jersey City, N. J., has been incorporated, with a capital stock of $500,000, by Henry M. Black, Joseph W. Keffer and John J. Hogan.

THE STANDARD ELECTRIC HEADLIGHT COMPANY, of Indianapolis, Ind., has been incorporated, with a capital of $50,000. J. A. Overman, W. S. VanBuskirk and C. H. Lewis are the directors.

New Incorporations.

BIRMINGHAM, ALA.—The Oliver Electric Company has been incorporated with a capital stock of $6,000 by S. W. Oliver and others.

BOONEVILLE, ARK.—The Booneville Ice, Light & Cold Storage [illegible] Latimer, G. A. Bryant and others.

TELLURIDE, COL.—[illegible] the Beaver River Power Company with the Secretary of State. The company proposes to generate and transmit electricity for light and power in Telluride. The officers of the company are: L. L. Nunn, president; L. B. Fuller, vice-president; Eldon P. Brown, secretary, and L. Bierbach, treasurer.

CARBONDALE, ILL.—The Citizens' Water, Light & Power Company, which is now being organized, will have a capital stock of $75,000. The incorporators are C. E. Hamilton, J. S. Lewis and L. R. Harrington.

KEOKUK, IA.—Articles of incorporation have been filed for the Keokuk & Columbus Junction Transit Company. The company is capitalized at $10,000, and the directors are J. E. Peterson, president; Ira W. Wells, W. J. Francey, Theodore Brinck, G. W. Mattern, D. B. Hamil, D. B. Weil and others.

WICHITA, KAN.—A company is being organized, to be known as the Wichita Light, Heat, Power & Space Company, for the purpose of furnishing heat, light and power to small manufacturers.

PADUCAH, KY.—Articles of incorporation have been filed for the Foreman Brothers Electric Company, with a capital stock of $20,000. The incorporators are S. E. Foreman and others.

PORTLAND, ME.—The American Transit Company has filed articles of incorporation with a capital stock of $260,000, by J. E. Menter, president, C. E. Eaton, clerk, and M. W. Baldwin, all of Portland.

FOWLERSVILLE, MICH.—The Fowlersville Light Company has been organized with a capital stock of $15,000. The incorporators are Lewis P. Cody, Amazon Antisdel and others.

OREGON, MO.—The Oregon Interurban Railway Company has made application to the Secretary of State for a certificate of incorporation with a capital stock of $60,000. The company proposes to build an elec[illegible] The incorporators are: Benjamin F. Morgan, Lewis I. Moore, Charles [illegible] Zachmann.

ZANESVILLE, OHIO.—[illegible] Leckrone, Harris Love, George F. Shrider and E. Leerone.

OKLAHOMA CITY, OKLA.—[illegible]

TOPEKA, KAN.—[illegible]

[illegible] Railway Company [illegible] with the Secretary [illegible] proposes [illegible] Morgantown [illegible] president [illegible] W. [illegible] and W. [illegible]

PHILADELPHIA, PA.—The [illegible] has been granted a charter by Governor Stuart. The company proposes to supply light, heat and power in the city of Philadelphia. James Collins [illegible]

[illegible] David Horn, Alfred Teter and others.

WEST CHESTER, PA.—The West Chester & Wilmington Electric Railway Company has applied to the Secretary of State for a charter to build an electric railway along the West Chester and Wilmington Turnpike between the two cities, a distance of 18 miles. The company is capitalized at $54,000, and the officers are: T. E. O'Connell, president, [illegible]

GANN VALLEY, S. D.—The Buffalo County Telephone Company has been incorporated with a capital stock of $25,000 by J. V. Drips, Arthur [illegible]

FRIZEVANT, TENN.—The [illegible] Telephone Company [illegible] organized for the purpose of establishing an independent system. O. C. Sloan was elected president and Nevins Arnold secretary.

BAIRD, TEX.—The Farmers' & Merchants' Gin, Light & Ice Company [illegible] incorporated [illegible] capital stock [illegible] P. H. Crook and B. Graham.

AMHERST, VA.- The Amherst Electric Light & Power Company has been incorporated with a capital stock of $15,000 to establish an electric [illegible] plant. [illegible] contract [illegible] been awarded [illegible] The officers of the company are: H. L. Page, president; H. C. Joyner, vice-president; O. V. Hanger, secretary; and J. E. Bowman, treasurer.

WHEELING, W. VA.—The Mozart Improvement Company has filed articles of incorporation, with a capital stock of $10,000. The incorporators are Edmond M. Kirchner, Harry L. Hesse, Emma K. Kirchner, Elizabeth R. Hesse, all of Wheeling, and William R. Harper, of Bellaire. The company proposes to construct and maintain plants for generating electricity for heating, lighting and power purposes. The chief works of the company will be in Union District, Marshall County, W. Va.

COTTAGE GROVE, WIS.—The Cottage Grove Telephone Company has been incorporated with a capital stock [illegible] others.

MILWAUKEE, WIS.—The [illegible] Power Company has been incorporated with a capital stock of $120,000 by Cyril J. Atkinson and others.

NESHKORO, WIS.—Articles of incorporation have been filed for the Neshkoro Telephone Company, with a capital stock of [illegible] T. Dahlke, J. F. Krueger and Charles A. Marks.

SEYMOUR, WIS.—The Culbert Valley Telephone Company has been organized and the following officers elected: J. J. Culbert, president and manager, and A. L. Clark, secretary and treasurer.

WAUPACA, WIS.—The Baldwin Mills Telephone Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are: E. T. Mather, Charles Rasmussen and Taylor Looker.

Legal.

[illegible] PLANT FOR ORANGE.—[illegible] Nov. 18, handed down a decision in the case of Herbert Lighthipe against the city of Orange, Crocker-Wheeler Company and Western Electric Company. The case was the review of an award by the Orange Common Council for a street lighting plant. The court held that Orange is not within the class of cities in the act of 1906 authorizing such plants. The resolutions and contracts are set aside, and the question of costs reserved. [illegible] the city, but the latter took an appeal.

[illegible] PURPOSES.—A city owning and operating an electric light plant, under a statute empowering cities to provide for lighting the streets, etc., may, after discharging its duty to the public, sell its surplus electricity to private citizens for lighting. So long as the affairs of a city are conducted by its council in a reasonably judicial manner, its acts will not be interfered with by the courts, unless it is transcending its powers, or a clear right has been withheld, or a wrong perpetrated or threatened; and one seeking to restrain a city owning and operating such an electric light plant to light its streets from selling electricity to private persons for lighting must show that the city did not sufficiently light its streets, and that it was financially able to extend its system for lighting its streets. Of course, if the sale of electricity for private purposes resulted in a material impairment of the lighting of the streets of the city, there would be some ground for interference by the courts. Crouch et al. vs. City of McKinney, Court of Civil Appeals of Texas, 104 S. W. Rep. 518.

EDISON PHONOGRAPH.—At Newark, N. J., on Nov. 29, a general [illegible] in the chancery suit brought by John W. Slater and other minority [illegible] New England Phonograph Company [illegible] have suffered damage by reason of the alleged violation on the part of the defendants of certain alleged territorial license rights of that company. The answer makes reference to similar suits brought against Mr. Edison and the phonograph companies bearing his name, by James L. Andem, who is also one of the complainants in this suit. Mr. Andem was recently arrested on a warrant issued by the United States Circuit Court for the District of New Jersey, charging him with having filed a "forged bill," to which he, as the "pretended secretary of the New England Phonograph Company," attested a blank wafer as being the genuine seal of the company. The Edison answer consists of 46 typewritten pages, to which are added 55 pages of schedules, and goes minutely into the details of the relations of the phonograph companies, and the involved litigation growing out of disputes over the patent rights and business agreements.

RIGHT OF TELEPHONE COMPANY TO ERECT TELEPHONE POLES IN CITY STREETS.—The owner of property abutting on Townsend Street, in the city of Syracuse, N. Y., brought an action against the Independent Telephone Company, of Syracuse, to restrain that company from erecting a telephone pole in front of his premises and stringing its wires thereon. The ground of the action was that the putting up of telephone poles along that street was not a proper use of the street and that it could not be done without compensating the owners of the abutting property for the additional burden so imposed. The plaintiff's premises were situated within half a mile of the center of the city of Syracuse, which city enjoys a population of over 100,000 persons, and the telephone company was the owner of a franchise granting to it the right to erect its line along the street in question. It was held that the company was making a proper use of the street, and that the plaintiff had no legal cause for complaint. Where the abutting owner owns to the middle of the street, which, as a rule he does, and the street is located in a rural district, and may properly be classed as a country road, the maintenance of a telephone line between the center line and the exterior line of the highway constitutes an additional burden not contemplated by the original dedication of the highway and not within the scope of the public use. And in such rural districts the owners of land abutting on the highway may restrain a telephone company from placing poles in front of their premises, unless the company has secured that right by grant or condemnation. But a distinction has been drawn between city streets and rural roads in New York, and the erection and maintenance of a telephone line along a city street is held by the New York decisions to be within the public easement and a proper street use which cannot be interfered with by the abutting owners. Gannett vs. Independent Telephone Company of Syracuse, New York Supreme Court, 106 N. Y. Sup. 3.

PROSECUTION FOR CUTTING TELEPHONE WIRES UNDER MISSOURI STATUTE.—Two employees of a telephone company were tried and convicted upon a charge of cutting wires of a telephone line owned by a partnership known as "Farmers' Bolivar & Van Telephone Company," and located in Polk County, Mo. The partnership was composed of a number of farmers who had joined for the purpose of operating a local telephone exchange, and they constructed their line so that it crossed the company's line at two places, the wires of the farmers' partnership being strung at some distance above those of the company. The company's employees, feeling that on account of the inferior construction of the farmer's line, the wires might become detached from the poles and fall across the company's wires, and thus interfere with the service of the company to its patrons, determined to provide against such a contingency. This they accomplished by severing the wires. The statute under which the defendants were prosecuted designated the act of cutting telephone wires as a misdemeanor, and on appeal it was shown that a subsequent statute was enacted which raised that offence to the dignity of a felony. Thus the court was confronted by the anomaly of a single act being defined as a misdemeanor in one section of a statute and as a felony in another, and it was argued that the statute under which proceedings were taken against the defendants was repealed by the new statute which made their act a felony. This contention was supported by the court and it was held that, while the defendants' lawless acts could not be defended from any reasonable standpoint, and while the defendants should be adequately punished for what [illegible] others, the judgment would have to be reversed for the reason that defendants were prosecuted under the provisions of a statute which was no longer in effect. State vs. McKee, Kansas City Court of Appeals, 104 S. W. Rep. 486.

GETTING A SHOCK PURPOSELY.—In the case of Johnston versus the New Omaha-Thomson-Houston Company, the Supreme Court of Nebraska has decided against the plaintiff for contributory negligence. It held that an ordinary bright and intelligent boy, 12 years old, living in [illegible] city in which electric light and power wires are in constant use on [illegible] all the principal streets and highways, who, having knowledge of [illegible] danger, but not of its extent, purposely takes hold of such a wire in order to obtain a shock, and is injured thereby, is as a matter of law [illegible] of contributory negligence. The decision says: "The circumstances [illegible] the accident themselves are such that all these questions may be [illegible] in favor of the plaintiff and still there can be no recovery. [illegible] were five boys in the party. One of them climbed upon the fence [illegible]

plaintiff's son climbed partly up the fence apparently with like intent, and his companions scared him down. Then he told them to go on to one side so as to be out of the way if he happened to fall, and then he climbed up again and touched the wire, and received the shock and consequent injury of which complaint is made. The evidence establishes several things without contradiction and conclusively. Electricity is a mysterious power, but in many of its common manifestations is not, and has not been for many years, an unknown force. It is a matter of common knowledge that electric light and power wires carry powerful and death-dealing currents, and that they are the frequent cause of severe and fatal accidents, and that ordinary prudence requires all persons to avoid contact with them, especially if they are imperfectly or defectively insulated. The evidence establishes conclusively that the plaintiff's son was an ordinarily bright and intelligent lad, 12 years of age, who lived in the city and knew that the wire carried a current sufficiently powerful to light the circuit of which it was a part, and knew that, because of defective insulation or other defect at the place in question, such current was capable of being diverted into the body of any person coming in contact with it, and knew that shortly before that time it had been so diverted, and had thereby caused a shock or injury more or less serious to the person of another boy. That he anticipated an injury of some degree to himself is undeniable, because what he deliberately sought was a 'shock,' which is nothing less than an injury. Whether he also anticipated its extent or degree is not known, but that he supposed that it would be of considerable severity is shown by his caution to the other boys to stand out of danger in case of his fall."

Obituary.

Prof. C. P. Matthews.

PROF. C. P. MATTHEWS.—It is with deep regret that we record the death of this well-known educator at Phoenix, Ariz., on Nov. 23. Charles P. Matthews was born at [illegible]ington, N. Y., Sept. 18, 1867. He received his primary education in the schools of his native town, and entered St. Johnsbury Academy, St. Johnsbury, Vt., in 1885, from which he was graduated in 1887. After a year in business he entered Sibley College, Cornell University, and was graduated with the degree of M. E. in [illegible]. In [illegible] he received the degree of Ph. D. from Cornell, the subject of his Doctor's thesis being "On Certain Photometric Apparatus and the Results [illegible] Obtained." After [illegible] Prof. Matthews engaged chiefly in teaching [illegible] engineering, but during vacation periods [illegible] during term time, took up various [illegible] engineering work. The [illegible] Company, the summer of 1902 in the National Bureau of Standards at Washington, and the winter of [illegible] the Electrical Testing Laboratories at New York City. From time to time he acted as consulting engineer, chiefly on matters in connection with electric lighting. From 1892 to 1896 he was instructor in physics and applied electricity at Cornell University, and in the latter year went to Purdue University, Lafayette, Ind., as associate professor [illegible] engineering at Purdue, and upon the resignation of Professor W. E. Goldsborough [illegible] of that university. Prof. Matthews was for four years photometrist for the [illegible] all the experimental work and designed the apparatus wherewith to carry [illegible] existence. Prof. Matthews was the patentee of an integrating photometer [illegible] determining the candle power of incandescent lamps and other sources [illegible] to him, and meant at last, with increasing ill health, the abandonment of [illegible]

[illegible] WEBSTER [illegible] Windsor Hotel, Jacksonville, Fla., on Dec. 2. His wife reached Jacksonville at 2:20, just after his death. He was a director in the National [illegible] Company. He lived in Lynn, Mass., with an uncle, the late Edwin Johnson, who practically adopted him. He started his career as a clerk in the [illegible] with a lawsuit by Mr. Lawson, who charged that Webster had violated [illegible]

Personal.

MR. THOMAS W. FINUCANE has tendered his resignation as president of the United States Independent Telephone Company, of Rochester, N. Y., and as chairman of the company's executive committee, to take effect immediately.

MR. CHARLES T. McDANIEL, of Omaha, Neb., has been appointed general manager of the Ozark Bell Telephone Company, of Ozark, Mo., succeeding Mr. C. C. Schoen, resigned. Mr. McDaniel was formerly manager of the Nebraska Telephone Company at Omaha.

MR. CASPER E. YOST, president of the Nebraska Telephone Company and of the Iowa Telephone Company, has been elected president of the Northwestern Telephone Company. He will attend to the executive affairs of the three companies at his present office in Omaha.

MR. J. R. VAN DYKE, manager of the Rocky Mountain Bell Telephone system in the Cœur d'Alene district, has resigned, and will engage in other business. He is succeeded by Mr. Fred C. Lewis, acting assistant superintendent under Mr. R. E. Hart, of the Cœur d'Alene branch.

MR. H. J. PETTINGILL, president of the Northwestern Telephone Company for the past three years, has resigned and will devote his entire time hereafter to the Southwestern Telegraph & Telephone Company, of which he has been president for three years. His headquarters will be at Dallas, Tex.

MR. L. H. TAYLOR, who for several years has been connected with the U. S. Reclamation Service, latterly in charge of the Truckee-Carson project in Nevada, and at the head of all geodetic surveys in that state, has accepted a position with the California-Nevada Power Company as supervising engineer. He is at present engaged on plans for reservoir sites in Nevada.

MR. W. B. T. BELT, of Omaha, Neb., has been appointed vice-president and general manager of the Nebraska Telephone Company to succeed Mr. H. Vance Lane, who was appointed president of the Rocky Mountain Bell Telephone Company, at Salt Lake City. Mr. Lane has been with the Omaha & Nebraska Company for 25 years, and [illegible] superintendent for some time, and is succeeded by Mr. A. S. Kelly.

MR. R. A. MACGREGOR, formerly commercial agent of the Wyoming Valley Gas & Electric Company at Plymouth, Pa., has been transferred to the Chicago office of the C. H. Geist Company in the position of manager of the commercial department. The Geist Company controls plants at Michigan City, Valparaiso, Hammond and Plymouth, Ind., as well as the other plant in Plymouth. Mr. MacGregor was formerly with the West Penn. Railways Company. The headquarters of the Geist Company are in the Commercial National Bank Building, Chicago.

MR. R. H. STERLING, of San Francisco, Cal., formerly connected with some of the constituent companies of the California Gas & Electric Corporation, and more recently general manager of the Coast Counties Light & Power Company, at San José, Cal., has been appointed general manager of the American River Electric Company, with headquarters in Stockton, Cal. He will have general charge of the company's hydro-electric plant, transmission system and sub-stations. Col. W. R. Johnson still retains the position as manager of the company's local office in Stockton.

Trade Publications.

VERTICAL GAS ENGINES.—The S. M. Jones Company, Toledo, Ohio, has issued a well illustrated circular devoted to Rathburn vertical gas engines. These engines are built in ratings of from 50-hp to 300-hp in the two-cylinder and three-cylinder types; twin three-cylinder engines are offered in ratings of from 150-hp to 600-hp. The six-cylinder engines are particularly designed for running 60-cycle alternators in parallel.

VITRIFIED CONDUITS.—The Rochester Sewer Pipe Company, Rochester, N. Y., has issued an eight-page folder descriptive of its vitrified conduits, and containing specifications, information and suggestions. The folder shows the various styles of conduits, both single and multiple duct, and gives complete dimensions and weights of each style. It gives a brief summary of the results accomplished in the manufacture of these goods. While very brief, the circular is decidedly interesting.

HUNTING PICTURES.—Mr. John S. Speer, of the Speer Carbon Company, St. Marys, Pa., the well-known manufacturers of the Speer high-grade carbon brush, is sending out to his friends a collection of hunting and fishing pictures. These pictures are 12 x 14 inches, mounted on dark green cardboard, and are exceedingly attractive. Mr. Speer will be glad to send a set of these pictures to any one using carbon brushes, and who will write to him upon the official letter head of the [illegible]

[illegible] and red cloth, gilt lettered. It has no fewer than 784 pages and thou[illegible] and priced. There is no index, but all the articles are grouped and the classes follow each other alphabetically. It is altogether a most admirable, creditable and useful publication. A discount sheet that is issued with [illegible]

Behrend, chief electrical engineer of the company, and allows the most important data to be obtained as to performance while the machines are still in the shop, the machines being subjected to full load conditions without putting them under full load. A copy can be obtained by any electrical engineer on request.

H. B. CAMP COMPANY, New York, Pittsburg and Chicago, has just issued another of its clever broad sheets, illustrative of the modern use of the telephone as compared with older methods of communication. It is got up like a large etching with tone background, and black paper mount, and is entitled, "From Waterloo to Mukden." A Japanese field officer is shown with map on his knee, using the telephone while a shadowy Cossack flees in the background. In the lower corner is a block of Camp conduit and the name of the company. The whole thing is very clever.

PORTLAND CEMENT.—An effective pamphlet has been issued by the [illegible] "Dragon" Portland Cement. In addition to instructions in detail for the application of hydraulic cement to numerous purposes, many well-engraved illustrations appear of buildings in whose construction "Dragon" cement was used, including concrete buildings. To catalogue makers the pamphlet will be of interest because of its cover design, an excellent effect being produced by simple but artistic means, as contrasted with the garish use of colors and draftsmanship on the usual catalogue cover.

WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has just isued a handsome quarto descriptive catalogue in green and gray paper cover, devoted to its electrical instruments of precision. It is Bulletin No. 79, and contains 32 pages, with a large folder of the scales employed in various types. It is now some ten years since the Wagner Company took up the design of alternating-current switchboard instruments for central-station work. This line has been followed up and worked out, and to it have been added direct-current instruments of equal reputation and merit. To all these the catalogue devotes space, as well as to detail apparatus such as compensators, instrument transformers, etc. A large amount of instructive data is crowded into the catalogue.

ELECTRIC LOCOMOTIVES.—"The Electric Locomotive in Heavy Passenger and Freight Work" is the title of Bulletin No. 4537, recently issued by the General Electric Company, Schenectady, N. Y., in which is described a large number of present and proposed locomotives built and planned by the company. Sketches are given of locomotives ranging from 17 to 150 tons for all classes of service, including mining, high-speed passenger, slow-speed freight, mountain-grade trunk lines, etc. Electrical and mechanical data are given and characteristic curves for each locomotive are shown. A short preface describes the reasons for the growing demand of electric traction, and gives interesting facts regarding the construction and characteristics of the General Electric heavy traction motors and locomotives, with figures relative to the saving effected by the substitution of electric for steam traction in both passenger and freight work. Bound in a flexible brown cover, the publication forms a ready reference book on the subject.

SINGLE-PHASE MOTORS.—The field for single-phase motors of moderate capacity is constantly growing by reason of the increasing tendency of central stations to generate polyphase current and feed a large portion of the lighting load through single-phase distribution. The General Electric Company, Schenectady, N. Y., has perfected a simple and substantial motor for this class of service. It is known as the Type IS, form KG, and is described in Bulletin No. 4545. The bulletin illustrates various sizes, describes the details of construction and operation, shows forms of starting boxes, and gives a large amount of general information, useful and important to power users. The motors are well adapted to the operation of all kinds of machines, by the use of belts and gears, and may be directly connected to loads requiring moderate starting torque. Clutch couplings and pulleys are used where the [illegible] for standard voltages and frequencies.

CONCENTRIC AND INVERTED DIFFUSERS.—In order to improve the distribution of light from enclosed arc lamps and adapt them to severe requirements, the General Electric Company, Schenectady, N. Y., has introduced the concentric light diffuser. Bulletin No. 4542, recently issued by the company, describes the device and illustrates many of its applications. It consists of a suitably designed metal diffuser attached to a lamp casing in the same manner as an ordinary reflector or shade. In place of an outer globe, a screening shade is used, which performs the double function of subduing the light directly under the lamp and reflecting a portion of it on to the diffuser. Some of the advantages claimed for this method of illumination are that the light is white, even and well distributed; that it does not tire the eyes; that the illumination is particularly adapted to the matching of colors, and that the nature or color of the ceiling does not affect the character of the illumination. Inverted diffusers have been designed to meet the demands which exist for a reflector producing a more concentrated illumination, and are used without the lower screening shades. The bulletin gives a partial list of the many installations in department stores, factories, machine shops, armories, public halls, colleges, etc., where the apparatus is in use, and includes some important data on the subject of arc lighting.

Business Notes.

THE HELIOS MANUFACTURING COMPANY, builder of arc lamps and storage batteries, has moved its New York office from 18 East Forty-Second Street to the World Building, Park Row.

THE WESTERN ELECTRIC COMPANY, of Chicago, Ill., has leased the old quarters of the First National Bank, at Third and Walnut Streets, Cincinnati, Ohio, where it will locate a branch office in that city.

ELECTRIC SERVICE SUPPLIES.—Mr. R. G. Widdows, formerly associated with the Cutter Company at Pittsburg, has recently been added to the staff of the Electric Service Supplies Company, of Philadelphia, as a city salesman.

THE D. M. STEWARD MANUFACTURING COMPANY, whose factories are at Chattanooga, Tenn., and Toronto, Canada, has opened a New York office at 66 West Broadway. It is now in a position to give special attention to its New York customers from this office.

COLUMBIA LAMPS.—The Columbia Incandescent Lamp Company, of St. Louis, Mo., has opened a New England branch office at 280 Devonshire Street, Boston, where it proposes to carry a full assortment of lamps in stock for the service of its trade in that territory.

COMMUTATOR TRUING DEVICE.—Announcement has just been made that Jordan Brothers, 74 Beekman Street, New York City, have been awarded a silver medal diploma for their exhibit of the Jordan commutator truing device at the Jamestown Exposition, 1907. This award is the highest in its class. As is well known, the Jordan device trues commutators without removing the armature. The device can be attached to any machine. It consists of a grinding wheel set in ball-bearings and equipped with appropriate clamps whereby it can be fastened to a rocker arm or the motor frame, or the outboard bearing, according to the type of the dynamo or motor. The grinding wheel, which is of carborundum, contains no emery, and so cannot injure the commutator. The device is bolted in position so that its shaft is parallel to the face of the commutator and the grinding wheel just clears the commutator. It saves labor and time and increases the life of the commutator threefold. Among some users are the Holtzer-Cabot Electric Company, Brookline, Mass.; Canadian General Electric Company, Limited, Toronto, Canada; Caruthersville Ice & Light Company, Incorporated, Caruthersville, Mo.; Tennessee Lumber Manufacturing Company, Sutherland, Johnson County, Tenn.; Chambers Electric Light & Power Company, Truro, Nova Scotia.; Central Massachusetts Electric Company, Palmer, Mass.; Samuel J. Shimer & Sons, Milton, Pa.; John Van Benschoten, Poughkeepsie, N. Y.; Kuehn Electric Com- [illegible]

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

AMERICAN ELECTRO-THERAPEUTICAL ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

[illegible] Secretary, Walter S. Mower, London, Ont.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

[illegible] Secretary, [illegible] Lucas, 10th and Sansom Sts., Philadelphia, Pa.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 102 Confederation Life Building, Toronto, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Mulholland, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

[illegible] ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electrical Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

Engine Builders' Association of the United States. Secretary, J. J. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New England, Philadelphia, Pittsburg and Chicago. Meetings in New York, second Thursday of each month.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Secretary, Charles West. Next meeting, Chicago, January 21, 22 and 23, 1908.

Iowa Electrical Association. Secretary, [illegible]

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Missouri Independent Telephone Association. Secretary, Houck McHenry, Jefferson City, Mo.

Missouri State Electric Light Association. Secretary, C. Z. Pierson, St. Charles, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. W. Freeman, [illegible]

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

National Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn. Next meeting, Chicago, January 21, 22 and 23, 1908.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Charles W. Ford, Oklahoma City, Okla.

Old Time Telegraphers' & Historical Association. Secretary, John Brant, 195 Broadway, New York.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

South Dakota Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electric Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. [illegible]

[illegible]

[illegible] APPARATUS FOR [illegible] WATER-TIGHT BULKHEAD DOORS; Robert H. Kirk, Cleveland, Ohio. [illegible]

[illegible] ELECTRIC TRAIN [illegible] Columbus, Ohio. App. [illegible] train from a dynamo carried by the wheel axles and including [illegible]

[illegible] FUSE [illegible] internal parts thereof to any flame, the arc being extinguished as soon [illegible]

[illegible] SHAFT OSCILLATOR [illegible] filed April [illegible] relation to the end of the shaft and circuit-closing means is arranged to intermittently energize the same so as to vibrate said shaft. The switch is controlled by the combined longitudinal and rotary movements of the shaft.

871,913. TROLLEY WHEEL BEARING; William M. Casewell, Warren, Pa. App. filed June 6, 1907. The trolley wheel bearing has an oil cup disposed therein so as to prevent the oil from running out of the bearing when the trolley wheel leaves the wire and the pole flies upwardly to a vertical position.

[illegible] PROCESS FOR THE MANUFACTURE OF WHITE LEAD; Frank W. Morris, Victoria, British Columbia, Canada. App. filed Dec. 28, 1906. Relates to a process for manufacturing carbonate of lead; produces formic acid by electrolytic action and utilizes said acid in the subsequent reactions.

[illegible] PROCESS FOR THE MANUFACTURE OF CYANIDE OF POTASSIUM OR SODIUM; Frank W. Morris, Victoria, British Columbia, Canada. App. filed Dec. 28, 1906. Relates to modifications [illegible]

871,960. SIGNALING SYSTEM; Wilmer W. Salmon, Buffalo, N. Y. [illegible] energized track rails and polarized relays operated by the short cir- [illegible]

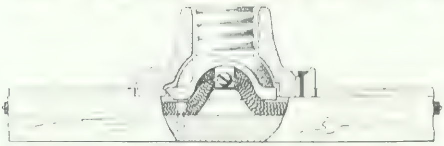
[illegible]

[illegible]

[illegible] ELECTRIC [illegible] [illegible]

[illegible] [illegible] strips.

[illegible] METHOD OF [illegible] [illegible]



[illegible] ting the [illegible]

[illegible] RAILROAD SIGNALING DEVICE [illegible]

[illegible] DOOR FASTENER AND OPENER [illegible] type in which the key is concentrically insertable in the doorknob.

[illegible] MOLDING RECEPTACLE [illegible] N. Y. App. filed June 29, 1906. A molding receptacle formed essen- [illegible] assembled therewith and which is adapted to properly guide the circuit wires into a position to make the connections so that they are [illegible]

[illegible] SUPPORTING AND CONVEYING APPARATUS [illegible] veying mechanism for use in electrolytic work for conveying plates [illegible] carrier and specially constructed tackle.

872,065. INCANDESCENT LAMP CLUSTER; Harvey Hubbell, Bridgeport, Conn. App. filed Oct. 13, 1905. A cluster lamp receptacle having a porcelain body with radially extending holes and a [illegible] central stud terminal for the lamps.

[illegible] TROLLEY SECURING DEVICE [illegible] frame surrounding the trolley wheel with upwardly extending swiveled hooks which close over the wire.

872,102. ELECTRIC STOP FOR ENGINES; James K. Wright, New York, N. Y. App. filed Feb. 4, 1907. Relates to engine governing [illegible] predetermined limits.

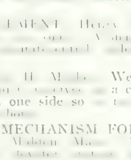
[illegible] MASSAGE IMPLEMENT [illegible] electric circuit.

[illegible] RAIL BOND [illegible] Westfield, N. J. App. filed [illegible] a conical plug with an eccentric hole and slotted on one side so [illegible]

[illegible],143. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; [illegible] brakes, slack cable controller and pilot circuits.

[illegible] PROTECTIVE SHIELD FOR SKELETON FRAME BELLS [illegible] provided for the shield.

[illegible] ADJUSTMENT FOR CONTACTS [illegible]



[illegible] the vibrator screw.

[illegible] ELECTROTHERAPEUTIC APPARATUS [illegible] mond, Brooklyn, and Joseph C. Vetter, Coney Island, N. Y. App. [illegible] cluding cylindrical casing having an induction coil and an additional cylindrical casing containing a battery, and connected so as to form [illegible]

[illegible] COMBINED CONTROLLER AND CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed April 9, 1907. Pro- [illegible] spond during [illegible] period [illegible]

[illegible] MEANS FOR PROTECTING OPERATORS [illegible] LEADS [illegible]

[illegible]

[illegible] PILLAR [illegible] APPARATUS [illegible] and their meeting surface.

[illegible] ELECTRIC SWITCHING DEVICE [illegible] point.

[illegible],204. APPARATUS FOR FUMIGATING TELEPHONE INSTRUMENTS; Louis I. Shrader, New Albany, Ind. App. filed May 29, 1907. A fumigator for telephone instruments comprising a casing provided with a receptacle for a fumigating agent, and also having an opening for the mouthpiece of a telephone transmitter, the said casing being adapted to be locked to and carried by the transmitter head through the intermediary of said mouthpiece, and said casing also having an opening for embracing the telephone receiver body with the hearing end thereof interior to the casing.

[illegible],208. INCLOSED RESISTANCE; Henry J. Wiegand, Milwaukee, [illegible] hollow insulating core and embedded in plastic material within a sheet-metal casing.

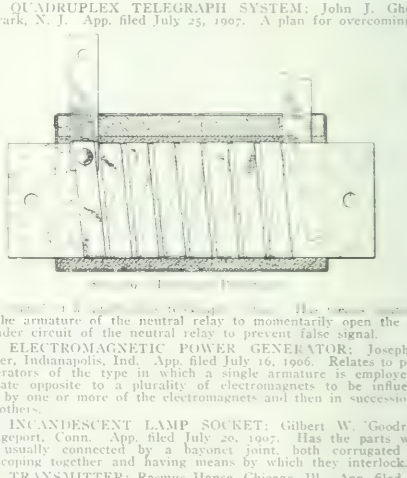
[illegible],209. INCLOSED RESISTANCE; Henry J. Wiegand, Milwaukee, Wis. App. filed Oct. 30, 1905. An inclosed resistance comprising a resistor, a casing therefor, and an insulating supporting member having said casing carried thereby.

[illegible],213. BATTERY SUPPORT FOR AUTOMOBILES; Samuel R. Bailey, Amesbury, Mass. App. filed Jan. 4, 1907. The battery box depends from the automobile chassis by four depending links having ball-bearing connections at their ends. The links are spring extensible to furnish a yielding support for the battery.

[illegible] AUTOMATIC ELECTRIC SWITCH [illegible] Brooklyn, N. Y. App. filed Jan. 6, 1905. A car-lighting system operated from a dynamo on the wheel axles and having a storage battery permanently bridged across the line and a cut-out switch for interrupting the series circuit of the dynamo.

[illegible],216. INSULATOR; Homer D. Bodley, Stanley, N. Y. App. filed [illegible] constituting a jaw with which co-operates a movable jaw impelled by a cam wedge.

[illegible],228. QUADRUPLEX TELEGRAPH SYSTEM; John J. Ghegan, Newark, N. J. App. filed July 25, 1907. A plan for overcoming the



[illegible] by the armature of the neutral relay to momentarily open the local sounder circuit of the neutral relay to prevent false signal.

872,251. ELECTROMAGNETIC POWER GENERATOR; Joseph L. Potter, Indianapolis, Ind. App. filed July 16, 1906. Relates to power generators of the type in which a single armature is employed to operate opposite to a plurality of electromagnets to be influenced first by one or more of the electromagnets and then in succession by the others.

872,283. INCANDESCENT LAMP SOCKET; Gilbert W. Goodridge, Bridgeport, Conn. App. filed July 20, 1907. Has the parts which are usually connected by a bayonet joint, both corrugated and telescoping together and having means by which they interlock.

872,284. TRANSMITTER; Rasmus Hanse, Chicago, Ill. App. filed Dec. 3, 1902. In a telephone transmitter, the combination of a chamber for granular material, carried by the casing, a main diaphragm situ- [illegible] electrode located in said chamber, and a connection between the main [illegible]

872,289. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; Edward D. Lewis, Elmira, N. Y. App. filed June 18, 1907. Provides means by which the motor field will be saturated in advance of the armature, the armature being entirely cut out during this initial [illegible] ing torque.

872,293. RINGING DEVICE FOR TELEPHONE EXCHANGES; William W. Dean, Elyria, Ohio. App. filed Aug. 8, 1906. An automatic ringing device for telephone systems, comprising a ringing [illegible] to momentarily close the relay circuit, short-circuit contacts controlled by the relay so that when energized it will lock itself, and non-inductive means controlled by the wanted subscriber to break [illegible]

[illegible] MEANS FOR AUTOMATICALLY CONTROLLING ELECTRIC MOTORS [illegible] electro-motive force in series with the armature of the motor and a regulator controlled by the work for automatically controlling the [illegible]

[illegible] ELECTRICAL MEASURING INSTRUMENT [illegible]

Electrical World

The consolidation of Electrical World and Engineer and American Electrician

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Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1906, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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During 1906 Electrical World *printed and circulated* 979,000 *copies, an average of* 18,827 *copies per week. Of this issue* 16,500 *copies are printed.*

NEW YORK, SATURDAY, DECEMBER 14, 1907.

CONTENTS.

Electrical Export Trade.

The general conditions of electrical export trade continue satisfactory as revealed by the figures for October. It would appear that for the ten months ending with October this year the total electrical exports were $14,864,463 as compared with $13,813,822 in 1906. This is a gain of over $1,000,000. It was all in heavier electrical machinery, as instruments fell off about $140,000, while machinery increased from $7,010,068 to $8,197,143.

The details for October itself bear more direct evidence of the slackening noted during the second half of the year. Electrical machinery for the month increased from $743,749 to $767,016 and electrical apparatus and instruments fell off from $863,287 to $690,898. It will thus be seen that the ten months' loss in apparatus is concentrated wholly in October. But it is to be borne in mind that October in 1906 gave some very excellent and exceptional figures, far above the monthly average. The loss was again almost wholly in shipments to the United Kingdom, the falling off being from $222,900 down to the remarkably small amount of $54,161. On the other hand, Brazil showed a gain from $51,896 to $174,057. In heavy electrical machinery, the gains were well distributed for the month and period, but Mexico made a big jump of $120,000 for the month and nearly half a million for the ten months. In other words, there is all around encouragement for the pushing of trade abroad, on the lower range of prices.

Annual Report of the British Institution of Electrical Engineers.

The report of the Council of the Institution of Electrical Engineers for the year ending in 1907, suggests some interesting comparisons between the Institutions of Electrical Engineers in England on the one hand, and in the United States on the other. In regard to membership, the English Institution still maintains the lead, its total membership being 5945 in 1907, as against some 5100 in the American Institute. On the other hand, the British membership is growing at the rate of only 2½ per cent per annum, whereas the American membership list is growing at a much more rapid rate, so that the American list seems likely to overtake the British list in the near future. In London, the membership is divided with a fair degree of uniformity between members, associate-members, associates and students; whereas, with us, only about one-eighth of the list consists of members, a somewhat similar fraction being students, while the bulk of the list consists of pure associates. Each of the Institutions maintains branches. In the British Institution five are in the British Islands and one in South Africa. In the American Institute there are more than 30 branch organizations, one of which is in Toronto.

The British Institution dispensed no less than nine annual premiums, in addition to five students' premiums. Since there were only fourteen papers read during the year, it is evident

that a large percentage of papers may reasonably expect to meet with a premium. If there were only a few more premiums annually awarded, it might be hard for an author to avoid receiving such an award. Nevertheless, the annual premium, within due limitations, no doubt constitutes a valuable incentive and index to the value of papers contributed. This feature might be adopted with advantage by the American Institute. The British Institution publishes, as an appendix to its report, a useful list of technical proceedings and journals kept on file in its library. Of these, among foreign transactions, 14 are from the United States, 7 from France, 5 from Germany, 3 from Canada, and 7 others collectively among Belgium, Holland, Italy, Russia and Sweden. Among foreign technical periodicals, 15 are from America, 17 from Germany, 10 from France, 4 from Italy and 6 others in all, from Austria, Denmark, Holland, Spain and Switzerland. If we assume that all the important publications from each country are kept on file, it follows that American representation is well maintained. A perusal of the report brings into clear recognition the fact that national engineering organizations are not only potent factors for national development, but also powerful forces directed to international cooperation.

Spark Coils.

We are glad to present to our readers Professor Springer's paper (page 1163) on the design and operation of spark coils. The whole subject is a somewhat intricate one which has been much neglected, and Professor Springer's comparatively simple analysis of the problem is most timely. The fundamentals of spark coil design are to produce a spark carrying the requisite energy and to do it at the smallest practicable outlay of energy, if the source of supply is a battery. When a magneto is used for ignition the output is of secondary importance, since the energy delivered by the machine is generally small with respect to the constant losses, and from any point of view is insignificant. The starting point is then output of energy in the spark necessary to secure good ignition. This is certainly rather variable according to the design and location of the spark plug and the circumstances of its use. For the ordinary four-cycle engine with gasoline as fuel, Professor Springer estimates the required energy in a touch-spark as 0.04 watt-second, running up to 0.1 watt-second in starting. The energy required with the more common jump-spark he does not state, save that in general it may be rather less than with a touch-spark, since the latter gets but one try at ignition as against several given by the vibrator. Obviously, however, it is advantageous to make each spark powerful enough to do the work, else the timing in a fast-running engine will be uncertain. An engine running at 20 or so revolutions per second cannot wait long for an effective spark.

Given the energy required in the spark, one can go about providing it intelligently, since this energy must be stored in the circuit and is directly proportional to the inductance and to the current squared. Professor Springer's equations give simple means of calculating from this requirement the relations of inductance, resistance and e. m. f. of supply desirable in any particular case. An examination of the conditions shows immediately the way in which the requirements for good service are constantly violated. A given coil requires for maximum effect a particular value of the applied e. m. f. at its terminals. If this is not available, either from too few cells or cells of too high resistance, there is bound to be trouble. An increase in current fattens the spark, it is true, but runs out the battery and may put the vibrator out of action or even damage the insulation of the coils. For battery work it is desirable to work the cells as efficiently as possible to secure long life, and this demands arranging the battery to suit the particular coil it is to operate. If one takes any convenient coil and the first battery he can lay his hands on, he has no reason to complain if the results are downright bad. Professor Springer goes at some length into the general characteristics of induction-coil design with respect to the size and shape of core, details which are both theoretically and practically interesting. Touch-spark coils and non-vibrating jump-spark coils require somewhat different design from coils to be used with vibrators, while the former two also have distinctive differences. The vital point in coils of the ordinary type is the vibrator, on which depends the sharpness of the break and the effectiveness of the resulting spark. The condenser also must be exactly proportional to the coil and its vibrator in order to give the best action.

In view of the investigation reported by Professor Springer it is time for coil builders to bestir themselves and to produce coils which have definite characteristics and known conditions of maximum efficiency. The sparking apparatus is vital in its importance and ought to be worked out with the utmost pains. The requirements in automobile work are particularly severe on account of the increasing demand for output at the battery and the lack of reliable batteries. It is not so much that the batteries are poor, as that they are often ill-adapted to the particular work demanded of them. It ought to be possible by careful design to produce a sparking system really suited to the required work, and making much less severe demand on the batteries than the helter-skelter combinations too frequently found. The saving in zinc might not be much, but the lessened wear and tear upon the disposition would be worth the price.

The "Concentric" Method of Teaching Electrical Engineering.

One of the papers read before the last convention of the American Institute of Electrical Engineers was on the so-called "concentric" method of teaching electrical engineering, by Prof. V. Karapetoff. In brief, the gist of this method consists in making outline courses on broad engineering methods precede the auxiliary sciences of mathematics, mechanics, chemistry and physics. In regard to teaching, as in regard to individual tastes, there is no complete agreement in detail. If we can agree on broad principles, we should be content. This is a necessary consequence of the fact that no two individual instructors have the same mental methods, or mental standpoints; and moreover, no two students have the same mental methods, equipments, experiences or receptiveness. All that can be hoped for in any educational establishment is such a course of studies as may be adapted to the average individual student, so that the best general result may be secured. The paper here considered will no doubt meet with assent, so far at least, as the proposition that students should not be forced to take preparatory courses in engineering when the subjects of these courses are purely theoretical and entirely remote from

practical applications. The reasons for this belief are not merely that such theory is not proper training for a man who is to have practical life work, but also that the interest of the student is seldom aroused by such abstract study; and unless the student's interest can be excited and maintained, the educational value of any course of study can be but little.

All will probably agree that an engineer should receive a good general training for the practical management of machinery, with an adequate knowledge of the laws and properties of the same, and should be trained in such a manner that his mind will be interested, aroused and normally developed by regular exercise. Differences of opinion arise as to the best method of securing this training. The difficulty with the method defined in the paper here considered is that the preliminary outline of engineering studies, entered upon before mathematics, mechanics and physics have been developed, may become so elementary and descriptive as to be almost popular discourses, and not call for sufficient mental effort from the student, however much they may interest and divert him. This is just the opposite extreme to the system held up to criticism by the paper—that is, long, difficult courses which seem to have no useful applications, which call for much mental labor but which do not produce the requisite mental development owing to lack of stimulus and interest. It really makes very little difference as to the course of study nominally followed, if the mode of treatment be properly selected. In the hands of good instructors, mathematics, mechanics, physics and chemistry for engineering students may be full of applications, replete with practical interest, and of stimulus to the student. On the other hand, in the hands of good instructors the outline concentric engineering courses recommended by the paper would contain ample material for mental application. In either case if the methods used are imperfect the results will be defective—in the concentric method due probably to vapidity, in the ordinary method, due probably to sterility. In teaching, it is as in soldiering, sailoring or any other walk in life; the individual men who carry on the business are of more consequence than the names of the methods they adopt.

It appears to us that, until a differentiation is made in technical education to accord with the widely different careers which are open to graduates, no entirely satisfactory system of instruction can be formulated. As it is, the course which would best meet the views of the manufacturer might be thought quite defective by the consulting engineer or central-station manager; and most parents will patronize that course which promises, through its practical training, a wage-earning status upon graduation, and will consider too "theoretical" a course which imparts only the principles upon which subsequent engineering practice must be based. The present-day system of technical education seems, in fact, to be largely a compromise to meet divergent lay views having an influence on college enrollment, and its discussion under these circumstances along purely educational lines cannot be otherwise than somewhat academic until the differentiation above referred to takes shape as a policy. This stage of evolution has already been reached in Germany, France and other European countries, where different classes of schools solve the problem now before those American colleges which endeavor, by means of a single course, to turn out men equally fitted not only for every grade of engineering work from designing engineer to generating room attendant, but also for the quasi-technical and non-technical positions which the electrical industry holds open to graduates.

Ionization in Air Within Closed Metallic Vessels.

Dry air, although electrically brittle, and not capable of withstanding much electric stress, is nevertheless perhaps the best insulating substance we know of, and fortunately there is plenty of it gratis. Text books on electricity, only a few years old, put air not only at the head of the list of insulating substances, but also as of infinite resistivity. Whenever an air-insulated brass sphere, supported, say, by a quartz fiber, was observed to lose its electric charge, the leak was always attributed to the imperfections of the quartz thread, and not to the unblemished air, in much the same fashion as the old doctrine that a king could do no wrong, but occasionally a prime minister, acting on a king's order, might do enough wrong to undergo capital punishment. More recent investigations concerning the insulating properties of air, especially since the discovery of radium emanation, have led to the unavoidable conclusion that air, after all, does leak electrically, even under very low pressures. It is now supposed that molecules of air are not the delinquents in the process of leakage, but that disrupted molecules carry off the electrical charge. It is also believed that a number of agencies may disrupt air molecules, or ionize them, into positive and negative individual atomic constituents. Among these agencies are radium, ultra-violet light, and high electric stresses producing high molecular velocities. On this theory, a spark discharge may be popularly regarded as ionization run wild, hordes of quiet, respectable neutral air-molecules having been very suddenly bombarded into disruption, and the divorce of positive and negative ionic constituents that rush like so many charged pithballs to carry on an electric discharge. Beyond a certain intensity in electric stress, nothing produces ions in air so rapidly as other ions, the collisions of these little active pithballs knocking the union and sobriety out of many neighboring molecules. Below this critical value of electric stress, the collision velocities are insufficient to affect much molecular instability, and the number of free ions per cubic centimeter of air is very small. In spite of all precautions, however, there are always a few ions present in air, even when the air is inside a metal chamber with thick walls.

The last number of *The Physical Review* contains a paper by T. Frederick McKeon on the variation of ionization in air. The results described in the paper show that the air contained between two large metallic cylinders, kept sealed and undisturbed, undergoes a steady change either of increase or decrease of ionization, associated with a periodic change making one cycle in 12 hours or two cycles a day, like the ocean tides. Whereas, however, the tide cycle is about 12 hours and 20 minutes, the ionization cycle within these closed metallic vessels was apparently not to be distinguished from 12 hours, suggesting, therefore, solar, rather than lunar influence. The maxima occurred shortly before noon and midnight, but these maxima did not develop at precisely corresponding times daily. The periodic change was noticeable, no matter what the metal from which the cylinders were constructed. It is suggested that the effect is due to the sun's light ionizing the earth's atmosphere, and so shifting the earth's electric field twice daily.

The New British Patent Law.

A new patent and designs act comes into force in Great Britain on Jan. 1, 1908. There are various changes of importance in the law, of which an abstract reaches us from Mr. Ernst Zappert, of London.

The Comptroller of the Patent Office may require samples and specimens to be furnished before the complete specification is accepted. The Comptroller may refuse to grant a patent if he is satisfied that an invention has been wholly and specifically claimed in any specification to which the official investigation has extended. Such refusal is subject to appeal which may be made to the law officer.

The period within which a sealing fee should be paid may be extended to such time as may be prescribed. This condition is applicable to patents which have lapsed owing to the omission to pay the sealing fee within the proper time prior to the commencement of the Act.

Where an applicant has made application for two or more patents, with provisional specifications, and which are modifications one of the other, and the Comptroller is of opinion that the whole of such inventions are such as to constitute a single invention, he may accept one complete specification in respect of the whole of such applications and grant a single patent thereon. In this case the patent will bear the date of the earliest application. This is important to inventors, and it is obvious that as the cost of provisional protection is but a small part of the cost of a patent, an inventor can put in a provisional specification for a new idea, and, as the invention develops, add further provisional specifications from time to time during the term of provisional protection, finally covering the whole by one complete specification.

A patentee under the new act will have the privilege of applying for a Patent of Addition for any improvements or modifications for which he has already obtained a patent, but such patent of addition will expire with the original patent. He will have the advantage, however, of having to pay only one set of renewal fees. This is an addition to the English law very similar to the conditions applying to patents in France, Germany and some other countries, where patents of addition have long been granted.

Where a patent has become void owing to the non-payment of fees, the Comptroller may in certain cases restore the patent. It must be shown that the omission to pay the renewal fees was unintentional and no undue delay must occur in applying for the patent to be restored.

In addition to the grounds hitherto existing a patent may now be revoked if it is shown that the reasonable requirements of the public with respect to a patented invention have not been satisfied, but such revocation will not be made before the expiration of three years from the date of the patent, or if the patentee gives satisfactory reasons for his default in not working the patent, etc. The Comptroller may also revoke a patent upon the application of any person who would have been entitled to oppose the grant of the patent, and upon any of the grounds upon which it might have been opposed, but such application must be made within two years of the date of the patent.

A patent may also be revoked if it is proved that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom. Application for revocation upon this ground may be made after four years from the date of the patent, but not less than one year after the passing of the act. Unless the year and number of the patent are applied to the patented article, notice is not deemed to have been given of the existence of a patent.

Subject to any contract to the contrary, where a patent is granted to two or more persons, each of such persons is entitled to use the invention for his own profit without accounting to others, but is not entitled to grant a license without their consent. In case of the death of one of joint patentees his beneficial interest in the patent will go to his personal representatives as part of his personal estate.

Opportunities in the U. S. Civil Service.

The United States Civil Service Commission announces an examination, open to American citizens, on Jan. 8, 1908, at the places mentioned, to secure eligibles from which to make certification to fill the following-named vacancies, and vacancies as they may occur in the Indian Service in the engineering positions indicated below: Engineer, $720 per annum, Mescalero Agency, N. M. The person to be appointed to this position should be qualified to operate steam engines, boilers, pumps, dynamos and electric light apparatus. Examination in branches 1 and 2 is required for this position. Engineer, $720 per annum, Zuni School, N. M. The person appointed to this position should be qualified to operate boilers, steam engines and pumps. Examination in branch 1 is required for this position. Engineer, $720 per annum, Riverside School, Okla. The person appointed to this position should be qualified to operate steam engines, boilers, pumps, a steam-heating plant, etc., and should have had experience in the management of electric light apparatus. Examination in branches 1 and 2 is required for this position. Assistant engineer, $720 per annum, Salem School, Ore. The person appointed to this position should be qualified to operate boilers, steam engines, pumps, dynamos and electric light apparatus, and a steam-heating plant. Examination in branches 1, 2, and 3 is required for this position.

Owing to the widely varying conditions in the various schools and agencies of the Indian Service general engineering examinations will be given under the following separate branches. An applicant may take one or more than one of these in his discretion. The prospects of appointment will be increased by successfully passing more than one of the branches indicated. Applicants should fully indicate in their applications the particular branch or branches in which they desire to be examined, and should state as definitely as possible the experience they have had which would tend to qualify them in the branches selected.

The salaries are $480 to $1,000 per annum. The majority of the appointments, however, are made at salaries of $720, $840 and $900 per annum. The age limit is 20 years or over on the date of the examination. Two days will be required in case more than three branches are taken. Application should be made at once for forms, etc., to the U. S. Civil Service Commission at Washington, or to the local boards. A synopsis of the branches of examination is given below:

Branch 1, steam engineering; time allowed, 3 hours. Subjects: 1. Practical questions (covering installation, repair and operation of boilers and steam engines, and pumps) 60. 2. Experience in handling steam engines and boilers and pumps (rated on application) 40. Total, 100 marks.

Branch 2, electrical engineering; time allowed, 3 hours. Subjects: 1. Practical questions (covering generators and motors, switchboard apparatus, wiring for lamps and motors) 60. 2. Experience in handling electrical apparatus (rated on application) 40. Total, 100 marks.

Branch 3, heating; time allowed, 2½ hours. Subjects: 1. Practical questions (covering heating by hot water and exhaust or live steam) 60. 2. Experience in handling heating plants (rated on application) 40. Total, 100 marks.

Branch 4, refrigeration; time allowed, 2½ hours. Subjects: 1. Practical questions (covering systems of refrigeration and operation of necessary apparatus) 60. 2. Experience in handling refrigerating apparatus (rated on application) 40. Total, 100 marks.

Branch 5, gas and gasoline engines; time allowed, 2 hours. Subjects: 1. Practical questions (covering operation of gas and gasoline engines) 60. 2. Experience in handling gas and gasoline engines (rated on application) 40. Total, 100 marks.

Branch 6, hydraulics; time allowed, 2 hours. Subjects: 1. Practical questions (covering operation of water turbines and water wheels) 60. 2. Experience in handling turbines and water wheels (rated on application) 40. Total, 100 marks.

Electrical Monopoly in Germany.

According to advices from Berlin, a project for the creation of a State monopoly in electricity is mooted by the local correspondent of the *Magdeburger Zeitung,* who, as is well known, is in close touch with the Government, and is frequently employed as the medium by which official views are conveyed to the German public. Whether he is inspired on this occasion from any official source, or by influential members of the National Liberal Party, or whether his communication be a *ballon d'essai* is not known. The proposal, which is elaborated with considerable detail in the columns of the *Magdeburger Zeitung,* may be summed up briefly as the nationalization of the production and distribution of electricity. The following extracts reveal the drift of the arguments in favor of the project:

"We are face to face to-day with the inauguration of a period in which electricity will become the most important factor in our whole industrial system. We can say, in the light of scientific research, as well as of practical experience, that all indications point to the necessity of centralizing motor powers. We are convinced that the era of electricity which we are approaching will compel the nation to organize a systematic exploitation of the natural sources of electricity, such as mountains and streams, as well as the systematic distribution of electrical motor power. We believe the Imperial Government ought to distribute electrical motor power for the common welfare.

"We consider that it would be a truly Imperial task to supply electricity to the gigantic machines of ships, railways and factories, as well as to the small workshops of independent artisans. It is superfluous to describe in detail all the far-reaching consequences of the nationalization of electricity, but we may point out that the State monopoly of electricity would be more than a mere financial reform. We have no illusions regarding the innumerable difficulties necessary to be overcome before the scheme could be realized. None but a political Hercules could realize it, but it is a case of 'now or never.' The time is ripe for the centralization of electrical motor powers."

The *Magdeburger Zeitung* argues glibly that the financial profits accruing to the Imperial Government from a State monopoly of electricity would relieve Germany from her present financial embarrassments, and remove the necessity of imposing new indirect taxation, and thereby causing new and widespread discontent.

Legal Right to Telephonic Privacy.

Justice Lynn, in New York City, delivered a decision recently that is causing a great deal of discussion, and that even if appealed must be conceded to put the right to telephonic privacy in a strong light. It appears that the wife of the superintendent of an apartment house had her own line cut in frequently on that of a tenant so as to overhear the conversation and then discussed publicly what she had heard. Under these circumstances the tenant, not getting redress, threw up his lease and left the place. The landlord sued for his four months' rent and has been non-suited. The justice in his decision says: "It is contended by the landlord that his superintendent was not guilty of these acts, but I find as a matter of fact * * * that this superintendent was guilty of this unusual act of listening or what might be properly called eavesdropping over the telephone, and learning what was said by various people to this lady, and took opportunity of giving expression at different times in the hallway of this apartment house, announcing that the tenant was a woman having other loyalties than her husband and intimating that her morals were not of that kind or character to warrant her remaining in that house."

The justice regards the telephone as a sort of wired extension of the privacy of the home. Of the instrument in general he says: "It has passed the period of experiment and is now a real living part of ourselves. It expresses the soul and mind of our feelings; the heart throbs of the human voice are felt as keenly over this instrument as when one person talks to another, and it can express its intonations and throbs when reflected by the human voice; and where it is installed as a part of an apartment house and made an inducing cause for the rental of such apartment, then its presence must be regarded as a sacred part of the home, entering into its privacies and secrets and giving communion with those we love and cherish. When such abuse is made of it as was made by the plaintiff's agents in this case, then I hold that as a matter of law it is a deprivation of the peace and quietness with which our common law surrounds every household; it is an invasion of the domicile worse than eavesdropping, more vicious than scandal, and more detrimental to the welfare of the home-dweller than any other ordinary abuse a landlord is capable of heaping upon a tenant."

Electric Transportation in Buenos Aires.

Having a population exceeding 1,100,000, Buenos Aires is the largest Latin city in the world, except Paris, and by reason of its many fine buildings, its splendid avenues and parks, and the organization of its public services, it lays a very strong claim to the title "Paris of South America."

An interesting point connected with the history of Buenos Aires was the fact that the franchise granted for the first transportation line required the exclusive use of horses.

The reason given by the authorities for this stipulation was that it was necessary to develop the national industry of the country, which at that time depended almost entirely upon horse breeding. The tramway was extended by degrees under the old concession for a distance of upward of 100 miles into the country, and there can be no doubt that it holds the record for long distance horse railway, as well as the first tramway to run a sleeping car over its lines. At a later date the authorities recognized that, for the purpose of giving an efficient service, it was necessary to grant a permission to use mechanical traction, and steam locomotives were employed.

The development of the transportation business in the hands of its organizer, Federico Lacrose, became, at his death, still more important in those of his active and energetic sons. Their first step was to enter into a contract, in the year 1905, with J. G. White & Company, of London, for the reconstruction and electrical equipment of the old city lines, which were double track. The work was commenced in March, 1906, and before the end of that year the new power house, with a 2250-kw equipment was in running order—an achievement which, considering the labor troubles and the port congestion, may well be considered a record for rapid construction. Part of the lines were opened formally to public traffic on March 10, 1907. The original lines consisted of 25 miles of track, owned by the company, and 6.21 miles held jointly with other companies and on lease. J. G. White & Company are now engaged in extending these lines an additional 25 miles, and for the purpose of serving these new lines another 750-kw generating set is being added to the station.

POWER STATION.

The power house is of brick, with an exterior plastering usual to the country. The buildings comprise an engine room 190 ft. x 50 ft.; a boiler room, 130 ft. x 30 ft., and a coal storage of the same size. The brick chimney is 150 ft. in height.

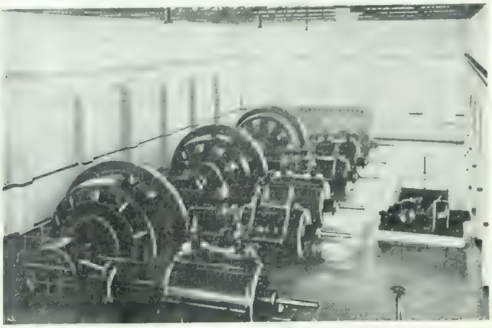
The engine room contains three 1100-hp horizontal cross-compound engines built by Carels Frères, Belgium, after the Sulzer patent; these coupled to General Electric generators. The consumption of the engines averages 22 lbs. of steam per kw-hour, with a load-factor of approximately 40 per cent. Each engine has its own condenser. The air pumps are of the Edwards type, independently driven by steam engines supplied by Allen & Company. Worthington motor-driven centrifugal pumps are used for circulating the water, each being capable of dealing with 1000 gals. per minute. The switchboard was supplied by the British Westinghouse Company.

The boiler room contains five marine type boilers, built by

[illegible] having a heating surface of 630 sq. ft. Each boiler is capable of evaporating 12,000 lbs. of water per hour, the grate area and heating surface being 49 sq. ft. and 2480 sq. ft., respectively. The three feed pumps installed are of the Worthington duplex type. A Wheeler feed-water heater and two cooling towers are used.

The feeders were supplied by Callender's Cable & Construction Company, and are paper-insulated, lead-covered, and are drawn into Sykes' stoneware conduits.

The rolling stock for city purposes will consist of 140 cars of the semi-convertible type, supplied by the J. G. Brill Company, and with a seating accommodation for 32 persons. Each



VIEW OF INTERIOR OF BUENOS AIRES POWER HOUSE.

car is equipped with two 40-hp motors, supplied by the British Westinghouse Company. In addition to the city cars, there will be at first ten interurban cars, which will seat 44 people, and will be fitted with four 50-hp motors.

Electric locomotives will also be used for hauling freight trains. They are being supplied by Dick, Kerr & Company, and each will be equipped with four 50-hp motors.

Mr. C. E. d'Ornellas acted as superintendent in charge of the above work for Messrs. J. G. White & Company, Limited. This company is also engaged upon engineering and construction work connected with the electrical equipment of about 7 miles of double-track for high-speed service from San Martin to Chacarita, for the Ferro Carril Central de Buenos Aires.

Specific Heat of Superheated Steam.

A paper by Prof. C. C. Thomas, read before the American Society of Mechanical Engineers at its recent New York meeting, presented in graphical form the results of an extensive series of experiments relating to the specific heat of superheated steam. In superheating the steam and measuring the energy thus imparted to the steam, use was made of electrical heaters and indicating instruments.

The method employed was as follows: All conditions having been arranged so that they could be controlled, thus providing for practically absolute steadiness of steam pressure, voltage and steam supply, steam was started through a calorimeter and the whole system was allowed to run for several hours before taking readings. When finally steady conditions had been obtained, steam of a certain quality was entering the calorimeter. Electrical energy was introduced sufficient to dry this steam as indicated by the thermo-junction in the calorimeter. Any change in quality was at once indicated by temperature change. Standard conditions having been obtained—that is, a given quantity of steam passing through the calorimeter per unit of time and receiving just enough electrical energy to dry it and thus bring it up to the "standard" or dry steam condition; then enough more electrical energy was added to raise the temperature of the steam through a given range, either 20, 40, 60, 80, 100 or 150 deg. C. corresponding to 36, 72, 108, 144, 180 and 270 deg. F. respectively. [illegible] to produce this rise of temperature [illegible] been noted, the initial standard (dry and saturated) conditions were gone back to by dropping out the energy introduced to give the range of temperature. This formed a check on the constancy of the standard condition. From these data specific heats including radiation from the instrument were calculated for the various pressures and temperature ranges employed.

Prof. Thomas found that the specific heat of superheated steam varies with both the pressure and the temperature. It increases when the pressure of the steam increases and diminishes with an increase in the temperature. The specific heat increases and decreases more rapidly when near the saturation point, with increase of pressure and temperature, respectively, than is the case in conditions more remote from the saturation point. These conclusions apply over the whole [illegible]vered in the investigation, which included pressures from 7 lbs. absolute to 500 lbs. absolute per square inch and up to 270 deg. F. superheat, for all pressures employed.

At 15 lbs. per square inch absolute and 120 deg. F. superheat, the specific heat is .5; it increases to .6 with the same degree of superheat and a pressure of 600 lbs. per square inch is absolute. At 20 deg. superheat the specific heat is .57 at 15 lbs. pressure, and it is .68 at 600 lbs.

Electrical Development in British Columbia.

The British Columbia Electric Railway Company of Vancouver is making vigorous efforts to get in operation by Christmas a 10,000-hp plant at Lake Buntzen to meet the demands for electrical energy around Christmas time. The complete cost of the single unit being installed, including hydraulic plant, generator, transformers, etc., represents an approximate expenditure of $300,000. Immediately upon its completion the company will make arrangements for the installation of another unit of the same rating, and a third unit will be placed in position later. The business of the company has grown by leaps and bounds during the last few years, and the management consider it necessary to plan far in advance for the meeting of the demands. Hence the announcement of the expenditure of over half a million dollars immediately upon the completion of the present work. The extensive program is also entered upon at once owing to the unavoidable delays which are incident in the delivery of machinery of all kinds nowadays. An illustration of this fact is shown in the installation of the present unit. Orders for its delivery on the ground were given with the last of October as the latest date, but it was nearly a month later before the equipment was at hand. As a result the company was compelled to make use of the old steam plant at the Westminster Avenue station. It is to guard against occurrences of this kind that the larger program of extensions is being immediately taken up. The power now generated at Lake Buntzen comes from four units of 3000 horse-power each. With the installation of the 10,000-hp unit, on which work is now proceeding, 22,000 horse-power will be available. The addition of two more 10,000-hp units will make a total of 42,000 horse-power at Lake Buntzen, which is estimated to be the limit of the water power at that point. The company will by that time have probably secured an additional source of energy, its management now being in possession of the facts concerning every available hydraulic power which has been investigated within a radius of 100 miles of the city.

Rumor has it that its officials already have an option of the Lillooet power scheme, but confirmation of this report cannot be obtained. The final decision as to additional power will be based on the cheapness of the development in connection with nearness to the cities where the company operates. The work now planned in connection with the Chilliwack tram scheme will give the company an established pole line along the south of the Fraser, which can be used in bringing energy from the water powers north of the river to New Westminster and Vancouver.

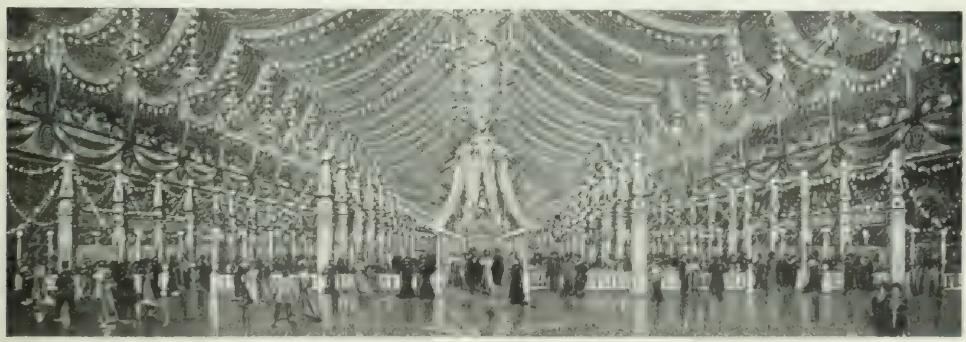
The work of developing the water power at Lake Buntzen for the 10,000-hp unit involved the extension of the power house [illegible] the work being done through solid rock. The

addition of each of the other units planned will mean additions of equal extent. The extension of the piping for the conveyance of water necessitated the driving of a 232-ft. tunnel, 9 ft. x 12 ft. in dimensions, through solid granite. The transformer house is constructed of concrete.

The work of installing the new plant has been greatly facilitated by the equipment supplied by the company. A track has been laid from the wharf and the loaded cars are taken direct to the site, where a traveling crane carries the various parts to their designated location in the buildings. The British Columbia Electric Railway Company is now contemplating the placing of a larger steamer on the run from the city to the plant owing to the constant demands for communication between the points and the increasingly heavy character of the freight and supplies to be delivered at the power station.

Illumination of the Chicago Electrical Show.

Note was made recently in these columns of the fact that at a meeting in November of the stockholders of the Electrical Trades Exposition, which will conduct the Chicago Electrical show in January, a large picture was exhibited showing the design of the decorative lighting of the Coliseum, which is to be the distinctive feature of the Chicago electrical show this year. This design, shown in the accompanying illustration, has been worked out by D. H. Burnham & Company, the noted Chicago architects. The general scheme comprises a row of mammoth decorative chandeliers the length of the center line of the building and festoons of lamps hung from the arches. The booths will be of uniform design, this design being also made by the architects. The erection of booths and supply of furniture is in the hands of the exposition company, so that the exhibitor has only to move in his exhibit, thus saving a lot of trouble and annoyance to the exhibitor and producing a much better general effect. As a spectacular display, the coming show will, it is asserted, be the finest thing of the kind ever attempted in the Coliseum. The dates of the show are Jan. 13 to 25, 1908. Mr. Homer E. Niesz, Monadnock Block, Chicago, is managing director, who reports a very large number of applications for space.



GENERAL VIEW OF CHICAGO ELECTRICAL SHOW.

Inverted Synchronous Converters.

The use of a synchronous converter as a combined direct-current motor and inverted rotary converter is disclosed in a patent issued Dec. 3, to Mr. Leonard Wilson. The arrangement employed is indicated in Fig. 1, where the equipment is used to convert direct current at constant voltage into alternating current at variable voltage. Instead of using a direct-current motor for driving an alternating-current generator, the inventor employs an inverted rotary converter and an alternating-current generator mechanically coupled to the converter and electrically connected in series with the alternating-current side of the converter. It is claimed that the machine is cheaper to construct than a motor-generator.

Fig. 2 shows an arrangement of two rotary converters used as substitutes for the motor and generator heretofore employed in a synchronous frequency converter, as patented by Mr. J. E. Noeggerath on December 3. It is stated that this arrangement is cheaper to construct than the ordinary motor-generator set, both because the rotary converters are self-exciting, and therefore require no separate exciter, and because less armature and field circuit copper is required. Moreover, the direct-current delivered by one converter to the other may be employed, by inserting field coils in the direct-current connections between the two machines, so as automatically to compound the frequency changer to cause it to operate at unity power-factor for varying loads, or to increase the voltage delivered as the load increases.

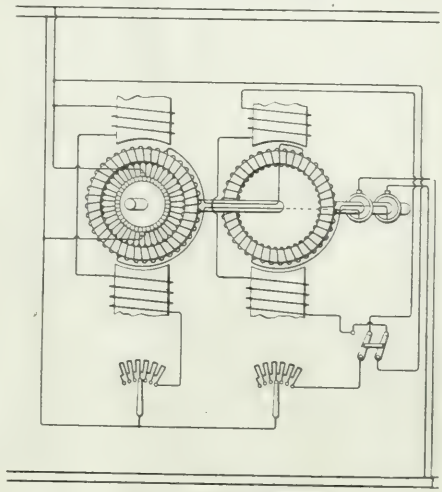


FIG. 1.—WILSON CONVERTER.

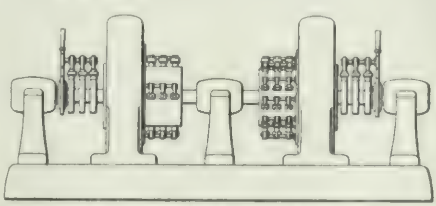


FIG. 2.—NOEGGERATH FREQUENCY CHANGER.

Carnegie Banquet of the Engineers' Club.

The new building of the Engineers' Club on West Fortieth Street, New York was opened for use last April, and is now finished in every part. The first banquet was given on Dec. 9, when Mr. Carnegie, who gave the building to his fellow members was the guest of honor, the occasion celebrating also his seventieth birthday. Two hundred and fifty members were present, a most representative and distinguished gathering from every branch of engineering. The electricals were very much in evidence, including Thomas A. Edison, Frank J. Sprague, H. G. Stott, president of the American Institute of Electrical Engineers; C. F. Scott, John W. Leib, Jr., Edward D. Adams, Joseph Barré, Putnam A. Bates, the consulting electrical engineer of the club; E. W. Rice, Jr.; B. E. Sunny, A. W. Burchard, W. S. Doran, R. C. Clowry, Philip T. Dodge, David Homer Bates, Maurice Coster, Herman H. Westinghouse, Henry L. Doherty, James H. McGraw, Albion E. Lang, Byron E. Eldred, J. R. Ellicott, Frank Hedley, Emerson McMillin, T. C. Martin, Calvin W. Rice, H. L. Shippy, Ernest Stutz, E. G. Bernard, W. H. Whiteside and several others. Mr. Edison sat at the speakers' table between Mr. Carnegie and Mr. John Fritz, who, during the evening, presented to the guest of honor a beautifully engrossed certificate of his honorary membership in the American Society of Mechanical Engineers.

Mr. Carnegie was in very happy mood, and made one of the best speeches of his life after his health had been proposed by Toastmaster Martin and drunk enthusiastically with all the musical honors. He said: "This is the age of the engineer. Never before in the history of the world has he been so important. Perhaps some of you have read Kipling's latest production, 'The Sons of Mary and Martha.' Upon the latter there has been thrown the work and cares of the world; theirs to transform conditions, to invent, plan and execute and bring to man all the improvements that have delighted and astonished us in this generation and the last, beyond all others that have preceded. We telegraph without wires, and neither under nor upon the ocean, but through the air, annihilating space. We fly with the speed of birds of the air by a spark of gasoline. We speak to each other through the telephone of Bell, and listen to the finest music in our homes from the imprisoned voices of the greatest singers in the phonograph of Edison. Mysterious powers hover round us subject to our call. All this would have seemed miraculous to our grandfathers.

"The engineers are the true sons of the more useful sister and are indispensable. They have played a great part in this transformation. The sons of Mary may be all well enough in their place, although I confess myself at a loss just exactly to find a place for them that redounds much to their credit in this everyday world. We can see little use for them and cannot help the thought arising at the moment that it may be very much with them as Josh Billings said about mosquitoes: doubtless the Lord made all things well and there was some reason for making mosquitoes, but he wished it had been so arranged in their case that they would only bite those that could see it. One feels something of the same thing when he views the gay, sporting, frivolous lives of the sons of Mary."

He concluded as follows: "I trust that this club is to see many such happy reunions as we have to-night. There are very few things in life more desirable, more beneficial, than a good laugh. Take life brightly. Of all things be optimistic. Do not lie awake at night troubling yourself about problems that have a way of solving themselves, and above all things don't worry about the republic—she is all right. She is the latest and best of the great nations, built upon the best specifications, up to date, of the best material, the finest grade of vanadium steel, warranted to stand all weathers and to give a good account of herself under any conditions that ever can prevail. Gentlemen, may the influence of this club upon you be such that in after life *Hamlet's* saying can be yours. 'I think myself in nothing else so happy as in a soul remembering my best friends.'"

Mark Twain, arrayed in spotless white, who came to New York 54 years ago to see the first World's Fair on the very spot where the new club now stands was particularly humorous at Mr. Carnegie's expense, attacking him vigorously with jibe and sarcasm on account of his "simplified spelling"—as an offset to the eulogies and compliments from all the other speakers. Mr. John Foord, member of the club and president of the Burns Society, was very felicitous and graceful in responding to the sentiment "The Scot in America." Mr. W. H. Fletcher, past president of the club, and chairman of the building committee, made an eloquent eulogy of those who had devoted their services to the club while they lived, and summed up the results of the committee's four years of work. The total cost of the club including land, building, plant and equipment was stated to be $867,000, and the clear equity of the body to-day above all indebtedness was over $565,000. During the evening the names of Mr. C. M. Wales, chairman of the house committee; Mr. G. E. Weed, treasurer, and of Admiral Melville, who was present as a member, elicited great applause.

CURRENT NEWS AND NOTES.

ILLNESS OF KELVIN.—We regret to state that special cable advices from London of Dec. 10 say: "Lord Kelvin, the noted scientist, has been confined to his bed for two weeks with a chill. His condition has become serious. He is 83 years old."

AT MAHOMET'S TOMB.—An imperial iradé has been issued by the Sultan of Turkey ordering the establishment of electric lighting in the sanctuary of the Prophet at Medina. The contract for supplying the plant has been awarded to an English firm.

ILLUMINATING ENGINEERING SOCIETY.—The December meeting of the Philadelphia section of the Illuminating Engineering Society will be held on Friday evening, Dec. 20, at 8 o'clock, in the assembly room of the Philadelphia Electric Company, Tenth and Chestnut Streets. Professor H. Clyde Snook will deliver a lecture on "The Light Spectrum," illustrated with lantern slides.

ELECTROCHEMICAL SOCIETY.—The next meeting of the New York section will be held on Tuesday, Dec. 17, at 8:15 p. m. at the Chemists' Club, 108 West Fifty-fifth Street, New York. There will be informal talks by the following speakers. The subjects will be open for discussion by members of the section: Mr. Lawrence Addicks, superintendent U. S. Metals Refining Company, Chrome, N. J., "The Refining of Copper;" Mr. Harold Martin, formerly of the Chloride Accumulator Company, "The Modern Developments in the Storage Battery." Members of the section are invited to introduce as visitors any of their friends who are interested in the above subjects.

TWO MILLION MORE.—Mr. Andrew Carnegie this week has added the sum of $2,000,000 to the $10,000,000 endowment fund of the Carnegie Institution for scientific research at Washington. Announcement of the fact was made at a dinner on Dec. 10, of the board of trustees of the institution, to which had been invited a number of scientists and men prominent in public affairs. The dinner followed a business meeting held earlier in the day at the institution's offices. The report of the trustees showed that much important scientific work had been done during the past year, and upon their recommendation $520,940 was allotted for the prosecution of the work of scientific inquiry next year. The trustees also decided to erect a suitable building in Washington for the accommodation of the administrative offices of the institution in place of the present rented quarters.

SUBWAY FOR BERLIN.—The Traffic Commission of the municipality of Berlin has decided to build an underground railroad running northwest and southeast through the heart of the city, from Charlottenburg to Rixdorf. The cost of the new line is estimated at $15,000,000. It is an addition to the subway to run north and south, plans for which are now under preparation. Berlin is also to have five new surface lines to meet the traffic demands of the population.

SEARCHLIGHT SHELLS.—It is stated from Paris that a French naval officer has invented a new shell, which, when it strikes, throws out a luminous white light which lasts for 30 or 45 seconds. The shells are being experimented with at Lorient Bay. They are 2.6 inches in diameter, and are likely to be a valuable asset in warfare since, during a night attack, they can be thrown from a masked battery and perform the service of searchlights without uncovering their source.

FRENCH TELEPHONY.—A special cable dispatch from Paris of Dec. 7, says: "The defective French governmental telephone service has long been a cause of complaint, consequently each provincial department has ordered that courses in telephoning be given to beginners, with money prizes for the best pupils and teachers. In certain cities the teachers give their telephone lessons during office hours. From one town, although the lessons had not yet begun, reports of the excellent results of the instruction were sent to the authorities, who promptly formarded rewards for the fictitious services."

POLICE ALARMS FOR RIO JANIERO.—A special cable dispatch from Berlin, Germany, of December 7, says: One of the great Berlin electric works is giving a private exhibition of an elaborate new police alarm installation it has just completed for the city of Rio de Janiero. It represents a cost of $500,000 and its special feature is a system of 580 patrol boxes to be scattered throughout the city, the keys to which may be purchased by trustworthy citizens, enabling any of them to turn in a police alarm just as fire alarms are now turned in by the public., In order to identify the person who turns in the call, his numbered key can be extracted only by the police.

LONDON UNDERGROUND.—A cable despatch from London, of Nov. 30, says: "Another half mile is added to-day to London's system of electric transit. This is a spur from the Strand to Holborn, where connection is made for Finsbury Park on the north and Hammersmith or Brompton on the west. It is the third crosstown line in operation between the Strand and the northern suburbs and is likely to command a large traffic as a branch of the Great Northern, Piccadilly & Brompton system of tubes. Investors are paying heavily for Mr. Yerkes's miscalculations, but traffic on the underground lines is slowly increasing. Owing to the quickening of trains and the improvement of electric services, motor omnibuses are dropping out and the volume of surface transit is decreasing."

THE LAKE NEMI GALLEYS.—Steps are being taken to recover the galleys that lie at the bottom of Lake Nemi, in the Alban Hills. The Italian Minister of Public Instruction has before him the report of Prof. Giuria, which by many is considered the most practical plan of all. It is certainly the cheapest to carry out. Prof. Giuria would make use of the old Roman aqueduct, which is still in fair working order, and employ two powerful pumps to carry the water in double pipes across the Valley of Ariccia, where it will drive an electric plant which, in turn, is to supply the energy for the pumps. When the water has been sufficiently lowered to permit dry working, Prof. Giuria purposes to raise the galleys by an inclined plane from the bed where they lie to the shore. By building a skeleton cradle in iron with double runners around each barge, he believes he might bring them to land without damage to the structures. It is expected that the lat- [illegible] will be [illegible] begin next summer. An encouraging piece of intelligence has just been added by Signor Rossi of the Italian Marine electrical staff, who, in diver's dress, spent an hour in the Caligula galley the other day. He reports that some of the apartments and even their furnishings and furniture are still intact, and, curious as it may seem, that, while the stonework has in many cases been eaten away, the woodwork still remains, especially the hulls, which were originally covered by cloth attached by a coating of pitch, above which Rossi discovered many folds of thin sheet lead, doubled over to a great thickness and fastened with copper nails.

ELECTRICITY FOR SAVAGES.—Advices from Japan state that the extermination of savage, murderous head hunters by electricity is the latest novelty introduced by the Japanese in Formosa. These head hunters' number about one hundred thousand and infest the entire eastern coast of the island. All efforts to civilize them have failed. They recently inveigled a party of 300 Chinese and Japanese into an ambush, on the pretense of showing some treasure, and killed all but three. Large bodies of troops were sent out, and now when a company of head hunters is located the place is surrounded by a wire fence. The wires are charged with electricity. The soldiers begin to shoot; the savages stampede, and then the deadly wires get those that the bullets miss. Presumably the Japanese carry a portable dynamo plant with them. Otherwise the story is apocryphal.

ELECTRIC CLUB OF CLEVELAND.—On the evening of Wednesday, Dec. 4, the Cleveland Electric Club held its regular meeting in the club rooms. The technical part of the evening was devoted to a paper by Mr. Chas. F. Saenger, engineer of equipment, the United States Telephone Company, Cleveland, his subject being "Notes on Modern Long Distance Telephone Practice." The paper was delivered from the standpoint of a practical man, and was interesting alike to the technical man and the layman. The theory of the telephone itself was first presented, and Mr. Saenger gradually worked up to the modern long-distance telephone. Practically all the forms of telephones in use to-day were discussed and their good and bad points brought out. The discussion following the reading of the paper was quite lively, and brought forth a great deal of valuable information. It branched off from the telephone itself to the composite systems of sending telegraph and telephone messages over the same wires, the "telharmonium" and other kindred devices.

WHEN A QUEEN TELEPHONES.—A special wireless dispatch from Paris reports that Queen Amelie of Portugal quite innocently interrupted the progress of business of two of the world's greatest financial centers one day last week by a friendly chat with members of the English royal family over the long distance telephone. As is commonly the case between London and Paris, the telephone on that day was working badly and only one wire could be depended on by busy bankers who transact much of their daily business with London by telephone, owing to the notorious slowness of the government telegraph service, which caused 60 to 80 persons to be on the waiting list. Then the central office received a call from the Hotel Bristol that somebady wanted, Buckingham, Palace, London. Central replied: "All right; your number is 75 on the list." The voice on the other end of the wire gave a wail of despair: "But it's for Queen Amelie. Her Majesty wants the royal residence, Buckingham Palace." Central began to understand. There was a hurried consultation of the chief supervisors and the call went through on record time, and on the one good wire the Queen chatted leisurely with her royal friends in London for a good half hour, unconscious of the turmoil she was creating in the financial world. English bankers who were discussing the American crisis and gold engagements with their Paris correspondents were frantic, not knowing what might happen during the interruption.

CANDLES GALORE.—According to the calculations of one of the best-informed manufacturers of candles in Chicago, over 130,000,000 lbs. of tallow are used every year in the manufacture of candles in the United States. And yet some of the central-station companies have stopped their canvass for new business!

ABRASIVE MATERIALS.—Natural abrasives valued at [illegible] and artificial abrasives valued at $777,081 were produced in the United States during the calendar year 1906, and imports to the value of [illegible] brought the total value of abrasive materials consumed in the year up to $3,160,438. These figures are reported by Douglas B. Sterrett, of the United States Geological Survey, in an advance chapter from "Mineral Resources of the United States, Calendar Year 1906." The values of different abrasives for 1905 and 1906 are shown in the following table:

Kind of abrasive.	1905.	1906.
Carborundum	$5,596,000	$6,225,300
Crushed steel	612,000	837,000
Alundum (artificial corundum)	3,612,000	4,712,000

METAL TRANSMUTATION.—A recent cable dispatch from London says: "Prof. Herbert McCoy of the University of Chicago in a letter to *Nature* says that it is possible that the making of copper by radium emanations, as recently announced by Sir William Ramsay, is not confined to the solution, for the transmuting may also occur in a solid state. If so, it should be possible with those minerals which contain both radium and copper-lithium also. Prof. McCoy then gives an account of his investigation with uranium and radium minerals, showing that they contain both copper and lithium, and adds that this does not necessarily indicate a change of copper into lithium, since the presence of lithium may be fortuitous. Assuming the accuracy of Sir William's observations, the presence of lithium in uranium and radium copper minerals is precisely what one should expect."

METER EXAMINATIONS.—The New York Public Service Commission in the Second District announces that arrangements have been perfected for testing the correctness of electric meters. The charge for testing will be refunded to the applicant in case the meter proves to register more than 4 per cent too fast. All applications must be addressed to the Light & Power Department of the Public Service Commission, Second District, Albany, inclosing $1 if the meter is rated at 5 amperes or under; $1.50 if over 5 amperes and not exceeding 10; $2 if over 10 and not exceeding 15; $2.50 if over 15 and not exceeding 25; $3 if over 25 and not exceeding 50, and 50 cents for every additional 10 or fraction thereof. The state has been divided into four inspection districts, with John P. Geberlein, of Brooklyn; Leo E. Northshield, of New York; Fred W. Schiller, of Utica, and Archie C. Brown, of Dannemora, as inspectors, at an annual salary of $1,200 each.

A RED LINE WIRELESS.—Despatches from Vancouver, B. C., state that a project for establishing a system of wireless telegraphy between Vancouver and New Zealand and Australia is being considered by the British Government. It is the outgrowth of a proposition to connect the various British islands in the South Pacific. Mr. F. J. Cross, an American electrical engineer, says the project is quite feasible and that he was commissioned last July to report on it. He returned recently on the steamer *Aorangi* from the Fiji Islands. His report is now en route to Winston Churchill, the colonial secretary in the Imperial Government. The only station on foreign soil may be located at Honolulu. The entire cost is estimated at less than $500,000. Mr. Cross says: "In the alternative scheme stations will be established in the Samoan group, now occupied by three powers, and the Marquesas Islands, owned by France. The British islands to be hooked up include Fanning Island, Tonga group, the Fiji group, and Ellice Island. From Fiji to New Zealand the distance is about 1540 miles, and from Fiji to Brisbane the distance is less."

WISCONSIN PUBLIC UTILITIES LAW.—A law recently passed in Wisconsin, putting all public utility companies under the supervision of a state commission and virtually taking out of the hands of the city councils the power of regulating or giving new franchises to street railway and electric light companies, has now been in force some months with good results. The Common Council of Milwaukee seems inclined to dispute the authority of the law, however, and passed a franchise recently granting the Continental Realty Company of that city authority to tunnel on several streets for the supply of steam heat. The Central Heating Company, controlled by Mr. John I. Beggs, is already in possession of the streets for heating purposes, and under the Wisconsin law has a monopoly of the business in Milwaukee, unless a competing company should apply to the railroad commission for permission to put in a competing system on the ground that the existing company is not properly serving the city. It seems likely that the practical effect of the new Wisconsin law as regards the monopoly clauses will, therefore, soon be tested in view of the action of the City Council.

FRENCH NAVAL WIRELESS.—*La République*, a cruiser of the French Navy, which has just arrived at Tangier, reports some remarkable results of wireless telegraphy to the Minister of Marine. This report was sent in a wireless message from the cruiser to the Eiffel Tower, in Paris. On leaving Toulon, the *République* first went to Ajaccio, choosing this port as exceptionally difficult from being almost landlocked and surrounded by high mountains. Nevertheless, she communicated easily and regularly with the *Jules Ferry*, in Toulon Harbor. Putting out to sea, and gradually increasing her distance, she kept in uninterrupted telegraphic touch with the *Ferry*, and exchanged messages across 750 kilometers or about 466 miles, or over twice the distance covered up to now. From the Gulf of Juan she also communicated with the Eiffel Tower over a land distance of 800 kilometers (about 497 miles). Being skeptical of having attained this result, the operators asked the Eiffel Tower for confirmation by wire, which they received. Hitherto, the French vessels in Moorish waters have been able to take messages from the Eiffel Tower, but not to send them back. However, it is finally proved that it is feasible to communicate over 500 miles of country and 1000 miles of water. This is due, it is asserted, to the new instruments invented by the French naval officers, MM. Ferrier, Dissot and Géance, which permit of perfect immunity from interception.

THE SOCIALISTIC MILLENNIUM has been definitely located at Brest, France. For three years Brest has been completely under the control of Socialists. It has 71,000 inhabitants. In 1904 less than 5000 were in receipt of poor relief. Last year this number reached 23,584, or one-third of the total population. Investigation has proved that the persons who received relief were not all in a state of poverty, but were the recipients of corrupt indulgences on the part of the Socialist Administration. In 1904 the council organized a municipal theater. After two years of Socialist plays the audiences so fell off that last year the theater was run at a loss of $8,000. In three years the building trade fell off 90 per cent, the local customs diminished 60 per cent and the council spent three-quarters of the $90,000 surplus left by their predecessors for purposes that have not yet been elucidated. Many of the schemes put forward seemed laudable enough, but ultimately turned out to be vehicles of wholesale extravagance. It was decided to organize the distribution of pure milk in the working class quarters. The total expenditure was $7,000, of which half was paid in wages and rent. Each litre (1¾ pints) of milk was sold among the working class for three cents, but it cost the municipality in distribution seven cents. At the last election the Socialists, having reduced the finances of the town to a state of absolute bankruptcy, surrendered their power, and the new administration has been obliged to appeal to local capitalists to prevent complete disaster. It is stated that investigations of the recent régime and criminal prosecutions will follow.

Combined Gas Works and Electric Generating Station.

A UNIQUE electrical installation, stated to be the only instance in England of an electric generating station running in connection with gas works, was formally opened at Ascot on Oct. 22. The Ascot District Gas Company, in answer to a demand for electricity within the area covered by its mains, obtained permission to change its title to the Ascot District Gas & Electricity Company, to erect a generating station, and to supply electrical energy in the parishes of Sunningdale, Sunninghill, Easthempstead, Warfield, Binfield, Winkfield, Waltham, St. Lawrence, Bisley, Cobham, Windlesham and Bagshot.

The electric generating station has been erected in close proximity to the gas works; in fact existing buildings formerly used in the manufacture of gas have been converted for the accommodation of the storage batteries and the gas engines. It is interesting also to note that electric motors are now being installed in the gas works for a number of purposes.

The electric generating equipment consists of two Johnston & Phillips direct-current 110-volt dynamos driven by Hornby-Stockport 90-hp horizontal gas engines operating at 210 r. p. m. The engines have electric ignition, and are started by means of compressed air provided by a motor-driven air compressor.

Outside the engine room there is mounted on iron columns and girders a cast-iron tank 18 ft. x 12 ft. x 6 ft. deep, which serves as a reservoir for the water for the gas plant and also for the water circulation of the engines. Each engine drives a small centrifugal pump for circulating the water. The water for the tank is taken from a well by means of a motor-driven pump; in the event of the well failing, a supply can be obtained from the water company's mains.

Gas for the engines is supplied from a Hornsby suction producer provided with the usual cleaning and scrubbing plant, as seen in Fig. 2. A motor-driven blower is provided for the producer, a hand-operated blower being installed as reserve. Moreover, there being only one producer, a branch from the lighting gas main is run, through a meter, into the engine room, so that either engine can be operated with illuminating gas when desired. The fuel used for [illegible] obtained from the gas works. Fig. 3 indicates the relatively small space occupied by the producer plant.

FIG. 2.—VIEW OF GAS PRODUCER PLANT.

The electric generating equipment includes a semi-automatic balancer-booster, consisting of two balancer-motors and two booster dynamos mounted on the same shaft. Each booster is designed for 100 amperes at any e. m. f. up to 90 volts. The field coils of the balancers are cross-connected, and the boosters are arranged with series and shunt field coils, as shown in Fig. 4, so that they automatically regulate the e. m. f. The feeder circuit voltmeters, in addition to being of the "compensated" type to show the e. m. f. at the ends of the feeders, have attachments by means of which electric bells ring when the e. m. f. rises or falls by a predetermined amount from normal. This plan is exceedingly convenient, because it obviates, with the assistance of the automatic booster, the necessity of constant attendance at the switchboard.

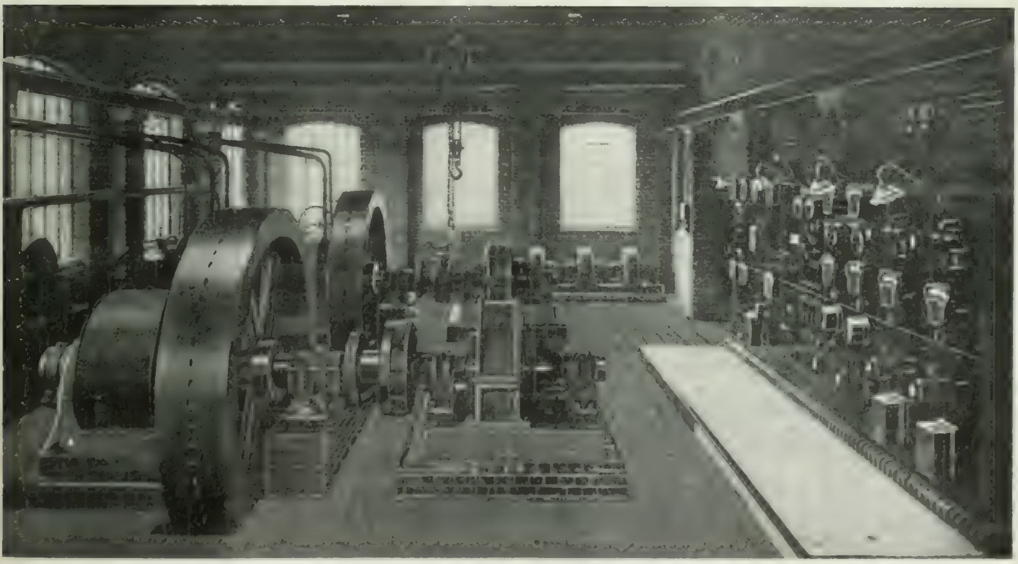


FIG. 1.—GAS ENGINE GENERATING STATION, SHOWING BALANCER-BOOSTER.

The storage battery regulating switches are actuated by means of spindles and handles on the main board, all of the battery connections being in the cell room. In order to prevent the boosters from racing in case the fuses blow, the following arrangement has been adopted. A switch, *S* (Fig. 4), is held

up by each motor fuse; in case the latter melts a circuit is closed through the coils of a relay, *R*, which operates the automatic switch shown, so that the battery is disconnected from the booster and connected directly to the bus-bars. The

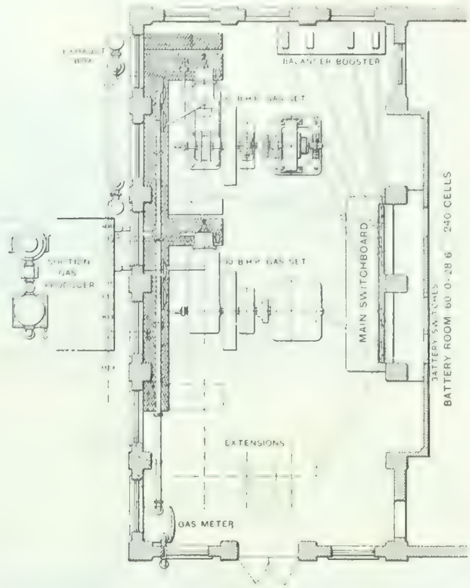


FIG. 3.—GENERAL ARRANGEMENT OF GENERATING STATION.

storage battery consists of 240 Tudor cells rated at 54 x 10 ampere-hours, or 140 x 3 ampere-hours.

At the present time about seven miles of three-core, paper-insulated, lead-covered Siemens cables have been laid on the

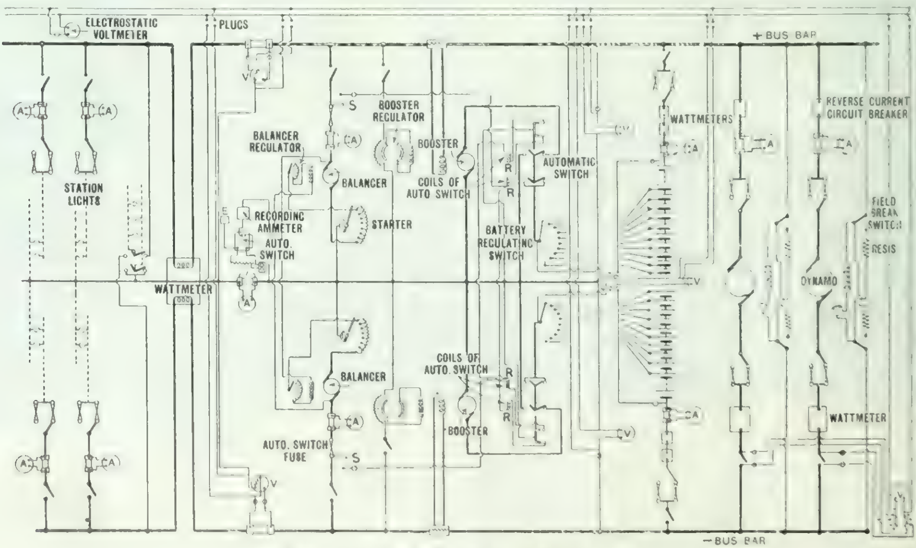


FIG. 4.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

solid system in wooden troughing. Owing to the large area over which energy is distributed to consumers, there has been a considerable outlay for mains. Lead-wiped joints are used throughout the whole system and at all three-way and four-way disconnecting boxes; the grounding of the lead sheathing being continuous throughout. The type of four-way disconnecting box which has been adopted is shown in Fig. 5; it will be noted that fuses can be used if desired. Ampere-hour meters of the Siemens pattern are used on consumers' premises.

It is estimated that about 1.3 lbs. of coke are required per kw-hour of energy generated, and that 72 lbs. of coke, when

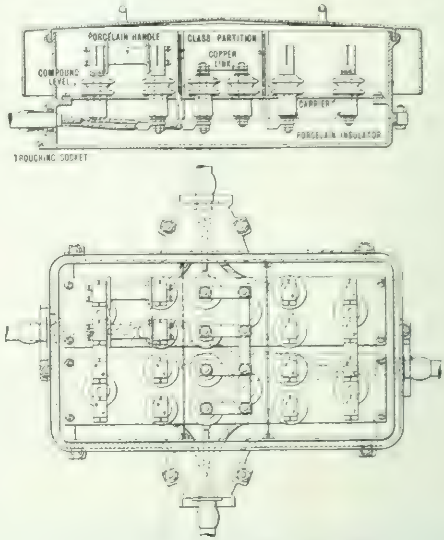


FIG. 5.—FOUR-WAY DISCONNECTING BOX.

burned in the producer, are equivalent to 1000 cu. ft. of the gas supplied to the consumers. The price of energy has been fixed at 14 cents per kw-hour for lamps and 8 cents for motors, the e. m. f. being 220 volts on either side of the three-wire system. Illuminating gas is sold at $1.18 per 1000 cu. ft., the coke for which costs 24 cents. It is estimated that the coke in the producer for one kw-hour costs .24 cent; the works cost of the kw-hour is 2.84 cents and the total cost 4.78 cents.

A brief item concerning the above combined gas and electricity works was published in our issue for Nov. 16. We are

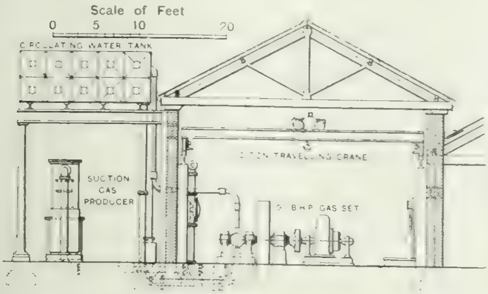


FIG. 6.—CROSS-SEDTION VIEW OF STATION.

indebted to the London *Electrician,* from which this item was obtained, for the illustrations used in the present article.

The Design and Operation of Spark Coils.

By F. W. SPRINGER.

IN the present state of the art of constructing igniting coils the basis of their design may be described as follows: 1. Methods of compromising and varying the various design factors of different coils and the effects of such variations. 2. The constructive and electrical characteristics of each kind of coil. It is the object of the present article to treat these two divisions in detail.

The factors which affect the operation of spark coils are so interdependently variable that it is somewhat difficult to foretell offhand exactly all the results of changes in the voltage, E, of the source of current; R, the total resistance; L, the total self-induction; t, the length of the time of contact in the contact maker or vibrator; I, the value of the current at the moment of breaking the circuit, and the various electrical and mechanical features of construction.

The energy, J, of the spark must, of course, be determined by experiment, and should be known for a particular engine operating under the desired conditions before attempting to design the spark coil.

It is permissible to assume that the energy, J, of the spark desired is known in discussing the determination of the best values of E, R, t, L and I, and the other electrical and mechanical features for: (1) a touch spark coil, (2) a non-vibrating jump spark, and (3) a vibrating jump spark coil.

The operation of coils, their characteristic current-time curves, etc., need not be discussed here as they have previously been rather fully treated in ELECTRICAL WORLD.

Referring to the two fundamental equations of spark coils, *i. e.*, the logarithmic current-time building up and energy equations, respectively:

$$I = \frac{E}{R}\left(1 - \frac{1}{2.718^{\frac{Rt}{L}}}\right) \quad (1)$$

$$\text{and } J = \frac{LI^2}{2} \quad (2)$$

it is seen from equation (1) that the current, I, at the moment of breaking the primary or battery circuit may be calculated for any desired values of [illegible] voltage E, self-induction L and resistance R. The [illegible] magnetic energy in watt-seconds or joules, J, stored may be calculated from equation (2).

Since the energy of the spark is largely determined by the amount of magnetic energy stored in the circuit, one may assume that J, of equation (2) represents the spark energy.

It is seen from equation (1) that the value of the current I at the moment of breaking the circuit in the timer for any given time, t (R and L being constant) varies directly as the voltage E. This is shown in a particular case by the curves A and B, Fig. 1, in which one curve represents results with 8 volts and the other with 12 volts.

From equation (2) it is seen that the energy of the spark varies as the square of the current I, or as E^2. Hence doubling the voltage will increase the energy of the spark to four times its former value—R, t and L remaining constant. See curve J-E, Fig. 3. Further, J varies (equation 2) directly as L, the coefficient of self-induction in henries, so that the value of the desired energy of the spark may be ascertained while using widely different values of L and I. If a value of I is decided upon, L may be determined by solving equation (2). If a certain value of L is used, such values of E, R and t must, of course, be taken as will give the necessary value of I (equation 1).

Therefore one needs merely to decide upon the desired values of L and I and then to compromise upon such values of E, R, t and L as will give the desired energy of the spark, J, and fulfill any other desired conditions. For example, use may be made of the data of the touch-spark coil taken as an illustration throughout this paper, as follows: A coil having a resistance of 9 ohms with the battery and wiring, provided with a 1 in. x 6 in. core of round iron wires and 1320 turns of No. 20 copper wire. Its self-induction is 0.22 henry.

It was found by experiment that each spark occurring in a

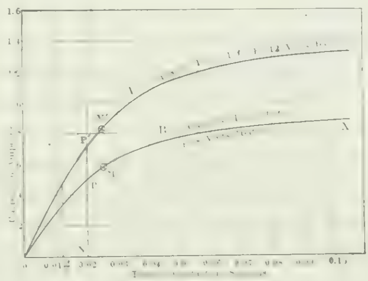


FIG. 1.—BUILDING-UP CURRENT CURVE OF AN [illegible]

2-hp White marine engine running at 600 r. p. m., had magnetic energy, J, equal to .025 watt-seconds.

The time of contact, t, at the above speed (see Fig. 2) was 0.02 second, the e. m. f. of 6 dry sells (open circuit) 8 volts. The total resistance being 9 ohms and the self-induction 0.22 henry, from equation (1).

$$I = \frac{8}{9}\left(1 - \frac{1}{2.718^{\frac{9 \times .02}{.22}}}\right)$$

$I = .48$ ampere (Point P curve B, Fig. 1)

From equation (2),

$J =$ [illegible] $= .025$ watt-seconds.

The above methods of calculating the current and the spark energy might be applied to any touch-spark coil under any known conditions, and also to the primary coil of a vibrating, or of a non-vibrating, jump-spark coil.

Equation (1), as illustrated above, may easily be solved by the use of the logarithmic side of the slide rule. There is, however, a much simpler method as follows:

Referring to equation (1) and curve B, Fig. 1, if in the equation the time t be made equal to $\frac{L}{R}$ (in this case $\frac{.22}{9} = .0244$

[illegible] $\frac{L}{R}$ [illegible]

cent of its full $\frac{E}{R}$ value (.89 amp.) or 63 per cent of that value which the current would attain if allowed to continue to increase for an indefinite length of time.

The time $\frac{L}{R}$ is called the "time constant" of a coil, and is designated by the letter T.

Knowing the self-induction and resistance of a coil, two points are determined, namely, the time required for the current to reach 63 per cent of its full value and the spark to reach $(.63^2)$, or 40 per cent of its full value.

Referring again to curve B, Fig. 1, it will be noticed that, between points M and O, the current varies approximately as the time, t, hence for any value of the current for a time less than the "time constant," $T = \frac{L}{R}$, a practically correct value may be obtained as follows:

Suppose it is desired to know the value of the current at 0.012 second for a coil having the data of Fig. 1, curve B (9 ohms, 8 volts, .22 henry). Then, for

$$t = L \div R = .0244; I = .63 \times .89 \text{ amp.} = .56 \text{ ampere}$$

Then $\frac{.012}{.0244} \times .56 = .27$ amp. is the value of the current when the time is .012 second. This approximation will be found to be sufficiently accurate for all practical purposes.

The energy, J, of the spark at this point would be

$$J = \frac{LI^2}{2} = \frac{.22 \times .27^2}{2} = .008 \text{ watt-second,}$$

a spark of small energy.

It has been found by experiment, that under the ordinary working condition of the common four-stroke cycle gasoline engine that a (touch) spark having a magnetic energy of .04 watt-second is sufficient. A more powerful spark, one whose energy is at least 0.1 watt-second, is desirable at starting, when the gas charge is at low compression and low temperature.

Under very favorable conditions it has been found that a spark having energy of .005 watt-second is sufficient to ignite the charge in a 2-hp White engine with practically no diminution in speed. But whether or not the energy of a spark is sufficient depends upon the temperature, compression and richness or leanness of the gas charge, and amount of diluent, such as that of burned gases, and the engine speed. A series of weak sparks may, no doubt, be equal to one strong spark in some cases, such as in starting and at low speeds.

It is desirable in seeking suitable values of E, R, t, L, etc., to know beforehand approximately how different values of the above factors will affect the result. These results may be discussed under three heads, as follows: First, those conditions which more or less involve the engine and other conditions outside of the coil; second, the more or less mathematical characteristics of the coil; third, the electro-mechanical features of construction.

(1) Practice seems to show that the e. m. f. in a touch-spark circuit should be not less than eight volts owing to the unreliability of contact in the engine. It should also not be so large as to hold the arc too long after the contact points are drawn apart in the engine cylinder.

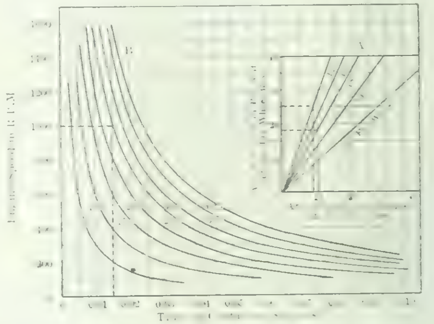
(2) Owing to armature reaction in a dynamo and to polarization in batteries, the equivalent working closed-circuit voltage in either case is liable to be considerably less than that measured by means of a voltmeter while the circuit is open.

(3) In case a dynamo of the direct-current magneto type is to be used, a rather large voltage is desirable owing to the brush resistance. In case of batteries it is generally thought [illegible] to keep the number of cells as small as possible. This is especially true in the case of non-vibrating and vibrating jump-spark coils where the contacts can be readily kept in good condition.

(4) If both a battery and a dynamo are to be used with the same coil (the battery for starting and as an alternative for the dynamo), the above conditions must be compromised. There is no objection, however, except as to cost and weight, to the use of separate coils for the dynamo and the battery.

(5) If the time of contact, t, is not a constant one but varies inversely as the engine speed, as is usually the case, thereby permitting a very long time of contact while running slowly in starting, the resistance in the circuit should be large enough to prevent short-circuiting and polarizing the battery. Further, it is desirable that the resistance be large enough so that any variation of the contact resistance of the points in the engine cylinder may not affect the total resistance by a large per cent.

(6) The time of contact, t, should occur over such a portion of one fly-wheel revolution that any slight wear, as of the timer, or "throwing off" as at high speed, may not materially alter the time of contact. The time of contact is usually between 15 and 25 per cent of that of one revolution. Fig. 2 shows the variation in the time of contact, t, for different engine speeds and different arcs of contact as expressed in per cent of one fly-wheel revolution.



[illegible]

(7) A small value of L would necessitate a large current, I, to give the desired spark with the resulting drain on the battery, and with large I^2R losses. (Equation 2.)

(8) While the efficiency of an igniting system is a matter of minor importance when a dynamo is used as the source of energy, it is of vital importance if batteries are to be used exclusively.

(9) The weight, cost of construction, shape, etc., of coils may also become important in special cases.

With the above conditions in mind it may prove instructive to follow the results of varying E, R, t and L upon the values of the current, I, and of the magnetic spark energy, J. It will be assumed that the coil used is the one described above.

The effects of varying the above factors will be taken up in the order given. As a rule only one factor will be varied at a time, in order to show the resulting variation in the current value, I, and the energy of the spark, J, at the moment of opening the circuit of the source of energy.

As already stated I varies directly as E, and J varies as E^2. These are shown respectively by curves A and B of Fig. 1, and J-E of Fig. 3.

In order to ascertain what value of E will give the maximum efficiency (that is, will make the ratio of the energy of the spark, J, to the chemical expenditure a maximum) let A be the area OPN under curve B of Fig. 1. This area represents the chemical expenditure per cell in coulombs, or ampere-seconds, when the spark [illegible] at point P and may be determined by

a planimeter or from the general equation for the area of a logarithmic curve, which is

$$A = \frac{E}{R}\left(t + T\left(\frac{1}{\epsilon^{\frac{t}{T}}} - 1\right)\right) \qquad (3)$$

in which $T\ (= L \div R)$ is the time constant, and $E\ (= Ne)$ is the number of cells times the voltage per cell. Equation (2) is the general expression for the energy of the spark, J, at point, P. It thus remains to find that value of Ne which will render $\frac{J}{NA}$ a maximum, NA being the total chemical expenditure,

$$\frac{J}{NA} = \frac{\frac{L}{2}\left\{\frac{Ne}{R}\left(1 - \epsilon^{-\frac{Rt}{L}}\right)\right\}^2}{N\left\{\frac{Ne}{R}\left[t + T\left(\frac{1}{\epsilon^{\frac{t}{T}}} - 1\right)\right]\right\}} \qquad (4)$$

By inspecting this equation it is seen that $\frac{J}{NA}$ is independent of N so that increasing the number of cells, the total resistance remaining constant, will in no way affect the chemical efficiency. This would require increasing the size of the cells as their number increases in order to maintain the same total resistance. An increase in the number of cells which simultaneously increases the total resistance would reduce the efficiency.

There are several conditions which affect the value of the resistance R. Referring to equation (1), it is seen that R enters into the equation in such a way that slight variations in R do not greatly affect the value of the current or the energy of the spark. This is illustrated in a special case by the current-resistance curve I-R of Fig. 3, and the energy of the spark, J, in the J-R curve of Fig. 3.

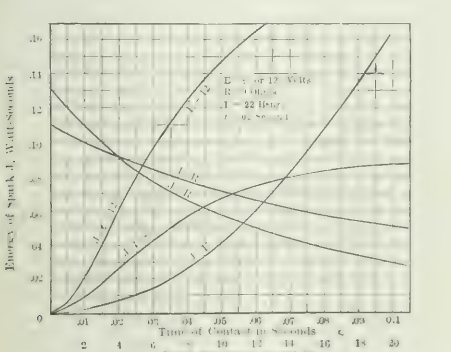


FIG. 3.—EFFECT OF VARYING THE RESISTANCE, TIME OF CONTACT AND VOLTAGE.

Treating equation (1) mathematically and solving for that value of R which will make I a maximum, other factors remaining constant, it is found to be zero, hence the smaller the resistance the more energy the spark contains. The rate of increase when reducing R is, however, not great, as shown in curves J-R and I-R of Fig. 3. Hence there is no gain in sacrificing anything else to obtain an extremely low resistance.

That value of R which will give the maximum efficiency in magnetizing the core may be determined by differentiating equation (5) with respect to $\frac{J}{A}$ and R, and solving for that value of R which will make $J \div A$ a maximum: A represents the coulombs or chemical expenditure per spark as above.

$$\frac{J}{A} = \frac{\frac{L}{2}\left(\frac{E}{R}\left(1 - 2.718^{\frac{-Rt}{L}}\right)\right)^2}{\frac{E}{R}\left\{t + T\left(\frac{1}{2.718^{\frac{t}{T}}} - 1\right)\right\}} \qquad (5)$$

The maximum is found when R equals zero, which means that when R is as near zero as possible, practically all the voltage of the battery is used in overcoming the counter e. m. f. of self-induction; that is, in storing energy magnetically.

However, in operating an engine equipped with a touch spark, or a non-vibrating jump spark, ignition system it is found that the use of a coil of very low resistance frequently results in

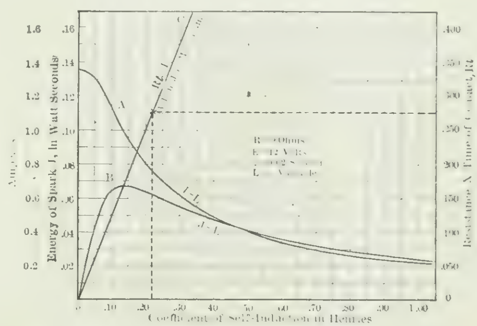


FIG. 4.—EFFECT OF VARYING THE SELF-INDUCTION, OTHER FACTORS BEING CONSTANT.

practically short circuiting the batteries when starting the engine, a few false starts resulting in throwing the batteries temporarily out of service as well as uselessly wasting their energy. Unless some automatic device is arranged to limit the starting current to a reasonable amount, the coil should have sufficient resistance in itself to afford the required protection.

The value of t, the length of the time of electric contact, is determined by the length of the arc of the contact, as measured on the periphery of the flywheel, and by the engine speed.

As shown by the general equation (1) the current will be a maximum when t is a maximum. But practically the current will reach its full value when $t = \frac{5L}{R} = 5T$. Thus, practically, the maximum spark will be obtained when $t = 5T$, except in cases of battery polarization, when the energy of the spark will decrease as the time of contact increases. For example, in Fig. 1, the energy of the battery is needlessly wasted when the current is allowed to flow for a longer time than $t = .05$ seconds.

The value of t which will render the efficiency a maximum is found as in the case of R above, the value of t being zero for maximum efficiency—that is, the less the time of contact the greater the efficiency. Thus, the point of cut-off should come on the steep part of the building-up curves, Fig. 1. Values should be selected for R and L so that the cut-off will occur at the proper moment, at least at the normal running speed. The point marked M in Fig. 1, near the "time constant," is a good efficient place at which to open the circuit.

The variations in t are shown in Fig. 2. For example, a 9.4-in. arc of contact on a 12-in. flywheel running at 1000 r. p. m. gives a length of time of contact of .015 seconds, as shown in dotted lines in Fig. 2. Upon the value of t depends the best value for L; the larger t is, the larger L should be.

The effect of varying t, as in the case of a variable-speed engine, is shown in curves I and E of Fig. 5, the one being for a 20 per cent and the other for a 10 per cent arc of contact, other conditions being the same in the two cases. See also curves

[illegible] 12 [illegible] 8 volt [illegible] 12 volt battery, respectively.

Regarding the self-induction, L, it is quite evident that if L is zero there will be no energy stored, and $J = 0$, while the current will reach its full $(\frac{E}{R} = I)$ value instantly, or at $t = 0$. On the other hand, if L is extremely large, the current will increase very slowly so that for any reasonable value of t, I will be very small and hence J also will be small. One should, therefore, determine not only what self-induction will give the strongest spark with any certain voltage, time of contact and resistance, but also what value of L will be efficient as to the consumption of electricity.

Curve A of Fig. 4 shows how the current values are affected by using coils of different amounts of self-induction, other conditions being unchanged. Curve B shows the resulting energy of the spark when varying the self-induction. It will be noted that an induction of 0.13 henry gives the spark maximum energy with $R = 9$, $t = .02$, and $E = 12$.

It will be most convenient to determine mathematically the value of L which will give the maximum J. Assuming J and L

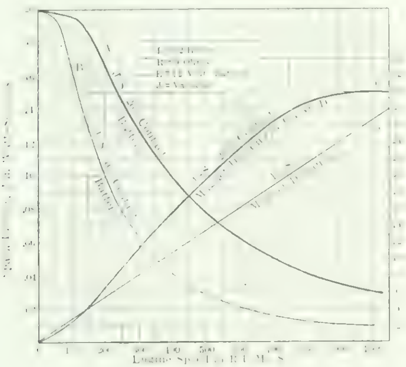


FIG. 5.—EFFECT OF VARYING THE SPEED.

to be variables, in equation (2) and substituting the value of I from equation (1), differentiating and putting $\frac{dJ}{dL} = 0$,

$$2.718^{\frac{Rt}{L}} = 1 + \frac{2Rt}{L} \qquad (6)$$

Having decided upon the values for R and t one may then determine, by trial, that value of L which will make the two sides of the equation equal. This value will be that self-induction which will give the maximum energy of spark in the particular case. The process may be reversed by assuming values for L and solving for Rt.

Curve C of Fig. 4, was drawn by solving for those values of Rt which would make J a maximum when L was .10, .15, .20 and .25 henry, respectively. As an example, when $L = .22$ henry Rt is .275; if R be 6 ohms then the time of contact, t, is $\frac{.275}{6}$ or .046 seconds. When L equals zero the current reaches its full value instantly and the stored (core) energy, J, equals zero, no matter how large the current. There may, however, be a spark, but it will be produced by the battery current only and have little disruptive character.

In order to find that value of L which will be most efficient so far as storing the magnetic energy, J, is concerned, one may proceed as before with equation (5) differentiating with respect to $\frac{J}{A}$ and L, as the variables, in order to find that value of L which will render the ratio of the magnetic energy, J, to the chemical expenditure, A, a maximum.

It is found that the larger is L the greater is the chemical efficiency. The effect of varying L upon the current and the energy of the spark is shown for a special case by curves A and B of Fig. 4. It is to be noticed that the current is a maximum [illegible] henry for the values assumed, although there is little variation in J between .10 and .20 henry. The higher value of L should be selected because of the much greater efficiency. Compare curves A and B, respectively, and $L = .13$ and .26, Fig. 4.

Since the desirable value of L changes with t, or Rt, in the case of variable-speed engines that value of L should be used which is suited to Rt or t at the average or normal speed.

The amount of current to be used is determined by the energy of the spark, J, or core energy and the self-induction, L, the chemical efficiency being independent of I.

The dimensions and the best construction of cores and number of turns of wire to be used for a desired value of self-induction L will be taken up later in connection with the design of cores for different types of coils.

In the curves A and C of Fig. 5, a comparison is made beween the energy of the spark supplied by a battery and a variable-voltage engine-driven dynamo; the time of contact, of course, varies inversely as the speed of the engine while the open circuit voltage of the magneto dynamo varies directly as the engine speed.

It is to be noted that the generator (curves A and C of Fig. 5) gives the same energy of spark as the battery at 450 r. p. m., the battery giving the stronger sparks at lower speeds. The engine speed at which the sparks from the two current sources are equal may, of course, be reduced by increasing the ratio of the dynamo speed to that of the engine; that is, by using a smaller dynamo pulley. The advantage of increasing the size of the sparks up to a certain point as the engine speed increases will be apparent. It is also desirable to have a strong spark in starting the engine.

In practice, the change from the battery to the dynamo is usually made by means of a throw-over switch, the battery being used only in starting.

It is to be noted in the case of curve C of Fig. 5 that the increasing dynamo voltage more than counterbalances the decreasing time of contact.

DESIGN OF CORES.

The selection of core dimensions is no doubt one of the most important and difficult problems in the design of spark coils, because the cross-section and length of the core not only determine the number of turns of wire which must be used to obtain the desired self-induction, L, but also to a large extent affect the resistance, R, of the coil, since the diameter of the core determines the length of the average turn of the winding.

The magnetic and constructional features can be eliminated from the discussion by recalling that the core should be of fine round shellacked iron wires of the best magnetic qualities. The finer the wires and the more perfectly insulated from one another the better, on account of the fact that the extremely rapid changes in the magnetic flux which occur in jump-spark coils tend to produce eddy currents in the core. The eddy currents act upon the core flux in the same way as a secondary current in a short-circuited coil; that is, they reduce the effective flux and greatly retard its rate of decrease.

Although it is not practicable to predetermine all of the dimensions of cores, if information is had concerning the constants of a coil and core which are of the same order as those of the coil to be designed, changes can be made in the first or experimental coil and the constants and results of such changes can be calculated. With these objects in view, several tests were made on iron cores in order to obtain a basis for calculating the dimensions of any spark coil.

A supply of commercial "annealed" round iron wire 0.062-in. in diameter was cut up into cores as follows:

The wires were slightly stretched in order to remove kinks.

They were then rolled between boards to completely straighten them, and shellaced, dried while lying cross-wise on one another, then gathered into bunches and pushed through suitable sized round holes in a board and taped as they came through.

The cores were of the following dimensions, 1 in. in diameter (180 wires) and 4 ins., 6 ins., 9 ins. and 12 ins. long, respectively, and 0.5 in. (45 wires), 0.71 in. (90 wires), 0.86 in. (135 wires) and 1.125 in. (225 wires) in diameter, respectively, by 4 ins. long.

Each core was wound with 191 turns of No. 16 copper wire in four layers, these coils being about 3 ins. long.

The magnetic flux for different ampere-turns on each core

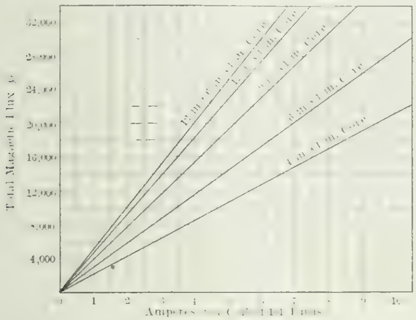


FIG. 6.—EFFECT OF INCREASING $\frac{l}{d}$ UPON THE NUMBER OF LINES OF FORCE Φ AND THE EFFECT OF VARYING THE NUMBER OF AMPERE-TURNS.

was determined by means of a ballistic galvanometer and a 20-turn exploring coil wound on the outside of the 191-turn coil. Fig. 6 shows the total flux in lines of force for different magnetizing currents in the case of different lengths of cores, each 1 in. in diameter. It is to be noted that the magnetism in each case increases directly as the current, and also that it is greater the *longer* the core.

Fig. 7 shows the rate at which the magnetism may be increased for any certain magnetizing force (in total ampere-turns) by increasing the length of the core; in other words, by varying the ratio of the length to the diameter $\frac{l}{d}$ and keeping d constant. It is to be noted that increasing the length from 5 ins. (5 to 1) to 10 ins. (10 to 1) increases the flux, the

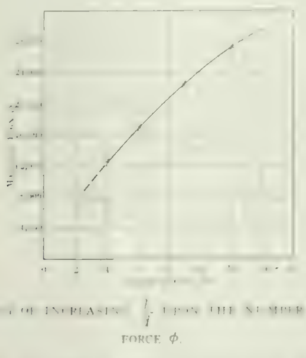


FIG. 7.—EFFECT OF INCREASING $\frac{l}{d}$ UPON THE NUMBER OF LINES OF FORCE ϕ.

current being six amperes, from 15,200 lines to 24,800, an increase of 63 per cent. An increase of 6 ins. (6 to 1) to 9 ins. (9 to 1) gives an increase of 41 per cent.

The effect of increasing the diameter of the cores, the length remaining 4 ins., is shown in Fig. 8. An increase in core diameter from .5 in. (8 to 1) to 1.125 in. (3.55 to 1) resulted in an increase in magnetic flux from 8400 to 16,800. The increase would be greater the greater the ratio of the length to the diameter — since the reluctance of the air path is relatively less the longer the core, so that a change in the number of iron wires would have a greater relative effect in the long cores; that is, in the cores having a large value of $\frac{l}{d}$.

The lines of force in the individual wires of the small cores (Fig. 8) were greater in number than in the larger cores, since the latter cores possess the greater relative reluctance in the air path. The lines of force per sq. in. in the .5-in. core above with 6 amperes were 63,000, while in the case of the 1.1125-in. diameter core they were only 25,000 per sq. in. of solid iron cross-section.

Annealing the cores by placing them in a length of gas pipe and heating them to a red heat, then cooling them slowly in a keg of lime increased the magnetic flux, other things being the same, about 3 per cent in the case of the 6-in. x 1-in core. Since the air part of the path of the lines of force has several times the reluctance of the iron core, the permeability of the iron was increased by much more than 3 per cent. In the case of long cores (large $\frac{l}{d}$) the effect of annealing would be much greater; that is, more than twice as much in case of the (12 to 1) 12-in. core.

For example, in the case of the 9-in. x 1-in. bending the wires back over the coil and forming a hollow horseshoe, doubled the magnetic flux, other things being equal. This relative increase, however, would be less the longer the core. Putting a few thin iron washers across the ends of the wires increased

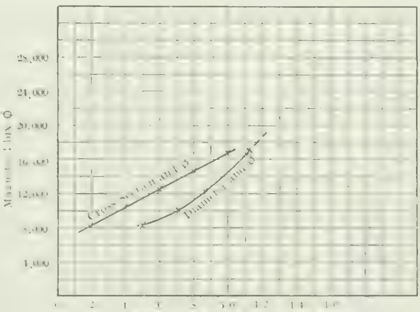


FIG. 8.—EFFECT OF INCREASING THE DIAMETER OF CORES OPON THE NUMBER OF LINES OF FORCE.

the flux again, by 170 per cent. Thus, closing the magnetic circuit, as shown above, nearly quadruples the flux in the case of the 9-in. to 1-in. core.

By comparison with the above results, the magnetic flux for a certain number of ampere-turns can be estimated for any ordinary spark coil, from which the flux per ampere of magnetizing current can be calculated. Then since,

$$L = \frac{N\Phi}{10^8}$$

in which N is the number of turns of wire and Φ is the flux produced by one ampere in the N turns, the self-induction, L, can be determined. For example, the 6 in. x 1 in. core has 20,000 lines of force with 7 amperes and 191 turns, or 1337 ampere turns (Fig. 6), hence,

$$L = \frac{191 \times \frac{20,000}{7}}{10^8} = \text{[illegible] henry}$$

With 2 × 191 or 382 turns at the same flux,

$$L = \frac{382 \times \frac{20,000}{7} \times 2}{10^8} = .022 \text{ henry}$$

L thus varies as the square of the number of turns on the core.

Any desired combination of size of core and number of turns of wire can be found to give the desired self-induction by a few trial calculations.

In designing cores for vibrating jump spark and magnetic touch spark coils the magnetic pull of the core upon the vibrating armature must be considered. From the well known law of magnetic traction,

$$P = \frac{B^2 A}{8\pi}$$

in which P is the pull in dynes (approximately milligrams), B the number of lines of force per sq. cm. in the solid iron, and A the cross-section in sq. cms. of iron, it is to be noticed that the pull varies as the square of the magnetic intensity and only directly as the area.

Since increasing the length of a core, the ampere-turns remaining constant, will increase the magnetic flux, a rather long core should be used, thereby giving a large value to $\frac{l}{d}$.

The results noted from the curves may be summarized as follows:

1. The flux will increase directly as the magnetizing current and as the number of turns.
2. The greater the length of the core the greater the magnetic flux for the same ampere-turns.
3. The greater the diameter of the core the greater the flux.
4. The shorter the core (the less the value of $\frac{l}{d}$) the greater will be the relative reluctance of the air path and the less the magnetic density in the iron core.
5. The longer the core the less is the air-path reluctance and the greater the iron reluctance and the greater the density of lines in the iron with a certain magnetizing force.
6. The self-induction, L, varies as the square of the number of turns of wire.
7. L varies directly as ϕ, N remaining constant; hence, increasing the length or the diameter of a core will increase the value of L.
8. The longer the core (greater the vale of $\frac{l}{d}$) the larger the self-induction for a certain resistance of coil, and the greater the iron loss.
9. The shorter the core (less the value of $\frac{l}{d}$) the greater will be the resistance of a coil of a certain L.
10. Annealing will increase the flux by from 3 to 12 per cent, depending on the value of $\frac{l}{d}$.

OPERATING CONDITIONS.

There are certain operating conditions which apply in general to the kinds of apparatus under consideration. Operating characteristic features of jump-spark coils which are of interest to the designer and operator, are shown in the oscillograms of Fig. 9 where curve A shows the voltage of a primary battery of moderately high internal resistance, supplying energy to a vibrating jump-spark coil. The "kick" which occurs in the primary coil is shown by the rise in voltage NH. The irregularities at K are due to a similar cause occasioned by a slightly chattering vibrator. Curve B shows the instantaneous values of the current in the primary coil. The line at K should be as nearly horizontal and smooth, NH as nearly vertical and MN as nearly straight as possible. The spark or secondary current HNP of curve C lasts about 0.001 second, varying inversely with the length of the spark gap, with the engine compression, etc. Curve D is not an oscillogram, but it has been drawn from known conditions. The secondary or jumping pressure VS may be measured by noting the length of the spark gap and the compression pressure. The voltage necessary to sustain the arc is not known exactly either in form or in amount, except that it is probably tens of volts.

Attention should be called here to the distinctive difference between the jump spark and the touch spark. The secondary voltage rises instantly on the cessation of the primary current, to V of curve D, as the secondary or spark current starts. Further, the shorter the arc (gap) and the less the compression pressure the larger the secondary current will be, and the longer it will continue. In other words, the longer the gap and the higher the secondary voltage the more of the spark energy is involved in the disruptive or detonative discharge VN, of curve D. The "kick" of a touch spark comes *after* the spark has started and hence has little disruptive or detonative effect.

The secondary voltage, up to the maximum jumping voltage of which the coil is capable, varies directly with the length of the spark gap and the absolute compression pressure.

While a long spark gap may have greater ignition power than a short one, probably largely owing to its disruptive character,

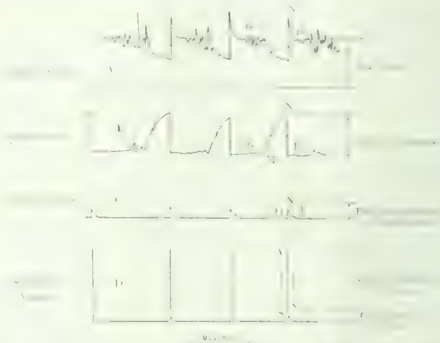


FIG. 9—OSCILLOGRAMS OF A VIBRATING JUMP-SPARK COIL.

the troubles liable to follow the use of a long spark gap must be borne in mind. They are liable to produce short-circuited spark plugs, secondary coils, etc.

TOUCH-SPARK COILS.

The design features of touch spark coils may be summarized as follows: With a battery as the source of supply, the e. m. f. should be not less than from 6 to 8 volts, depending upon the engine. The resistance should be as small as possible both in respect to the coil and as to the internal resistance of the battery and the wiring. The time of contact should extend throughout about 20 per cent of one fly-wheel revolution. The coefficient of self induction should be as large as possible, and still obtain a sufficiently strong spark with the values of e. m. f., resistance, and time of contact. If possible a value of L should be selected which is at least twice as large as that value of L which will give the maximum energy of spark as shown above in connection with Fig. 4.

In general such values of R, t and L should be selected as will bring the cut-off of the current at not more than 63 per cent of the full $\frac{E}{R}$ value. The time, t, in such a case will be equal to the "time constant," which is equal to $\frac{L}{R}$, and will result in good efficiency.

The core should be built up of very small iron wires carefully annealed and varnished. The diameter of the core should be large and the ratio of the diameter to the core length $\frac{l}{d}$

should be large, such as 10 or 12 to 1. Of course, the whole coil may be increased or decreased in size according to the desired energy of the spark.

When the source of supply is a dynamo, the e. m. f. should be from 10 to 16 working volts. The resistance should be somewhat large since the current is to be small and the coil may be wound with rather fine wire; or R may be selected just small enough so that the armature reaction of the dynamo will limit the energy of the spark at high engine speeds. The time of contact, t, may be from 20 to 25 per cent of one revolution. The coefficient of self-induction, L, may have any value which will give the desired energy of spark, since the efficiency is of no particular importance.

A short thick core of small shellacked iron wires will provide a satisfactory coil; annealing is not worth while.

In the case of a magnetic touch-spark plug with a variable-speed dynamo and a battery as a source of supply, the available space would determine the shape both of the coil and core to a large extent. The e. m. f. should be from 8 to 10 volts for the battery and from 10 to 16 volts for the dynamo. Generally the battery would be used in starting, and a plain direct-current magnet-dynamo would be used for the lowest running speed and above. This combination would give constantly increasing voltage and spark with increased speed and with decreasing igniter lag.

The resistance should be rather large, because of the small space, in order to obtain a large number of turns on a small core.

The value of L should be as large as possible with the large value of resistance used.

A small igniter lag is desirable. The time of contact should be nearly as small as that of an ordinary vibrating jump-spark coil, that is, from 0.005 to 0.010 second.

The energy of the spark need not be so large as in the case of the ordinary touch-spark coil, because there would then be a series of sparks at each explosion, when starting.

NON-VIBRATING JUMP-SPARK COIL.

The primary coil of a non-vibrating jump-spark coil in general follows the design of a touch spark coil as discussed above. The voltage may be relatively lower (from 6 to 8 volts) and the current larger, owing to the fact that a good contact is possible at all times in the timer. The resistance of the primary coil is generally small, owing to the use of a low voltage source which results in a coil of small self-induction with few turns of wire.

In case a dry battery is used in starting and a dynamo, either of the constant or variable-voltage type, is used at all speeds above the minimum, there is no particular advantage in using large wire on the primary coil to keep the resistance low. In fact, it is a distinct advantage to use small wire in order to get the secondary coil as near the core as possible.

The time of contact should preferably be a constant one, in case the voltage supply is constant, but if a dynamo is used which gives a rising voltage with increase of speed, a fixed arc of contact of approximately 20 per cent of one engine revolution, should be perfectly satisfactorily.

Inasmuch as the number of secondary turns necessary is directly proportional to the quickness with which the primary current is stopped, a timer of the "snap break in oil" type, having hard platinum alloy contact points, should be used. This detail has more to do with the jumping power of a coil than any other constructive feature. These coils have practically a zero igniter lag.

In order still further to assist in stopping the primary current quickly a condenser should be connected with one terminal on each side of the timer contact points to accept the flow of electricity while the contact points are being separated in the timer. This condenser should have the smallest resistance possible and the least capacity in micro farads possible in order to prevent arcing in the timer, as determined by trial.

As already stated, L may be small as compared to the value used with a touch spark coil because a rather large current at low voltage is usually employed.

The amount of energy, J, stored in the primary coil, should be about the same as that of a touch-spark coil, since the greater igniting power of the jump spark is counterbalanced by the lower efficiency of all jump-spark coils.

The core of a jump-spark coil possesses some features entirely distinct from those of a touch-spark coil. If the coil is to be used with a battery as the only source of supply, the core should have a large ratio of length to diameter $\left(\frac{l}{d} = 12 \text{ to } 1\right)$ but it must be long in any case so that the core, and the primary coil as well, may project well beyond the ends of the secondary coil in order that all the lines of force may enclose all the turns of the latter. In order to insure a quick break, *eddy currents must be reduced by using fine iron wire well varnished.*

Annealing will greatly increase the efficiency of the equipment inasmuch as a long core is to be used.

The secondary coil should have the least possible number of turns which will give to the coil the necessary jumping power, and it should also have as little resistance as possible so as to obtain a high efficiency. The requirements can be met by the use of a closely wound primary coil with thin insulation, having high dielectric strength, between it and the core, a *thin* insulating tube of rubber or built-up mica between the secondary and the primary coils, a long secondary coil, if possible of *one section,* and wound with wire as large as the space will permit.

In case the secondary e. m. f. is to be very high such as that required to jump 1.0 inch between needle points in air (26,000 volts) it may be necessary to wind the secondary coil in two or more sections to prevent sparking between successive layers. The second section of the secondary coil should have an extra thick insulating tube between it and the primary coil. *A one-section secondary is better and cheaper if it can be used.*

The number of turns in the secondary coil should decrease in general with an increase in the length and diameter of the core. The benefits of a very large increase in the size of the core, however, are soon overbalanced by magnetic leakage, by the slowing up effect of the eddy currents in the core when the core is large compared to the secondary coil, and by the resulting increase in the resistance of the secondary coil. Moreover, no core should be used which will not allow the use of full layers of primary winding of suitable sized wire.

SECONDARY SAFETY SPARK GAP.

The insulation of many jump-spark coils is broken down by allowing the secondary coil to generate an excessive voltage. The voltage can be limited by determining the maximum safe e. m. f. and then connecting the terminals of the secondary coil to a "safety" spark gap of a proper length, placed upon the case of the coil and connected in parallel with the spark-plug gap. The "safety" gap will also act as a tell-tale to indicate the accidental opening of the secondary circuit.

SECONDARY INSULATION.

The secondary coil should not be subjected to high voltages until the whole coil has been thoroughly "filled" with a suitable insulating compound by the heat-vacuum process. Every trace of air and moisture should be eliminated from the coil, otherwise the insulation will soon break down. Many kinds of insulating materials are used for this purpose, such as paraffin, which is not very good because it absorbs moisture, and various combinations of beeswax, resin, etc. Mosciki's mixture, consisting of four parts of resin, one part of ozokerite and one part of vaseline should give good results because it has a very high dielectric strength.

During the experimental stages of the building of a jump-spark coil it may be immersed in common kerosene for the trials, and there is no reason, so far as the insulation is concerned, why a liquid oil should not be used at all times instead of wax.

The energy of the spark from a non-vibrating jump-spark coil may be increased by increasing the voltage, decreasing the resistance of the source, and by increasing the arc of contact or

the time of contact up to a value which is equal to about five [illegible]

The design of a vibrating jump-spark coil conforms to the conditions noted above for a non-vibrating coil design, with a few minor exceptions. In general, the coil may be slightly smaller as it is not necessary in case of a series of sparks during one ignition that each spark be as strong as the single spark of a non-vibrating coil. The jumping power should be nearly equal to that of a non-vibrating coil, but this can be obtained with a smaller secondary coil, because as a rule a quicker break is given with a vibrator than with a timer. *A quick non-arcing break at the vibrator is absolutely essential.*

Many tests show that the great difference noted in the operation of jump-spark coils lies principally in the vibrator design.

The contact terminals should be large and perfectly flat, and the vibrator movement should be *so arranged that all parts of the contact are broken at the same time.* The time between the beginning of the movement of the contact point and complete separation should be not greater than the "time constant" of the vibrator condenser, as, for example , a condenser having .10 micro farad and .01 ohm resistance would receive 63 per cent of its full charge in *RC* seconds or in .01 × .000010 sec., or *one ten millionth part of one second.* If the above condition is not fulfilled the condenser will become charged before the points are entirely separated and sparking will result. The contact points should be the hardest, non-fusible, non-volatilizable metal obtainable, such as iridium-platinum.

A mica insulated condenser of the least resistance possible and of the smallest capacity possible (to be determined by trial) should be used in order to prevent arcing. Mica is preferable to paraffined paper for insulation for it not only has a much greater dielectric strength but has greater specific inductive capacity and a greater free discharge capacity.

The use of the vibrator does not necessarily introduce any change in the relative core dimensions as compared with those for a non-vibrating jump-spark equipment, except, perhaps, that the core should be slightly longer in proportion to its diameter in order to take advantage of the fact that the greater concentration of the lines of force in a small core will give greater pulling power to the vibrator. As stated above, the pull increases as the square of the number of lines of force per square inch and directly as the cross section of the core.

In general the primary coils are wound for rather low e. m. f. (6 to 8 volts) in order to limit the number of cells and also to keep the voltage at the vibrator well below the limiting arc sustaining pressure. Not much more than 12 volts should be used in case the supply of energy is obtained from a dynamo.

Owing to the fact that any change either in the resistance or the voltage of the sources of pressure requires a readjustment of the vibrator to obtain the best operation of the coil, vibrating jump-spark coils are strictly *constant potential coils.* A non inductive source, such as a battery, is better than an inductive one for a vibrating jump-spark coil.

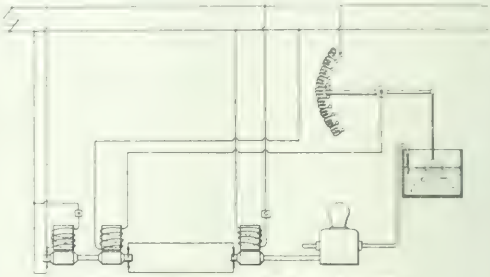
A vibrating jump-coil should have a constant time of contact at the vibrator. In many coils the first contact is made for a longer time than later ones, owing to the accelerating effect of the rebound of the vibrator. Inasmuch as the duration of the first contact is the igniter lag, the time should be as short as possible, especially for high-speed engines. The time of contact may be decreased by setting the vibrator close to the core, adjusting the spring [illegible]

Generally speaking, any coil designed for very high speed, that is, with small igniter lag, will give a large number of *small sparks* per explosion and will require a small average primary current when vibrating continuously.

The energy of the sparks may be increased by increasing the voltage of the source, by increasing the spring tension and by setting the vibrator farther from the core. The adjustments, however, will result in an increasing energy of secondary spark only when the changes do not cause sparks at the vibrator contact points.

Speed Control of Direct-Current Motors.

A patent issued Nov. 26 to Mr. H. Ward Leonard is interesting both on account of the means employed and by reason of the early date of the original application, Feb. 6, 1897. In many respects the system described resembles the motor-generator locomotive system with which the name of the above inventor is associated, as seen from the accompanying illustration, which shows a direct-current motor driving a pump for



WARD LEONARD SYSTEM OF MOTOR CONTROL.

filling a tank with water. The field current of this motor is obtained directly from the main supply leads, but the armature current comes from a special motor-driven generator whose field strength depends upon the depth of water in the tank

Preservative Treatment of Poles by the Open-Tank Process.

BY D. A. ROCKWELL

In the work which has been done in connection with the preservative treatment of telegraph, telephone and transmission line poles it has been considered that, compared with other preservatives, dead oil of coal tar is the most efficient and the most economical in the long run. Carbolineum which is in reality a refined dead oil of coal tar, may have a limited use.

Timber may be treated with dead oil of coal tar by three methods, namely, the closed-cylinder method, the open-tank method, and the brush method. The relative efficacies of the methods are undoubtedly in the order stated.

The open-tank method differs from the closed-cylinder process in that tanks or vats, which are open to the air, are employed. The open-tank process, in that it does not necessitate the use of expensive cylinders and auxiliary apparatus, promises to effect, by reduction of plant costs, considerable economies in the preservative treatment of timber. Another advantage offered in the case of poles is that the portion of the pole subject to the maximum decaying action, that is, the butt end, can be selectively treated. This procedure results in a considerable saving of preservative compound. The possibility of treating poles at a comparatively small cost so as to obtain thereby an increased life of several years should insure a considerable field for the application of the open-tank process.

There are two distinct methods of carrying out the open-tank process of treatment, the single-tank method and the double-tank method.

SINGLE-TANK METHOD.

In this method, the timber under treatment is placed in the tank and covered with dead oil of coal tar, means being taken if necessary to prevent the timber from floating. Heat is applied to the tank, either by a fire built beneath the tank, or, preferably, from the standpoint of fire hazard, by steam coils placed within the tank, and the oil maintained at a temperature of from, say, 212 deg. F. to 230 deg. F., for several hours, depending on the size and character of the timber. As a result of this heating, the air and moisture are expelled from the wood structure, which fact is indicated by a seeming ebullition of the oil.

This method may be carried out in two different ways: *a* With change of oil; *b* without change of oil.

When the heating process has been sufficiently prolonged, the hot oil can be run out of the treating tank into the emptying tank, method *a*, and the treating tank quickly refilled with cool oil from the storage tank. The oil storage tanks and connecting pipes should be so proportioned that the emptying and refilling process can be carried out in a short time, as an exposure of the treated surface to the air between the hot and cool oil baths is liable to react on the oil penetration. The timber is allowed to remain in the cool oil bath for an interval of time such as experience shows sufficient to ensure the desired penetration.

Instead of emptying the treating tank between the hot and cool baths, the valves of the connecting pipes may be so arranged that the oil level in the treating tank is maintained substantially constant during the change of oil. If the supply tanks are of sufficient size, the temperature of the oil in the treating tank will be considerably lowered by this procedure.

In method *b* the heat supply is shut off at the end of the heating interval, and the oil is allowed to cool by atmospheric radiation. The results obtained by this method are essentially the same as with a change of oil. This method has been successfully followed in the experimental treatment of cedar and chestnut poles, and Norway pine cross-arms.

Method *b* would probably require a longer time for treatment than method *a* owing to the slower process of oil cooling. However, if it is desired to make only one run per tank per day, that is, heating during the daytime and allowing the poles to remain in the cool or cooling oil during the night, then method *b* offers certain economies in plant cost. As it is not necessary to empty the treating tank in order to recharge with poles, the emptying tank is not required. The storage tank can be used in method *b* if it is desired to store considerable oil at the treating plant. Such a tank greatly facilitates the handling of the oil, as otherwise it is necessary to fill the treating tank from barrels.

DOUBLE-TANK METHOD.

In this method two tanks are provided, one for the hot bath and one for the cool bath. After the timber has been in the hot bath for a sufficient length of time, it is transferred to the cool bath and allowed to remain therein for the necessary time. The question of the exposure of the treated surface enters, however, and, as several minutes might be required to transfer a pole from the hot to the cool bath, it is not felt that the method should be carried out in practice until further experimentation has determined what exposure of the treated surface, between the hot and cool baths, can be made without reacting on the depth of oil penetration into the wood structure.

A disadvantage of the method is the increased cost of handling incident to the transfer of the poles from the hot to the cool oil tanks. This method presents the advantage, however, that the treatments can be carried on without interruption, as both the hot and the cool tank can be kept filled with poles.

Experiments made in 1905 by the Forest Service showed that penetrations through the sap wood could be obtained on partially seasoned and seasoned cedar and chestnut poles. The results on green poles were not as satisfactory, the penetrations being somewhat irregular. Winter cut poles, after the outer bark is removed, have an almost impervious layer of inner bark which adheres to the green wood, but wherever this inner bark layer is removed, the oil penetrates the sap wood. It is probable that, by shaving the butts of green poles, good penetrations could be obtained, but it is considered advisable at present to limit the open-tank treatment to seasoned or partially seasoned poles, by which it is established that good results can be obtained.

In connection with the treatment of seasoned cedar and chestnut poles, it is fair to assume that a 30-ft. pole will on the average absorb at least 50 lbs. (about 6 gals.) of dead oil of coal tar.

Seasoned loblolly pine can be treated easily by the open-tank method. This timber seasons in a few months in the South, and the treatment of loblolly pine poles can be carried out without an undue holding for seasoning.

About 5000 seasoned Norway pine cross-arms have been treated by the open-tank process with excellent results. An average absorption of about 12 lbs. of dead oil of coal tar per cross-arm was obtained.

PLANT REQUIREMENTS.

In the design and construction of open-tank treating plants, it is necessary to consider the following factors as reacting on the design: 1. Location of the plant and accessory apparatus as affecting the ease and economy of handling poles and oil. 2. Reduction of heat radiating surfaces to a minimum. 3. Means of keeping timber below the oil surface. The last factor does not enter into the pole treatment, but in the treatment of seasoned cross-arms; for example, it has been found necessary to adopt means to keep the arms submerged at the beginning of the treatment.

The effect of a proposed treating plant upon the insurance of the surrounding property should be ascertained before a definite location is selected. In plants heated by steam the fire hazard should be small if the boiler is somewhat removed from the storage and treating tanks. Dead oil of coal tar at ordinary temperatures does not take fire easily, but after catching fire it burns fiercely; such a fire is best controlled by throwing sand upon it.

The apparatus necessary for the operation of method *b* is a treating tank with steam heating coils, a source of steam supply and a derrick for handling poles and oil barrels.

Method *a* requires, in addition to the above apparatus, a storage tank for dead oil of coal tar, an emptying tank, and a pump for the transfer of oil from the emptying tank to the storage tank, and from the tank-car to the storage tank.

The size of the treating tank is dependent primarily upon the number of poles which it is desired to treat per charge, and also to some extent upon the source of steam supply for heating. The depth of the tank is controlled by the longest poles which are to be treated at the plant. The greater the height of the tank above the ground level, the greater the difficulty in loading and unloading the tank. A tank 8 ft. deep will treat the butts of poles up to 40 ft. in length, and a tank 9 ft. deep up to 50 ft. Occasional poles of greater length than these could be treated by placing them diagonally in the tank and regulating the oil level to the proper height on the pole. To facilitate the handling of poles, the tank should be set as much below the ground level as is compatible with the requirements for steam circulation. A ¼-in. steel tank with lap-riveted joints, and properly braced, should be satisfactory.

The oil in the treating tank should be heated by means of steam pipes arranged on the bottom of the tank. The heating pipes may be in the form of a return-bend coil, or, preferably, of a coil made up of branch T's. The latter form would provide a better steam circulation. Although there is very little information relative to the heating of open-tanks filled with dead oil of coal tar, it is estimated, on the basis of theoretical considerations, that, if steam is supplied at a pressure of 100 lbs. per sq. in., a steam pipe area of 0.075 sq. ft. per cubic foot of oil will raise the temperature of the oil at a rate of between 1 deg. F. and 2 deg. F. per minute. The steam coils should be protected from possible injury, as the dropping of poles upon them, by being coiled about I-beams or rails, the protection being placed so that the smallest poles to be treated will not pass between the beams or rails and strike the coils.

If the bottom of the tank is located lower than the steam boiler, it will be necessary to install a condensing steam trap, condensing well, and an injector or circulation pump, if it is desired to return the condenser water to the boiler.

The steam supply should, if possible, be sufficient to raise the temperature of the oil to 220 deg. F. in from two to three hours, which would correspond to a temperature rise of the oil of from 1 deg. F. to 2 deg. F. per minute. Assuming a combustion of about 8 lbs. of coal per square foot of grate surface and an evaporation of 8 lbs. of water per pound of coal, it is estimated that a grate surface of about 0.035 sq. ft. per cubic foot of oil will be ample. These assumptions are based on the

use of vertical boilers of the type used with hoisting engines and a medium efficiency of coal combustion.

In calculating the requisite steam pipe and grate surfaces for any treating tank, it would undoubtedly suffice to assume the oil volume as one-half of the tank space at the highest oil level to be maintained in the tank. It may be considered, for purposes of calculation, that the oil will be heated before the poles are placed in the tank. Even if the poles are in the oil during the initial heating process, the oil will probably absorb the greater portion of the heat owing to the poor conductivity of wood. After the oil has reached the maximum temperature, sufficient heat must be supplied to overcome the loss of radiation and the heat absorbed by the wood.

The supply of steam can, if desired, be controlled by means of a thermostatic regulator set to maintain a maximum temperature of 220 deg. F.

If the treating plant is situated near a steam plant of considerable size, it will probably be more economical to obtain the steam from that plant in preference to installing a special boiler for heating purposes.

As the steam is required at the maximum rate during only the heating of the oil, it would undoubtedly be possible to furnish from one small boiler steam necessary for heating the storage tanks, tank cars, circulation and oil pumps, and for a steam winch in connection with the derrick for handling the poles.

The oil storage tank for large plants should have a volume of at least 25,000 gals.; that is, somewhat in excess of two oil-tank cars. The tank should be provided with steam heating coils in order to maintain the temperature of the oil above the temperature of solidification. The storage tank should be placed at a height sufficient to enable the filling of the treating tank by gravity. The connecting pipe between the storage and treating tank should be at least 10 ins. in diameter and controlled by a valve. The storage tank should be equipped with a float gauge to indicate the height of oil in the tank.

The emptying tank should be placed underground so that the oil will flow into it from the treating tank by gravity, and should be of somewhat greater volume than the treating tank. The connecting pipe should be at least as great in diameter as the pipe between the storage and treating tanks.

The treating tank should also be joined to the emptying tank by means of an overflow pipe connected at different heights with the treating tank. By opening proper valves, the oil level in the treating tank can be maintained at the desired height. It will not be necessary to place heating coils in this tank if care is taken to pump the oil back into the storage tank before it has cooled to the temperature of solidification. The tank should be provided with a float gauge as an indicator of the depth of oil in the tank.

A steam-driven pump should be provided for transferring the oil from the emptying tank to the storage tank. The pump would also be used when filling the storage tank from tank cars.

A derrick should be provided in order to facilitate the transfer of the poles into and from the treating tank. The derrick could, if desired, be operated by a hoisting engine, the steam being supplied from the heating boiler.

Central Station Progress in Montreal.

The Montreal Heat, Light & Power Company has recently moved into a commodious new building of its own at the corner of Craig and St. Urbain Streets, opposite the Street Railway Chambers. The new home of the company has been appropriately christened the Power Building, and is located in the business center of the city, close to the post office and the leading banks. Since the formation of the company in 1901, out of divergent elements, among which were the Royal Electric Company, the Lachine Rapids Hydraulic & Land Company, Ltd., the Montreal Gas Company, the Standard Light & Power Company and several suburban organizations, it has been handicapped for lack of space and proper accommodation. Although the building is not quite completed at this writing, it has been constructed to afford the public and the company every convenience for the speedy transaction of business.

The new building is a steel frame structure of seven stories and a basement, about 100 ft. square and 125 ft. high above the ground level. Its exterior walls are of Indiana sandstone. The basement will contain vaults and storage room, with space for sub-station equipment if necessary. On the first floor will be the contract department and office of the general agent, Mr. J. J. Cagney, adjoining a display room, containing 1000 sq. ft. of exhibition space, provided with gas and electric outlets, and in which will be a large illuminated display of gas, electric lighting, heating, cooking and power apparatus. Electric elevators and a local branch telephone exchange of 50 stations will keep the various departments in close touch with the public. The building is heated by steam transmitted underground from the company's steam plant on Chenneville Street. The second floor will contain the construction and operating department offices; the third, the executive offices, boardroom, the offices of the president, vice-president, secretary and treasurer, and of the auditing and legal departments. The fourth, fifth and sixth floors will be rented, and the seventh will contain a convention hall and lunchroom for employes.

It is only fair to attribute the steady growth of Montreal during recent years to electric power utilization. The local street railway is operated by energy obtained in part at Shawinigan Falls and transmitted 87 miles to the city; while the company is also supplying energy to the Dominion Textile Company, the plants of the Montreal Water & Power Company, the Montreal Steel Works, the American Locomotive Company, the Dominion Steel Car Company, the Simplex Railway Appliance Company, the Robert Mitchell Company, Ltd., the Jas. Robertson Company, Ltd., the Montreal Rolling Mills Company, the Dominion Oil Cloth Company, Ltd., oil and flour mills, the Grand Trunk and C. P. railroads, Dominion Park and many other large consumers, constituting about 75 per cent of the users of energy on the island of Montreal. Twenty cities and towns surrounding the city are also lighted by the company. As has been remarked in these columns before, Montreal consumes more electric energy per capita than any other city in the world.

While the price of practically all other commodities has been increased of late, the price of gas and electricity has been steadily decreased, notwithstanding the greatly augmented cost of labor and material. In 1854 the price of gas in Montreal for lighting and fuel purposes was $4.20 per 100 cu. ft., while to-day the prices of gas for lighting and cooking are $1.20 and $1.00, respectively. Similarly, the price of electric lighting service has been reduced from $11 per 16-cp lamp per year in 1884 to a basic meter rate of 15 cents per kw-hour, subject to varying rebates, depending upon consumption, under which the cost of burning a 16-cp lamp during ordinary lighting hours does not exceed $3 per year.

The rates for motors now obtaining in the city are lower than ever before at Montreal. In 1894 the Royal Electric Company was supplying the equivalent of 14,700 16-cp lamps and 50 hp in motors; its total number of customers did not exceed 300, and none of the various heating appliances were heard of. At present the Montreal Heat, Light & Power Company has connected to its system the equivalent of 450,000 16-cp lamps, about 37,000 hp in motors, and upwards of 1000 appliances for heating, cooking, refrigerating, etc. The company serves upwards of 13,000 electric consumers and about 50,000 gas consumers, or a total of nearly 70,000 consumers.

The company's motor rates are of particular interest in view of the success which has been attained in the broadening of the load curve. Non-peak power users are encouraged by a special concession, as will be seen by the following brief discussion of the rates at present in force. The services are classified as follows:

Unlimited day service, 10 hours straight, 7 a. m. to 6 p. m.

Unlimited day and night service, 24 hours, continuous.

Limited day service (off-peak) from 7 a. m. to 6 p. m. throughout the year except from 4 to 6 p. m. between Sept. 15 and March 15.

Limited day and night service (off-peak) 24 hours per day throughout the year except between 4 and 7 p. m. between Sept. 15 and March 15.

On the limited day service the reductions given by the company amount to 25 per cent of the unlimited day rate. The same ratio of difference applies to the unlimited day and night service and the limited or off-peak day and night service.

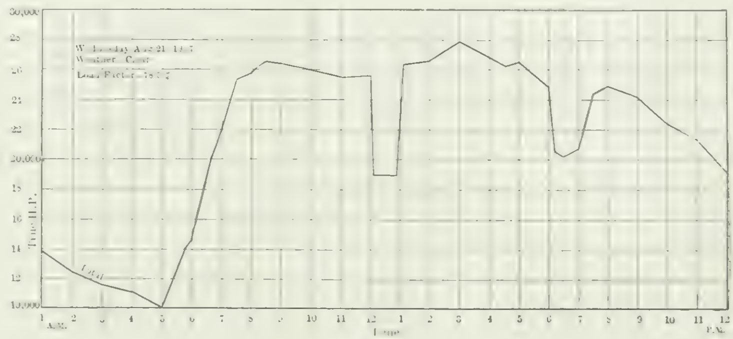
Three systems of charge, equalizing one another under certain load factors, are in vogue, as follows:

1. A straight flat rate per hp-year, varying acording to the average maximum load as determined by test.
2. A readiness-to-serve charge based on average maximum demand plus a meter charge per hp or kw-hour, also varying according to demand.
3. A straight meter rate per kw-hour or hp-hour as the customer chooses, likewise varying according to demand.

The results of encouraging the non-peak business are seen clearly in the accompanying diagram, which is a reproduction of the total load curve of the company on Wednesday, Aug. 21, 1907. The shape of the curve is remarkable for a central station, and its load factor of 78.5 per cent speaks volumes for the steadying influence of a very large power output. The load in general falls off in the early morning hours to 10.000 hp, rising to a well-sustained maximum average of about 26,000 hp during the forenoon. During the lunch hour, 12 to 1, the load fell to 17,000 hp. The afternoon peak occurred at 3 p. m., 28,000 hp, the high average of about 27.000 hp being well sustained between 1 and 5 p. m. The falling off of the power load during the latter part of the afternoon is conspicuous, and the occurrence of a minimum of 20,000 hp at 6:30 p. m. is of special interest as indicating the preponderance of motor load in the company's total load output. At this time of the year the lighting load is, of course, late in coming upon the machines, and the 8 p. m. maximum of 25,000 hp is soon over. with a rapid fall in output between 8 o'clock and midnight. In the 12 hours between 7 a. m. and 7 p. m., the company's motor load represents a most unusual constancy and volume, and it bears eloquent testimony of the economic value of hydroelectric power when scientifically distributed in a large manufacturing city.

It has been found that about 40 per cent of the company's customers can cut off power at the time of peak load without detriment to themselves. Among the loads are 3500 hp in cotton mills, which start at 7 a. m. instead of 8, and which allow half an hour for lunch, stopping work at 4:30.. The operatives in many instances prefer to follow these hours and go home early than to begin later and close later. Among these off-peak consumers are the various morning and afternoon newspapers, to whom the company supplies upwards of 400 hp. Another class of customers is found in brick yards. These require entirely a summer service, and get about 50 per cent of the regular rates on seven months' operation. These amount to 600 or 700 hp, the motors being used to drive casting machines, mixers and conveyors. Other non-peak users are the local water power company, which uses 1200 hp in pumping drinking water; the Railway Appliance Company, 500 hp; various wood yards and cement works. In the wood yards all the cutting is done during two or three hours of each day. From 5000 to 6000 hp will be used in the cement industry at Montreal next year. The non-peak rates are as yet given only to trustworthy customers consuming relatively large amounts of power. An installation of 20 or 25 hp would be about the limit below which the non-peak rate would not as yet be granted. Separate circuits are not run and the time switch has not yet been applied to any extent, though the latter is being considered by the company. The company makes a special rate for electric heating wherever the installation is large enough to warrant.

The company controls practically all the developable or commercially practicable water powers within transmission distance of Montreal. The present plants include a 12,000-hp station at Lachine Rapids; a 22,500-hp plant at Chambly on the Richelieu River; the selling rights in Montreal of the large Shawinigan plant, and 8000 hp in steam plants on Queen Street and elsewhere in Montreal. A new plant is now being built on the Soulanges Canal, about 38 miles from the city. This will contain three Canadian Westinghouse 4400-volt, three-phase generators of 5000 kilowatts rating each, direct-connected to Allis-Chalmers-Bullock turbines of the horizontal shaft type, four turbines being provided per unit of generating capacity. The head upon the turbines will be 50 ft. The power house will be a concrete structure, 150 ft. long by 43 ft. wide, and the transmission potential will be 44,000 volts, three-phase. Mr. R. S. Kelsch, of Montreal, is the consulting engineer for this work.



LOAD CURVE

The commercial service of the company consists of 550-volt three-phase, 63-cycle current throughout the industrial territory; 220-volt and 110-volt single-phase lighting service. There is also a 250-volt, direct-current motor circuit used mainly for electric elevators, the charge for this service being about 25 per cent more than for alternating current on account of the losses in conversion and distribution. The minimum power-factor of motors when operating the consumer's maximum load is required to be as follows: Motors not exceeding 5-hp rating. at least 75 per cent; motors of over 5 hp, and not over 10 hp, 80 per cent; motors over 10-hp rated capacity, 85 per cent.

During the year ending April 30, 1907, the gross earnings of the company were $3,453,000, and the net profits, after providing for fixed charges, were about $1,440,000, being an increase in gross over the preceding year of over a quarter of a million dollars, and an increase of about $162,000 in net, despite the increased cost of labor and material. The company completed during the year the erection of a dam on the Richelieu River, at Ste. Thérèse, for storage purposes, at the same time drowning the rapids at that point with the object of obviating the troubles experienced in past years at the Chambly plant from frazill ice. The experience of the past winter fully demonstrated the value of this dam. A 2000-hp steam turbine unit has also been added to the steam plant at the Queen Street Station. The increase in electric connected load during the year was 41,665 incandescent lamps, 266 commercial lamps, 33 street lamps, and 4884 horse-power in motors.

Steel Transmission Towers on the Jersey Meadows.

The new line of the Pennsylvania Railroad Company into New York City crosses the "Turnpike" between Jersey City and Newark overhead, and at this point the transmission lines of the Public Service Corporation of New Jersey are at present carried over on wooden poles. This transmission line was fully described in the Electrical World for Jan. 20, 1906. As the railway embankment at this point is about 25 ft. high, it became necessary to provide higher and more substantial supports for the wires than provided by the wooden poles in order to give ample clearance for passing trains.

The Pennsylvania Tunnel & Terminal Railroad Company, which is constructing the new railway, is erecting two steel towers for this purpose for the Public Service Corporation. A feature of the construction is the platform at the top to give the linemen a safe foothold while working on the wires and insulators.

The legs of the towers are bolted to concrete foundations, set 11 ft. below the surface with 2 ft. above. From the ground line to the top row of insulators the distance is 94 ft. 9 ins. At the base, the towers measure 9 ft. x 15 ft., the latter

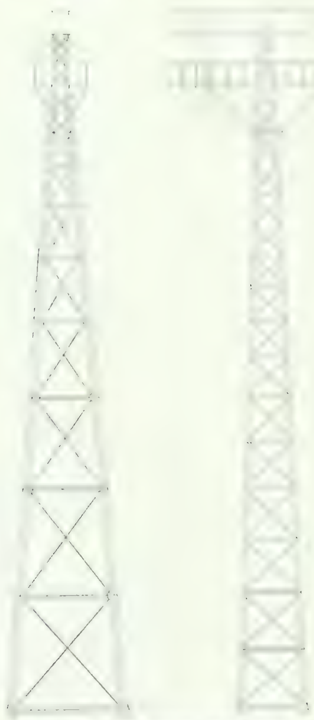


FIG. 1.—SIDE AND FRONT ELEVATIONS OF TOWER.

being the side dimension. The span between towers, from center to center, is 357 ft.

The platforms are of rod and bar construction, and are 26 ft. long by 7 ft. wide, the railings being 2 ft. 9 ins. high. Above the platform are two cross-arms, 26 ft. long by about 2 ft. wide, each carrying a double row of 9 insulators. The insulators are placed one behind the other, each couple forming an anchor insulator and practically eliminating all danger of wires breaking at the insulators, as shown in Fig. 2. The two cross-arms provide accommodation for 18 wires, but at the present time only 10 are in use, thus leaving ample room for future extensions. The height of the first row of insulators from the floor of the platform is 7 ft. 6 ins. and of the top row, 10 ft. 6 ins. This gives an abundance of room for wiremen to work with safety.

The insulators are placed longitudinally 3 ft. between centers, with the exception of the third insulator from each end, which is placed 3 ft. 6 ins. from the second. This variation permits of symmetrical spacing with reference to the upright supports of the cross-arms. These insulators were supplied by the R.

FIG. 2.—DIAGRAMS OF ANCHOR INSULATOR.

Thomas & Sons Company, East Liverpool, Ohio. They measure 6⅞ ins. across the umbrella and are 6 ins. high, each insulator having two petticoats. They were designed for a voltage of 25,000, but the present service pressure is 13,000 volts.

Mr. R. D. Coombs, structural engineer of electric traction for the Pennsylvania Tunnel & Terminal Railroad Company, designed the towers and the Archbold-Brady Company, Syracuse, N. Y., was the contractor for their construction and erection.

Mr. George Gibbs is chief engineer of electric traction for the railroad company, and Mr. Farley Osgood, general superintendent of distribution of the Public Service Corporation.

Letter to the Editors.

Steam Consumption Tests of Turbine.

To the Editors of Electrical World:

Sirs:—Permit me to verify the statements made on page 895 of your issue for Nov. 2, in connection with a steam consumption test on a large turbine of the New York Edison Company. The accuracy of these results has been questioned by Mr. Chas. B. Burleigh, of Boston, in your Nov. 16 issue, in the following terms: "The above is undoubtedly a correct quotation of the statement, but the statement is not borne out by facts."

In this I have a two-fold object; first, to uphold the accuracy of your published report, and second, to correct a popular misconception regarding the comparison of turbine economies under different operating conditions.

It is questioned by Mr. Burleigh, that a water rate of 14.9 lbs. per kw-hour is superior to 12.5 lbs. per kw-hour, which he states was developed by an 8000-kw Curtis turbine operated by the Chicago Edison Company. In the first place, Mr. Burleigh has apparently established a new record for the Curtis type of turbine, as all previous published reports on this Chicago machine indicate a minimum consumption of 12.9 lbs per kw-hour at a 10,000-kw load. Although the latter figure has recently been reported on a machine rated at 9000-kw, presumably it is the same machine Mr. Burleigh refers to. In the second place, I desire to emphasize the fact that economy tests are not comparable from either a technical or a commercial standpoint, unless respective operating conditions are known; so that it is manifestly improper to question the accuracy of your published report on such a superficial basis.

And herein, by the way, lies the greatest fallacy in the ceaseless struggle for high economies. Every engineer is, of course, deeply interested from a personal standpoint, in the attainment of the highest cyclical efficiency for all forms of prime movers; but high efficiency, in itself, means little from a commercial standpoint, unless the cost of attaining it is reckoned. This is apparently true of the extreme operating conditions assiduously cultivated in turbine operation. Unquestion-

ably, the results are spectacular; but, when we take into consideration the extra cost, maintenance and complexity of the additional auxiliary equipment and the losses incident thereto, our enthusiasm wanes, and we intuitively seek a lower plane where efficiency and cost form a more reasonable balance.

With this in view, I beg to submit that the 16 per cent difference between the economies noted by Mr. Burleigh does not exist. Apparently he has overlooked the premises in the original statement, which have been only partially quoted. The actual statement was, in substance:

"These consumption results, while not being less in actual steam consumption than the best results of European practice, yet are extremely good in view of the moderate operating conditions under which the test was conducted; in fact, they represent the best results that have yet been obtained by any turbine under the conditions named."

Taking both machines at their point of minimum consumption, the turbine tested by the New York Edison Company developed a water rate of approximately 15.1 lbs. per kw-hour for two consecutive hours, with an average pressure of 175 lbs., 97 deg. superheat, and 27.3 ins. of vacuum. Corrected to contract conditions, 175 lbs. pressure, 100 deg. superheat and 28 ins. vacuum, this is equivalent to 14.73 lbs. per kw-hour.

The turbine tested by the Chicago Edison Company developed a water rate of 12.9 lbs. per kw-hour, with 176 lbs. pressure, 147 deg. superheat and 29.5 ins. vacuum. Correcting to the above contract conditions by the percentages advocated by the builder of these machines, it is found that the equivalent water rate at the same load is 15.08 lbs. per kw-hour, a result which seems not to bear out Mr. Burleigh's contention. The results might be reduced still further—to a basis of dry saturated steam—and still be within the limits of your published statement regarding the record established by the New York Edison turbine, but I believe the above figures will be sufficient for the point in view.

In making comparisons such as these, which heretofore have seemed neither necessary nor opportune, I do so purely in the interest of a clear understanding of the situation, not for the purpose of drawing illusive conclusions, even though the latter may be quite tenable on careful analysis. In examining the performance of prime movers, we must not simply accept the rate of consumption of heat energy in the form of steam, gas, oil, etc., but make the comparison on a true scientific basis, else the results will quickly lead to erroneous conclusions. The sooner these principles are clearly understood and appreciated at their true value, the sooner will the apparently great disparity between turbine tests, such as those above outlined, be dispelled.

PITTSBURG, PA. J. R. BIBBINS.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Repulsion Motors.—K. SCHNETZLER.—A paper read before the German Association of Electrical Engineers on the regulation of repulsion motors by moving the brushes. The possibilities of this method, especially in the arrangement of Deri, are discussed, and it is found that between wide limits of torques and speeds all conditions are fulfilled which may be required from a satisfactory motor with regard to efficiency, power factor and commutation. The limitations of this method of regulation are investigated and some points of the construction of the motor are briefly discussed.—*Elek. Zeit.*, Nov. 14 and 21.

Lamps and Lighting.

Arc Lamp.—An illustrated description of an arc lamp of English make which has some new features. The simplicity of the mechanism is indicated by the total absence of a shunt coil, the regulation of the feed being controlled entirely by the series solenoid. The construction is shown in Fig. 1, where A is a dash-pot, B the series solenoid with plunger C, E a rocker, F a clutch link, G and J the bottom and top carbon holders respectively, H center rods, K a flexible conductor, L the negative lead and O the negative rod. The pull of the solenoid B is [illegible] and is also regulated by the spring in the dash-pot A, which increases the pull of the soleniod upon its core and equalizes the increased sensitiveness of the current variations. There is a special feature in these lamps, which comprises a regulating clutch which is directly connected to the lever arm of the balance weight. This clutch N is of the usual washer type, acting directly on the carbon, and regulated by the motion of the rocking arm of the [illegible] an air dash-pot, which is [illegible] this type. By this [illegible] and the steadiness and regular feeding of both electrodes is regulated with a consumption of 550 watts. The lamp takes from 2½ to 5 amperes of current, and can be used singly on voltages from 200 to 230.—Lond. *Elec. Eng'ing*, Nov. 14.

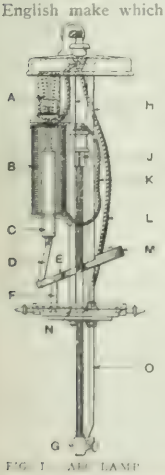


FIG. 1.—ARC LAMP.

Low-Pressure Mercury-Vapor Lamp for Strong Currents.—J. E. LILIENFELD.—A description of a new lamp of this type. The use of the mercury lamp with strong currents is subject to the difficulty that the mercury is extensively evaporated, and the pressure of the mercury vapor is increased beyond the most favorable point. For any given current density there is a certain low pressure at which the amount of luminous radiation is in the largest ratio to the heat radiation. If the current density is increased, the pressure increases at a higher rate, and soon becomes too great for the optimum. This disadvantage is avoided by the lamp of the author, who divides the vacuum tube midway by a stopper having a narrow channel, which leads into a narrow tube opening just above the other mercury electrode. The two halves of the vacuum tube on each side of the stopper can be taken apart. The inner narrow glass tube has the effect of concentrating the current, and thus keeping pace with the vapor density. The diameters of the outer and inner tube can be adjusted beforehand so as to have the optimum effect for any given current density.—*Phys. Zeit.*, Oct. 24; abstracted in Lond. *Elec. Eng'ing*, Nov. 14.

Sealing-in Wires.—A note on a recent British patent of Bastian and Calvert for a method of sealing electric conductors in or through glass. Specially-shaped metallic conductors of minimum sectional area consistent with the required current-density are employed. "An important part of this invention is the method of coating the conductor at the portion where it is to be sealed into the glass, a small tube or envelope of enamel glass being applied to the conductor before sealing the conductor into the glass. The conductor is formed from a thin strip of foil, over which is slipped a small tube of flux. The flux is then heated rapidly in a flame and is melted on to the conductor, thus preventing oxidation of the conductor. These coated conductors are then melted into ordinary glass in the usual manner."—Lond. *Elec. Eng'ing*, Nov. 14.

Tungsten.—The export of tungsten from Portugal has increased from 9 tons in 1905 to 336 tons in 1906. This is thought [illegible]

Power.

[illegible] Turbines and Gas Engines.—E. J. Fox.—A further contribution to his controversy with Andrews on the comparative cost of large steam-turbine and gas-engine plants. In the case of a 16,000-kw plant he estimates a capital expenditure of $861,060 for a steam-turbine plant and of $2,014,160 for a gas-engine plant with 50 per cent reserve plant. "It remains for those installing a plant to decide for themselves whether the low fuel charges accompanying the use of gas engines—and after making due allowance for the increased cost of running gas engines in other respects—will justify the big difference in capital expenditure. It seems that the extreme ease with which overloads can be dealt with on steam turbines is sometimes overlooked, in view of the fact that the overload range is frequently used for dealing with the peaks of loads without a special plant being installed for the purpose, and also obviating the necessity for installing further reserve plant."—Lond. *Elec. Eng'ing,* Nov. 14.

French Water-Power Plants.—H. Armagnat.—An article, with map, on the electric power stations on the Mediterranean Sea coast of France. The development began in 1897, and there are now 11 hydroelectric stations with an aggregate rating of 61,500 kilowatts. For reserve, nine steam plants, having a total of 21,150 kilowatts, are provided. In operation the plants are not connected in parallel; each supplies energy to a distinct area, but it is possible to interchange energy between the different plants.—*L'Industrie Elec.,* Nov. 10.

Sweden.—M. J. Heilmann.—An article on the water-powers available in Sweden. A list of 17 water-powers is given with an aggregate power of 570,000 kilowatts, which figure is increased to 585,0000 kilowatts by the addition of secondary auxiliary plants.—*L'Industrie Elec.,* Nov. 10.

Traction.

High Speed of Electric Locomotives on Grades.—A. H. Armstrong.—A communication discussing the question whether in view of the desirability of uniformity in station load high-speed up grades is worth the while for freight haulage. The writer emphasizes that the generating station of electrically-operated railroads occupies the position of an auxiliary and must conform in its practice and economy to the demands of the operating department, which latter are paramount. Electrification of steam roads is not attractive either financially or otherwise, if the electric locomotive is called upon simply to duplicate the present performance of the steam locomotives. It is largely in connection with increased speed that the supporters of electrification hope to make a showing sufficient to warrant the expense. The introduction of the electric locomotive not only gives the operating department a means of quickening the passage of freight and passenger trains over heavy grade divisions with resulting reduction in operating expenses, but it also permits an increase in the tonnage over congested track sections by reason of the increased speed.—*St. R'y Jour.,* Nov. 23.

Lötschberg Railroad.—S. Herzog.—An article on this road which will be the first European main railroad in the design of which electric operation is taken into consideration. The road is a connecting link between the railroad systems of different countries so that express trains of 300 tons and freight trains of 600 tons will run on it. Electric locomotives will, of course, be used. The electrical energy will be supplied at the northern end from the Kander and Hagneck generating plants and at the southern end from the Lonza Works. No decision has yet been reached concerning the electric system to be used. Although the first cost will be higher for electric than for steam operation, the operating cost will be lower, and for the traffic to be expected the total cost, including interest and amortization, will be lower for the electrical system. Notes are given on the use of electric energy in building the tunnels.—*Elek. u. Masch.,* Oct. 27.

London.—H. M. Sayers.—A critical analysis of last year's account of the London County Council's Tramways. The progress of the electric equipment made a rapid stride during the year, at the cost of much disturbance to traffic on the northern lines, shown by a large falling off in the receipts. The extension of electric traction to about half the mileage operated, and the supply of energy from the Greenwich station during the greater part of the year, permit, for the first time, of a useful analysis of the returns from which some forecast of the results of working the whole of the lines electrically is possible. It is shown that, on the average mileage operated, the gross receipts are over $100,000, and the net over $40,000 per route-mile; and that there is a fair net profit after paying all capital charges and providing 2 cents per car-mile for the renewal reserves fund. Examination of the working expenses in detail shows that while certain items are high, compared with the average figures on other tramways, the special circumstances, including the use of the conduit system, afford a reasonable explanation, and also a prospect of a material reduction as the system expands and the conditions become more settled. The high rate of earning per route-mile and per car-mile, on account of high traffic density, quite compensate for the higher expenditure. The average total annual receipts per route-mile were $103,655 and are probably the best in the world. The statistics show that unusually high rate of average speed (8½ miles per hour) and car mileage per day (106 miles per day per car) are maintained. The question of the extra capital and working costs of the conduit system is briefly examined in relation to the receipts, and it is shown that for the lines in operation, the density of the traffic covers the cost of the luxury, but that a less expensive equipment will be needed to make outlying extensions remunerative.—Lond. *Elec. Eng'ing,* Nov. 14.

Rail Corrugation.—An elaborate illustrated report presented before the German Street and Interurban Railway Association. It is based on extended experiments with dummy wheels and rails of different degrees of hardness, and the conclusion is reached that corrugation arises when the strains on the track approach or equal the elastic limit of the rail. It is also stated that corrugation cannot be ascribed to the usual slight differences in material due to imperfect rolling.—*St. R'y Jour.,* Nov. 9.

Braking.—F. Heckler.—A paper on foundation brake-gear design for electric railway cars. The author discusses the importance of braking and presents several combinations of trucks and brake rigging, with comments on their relative value.—*St. R'y Jour.,* Nov. 30.

Installations, Systems and Appliances.

Three-phase Energy Transmission Without Switchgear.—R. C. Roberts.—For plants employing underground cables for transmitting energy to motor-generator sub-stations, the author recommends the employment of equal-sized units in generating station and sub-station, permanently connected together respectively on separate circuits without parallel running. This method results in the elimination of switchgear, in the elimination of the difficulties of charging up feeders and switching on large high-tension motors, in the elimination of synchronizing and in the simplicity of the automatic protective devices. The author thinks, however, that the chief advantage would be the enhanced reliability of supply ensuing from a complete isolation of each unit of high-tension transmission.—Lond. *Elec. Eng'ing,* Nov. 14.

Lightning Arresters.—J. Liska.—An article in which the author discusses the principles on which the Wurts cylinder lightning arrester operates. To speak of non-arcing metals is not sufficient. Steinmetz has already called attention to the influence of the capacity of the cylinders with respect to one another and to earth. On this basis the author considers the distribution of the potential along the arrester and gives a simple equation for it. He suggests the adjustment of the capacity between cylinders and earth on the basis of his formula, and gives a few notes on the design of such arresters with adjustable capacity.—*Elek. u. Masch.,* Oct. 27.

Motor-Switch and Fuse-Box.—An illustrated description of a combined motor-switch and fuse-box, of English make, designed on the principle that it cannot be opened unless the switch is in the off position.—Lond. *Elec. Eng'ing,* Nov. 14.

Wires, Wiring and Conduits.

Grading of Cables.—A. RUSSELL.—A paper read before the (British) Institute of Electrical Engineers on the dielectric strength of insulating materials and the grading of cables, commented on in our issue last week. It is not safe to conclude that a disruptive discharge ensues the moment the maximum electric stress at any point of the dielectric between the two electrodes attains the breaking-down value for that dielectric. The breaking down of a portion of the dielectric may relieve the electric stress on the remainder. A disruptive discharge ensues only when the breaking down of part of the material leads to the electric stress on the remaining part being greater than it can withstand. The easiest way of finding the dielectric strength of insulating materials is by finding the disruptive voltage between two equal spherical electrodes embedded in the material. The electrodes should not be too near together. When a maximum inaccuracy of more than 1 per cent is not permissible, they should be at least one-half centimeter apart. Under normal conditions the dielectric strength of air, determined in this way, is about 3800 volts per millimeter. Of other gases, helium has an extraordinarily high dielectric strength, more than eight times that of air. The dielectric strength of oils can be found by the same method with a distance between the spherical electrodes greater than 0.3 centimeter; at this distance 40,000 to 50.000 volts will be required to break down good insulating oils. In order to find the true dielectric strength of an oil, it is necessary to dry it thoroughly before the test. This is best done by bubbling hot air through it, but it is not advisable to heat the oil above 100 deg. C. In case of isotropic solids as insulating materials, the same method as for gases and liquids may be employed, provided the test electrodes can be entirely embedded in the material. The method frequently adopted of putting thin sheets of the insulating material between metal electrodes in air is of doubtful value; as the voltage is increased, the air surrounding the electrodes breaks down long before the disruptive voltage is reached. High-pressure concentric cables, having an isotropic dielectric, for a maximum working pressure V should be constructed so that $b = a\,\epsilon^{d/a}$, where V/d is the maximum permissible working stress to which the dielectric may be subjected, b is the inner radius of the outer conductor and a is the outer radius of the inner conductor. ϵ is the base of Naperian logarithms. The smallest permissible value of a is d. When the core is stranded, it should be encased in a thin lead tube. The effect of the temperature gradient in the dielectric of a concentric main when working, is often to make the electric stress between the two conductors more uniform. Jona's experiments indicate that the dielectric strengths of paper-insulated cables do not vary much when the range of temperature does not exceed 60 deg. C. They are probably slightly less at the high temperatures. Skinner's experiments on glass, treated cloth, mica, etc., show that the dielectric strengths of many insulating materials in the solid form diminish as the temperature rises. With a composite dielectric subjected to alternating pressures, the potential differences across the layers are usually out of phase with one another. It is only in a limited number of cases, however, that the increase of the stress due to this cause has to be considered, as the leakage currents are usually negligibly small in comparison with the capacity currents. The effects of alternating and continuous pressures in producing stresses in the dielectric are sometimes quite different. High-pressure cables for alternating and direct-current circuits should be graded so as to make the maximum electric stress on the dielectric as small as possible, and stranded conductors should be encased in thin lead tubes.—Lond. *Elec.*, Nov. 15.

High Tension Insulators. [illegible] observations made by M. G. Anfossi on a 25,000-volt line at Genoa near the sea. Leakage and interruptions of the service frequently occur and are considered to be due to the deposit of a mixture of salt and [illegible] which are protected from wind and rain. This deposit is hydroscopic and increases in time. No similar effects have been observed on the 5000 and 10,000-volt lines, so that the ordinary insulators would appear to be sufficient for the same. The author proposes to overcome the difficulty by using an insulator with as small an interior surface as possible, while the surface exposed to the rain is increased. The new type consists of a grooved stem carrying a very flat bell; the caking of salt is then easily removed by the wind and rain.—Lond. *Elec.*, Nov. 15.

Electrophysics and Magnetism.

Resistance of Coils for High Frequencies.—A. SOMMERFELD.—A. Battelli had formerly found a strong increase of the resistance of coils with the frequency and had developed a theory which he considered to be in good agreement with the results of his measurements, while they were said to be in contradiction with a formula of the present author. The latter now maintains that his own formula is correct and that the apparent agreement between Battelli's theory and results is due to a mistake in the calculations. The same issue contains a further paper by Battelli on the same subject.—*Phys. Zeit.*, Nov. 1.

Internal Temperature Gradient of Metals.—S. B. SERVISS.—Thwing has formerly found that cylinders of common materials showed at points 3 centimeters from their surfaces an excess of temperature above their surroundings, which he ascribed to their radioactivity. This has been doubted and the investigation of the present author, who repeated Thwing's experiments with some modifications in the apparatus, gave negative results. —*Am. Jour. Science*, December.

Electrochemistry and Batteries.

Storage Battery Electrode.—A note on a recent British patent of H. F. Joel, the object of which is to provide strong circulation of the electrolyte over the surface of the plates during charging. For this purpose the electrodes are provided with slightly projecting ribs, rather inclined from the horizontal, and in the grooves thus formed he places his insulators, of flat material, which rest between the electrodes, forming a duct, whereby the electrolyte is caused by the gases which are set free, to circulate over the faces of the plates.—Lond. *Elec. Eng'ing*, Nov. 14.

Units, Measurements and Instruments.

Electric Thermometer.—G. A. SCHULTZE.—A description of an electric resistance thermometer based on the following principle proposed by Koepsel and indicated in Fig. 2. The

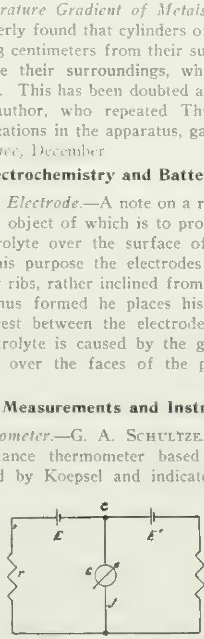


FIG. 2.—DIAGRAM OF ELECTRIC THERMOMETER CIRCUITS.

two equal and constant sources of current E and E' are in series with a constant resistance r and a variable resistance t. The bridge contains the galvanometer G. The current J through the galvanometer is zero, if r and t are equal. Otherwise the current J indicates directly the difference between t and r or between their temperatures, if both resistances are otherwise identical.—*Elek. Anz.*, Sept. 22; abstracted in *Elek. u. Masch.*, Nov. 10.

Speed Meters for Automobiles.—W. VON MOLO.—A discussion, with diagrams, of a number of commercial electric speed meters, all of which are based on the principle that a revolving magnet system acts on a disc and as a result of the eddy currents produced the disc is set in rotation which is counter-[illegible] by a spring.—*Elek. u. Masch.*, Nov. [illegible]

Water Resistances for Tests.—C. RICHTER.—For testing large electrical machines water resistors have various advantages. The author shows in detail how to calculate the quantity of water required, the speed of the running water, the size of, and the distance between, the electrodes, etc. Numerous formulas, tables and diagrams are given.—*Elek. u. Masch.*, Nov. 17.

Batteries for Testing Mains.—K. Edgcumbe.—A note calling attention to the surface leakage of the battery, especially in the case of dry cells. With an ordinary 200-volt dry battery the insulation after one month's use will probably be of the order of 0.1 megohm, which means a loss of some 10 ampere-hours in about six months. The remedy is to divide the cells into groups of, say, 25 volts each, which groups, although all mounted in one box, are kept quite distinct, and are only joined up in series when actually required for use. The ampere-hours lost are thereby reduced to about one-tenth of their former value.—Lond. *Elec. Eng'ing,* Nov. 14.

Telegraphy, Telephony and Signals.

British Telephone Exchange.—An illustrated description of a new telephone exchange recently opened in Hornsey. It is equipped for 2700 subscribers and has an ultimate capacity of 5400. It is on the full common battery system. There are 43 outgoing and 47 incoming junctions, worked on the order-wire system, and 10 outgoing and 10 incoming ringing junctions. The switchboards are arranged for two-party ringing with a two-party master ringing key on the subscribers' board, and separate keys on the junction board. There is a modification of the usual design of the main distributing frame. The cables enter on the horizontal side, through fuses placed on large porcelain fuse strips, and the heat coils are on the vertical side. —Lond. *Elec. Eng'ing,* Nov. 14.

Cable Telegraphy.—A note on a recent British patent of S. G. Brown for accelerating the speed of transmission in submarine telegraphy. "This is done by utilizing not only the quick-changing currents, but also the slow discharge currents, as used in the present mode of signaling, and using them at a speed much beyond that of any of the present systems. The automatic transmitter operated by a sending battery, the transmitter being constructed so that the battery current may be applied as much as possible for the whole signaling period. The receiver being a relay having the moving signaling parts constructed as light as possible for the work to be performed, the relay is able to translate and record the message by value of the total incoming current at any instant."—Lond. *Elec. Eng'ing,* Nov. 14.

Hungary.—Statistical notes on telegraphy and telephony in Hungary in 1906. The total length of telegraph lines was 130,958 kilometers and that of telephone lines 213,559 kilometers. The total number of telegrams was 10,017,452, an increase of 5 per cent over 1905. The total number of telephone conversations was 104,023,110, an increase of 25 per cent over 1905.—*Elek. u. Masch.,* Nov. 3.

Miscellaneous.

Electrical Engineering.—F. Niethammer.—A lecture of a general nature on the development of the electrical industries in their various branches.—*Elek. u. Masch.,* Nov. 3.

BOOK REVIEWS.

Trattato Di Telefonia. By I. Brunelli and F. Longo. In 12 parts. 600 pages, 300 illus. Rome: G. Scotti & Company. Price, each part, 1.25 lire.

The authors have sought to present a treatise on telephony which should be both scientifically reliable and practically useful to telephonists. The work is divided into seven parts, following a historical introduction: I. The telephonic apparatus; II. Telephonic lines; III. City service; IV. Interurban service; V. Special questions; VI. The installation and operation of modern telephone stations; VII. Tariffs. The treatment is simple, employing plenty of illustrations and simple algebra in the mathematical demonstrations. The book will be of interest to students of telephony in Europe, and particularly to students of the development of Italian telephony.

Electrical Engineers' Central-Station Directory. London: Biggs & Co. 592 pages.

The main title of this useful directory, published from the office of the *Electrical Engineer,* is a misnomer insofar as it ignores electric railways, to which subject more than 100 pages are devoted. In addition, isolated plants occupy about 50 pages, and a list of electrical engineers is included. Owing to Board of Trade requirements, British lighting and railway plants are required to give publicity to their capital, operating and trading accounts, and consequently the directory is enabled to publish much fuller data than would be obtainable in this country, if we except the case of the Massachusetts central stations, of which similar publicity is required. The entry for each central includes full plant data, rates in detail, number of men employed, and financial and operating data for the current and several preceding years. The final pages of the book contain a list of stations in British possessions, of which, however, the data are much fewer than in the main section. Whoever has need for information concerning the British central-station and electric traction industries will find this volume a valuable compendium.

Alternating-Current Motors. By A. S. McAllister, Ph. D. New York: McGraw Publishing Company. 291 pages, 126 illustrations. Price, $3.

This excellent treatise has reached its second edition within a year from the publication of the first. While this fact alone is evidence of the quality and character of the work, we cannot refrain from commenting at greater length upon some valuable additions which have been made in the second edition, which will prove this work of interest also to those who have studied the book when it first came out. On page 15 the author discusses the advantages derived from employing equivalent single-phase quantities in connection with polyphase circuits. A consistent use of such equivalent single-phase quantities would appear to be of advantage, although we believe that the author overestimates the importance of such convention. In general, it would appear best, and surely freest from ambiguity, to speak of the resistance of the phases between neutral and terminal, etc., rather than of the equivalent single-phase resistance. The suggestion, however, is very excellent and it well deserves being carefully borne in mind. In the fourth chapter, on frequency-converters, there is much that is new and of considerable interest concerning motor-converters, and, while the practical application of these machines is not very great as yet, the study of their characteristics is extremely interesting and instructive.

The treatment of the single-phase commutator motors is one of the finest contributions to the theory of these machines. Clear, concise and lucid, it forms one of the most instructive chapters of the book. The appendix contains a chapter on "The Leakage Reactance of Induction Motors," which is a most readable account, and a supplement is given with the work entitled "Circular Current Loci and V-Curves of the Synchronous Motor," which is an excellent exposition of the phenomena of synchronous motors in a remarkably perspicuous manner.

The book represents one of the finest contributions to electrical literature of recent years. The author's exceptional ability and clearness of presentation make this book fascinating reading even to those who are familiar with the subject, and no one can lay it aside without bestowing a large meed of admiration on the author for having written a book altogether extraordinary and showing the marks of exceptional talent.

Konstruktion und Schaltungen aus dem Gebiete der Elektrischen Bohnen. By O. S. Bragstad. Berlin: Julius Springer. 31 plates in portfolio, with 58 pages of explanatory text in pamphlet form.

This series of plates by Professor Bragstad, of the Karlsruhe Hochschule Friderciana, will be found of value by electric railway engineers and electricians, as well as by students and others interested in the technical side of electric traction. Four sheets of drawings with accompanying characteristic curves, of four types of railway motors are followed by a similar number of sheets of time-curves of Westinghouse motors. Then come 28 sheets of diagrams of controller and motor connections covering direct-current, single-phase and

three-phase equipments. All of the diagrams, which are very satisfactory, are based upon the same scheme of representation. The three final sheets show respectively, details of the overhead construction of the Simplon tunnel line, various types of third-rail construction, and details of the Westinghouse brake valve. The pamphlet accompanying the portfolio contains explanatory matter relating to each plate.

Messungen an Elektrischen Maschinen. By Rudolf Krause. Berlin: Julius Springer. 193 pages, 178 illustrations. Price, 5 marks.

This excellently illustrated little text-book gives a very full account of the ordinary testing instruments and their application to the testing of the more usual types of dynamo-electric machinery. The book is divided into nine chapters, as follows: Chapter I, instruments and their connections; II, measurements of electric power; III, resistance and conductance; IV, speed frequency and slip; V, insulation of machines; VI, magnetic flux and wave form; VII, load torque and power of machines; VIII, losses in machines; IX, standard types of report on machine tests. The book is clearly written from the standpoint of the testing engineer. It will be of value to all students of electric machinery, and evidently represents the most recent German practice in the testing of such machinery.

Transformatoren fur Wechselstrom und Drehstrom. (Transformers for Single-phase and Polyphase Service.) By Gisbert Kapp. Third edition, revised and enlarged. Berlin: Julius Springer. 326 pages, 185 illustrations. Price, 8 marks.

The third edition of Prof. Kapp's book on transformers shows a marked revision and enlargement over the preceding editions and the development of the subject has been brought up to date. The treatment of the subject is from the standpoints of the designer and of the operating engineer, as well as of the student. The volume is well adapted to text-book purposes in teaching. The mathematics are not elementary in character, nor are they beyond the reach of the properly equipped student of engineering. The descriptive matter is essentially clear and thorough. The book will be of particular value to students of electrical engineering.

Electric Railway Engineering. By H. F. Parshall and H. M. Hobart. New York: D. Van Nostrand Company. 475 pages, 437 illustrations, 123 tables. Price, $10.

This volume, which has been prepared for covering the whole field of electric railway engineering, is divided into three parts dealing, respectively, with the mechanics of electric traction, the generation and transmission of electrical energy, and the rolling stock.

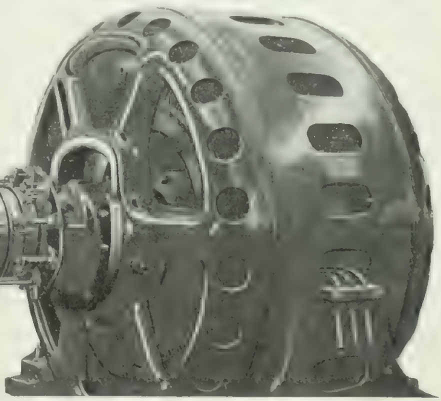
Part I contains a thorough analysis of the power and energy required for propulsion and the characteristics of motors that may be used for supplying the tractive force. In Part II much reliable information is given concerning generating equipments, the transmission system, sub-stations and distribution systems. The portion of the book which touches upon subjects of particular interest at the present time is Part III, in which the authors discuss the relative merits of direct and alternating-current equipments for train propulsion. The attitude of the authors is well expressed in the following sentences: "Half the sum spent in developing the single-phase commutator motor to its present condition (in which it still remains less efficient, more bulky, and less satisfactory in several respects than the 600-volt continuous-current motor) will result in the development of thoroughly satisfactory high-tension continuous-current motors. These motors will be as efficient and as light for a given temperature rating and a given speed as the present standard 600-volt motors. The commutation will be better. While the development of each class of machine has advanced beyond the point that could reasonably have been foreseen, and while, in our judgment, it is impossible at the present time to predict where the limitations will be reached, we are satisfied that a careful comparison of the two types at the present time is decidedly to the advantage of the high-tension, continuous-current motor." The boldness of the authors in making such a statement will be appreciated when it is known that their conclusions as to the operation of single-phase commutator motors seem to have been based largely on the results obtained with certain early experimental motors; the book contains no description of the 25-cycle locomotives now in successful use on the New Haven Railroad, or of the 15-cycle locomotive recently constructed for the Pennsylvania Railroad. Moreover, the most excellent operating characteristics of the commutating-pole type of direct-current railway motor are given merely an incidental mention, and the discussion is expressed in the future tense.

The book is a storehouse of carefully selected and well arranged information of value to the electrical railway engineer.

Induction Motors for Copper and Brass Rolling Mills.

The new plant of the Buffalo Copper & Brass Rolling Mills at Black Rock Station will be driven by means of induction motors supplied with energy transmitted from Niagara. For driving the rolls, three Allis-Chalmers motors will be used, one rated at 500 horse-power for the main rolls and two at 250 horse-power for the finishing rolls. All three motors are of the wound-rotor type designed to operate at 25 cycles, 2300 volts; the 500-hp motor runs at 375 r. p. m. synchronous speed, and the 230-hp at 500 r. p. m. The motors are connected to the rolls by means of flexible couplings.

The accompanying illustration shows the 500-hp motor; the two 250-hp machines are of exactly similar design. The construction throughout is very substantial and suited to the exacting requirements of rolling mill work. The stator coils are placed in open slots and held in place by wedges so that they can be readily removed. The stator core is provided with



Slip Ring, 500 HP Induction Motor

numerous ventilating ducts to allow circulation of air through the core and windings. The end connections of the stator coils are securely held where they project beyond the core.

The rotor is provided with a three-phase, Y-connected winding joined to three cast-copper collector rings mounted on the shaft. The rings are outside the bearing housing so as to be readily accessible, the leads from the winding being brought through a hole in the shaft.

The rotor winding is made up of copper strip having the conductors in the slots joined at the ends by involute end connections securely held in place by brass shields. The whole rotor construction is such as to give thorough ventilation of all parts.

Each motor is provided with a cast secondary starting resistor with an oil-immersed controlling switch for cutting the resistance out of circuit and gradually bringing the motor up to speed. A small part of this resistor is designed for continuous service, and can be left in circuit.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Further improvement in the financial situation is facilitating the return to normal commercial conditions, but there is still a good deal of idle machinery at mills and factories. In the leading industries a disposition is shown to defer production until there is no probability of accumulation, and consumers show an inclination to place orders for future deliveries. At best, however, trade as a whole is still very quiet and industrial activity is below the normal for this season of the year. Collections are still very backward, although a slight improvement was shown. More interest was evinced by buyers of pig iron for future delivery; prices, however, are lower, and production is still being curtailed. It appears that most of the furnaces in the Mahoning and Shenango regions will be out of blast by the middle of this month. The output in November declined 23 per cent from that of October, but this ratio does not begin to represent the curtailment thus far in December. Some steel plants have resumed operations, but others have discontinued and wages are being reduced. No new business is being done yet in steel rails, but it is understood that the railways will soon come into the market for large tonnages. Structural material was in moderate demand. The lumber and allied trades were rather dull. Railways earnings for November were 2 per cent less than in November, 1906. Foreign commerce at the Port of New York for the week shows a gain of $4,526,856 in exports and a loss of $383,049 in imports as compared with the corresponding week last year. Copper remains inactive, but prices are no lower, although the undertone does not appear to be so firm, and the European interests seem to be more anxious to force sales. Quotations are 13½c. for lake, 13¼c. for electrolytic and 13c. for casting stock. According to *Bradstreet's*, the business failures during November were more numerous than in October or in November of last year, and liabilities were more than three times those of November last year, but only one-fifth those of October, because bank suspensions were fewer and less important, indicating that the crisis really passed in October. There were 1108 failures in November, an increase of 14.2 per cent over October and of 36.8 per cent over November last year. The number of failures during the week ending Dec. 5 was 272, against 258 in the week previous, and 216 in the corresponding week last year.

CHICAGO TELEPHONE RATES.—It would appear by advices from Chicago that as a result of the extension of the franchise recently granted by a new ordinance, the Chicago Telephone Company must spend large sums in readjustment and extension of the plant. The old ordinance does not expire until January, 1909, but the annual report for the year ending Dec. 31, 1907, will show considerable in the way of concessions granted at various times this year. The management has formally accepted the 20-year extension of its franchise and is now putting the reduced schedules into effect. A further concession has been announced to the 80,000 subscribers to the slot machines. The ordinance provides that the excesses or deficits therein at the end of one month may be balanced by the collections of the subsequent months, and the company has made this arrangement effective for November in advance of the beginning of the new ordinance. Abolition of toll charges within the city limits has taken effect, as has the 5-cent rate between neighborhood exchanges. Dime telephones in the down-town district have been replaced by nickel instruments. The city has become a sort of partner of the company. President Wheeler says: "All bills will be made out from Dec. 1 at the new rates for the grade of service which the subscriber is now getting. Thus every subscriber will be offered a reduction in rates." It is optional with a subscriber to call for a better grade of service at the old rate, or to avail himself directly of the reduced rates. This involves many immediate mechanical changes, as the prevailing tendency is to get the better service available. Chicago's druggists, the hotels, and other places where public telephones are installed and which have received a share of the receipts, will in the future get nothing, and the telephone company everything. Under the old arrangement, after a certain guaranteed amount had been put in the coin-box by the patrons of drug stores, the remainder was divided between the druggist and the company. But there is a clause in a new telephone ordinance which provides that the company shall furnish telephones "without discrimination, and at the same rates" to all persons electing to take any class or kind of service. Assistant Corporation Counsel Miller, to whom the question was referred, has decided that inasmuch as all these public telephones are in the class of the nickel-in-the-slot measured rate instruments, the company must charge the same for them as for residence telephones used only by one subscriber.

STANLEY ELECTRIC WORKS.—According to latest reports from Pittsfield, Mass., First Vice-President Cummings C. Chesney, of the Stanley G—I Electric Manufacturing Company, has stated that matters have so adjusted themselves at the plant that it will be possible to swing through the winter with practically the entire operating force of 2100 employees. Had it not been for the disturbances in the financial world, the force would have been increased to 3000 early next year. As it is, it is felt that if present hands are retained the concern will be doing its part in the scheme of co-operation among employers and employed that is urged so earnestly everywhere just now. As a matter of fact there are only three or four out of 15 or 16 departments that are not working on full time, and these exceptions are governed by purely normal conditions. In some instances the departments have overmanufactured; that is to say, they have secured such a lead over the others that they must of necessity wait until those others catch up. "We are running," said Mr. Chesney, "pretty close to the entire capacity of the plant, which is doing very well, all things considered. We cannot hope to expand to any great extent until a change comes over the financial world, but we hope to swing through the winter with practically our present force." With 2100 employees and a payroll of $27,000 every week, the Stanley is one of the big factors in the industrial life of Pittsfield, and that the management is facing the long winter so hopefully will be good news to the community.

GENERAL ELECTRIC EMPLOYEES.—An unauthorized statement to the effect that the General Electric Company was to dispense with the services of 7,500 men last Saturday was positively and emphatically denied by President Coffin, of the company. He said: "Such a proposition was not even suggested. We have more men at actual employment to-day at both our Schenectady and Lynn works than we had two years ago. Of course, gradual decreases are suggested at times, but we certainly would not disorganize our large and efficient force by such wholesale reductions as the unauthorized statement makes it appear. Rather than reduce our force at all I would much prefer to see all our men employed, even though they were required to reduce their working time to four or five days each week." This states the case succinctly and exactly, and this is why President Coffin always stands conspicuous in fair treatment of labor.

CLARK ON COPPER.—In an interview at Salt Lake City last week, Senator W. A. Clark said: "The total reduction in the output of copper is so large that six months ought to see the surplus eliminated entirely. When that is done, I expect to see copper go back to about 16 cents a pound, and that is enough. At that figure consumption is possible on a large scale, and, while it will not permit all the mines to resume on the old basis, it will still furnish employment for a large proportion of the men who have been thrown out of employment by the recent slump."

ELECTRICITY IN INDIA.—Kilburn & Company, of Calcutta, have been granted a license by the British-India Government for the supply of energy for electric traction and for the general supply of electrical energy to the public, including particular consumers under special agreements in respect of the cantonment of Jubulpore in the Central Provinces.

THE McCALL'S FERRY POWER.—The first official announcement of the causes which led to the discontinuance of operations on the big power dam at McCall's Ferry has just been made from the office of the power company in New York City. In a letter to the executive committee of the board of directors, President Dimock states that the company had no funds on deposit in the Knickerbocker Trust Company and consequently lost none, and that when conditions are such as to enable the enterprise to make suitable financial arrangements the work on the dam will be rushed to completion. President Dimock's letter is accompanied by one from Chief Engineer Dr. Cary T. Hutchinson, in which the latter says that the suspension occurred at a particularly favorable time and that the danger from winter floods is practically negligible. Dr. Hutchinson estimates that the work on the dam and power house is 80 per cent finished. The plans of the company provide for the construction of a dam 2530 ft. long and a power house 500 ft. long, to contain ten turbines, each of 13,000 hp, making the total rated output of the power house 135,000 hp; this power house, with the generators, transformers and other electrical apparatus make together a plant having a capacity to deliver to Baltimore or Philadelphia 100,000 hp with nine units in service, leaving the tenth unit as a reserve. This enlarged plan gives a salable output double that of the original plan, and ensures net earnings more than double of the original plan.

MOTORS FOR GRINDING SHOPS.—Deer & Company, Moline, Ill., one of the largest manufacturers of plow and agricultural implements in the world, recently purchased a number of 20-hp and 30-hp, 60-cycle, 3-phase, 440-volt Allis-Chalmers induction motors, which are intended for use in the grinding shop where the mold boards, shares and other plow parts are ground. The service to which these motors are to be applied is intermittent in character, and the application itself is something out of the ordinary. Each motor is arranged for a pulley on either end of the shaft, but the pulleys are left off and the shaft extended by coupling to it a piece of shaft about six feet long carrying pulley and having extra bearings. From each pulley is belted a grinding machine, each machine having two emery or carborundum wheels, as desired, for the special type of steel to be ground, making a total of four grinding wheels to each motor, allowing four men the service of one motor, which gives a group-drive effect. The pieces of steel to be ground are laid on the frame, and the operator presses the steel against the wheel by lifting the frame up so that the desired part of the steel can be ground. Thus there is a possibility of four men grinding simultaneously, but rarely more than two wheels are working at once because of time consumed in shifting the steel pieces on the frame so as to get them in position to be ground.

ORDERS FOR RELIANCE ENGINES.—The Allis-Chalmers Company reports several large orders for its Reliance Corliss engines and generator sets. The Lodge & Shipley Machine Tool Company, of Cincinnati, Ohio, has purchased one of these sets, comprising an 18 in. x 36 in. "Reliance" engine, direct coupled to a 200-kw, 240-volt, engine-type generator. The unit will be used for lighting and power service. Other sales of "Reliance" sets recently made are as follows: W. J. Rainey, Connellsville, Pa., a 20 in. x 36 in. engine, direct coupled to a 250-kw, engine-type, direct-current generator; The Jeanerette electric light plant, of Jeanerette, La., one 14 in. x 24 in. engine direct coupled to a 100-kw, engine-type, direct-current generator; The Chattanooga Implement & Manufacturing Company, Chattanooga, Tenn., one 16 in. x 30 in. engine, direct connected to a 150-kw, engine-type, alternating-current generator, together with exciter, switchboard and seven standard Allis-Chalmers induction motors; W. B. Mershon & Company, Saginaw, Mich., one 12 in. x 30 in. engine, direct-connected to a 75-kw, alternating-current generator; the City of Waynesboro, Waynesboro, Ga., one engine 14 in. x 30 in., and a 125-kw, alternating-current generator.

ALUMINUM PRODUCTION.—The closing down of two of the five plants of the Aluminum Company of America follows very largely as the direct result of the present curtailment in the electrical industry. The company has five plants, located at St. Louis, Niagara Falls, Shawinigan Falls, Canada, Massena Springs and New Kensington, Pa. The two former plants are now closed. Another case contributory to the slump in the company's sales has been the [illegible] in the orders from automobile manufacturers, who have been very large consumers of the metal as well as of [illegible] aluminum. For the past two years the Aluminum Company of America, which is the corporate successor of the Pittsburg Reduction Company, has been doing a record-breaking business.

ELECTRIC RAILWAY MATERIAL.—The Mexican "Diario Oficial" has printed a copy of a decree authorizing the Empresa del Ferrocarril Industrial de Puebla to import into Mexico free of duty all necessary material for converting the line to electric traction.

Financial Intelligence.

THE WEEK IN WALL STREET.—Contrary to very general expectation, the stock market continued to advance with only temporary and comparatively slight interruptions. Although on the surface considerable weakness was displayed, the undertone was surprisingly good and the turn upward again abrupt and pronounced. Union Pacific and Reading continued to attract the greatest attention, although U. S. Steel stocks, American Smelting & Refining and Brooklyn Rapid Transit were dealt in on a large scale and scored advances well in proportion to those recorded for the acknowledged leaders. The prevalent feeling in Wall Street is that normal conditions are being rapidly restored, and that the market is justified in discounting them. As to banking matters, the situation has undoubtedly improved greatly. Several cities report that the issuance of clearing house certificates for emergency currency has been suspended. Bonds were notably active, with decided rises in active issues. There were very few incidents affecting the position of particular stocks. Amalgamated Copper was quite active and developed strength in sympathy with the rest of the list, notwithstanding the absence of any favorable indications in the copper metal situation. Brooklyn Rapid Transit was something of a feature in the trading, presumably on the covering of a substantial short interest. An active business was done in Brooklyn Rapid Transit which resulted in a net gain of 6⅛ points. Westinghouse common advanced 7½ points, and General Electric made a net gain of 3 points, ex-dividend. On the curb market, trading resulted for the most part in considerable net gains, some of them being sensational. Following are the closing quotations for Dec. 10:

NEW YORK.

	Dec. 3	Dec. 10		Dec. 3	Dec. 10
Allis-Chalmers Co.	[illegible]	[illegible]	General Electric	[illegible]	[illegible]
Allis-Chalmers Co. pfd	[illegible]	[illegible]	Hudson River Tel	—	
Am. Dist. Tel..........	—	—	Interborough Met. com	[illegible]	[illegible]
American Tel. & Cable..	—	—	Interborough Met. pfd	18	[illegible]
American Locomotive	[illegible]	[illegible]	Mackay Cos.	[illegible]	[illegible]
Amer. Locomotive pfd	86	87	Mackay Cos. pfd	[illegible]	[illegible]
American Tel. & Tel.	[illegible]	102	Marconi Tel	—	
Brooklyn Rapid Transit.	35⅞	38⅝	Metropolitan St. Ry...	—	
Electric Boat	—	—	N. Y. & N. J. Tel.....	97½	
Electric Boat pfd...	—	—	Western Union Tel	58	60
Electric Vehicle ...		—	Westinghouse com..	36	43½
Electric Vehicle pfd. ..	—	—	Westinghouse pfd ..	[illegible]	—

BOSTON.

	Dec. 3	Dec. 10		Dec. 3	Dec. 10
American Tel. & Tel..	101¾	102¼	Mass. Elec. Ry. pfd	[illegible]	38
Cumberland Telephone	—	—	Mexican Telephone.	[illegible]	[illegible]
Edison Elec. Illum.	[illegible]	[illegible]	New England Telep.	[illegible]	[illegible]
General Electric	[illegible]	—	Western Tel. & Tel.....	—	4
Mass. Elec. Ry.	[illegible]	[illegible]	West. Tel. & Tel. pfd	[illegible]	[illegible]

PHILADELPHIA.

	Dec. 3	Dec. 10		Dec. 3	Dec. 10
American Railways	44	44	Phila. Electric	[illegible]	[illegible]
Elec. Co. of America..	8⅛	[illegible]	Phila. Rapid Transit	[illegible]	[illegible]
Elec. Storage Battery	[illegible]	[illegible]	Phila. Traction	[illegible]	[illegible]
Elec. Stor. Battery pfd		—			

CHICAGO

	Dec. 3	Dec. 10		Dec. 3	Dec. 10
Chicago City Ry	[illegible]*	[illegible]*	National Carbon	—	[illegible]
Commonwealth Edison	[illegible]	[illegible]	National Carbon pfd	—	99
Chicago Subway	[illegible]	[illegible]	Union Traction	—	—
Chicago Tel. Co.	[illegible]	[illegible]	Union Traction pfd	—	—
Metropolitan Elec. com	[illegible]	—			

*Asked.

SOUTHERN NEW ENGLAND TELEPHONE.—It is stated in New Haven, Conn., semi officially, that following the death of President Morris F. Tyler, of the Southern New England Telephone Company, his duties and the general management of the company, under the direction of Vice-President James English, will be in the hands of a committee of the board of directors, which some months ago was appointed by President Tyler himself. The committee will consist of General Sherwin, of Boston; A. H. Robertson, Max Adler, J. T. Moran and J. W. Alling, the last four of New York. The annual meeting of the company will be held Jan. 28, and it is not likely that a new president of the corporation will be announced before that time.

THE WESTINGHOUSE REPORT.—Note was made in these pages last week of the figures of a balance sheet for the Westinghouse Electric & Manufacturing Company, as of Oct. 23, prepared by the receivers. We now give the data below:

ASSETS.

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Interest accrued, not due	195,307
[illegible]	[illegible]
[illegible]	[illegible]
Other assets	7,523,106
[illegible]	[illegible]

LIABILITIES.

Preferred stock	$3,998,700
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Collateral notes	8,702,702
Current liabilities	13,462,609
Interest accrued, not due	410,528
[illegible]	[illegible]
[illegible]	[illegible]
Profit and loss surplus	11,610,756
Total liabilities	$82,817,923

The balance sheet presented at the annual meeting held March 31 follows:

ASSETS.

Property and plant	$12,570,073
Cash	[illegible]
Accounts and notes receivable	10,443,116
Raw material	16,988,176
Completed apparatus	1,468,513
Investments	22,296,806
Charters, franchises, patents, etc	7,120,276
Total assets	$72,270,854

LIABILITIES.

Preferred stock	$3,998,700
Assenting stock	[illegible]
Non-assenting stock	[illegible],100
Convertible bonds	[illegible]
Debenture certificates	2,278,000
Collateral notes	6,000,000
Current liabilities	[illegible]
Inventory adjustment	179,662
Profit and loss surplus	12,595,151
Total liabilities	$72,270,854

The financial community has shown itself well disposed to accept the report as conservative and well calculated to show the real condition of the corporation.

ELECTRIC VEHICLE RECEIVERSHIP.—The Electric Vehicle Company, the parent company of a large number of electric transportation companies, went into the hands of receivers in New Jersey and this city on Dec. 10, in a friendly proceeding to reorganize the concern. The action was taken on account of the default of payment of an issue of $2,500,000 6 per cent gold bonds which fell due on Nov. 1 and other obligations that recently matured. The company had a capital stock of $20,000,000. The tight money market, in which the company was unable either to borrow or collect what was due it, is given as the cause of the embarrassment. The business, it is understood, will be continued for the present by the receivers. An effort to reorganize will be made. Judge Cross, of the United States Circuit Court in Newark, appointed Halsey M. Barrett, of Newark, and Henry W. Nuckles, an officer of the company, receivers. In New York City, Judge Ward, of the United States Circuit Court, appointed Mr. Barrett and William S. Montgomery ancillary receivers. The company's business in New York City was at 134 West Thirty-Ninth Street and 621 West Forty-Second Street. The receivers took charge of both places, and also of the company's manufacturing plant in Hartford, Conn. Other indebtedness of the company is declared to consist of the issue of $2,500,000 bonds, secured by a mortgage held by the Morton Trust Company, of this city, as trustee; demand promissory notes to the amount of $591,043.32; a note for $300,000 which fell due on Dec. 3; a note for $2,600, due Dec. 27, and a note for $5,708.18, due Jan. 15, 1908; accounts payable aggregating $204,790.32, of which $150,000 has been due and unpaid since Nov. 15. Of the liabilities $2,016,000 is said to be past due. The assets are listed as the manufacturing plant at Hartford, Conn., including machinery, stock, building, and other things, with a book value of $717,498.16; office furniture, $4,731.54; finished vehicles, $173,087.73; consigned vehicles and merchandise of book or cost value of $90,387.51; patents and patent licenses of a book value of $11,447,537.28; raw materials and supplies, with parts in process of manufacture, $770,474.20; finished parts, $378,714; stocks and bonds of other corporations of a book value of $358,002; accounts and notes receivable, $132,000, and cash, $12,000. In addition, the bill mentions as an asset the item of "good will," and alleges that under this head the trademark of "Columbia" is of great value. The company is the sole owner of the noted "Selden" patent, which is used by the Association of Licensed Automobile Manufacturers, and which yields a large amount in royalties.

WESTERN ELECTRIC COMPANY.—Advices from Boston state that while the fiscal year of the Western Electric Company ended Nov. 30 last will show a decrease in gross sales of approximately $19,000,000, or 27 per cent. from the previous 12 months, there are strong internal evidences in the general telephone situation which warrant the belief that Western Electric has already passed through its period of depression and is now gaining rapidly. The opening of 1907 found the American Telephone subsidiaries generally overstocked with telephone apparatus and the large bulk of unfilled orders on the books of the Western Electric, which were worked off during the first half of the last fiscal year, tended to augment the total of over $10,000,000 telephone supplies, which the associate companies were carrying practically in storage at the beginning of 1907. As a result of the sharp curtailment in orders for telephone apparatus, the gross sales of the Western Electric, which were between 1 and 2 per cent greater for the first seven months of the 1907 year than for the same period of 1906, were but little more than half as large during the last five months of the 1907 year as during the same five months last year. The American Telephone subsidiaries which have been gradually using up idle apparatus are soon coming into the market for new supplies and these orders in themselves will be sufficient to cause a marked increase in total sales. In addition there is little doubt that the recent decision to sell telephone apparatus direct to the public is destined to lead to a very material increase in the sales of the Western Electric. On the first of January, 1907, the Central Union Telephone Company had in addition to its regular subscribers a total of 58,044 sub-licensees representing almost entirely independent companies using Bell apparatus. A few months ago, independent companies not equipped with Bell apparatus and non-competitors of existing Bell companies were generally given the privilege of becoming sub-licensees. As a result, the Central Union had on Nov. 1 a total of over 200,000 sub-licensees, an increase in 10 months of over 140,000.

BALTIMORE TELEPHONE.—The Baltimore Electric Company has sold the Maryland Telephone Company to interests said to be independent and who announce that the property will continue to be operated in competition with the Chesapeake & Potomac Telephone Company. The purchase price is said to have been about $300,000, the property being taken subject to $1,000,000 of first mortgage 5 per cent bonds and $1,155,000 of 5 per cent general mortgage bonds issued by the Maryland Telephone & Telegraph Company, the predecessor of the Maryland Telephone Company. Mr. H. P. Miller, of Columbus, Ohio, is in charge of the property, representing the new owners, and has been elected vice-president. Mr. Miller is an experienced telephone manager. As yet the organization of the company by the new interests has not been completed. A president has not been chosen, but Mr. Miller has been named as vice-president, while the directors include, in addition to him, Messrs. Joseph Taylor and F. M. Twomey, of New York, and Dudley G. Browning, of New Jersey. When the Consolidated Gas, Electric Light & Power Company leased the Baltimore Electric Company, Mr. S. Davies Warfield, chairman of the board of directors of the former, announced that it was not the intention of the Consolidated to go into the telephone business, and that negotiations had been opened with the Bell interests looking to the sale of the Maryland Company to them.

LARGE TRACTION BOND ISSUE.—The Philadelphia & Western Railway, which operates an electric line running out of Philadelphia, has filed a mortgage to the Trust Company of America as trustee to cover an authorized issue of $20,000,000 of first mortgage five per cent bonds. Of this issue only $4,000,000 are immediately issuable, the balance being reserved for extensions, improvements, or additions. All the stock of the Philadelphia & Western is owned by a syndicate of which George R. Sheldon and Mackay & Company are managers.

DIVIDENDS.—At a meeting of the directors of the Columbus, Ohio, Citizens' Telephone Company the regular 1 per cent on the common stock of the company was declared, payable Dec. 1. The directors of the Twin City Rapid Transit Company have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2.

GENERAL NEWS

Construction News.

DADEVILLE, ALA.—An election will soon be held to vote on the proposition to issue $[illegible] in bonds to improve the municipal electric light plant.

TALLADEGA, ALA.—The Alabama Power Company contemplates the construction of an electric light plant, and installing a [illegible] engine, boiler and new generator at the shoals plant. Contracts have been awarded for the machinery.

UNIVERSITY, ALA.—Bids have been asked for by the University of Alabama for the following power house equipment: Three boilers having a combined rating of 500-hp; one or two 100-kw, direct-current generators and accessories; one or two 125-hp, automatic, four-valve or Corliss engines, complete; one 25-kw alternating-current generator with exciter; a heater and separator of 500-hp rating. John W. Abercrombie is president.

LITTLE ROCK, ARK.—Plans are being made by the Southwestern Telephone & Telegraph Company for an expenditure of $1,500,000, of which $500,000 will be used in improving and extending the Little Rock service. The underground conduit system is to be greatly extended. F. K. Baker is superintendent of the local system.

BERKELEY, CAL.—C. S. Forney recently submitted a proposition to the Chamber of Commerce in regard to establishing a new electric lighting company to furnish electricity in competition with the Berkeley Electric Light & Gas Company. Mr. Forney stated that the preliminaries for the formation of the company were complete, and that it had a plant located on the bay shore near the town line, where the power house would be located.

HOLLISTER, CAL.—The Hollister Light & Power Company is planning to enlarge its electric light plant.

LONG BEACH, CAL.—Shortly after the first of the year the Edison Electric Company will expend from $100,000 to $150,000 on a new substation here.

MONTEREY, CAL.—Bids will be received until Dec. 30 by John L. Clem, chief quartermaster U. S. A., at the Presidio of San Francisco, for furnishing and installing electric lighting fixtures in a double set of noncommissioned officers' quarters for hospital corps at the Presidio of Monterey.

NAPA, CAL.—The Snow Mountain Power Company has begun work on the construction of its transmission lines in Napa County. The line will be extended to St. Helena and Calistoga without delay, and also across Napa County to make connections with lines at Santa Rosa, Vallejo and San Rafael. The company is constructing a large plant at Ukiah and will furnish electricity to Napa and surrounding counties.

OAKLAND, CAL.—It is reported that the engineers of the Great Western Power Company, which recently acquired property on Brooklyn Basin, south of Fifth Avenue, in East Oakland, are at work with the intention of preparing for the construction of a large power plant there. The company, whose principal place of business is Richmond, has filed a series of deeds of right of way with the Contra Costa county recorder, giving the concern control of a large amount of land. An electric transmission line is being built from Antioch, by way of Concord and Walnut Creek, to Oakland. The company will obtain its energy from the Sierra Mountains. Its announced purpose is to supply energy to large manufacturing plants in this part of the State, but it is rumored that the company will furnish energy for an electric ferry train service to be operated by the Western Pacific Railroad when its terminal is completed in this city.

REDDING, CAL.—A deed has been filed in the county recorder's office conveying to the Northern California Power Company 280 acres of land on which is situated the Manzanita Lake acquired by H. H. Noble from Albert Smith. The deed includes all water rights in the lake and all water rights acquired by Mr. Noble.

VALLEJO, CAL.—E. D. Lehe, owner of the electric lighting plants at Dixon, Wheatland, Rio Vista, Cordelia and towns in the Sacramento Valley, is planning to erect a transmission line throughout the Suisun Valley to supply the farmers with electricity. He has obtained rights of way and sufficient contracts to guarantee the success of the system.

WILLOWS, CAL.—C. H. Sehorn contemplates installing a pumping plant to be operated by a gasoline engine or an electric motor. P. R. Garrett is also arranging to install a pumping plant.

FLORENCE, COL.—[illegible] $25,000.

SALIDA, COL.—[illegible]

BRISTOL, CONN.—The [illegible] Company has been completed [illegible] plant located in the main factory will be abandoned. An auxiliary water power plant is now [illegible] soon as completed.

CHESTER, CONN.—The Selectmen have closed a contract with the Chester Light & Power Company to light the streets of the town. The company will furnish 13 lamps of 30 cp, three of 37½ cp and eight of 25 cp, at a cost of $601 per year.

GLASTONBURY, CONN.—The Glastonbury Power Company has awarded the contract for the construction of a large power plant on Roaring Brook in Cotton Hollow in South Glastonbury to F. T. Ley & Company, of Springfield, Mass. The cost of the plant is estimated at about $200,000, and will have an output of 1300 horse-power. Work will commence early in the spring and is expected to be completed in the fall. Electricity will be furnished for lighting and power purposes in Glastonbury, Manchester and Rocky Hill.

PLAINVILLE, CONN.—At a town meeting held recently it was voted to rescind the vote passed at a meeting held about two weeks ago instructing the Selectmen to contract with the Connecticut Company for lighting the streets of the town. The meeting voted to increase the appropriation for street lighting from $1,600 to $1,700 and to give the Selectmen power of awarding the lighting contract.

SUFFIELD, CONN.—The Village Water Company has announced that it has established a minimum rate of $1 per month. On Dec. 1 it began furnishing incandescent lamp renewals free.

DOVER, DEL.—The citizens are contemplating the installation of a 60-kw generator in the municipal electric light plant. F. T. Cooke is superintendent.

WASHINGTON, D. C.—Bids will be received at the office of Elliott Woods, superintendent of the U. S. capitol building and grounds, until Jan. 15, for equipment for the heating, lighting and power plant for the U. S. capitol and Congressional buildings, including boiler feed pumps, barometric condensers, centrifugal pumps, motors, cranes and chimneys.

JACKSONVILLE, FLA.—John G. Christopher has been awarded the contract for furnishing the feed pumps for the municipal electric light plant for $1,789.

ST. AUGUSTINE, FLA.—The City Council has awarded the contract for lighting the city to the St. Johns Light & Power Company. The cost of lighting for the city for the past year was $8,500; according to the new contract, the cost will be $6,500 for the ensuing year, saving the city a sum of $2,000.

COLUMBUS, GA.—Surveys are being made by the Columbus Power Company of its water power on the Chattahoochee River between Columbus and West Point with a view of further developments. The company is preparing to build a third hydro-electric plant for the transmission of electricity for manufacturing and other purposes. It is stated that 125,000 horse-power can be developed at the various properties. The company has two plants in operation with a combined output of 80,000 horse-power. F. E. Reidhead is manager.

LAGRANGE, GA.—The managers of the municipal electric light plant are contemplating doubling the output of the plant and increasing the number of city lamps and making other extensions to the system. J. R. Black is superintendent.

WASHINGTON, GA.—The Washington & Elberton Construction Company has filed a petition for a charter. The company will be capitalized at $75,000 and proposes to construct the projected railway between Elberton and Washington, which will ultimately be extended to Hartwell. Among the petitioners are M. M. Elkan, J. H. Blackwell, W. H. Hudson, V. E. Hudgens and others.

MILNER, IDAHO.—The Milner & North Side Railroad Company is contemplating the construction of an electric railway, 65 miles in length, which when completed will connect Milner, Jerome, Wendell and Gooding. The company plans to erect a power station at Shoshone Falls. D. C. McWaters, of Milner, is president and general manager.

CABERY, ILL.—The Cabery telephone exchange, owned by A. C. Schrader, has been sold to N. A. Watts, of Maroa, Ill., who took possession of the plant Dec. 1.

CAIRO, ILL.—O. C. Macy, manager of the Cairo Electric & Traction Company, writes that about $150,000 will be expended on improvements to its system, but nothing will be done for the present.

CHICAGO, ILL.—The Lake Shore & Michigan Southern Railway Company recently purchased a 250-kw, 240-volt, two-phase, 60-cycle Allis-Chalmers engine type generator, and a 15-kw exciter unit to increase the power equipment of the Chicago, Indiana & Southern Railway Company, a subsidiary line. The new generator will be installed at Danville.

EAST MOLINE, ILL.—Harry D. Swartz, manager of the Central Union Telephone Company, and Charles E. Knorr, representing the Electric & Gas Heating & Lighting Company, have presented to the City Council an ordinance to furnish street lighting and also for lighting the city hall.

[illegible] to purchase the local electric light plant and will make improvements to [illegible]

[illegible]

[illegible], IND.—[illegible] to control the Evansville & Mount Vernon Electric Railway and the Evans- [illegible] capital stock. The company has projected extensions to its system [illegible].

[illegible], IND.—The [illegible] has been awarded to the Co-operative [illegible], Ill.

INDIANAPOLIS, IND.—It is stated that the Grand Central Traction Company will soon be in the market for materials necessary for the construction of its railway. Surveys and estimates have been completed for the line, which is to connect Indianapolis and Evansville. A branch line will also be built from Bloomington, Ill., to Terre Haute, Ind. W. Dun- [illegible].

LIGONIER, IND.—The question of constructing a municipal electric light plant is under consideration here.

RICHMOND, IND.—The United Gas & Electric Company, of New York, N. Y., owning and controlling the Light, Heat & Power Company of this city, has submitted another proposition to the City Council to buy the city plant. The proposition includes a willingness to accept a new franchise safeguarding the city as to rates, etc. The consideration is to be based on an estimate or appraisal to be made by competent electrical engineers. The Council and Board of Public Works has the proposition under advisement.

TERRE HAUTE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has decided to furnish electric light service in the residences along the company's line west of this city. It is understood that other localities along the line will be equally favored.

WARSAW, IND.—The Wino Water & Light Company, of this city, has made a report to the City Council acknowledging the loss of $5,400 during the past eleven months. The company is willing to go into partnership with the city or sell its plants outright to the city.

DES MOINES, IA.—Judge Howe has appointed W. B. Starkey receiver of the Iowa Light & Power Company, on application of the Iowa Loan & Trust Company. The Iowa Light & Power Company was recently organized to take over the heating and lighting franchise of the Polk and Hippee interests. The appointment of a receiver is simply a formal action.

GRISWOLD, IA.—Daniel Eppelsheimer, city clerk, writes that the Griswold Light & Power Company has received a franchise to erect and maintain an electric light plant. The proposed plant will cost about $3,000. R. C. Prather and J. M. McAvoy are interested in the company.

GUTHRIE CENTER, IA.—The Guthrie Center Electric Light Company will install another unit in its plant next year. C. T. Harney is manager.

JEFFERSON, IA.—Percy Gray, manager of the Jefferson Light, Heat, Power & Water Company, writes that among the improvements contemplated are the installation of one 150-kw, three-phase alternator, 100 to 200-kw, new three-phase set, 100 to 300-hp boilers and possibly a heating plant.

PELLA, IA.—The electric plant of the Pella Electric Light & Power Company has been purchased by Henry Rhynsberger and Walter Fowler, of this city. The plant will be overhauled and put in first-class condition.

SILVER LAKE, IA.—At an election held here recently the proposition to install an electric lighting system was defeated.

LOUISVILLE, KY.—The Kentucky Electric Company contemplates the construction of a power house, to cost about $125,000. Bryan Allen is secretary.

SACO, ME.—The York Manufacturing Company contemplates the construction of a large power plant on Factory Wharf in the spring. The station will be near the wharf, where it will be possible to unload coal from the boats directly into the coal yards.

BALTIMORE, MD.—Plans are being made by the University of Maryland to erect a power house and nurses' home to cost $25,000. Sunderlin Bros. are the architects.

BALTIMORE, MD.—The Forestglen Land Company contemplates the construction of a central electric lighting and heating plant to supply light and heat to 900 double houses which the company proposes to erect in the suburbs of Baltimore. Charles F. Behrens, Calvert Building, is manager.

AYER, MASS.—The Ayer Electric Light Company has notified the Selectmen of an increase in the price for street lighting, to take effect from Dec. 1. The lamps are to be extinguished at midnight instead of one o'clock as at present, and the price of incandescent lamps increased from $15 to $17.50 per lamp per year, which will increase the cost of street lighting by more than $300 per year.

BOSTON, MASS.—The West End Street Railway Company has petitioned the State Railroad Commission for permission to issue 20,218 shares of additional common stock, as an amount necessary for payment to the Boston Elevated Railway Company for additions, improvements and alterations made from April, 1904, to Sept. 30, 1907, which amount to $2,135,750. The company also asks for authority to issue $750,000 in bonds.

BROCKTON, MASS.—The electric lighting plant of the Edison Electric Illuminating Company in East Bridgewater and the new sub-station in the city are expected to be completed and in operation about the middle of this month. The East Bridgewater plant will furnish electric energy for the sub-station in this city and the station now in use will [illegible] [illegible]. [illegible] have been [illegible] and another one has been ordered and will be [illegible]. H. A. Davidson will be chief engineer of both stations.

HAVERHILL, MASS.—The new [illegible] contract between the city and the Haverhill Electric Light Company has been signed by the Common Council. According to its terms the company is to furnish and [illegible] per lamp per year, and also agrees to furnish electricity for lighting the public buildings and clocks for each year of the contract, on the following schedule: 10,000 kw-hours, in any one year, at 10 cents per kw-hour; from 10,000 to 20,000 kw-hours, at 9 cents; from 20,000 to 30,000 kw-hours, 8 cents; all in excess of 30,000 kw-hours, at 7 cents per kw-hour. The contract calls for the installation of new alternating-current arc lighting system.

LEICESTER, MASS.—The Board of Selectmen is contemplating having the streets lighted from 6 to 6.30 a. m. during December and January, for the benefit of the employees in the Cherry Valley and Rochdale mills.

MERRIMAC, MASS.—A 5-hp motor has been installed at the new laundry, power for which is supplied by the municipal electric plant.

PEABODY, MASS.—At a special town meeting held Dec. 2 to vote on the proposition to make an appropriation of $55,000 for reconstructing and enlarging the electric light plant the measure was lost. It was voted to lay the matter over until the next town meeting.

SANDWICH, MASS.—A new power plant is being installed in the plant of the Alton Manufacturing Company.

CHARLOTTE, MICH.—A receiver has been appointed for the Charlotte Electric Company on application of the Union Trust Company, of Detroit, as trustee for the Guardian Trust Company, of Cleveland, Ohio, which represents the minority bondholders of a $30,000 issue, due in 1920, on which the interest payments have been defaulted.

ISHPEMING, MICH.—Extensive improvements and additions are being made to the plant of the Marquette County Gas & Electric Company, which includes the installation of a 500-kw Curtis steam turbine, a 200-hp engine direct connected to a 500-volt General Electric generator for street railway use, and a 300-hp Babcock & Wilcox boiler. Extensive additions and improvements are also being made to the gas plant. The work now under way will involve an expenditure of about $50,000.

GRANITE FALLS, MINN.—The Granite Falls Telephone Company has been granted a franchise for a local exchange.

MINNEAPOLIS, MINN.—It is reported that the Twin City Rapid Transit Company has leased and will electrify and operate that portion of the Minneapolis & St. Louis line between Manitou and Tonka Bay, Lake Minnetonka. The Twin City Rapid Transit Company will construct a mile and a half of line from its present terminus at Excelsior to Manitou, and will improve the mile and a half of the Minneapolis & St. Louis track from that point to Tonka Bay.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company has submitted a new schedule of rates to the special committee of the City Council for electrical energy, which will mean a reduction of 30 per cent over the present rates. The rates are as follows: For commercial lighting, 10 cents per kw-hour for the first 65 hours per month, and 6 cents per kw-hour for all used in excess. (Present rates are 14 and 6⅔ cents, respectively.) Residence lighting, flat meter rate of 10 cents per kw-hour for the first 52 hours per month, and 6 cents for all used in excess. (Present rates, 14 and 6⅔ cents, respectively.) For motors, 6¼ cents per kw-hour for the first 52 hours used per month; 2¼ cents per kw-hour for all used in excess. (Present rates, 7½ cents for first 52 hours, 5 cents second 52 hours and 2 cents for all in excess of 104 kw-hours.) Discounts will be allowed from the above rates as follows: Monthly bill of from $50 to $100, 5 per cent; from $100 to $150, 10 per cent; from $150 to $200, 15 per cent; from $200 to $250, 20 per cent; $250 and over, 25 per cent. For street arc lamps, $67.50 per lamp per year, for a total number of lamps not to exceed 3000. (Present rate, $84 per lamp per year.) This proposition contemplates changing the present system of street lighting to a more modern one, subject to the approval of the City Council. The above rates are made with the understanding that the company is not to receive less than $1 per month per meter for lighting service and $2 per month per horse-power demand from motor customers, except in elevator business, which will be $1 per horse-power per month of the rating of the motor.

SLEEPY EYE, MINN.—The American Electrical Company, of St. Paul, has secured the contract to install a generator in the municipal electric light plant.

HUMANSVILLE, MO.—Clayton Cavin, of Springfield, has purchased the exchange and lines of the Humansville Telephone Company, the consideration being $[illegible].

KIRKSVILLE, MO.—The Fort Wayne Electric Works, of Fort Wayne, Ind., has been awarded a contract to install dynamos and other electrical machinery and equipment in the new power house in this city.

HARLOWTON, MONT.—A company is being organized here for the purpose of establishing a light and water plant. [illegible] Graves and Benjamin Urner are interested in the enterprise.

PENDER, NEB.—M. M. Neumann has submitted a proposition to the Village Board to install an electric light plant. Mr. Neumann owns a small plant and proposes to install a plant large enough to light the whole village if the board will grant him a franchise for [illegible] years.

FALLON, NEV.—State Engineer Nicholas has issued a water right on the Truckee River to Percy Gardner. It is said that plans have been submitted to the railroad officials for the construction of a large power plant on the Truckee River near Clark's Station. The proposed site is on Southern Pacific ground.

ORANGE, N. J.—The Common Council has decided to take an appeal from the decision of the Supreme Court in the municipal lighting case. The opinion as handed down by Justice Pitney was to the effect that the city of Orange has no power to develop or to be developed from its water plant to use for the operation of a lighting plant. The city contends that the court has not taken a proper view of the situation, and it is also said that the decision was not unanimous.

HERKIMER, N. Y.—The Board of Supervisors has adopted the report of the military committee recommending that a new electric lighting plant should be installed in the armory at Mohawk.

MINEOLA, N. Y.—The New York & North Shore Traction Company has applied to the Supervisors for a franchise to construct an electric railway on the North Hempstead and Flushing Turnpike at its intersection with the Middle Neck Road.

NIAGARA FALLS, N. Y.—The hearing before the State Public Service Commission, originally scheduled for Nov. 26 on the application of the Niagara Falls Lighting Company to distribute electrical energy in Niagara Falls and Lewiston, has been postponed indefinitely at the request of the company's attorneys.

ROSLYN, N. Y.—The Public Service Commission of the Second District has granted the Nassau Light & Power Company permission to acquire the $35,000 capital stock of the Oyster Bay Electric Light & Power Company. The stock of the company was actually purchased by the Nassau Light & Power Company in 1905, without applying as required by law to the Commission of Gas and Electricity. In its petition to the Public Service Commission the company claimed that they were ignorant at the time that such consent should have been secured, and had acted in good faith in the matter.

SILVER SPRINGS, N. Y.—The question of lighting the town by electricity is now under consideration. Energy for operating the system may be secured from Lamont.

STAMFORD, N. Y.—At a special meeting of the Township Council the franchise of the Ontario Distributing Company (Boyle & Symmes) was amended in its application to rates. Under the original franchise all private service was to be on a flat rate and consumers were to make an advance to the company for the cost of building the line. As amended, the by-law provides for all service on a meter system at a rate of 7 cents per kw-hour. The township may hold to the flat rate for its street lighting, in which it will advance $500 to the company on the cost of lines.

FAYETTEVILLE, N. C.—The Fayetteville Steam Laundry is contemplating the installation of an electric plant to furnish electricity for lighting and for heating irons.

WHITNEY, N. C.—Work has commenced on the construction of the large power house of the Whitney Power Company at this place, where the Yadkin River has been harnessed and will furnish electricity to the Peidmont section of North Carolina. The plant will develop about 46,000 horse-power, a good share of which has already been contracted for by manufacturing interests. It is expected to have the plant in operation by March, 1908.

LIDGERWOOD, N. D.—A company has recently been organized, with a capital stock of $500,000, to construct an electric railway from Lidgerwood to Vebler. E. A. Movius and J. H. Movius are interested in the project.

NEW BREMEN, OHIO.—A. M. Steinbrey, village clerk, writes that it is proposed to purchase the present lighting plant and transfer the same to the water works plant.

NEWBURG HEIGHTS, OHIO.—Bids will be received until Jan. 7 by P. S. Ruggles, village clerk, for furnishing materials and supplying this village with street lighting. Bids will be received as a whole or separately on material and labor.

ANADARKO, OKLA.—The City Council contemplates issuing $75,000 in bonds, the proceeds to be used to improve and enlarge the municipal electric light plant.

PORTLAND, ORE.—The Oregon Electric Railway Company has completed laying its track between Portland and Salem. It is said that a branch will be constructed within the next few months to Hillsboro and Forest Grove, and the main line extended down the Willamette Valley from Salem to Eugene. Feeders will be built throughout the valley. H. B. Clarke is president of the company.

THE DALLES, ORE.—George E. Jacobs and other Portland capitalists have purchased a water site on the Deschutes River from G. L. Rohr, who owns the property known as Rohrvilla, about seven miles from Moro. The new owners propose to develop the water power to furnish electricity for lamps and motors in the towns of Moro, Grass Valley, Wasco and The Dalles.

HAZLETON, PA.—The sub-station of the Consumers' Electric Light & Power Company, a subsidiary corporation of the Harwood Electric Light & Power Company, is completed and in operation. This station supplies electricity needed for the service in this city.

JOHNSTOWN, PA.—The City Council passed over Mayor Young's veto, the ordinance granting the [illegible] Railway Company the right to operate in Morrellville.

LEBANON, PA.—The City Council on Nov. 25 awarded the contract for street lighting to the Edison Electric Illuminating Company for a term of five years. The company agrees to furnish arc lamps at $79.92 each per year, and incandescent lamps for $16.80 per lamp per year.

McADOO, PA.—It is reported that the Consumers' Electric Light & Power Company, of Hazleton, has offered to lease the municipal electric light plant for 25 years, and pay off the indebtedness of the plant. It is probable that it will be accepted, as municipal ownership has been a financial failure in this borough.

BROOKINGS, S. D.—The Brookings & Sioux Falls Railway will be equipped for the present with gasoline-electric cars, with a view of installing the overhead electric system when business warrants it. Neil Stewart is president and general manager.

MITCHELL, S. D.—The City Council has granted a 20-year franchise to a new company, recently formed by local men. The company proposes to buy the plant of the Mitchell Gas Company or erect a new plant, and offers a large reduction in rates. The maximum price for electricity is 10 cents per kw-hour.

SERVIERVILLE, TENN.—An election has been ordered by the court of Servierville to be held Dec. 14 to vote on the question of buying $150,000 in bonds to aid the proposed electric railway between Knoxville and Rutherford, N. C., the road to be known as the Knoxville & Eastern Railway. Preliminary surveys for the road have been completed.

DALLAS, TEX.—We have been informed that the Dallas Interurban Electric Railway Company, which is building an electric railway between Dallas, Terrell and Tyler, will resume construction work about March 1, 1908. S. A. Stemmons, secretary of the company, states that the company will probably locate its power house in Dallas. The company is capitalized at $2,400,000. D. E. Waggoner is president, and I. J. Willingham, vice-president and general manager.

HOUSTON, TEX.—Arrangements are being made by the Houston Home Telephone Company for the construction of its proposed automatic telephone system, the cost of which is estimated at $646,746. McMeen & Miller, of Chicago, Ill., have charge of the work. The system will be extended to Houston Heights, where a sub-station will be built. J. S. Slusher is president.

McKINNEY, TEX.—R. F. Dowell, city secretary, writes that the citizens on Nov. 26 voted to issue $26,000 in bonds for water and electric light extension and park work.

MT. PLEASANT, TEX.—The Mount Pleasant Electric Company contemplates the installation of a 75-kw generator direct connected. G. M. Greenspun is vice-president and general manager.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has submitted a proposition to Mayor Bransford to install 1000 arc lamps, at the cost of $60 per lamp per year. Under the present arrangement with the company the city pays $42,336 for 588 lamps. It is understood that the offer is made on condition that the clause requiring the sprinkling and flushing of the paved streets by the railway company, as provided for in the franchise recently passed by the Council, and refused by the company, be eliminated when the new franchise asked for is granted by the Council. If the proposition is accepted, the company promises to expend from $110,000 to $150,000 for improvements to its plant to meet the increased service.

RICHFORD, VT.—Owing to the delay in receiving the equipment for its power house, the Sweat-Comings Company will probably be unable to have its electric light plant in operation before next April.

ST. ALBANS, VT.—A new storage battery is being installed in the power house of the St. Albans Street Railway Company, at a cost of $3,500.

PORTSMOUTH, VA.—The Retail Merchants' Association contemplates organizing a company to install a lighting plant. J. A. Morris and Nathan Levy have charge of the project.

COLTON, WASH.—The City Council has granted the Idaho Washington Light & Power Company, of Moscow, Idaho, a franchise to erect and operate an electric light plant in this city.

SPOKANE, WASH.—J. P. Graves, president of the Inland Electric Railway Company, recently stated that the company would extend its line from the present terminus at Colfax to Walla Walla, in the near future.

SPOKANE, WASH.—It is reported that the Big Valley Electric Railway Company, which contemplates the construction of an electric railway to connect Huntingdon, Mill Creek, Allenville, Belleville, White Hall, Reedsville and Lewistown, a distance of 32 miles, has made all surveys and secured all rights of way. The company is owned and controlled by the Juniata Valley Electric Street Railway Company, of which R. W. Jacobs is president and general manager.

TACOMA, WASH.—Henry Hewitt, of this city, has obtained important franchises from the cities of Marshfield and North Bend securing the privilege to construct and operate an electric light plant and street railway system, etc.

ALMA, WIS.—The State Railroad Commission has granted the Alma Electric Light Company permission to abolish its flat rates for service and put in force meter rates at a maximum of 10 cents per kw-hour, with a discount of 20 per cent on monthly bills of over $10; 30 per cent on monthly bills of $[illegible] and [illegible] per cent on monthly bills of over $[illegible]

[illegible] WIS.—The [illegible] Light & [illegible] [illegible] a decision to the effect that it means to surrender its franchise and take out an indeterminate franchise under the public utility law. By this action the company has prevented the City Council from granting a franchise to the Economy Light & Power Company or any of the three companies now trying to obtain a franchise from the city. The companies will now have to petition the railway for the desired franchise.

WASHBURN, WIS.—The City Council has decided to purchase the outside equipment, good will and business of the Washburn Light & Power Company. The power plant was also leased and the transfer of the entire property will be made soon. The lighting plant will be managed by a commission composed of five members appointed by the [illegible]

WATERLOO, WIS.—Jackson & Jackson, of Madison, are preparing plans for an extension to the municipal electric light plant, to cost about $10,000.

RIVERTON, WYO.—A. H. Stevenson, of Butte, Mont., and E. T. Glenn contemplate making an application to the town of Riverton for a franchise to erect and operate an electric light and power plant.

VANCOUVER, B. C.—The British Columbia Electric Railway Company is planning to develop water power on the Jordan River to generate electricity to be used on Vancouver Island.

MINNEDOSA, MAN.—Joseph Barrett, 573 Dufferin Street, Toronto, Ont., writes that the Minnedosa Power Company has awarded the contract for the construction of its power plant to the Hydro Electrical Construction Company, of Toronto, for about $80,000. Alexander Keith is president of the company.

BRANTFORD, ONT.—The City Council is considering the question of securing electrical power from the Hydro-Electric Power Commission, but in the meantime will ask for rates for street and residential lighting from the Western Counties Electric Company, Ltd., and the Grand Valley Electric Company.

NAPANEE, ONT.—The town of Napanee has applied to the Hydro-Electric Power Commission for estimates of the cost at which it can be supplied with electric energy.

MONTREAL, QUE.—The Montreal Street Railway Company has secured the right of way from its present terminus of the Black River route to a point on the outskirts of the village of St. Vincent-de-Paul. A 50-year franchise has been obtained for an extension through Notre Dame-de-Grace. The company has also purchased an additional right of way on the Cartierville line.

SHERBROOK, QUE.—The City Council contemplates the construction of a municipal electric light and power plant in the near future. Plans and specifications are being prepared by Ross & Holgate, of Montreal.

Company Elections.

SALISBURY, N. C.—At a meeting of the directors of the Whitney Power Company the resignation of President George I. Whitney was presented and accepted. Vice-president Edward F. Buchanan, member of the firm of A. O. Brown & Company, was elected to succeed Mr. Whitney. The following directors resigned: J. D. Finley, C. S. Ritchie, J. B. McClelland, A. W. Herron and F. L. Stephenson, and are succeeded by G. L. Stout, L. G. Young, W. D. Sargent, J. S. Henderson and A. O. Brown. The Whitney Power Company is developing about 50,000 horse-power on the Yadkin River, near Yadkin, N. C., and contemplates developing 50,000 additional horse-power later.

New Industrial Companies.

THE BANKERS' ALARM PROTECTION COMPANY, of [illegible], has been incorporated, with a capital stock of $3,000, for the purpose of manufacturing and dealing in electrical appliances. The incorporators are Ole Jacobsen, George English and Enos T. Welant.

THE DAVIS ELECTRIC COMPANY, of Parkersburg, W. Va., has been organized to manufacture an electrical medical battery invented by Jesse R. Davis. J. Menton Caldwell is president.

THE ILLINOIS ELECTRIC RENOVATOR SALES COMPANY, of Chicago, Ill., has filed articles of incorporation, with a capital stock of $15,000, for the purpose of manufacturing and selling renovators. The incorporators are A. E. Lake, M. Poffinberger and F. J. Haake.

THE LUXENBERG'S ELECTRIC PROTECTIVE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $5,000, by Jacob Luxenberg, Abraham Luxenberg and Henry Tannebaum.

THE MACCALLEN COMPANY (electricians), of Boston, Mass., has been incorporated, with a capital stock of $300,000, by Thomas Allen, Louis MacCarthy and Gardner W. Prouty.

THE POWER EQUIPMENT COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $10,000, by Orrington C. Foster, A. C. Field and others.

THE GEORGE H. RICE COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $40,000 and the following directors: George H. Rice, John J. Holshuh and Thomas H. Harvey, all of Brooklyn. The company proposes to carry on an electrical engineering business.

New Incorporations.

SOLDIER, IDAHO.—The Soldier Telephone Company, Ltd., has been incorporated with a capital stock of $4,800. The directors are Frank Housman, A. G. Barker, D. H. Gwinn, W. Y. Perkins and James King.

CENTRALIA, ILL.—The Centralia & Sandoval Railway Company has been formed by the owners of the Centralia & Central City Traction Company, for the purpose of constructing an extension from the present terminus of the line to Sandoval, a distance of four miles, to serve the mining district. Work on the construction of the road will probably begin about April 1. E. R. List is president.

CHICAGO, ILL.—The Interstate Automatic Telephone Company has been incorporated, with a capital stock of $10,000, by C. J. Huff, T. A. Hall and V. H. Huff. The Indiana office of the company is at Hammond.

GILLESPIE, ILL.—The Gillespie Electric Railway Company has been incorporated, with a capital stock of $30,000, for the purpose of building and operating an electric railway from Gillespie to the mines in Macoupin County. The incorporators and the first board of directors are H. Y. Bycroft, R. H. Isaacs, H. W. Rice, G. W. Schmidt, S. P. Preston, all of Gillespie.

JERSEYVILLE, ILL.—Articles of incorporation have been filed for the Improved Electric Railway Company with a capital stock of $200,000. The directors are H. H. Bowman, S. L. Hill, Dr. A. A. Shobe, William J. Herman, William Embly, P. M. Hamilton, all of Jerseyville, and William J. Hamilton, of Evanston.

LITTLETON, ILL.—The Littleton & Brooklyn Mutual Telephone Company has filed articles of incorporation, with a capital of $1,000. The incorporators are Herman Yaap and others.

TONTI, ILL.—The Tonti Telephone Company has been incorporated with a capital stock of $500 by John H. Kretzer, Walter Cope and Jacob Hershberger.

BLACK HAWK, IND.—The Pierson Mutual Telephone Company has filed articles of incorporation, with a capital of $2,000. The company will build a telephone system in this town and western part of Vigo County. Charles Yaw, B. F. Beard and S. C. Elliott are the directors.

HARLAN, IND.—The Harlan Telephone Company has filed articles of incorporation with a capital stock of $25,000. The company has purchased the plant of the Harlan Telephone Company (partnership). The officers of the new company are J. H. Zimmerman, of Harlan, president, and Frank Dalrymple, of Hicksville, Ohio, secretary.

SHELBYVILLE, IND.—The Shelbyville Gas Company has been formed to take over the Shelbyville Gas & Light Company and will enlarge and rebuild the plant.

COLONY, KAN.—The Colony & Carney Telephone Company has filed articles of incorporation with a capital stock of $1,100. The incorporators are James Suttles, of Colony; C. S. Kern, of Kern; W. T. Motley, and Frank Nelson, of Boise.

BAY'S FORK, KY.—The Bay's Fork Telephone Company has been incorporated by A. Welch, Daniel H. Read, J. A. Read and R. A. Read.

LANCASTER, KY.—The Kentucky Telephone & Telegraph Company has been incorporated with a capital stock of $10,000 by J. W. Elmore, H. V. Bastin, H. T. Logan, James I. Hamilton and Frank B. Marksbury.

MONTICELLO, KY.—The Monticello & Cumberland Telephone Company has been incorporated with a capital stock of $2,000.

PORTLAND, ME.—The Rio de Janeiro Telephone Company has been incorporated with a capital stock of $1,000,000. J. E. Manter, of Portland, is president, and C. E. Eaton, also of Portland, is treasurer.

DAGGETT, MICH.—The Daggett-Nathan Telephone Company has been incorporated with a capital stock of $1,000 by Paul Perrizo, Jr., C. W. Wilkins, Eugene Houte, Dr. D. R. Landsborough, Charles Erickson and Peter LaCroix.

PORT HURON, MICH.—Articles of incorporation have been filed for the Port Huron Citizens' Telephone Company, with a capital stock of $200,000, by Charles Greer and others.

CLARISSA, MINN.—A new telephone company has been formed in this place to install a rural telephone line. George A. Etzel is secretary.

FOREST, MINN.—The Fox Lake Rural Telephone Company was formed recently to erect a telephone system in this place.

MONTICELLO, MINN.—The Gilchrist Lake Rural Telephone Company has been formed and will build a line in the spring. Arthur Hoar is secretary.

ST. LOUIS, MO.—The Baden Power Company has filed articles of incorporation, with a capital stock of $2,000. The object of the corporation is to manufacture, distribute and deal in electric, steam and hydraulic power. The incorporators are Robert Gaylord, of Chicago; George S. Gaylord, of Evanston, Ill.; James A. Seddon, Warren D. Harris and Samuel B. McPheeters.

BROOKLYN, N. Y.—The Inter-City Telephone Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $250,000 and the directors are: Frederick G. Ashley, Albert W. Linton, Thomas B. Stevenson.

NEW YORK, N. Y.—The Kage Light Company has been incorporated with a capital stock of $[illegible] by Harry A. Gordon, Harry M. Markson and William Jasie.

OGDEN, N. Y.—The Ogden Telephone Company has filed articles of incorporation with a capital stock of $25,000. The directors are Frank C. Blackford, of Adams Basin; Charles H. Gallup, of Parma, and Lewis W. Adams, of Ogden.

BURLINGTON, N. C.—The Burgrahaw Traction Company has been incorporated with a capital stock of $250,000 for the purpose of manufacturing and distributing electricity and gas to Burlington, Graham and Haw River, N. C.; also to equip and operate a street railway in the above places and to connect them.

KING, N. C.—The Farmers' Quickstep Telephone Company has been chartered, with a capital of $25,000, by S. F. Tillotson and others.

LIBERTY, N. C.—The Liberty Telephone Company has been incorporated with a capital stock of $10,000 by J. L. Hardin, M. J. Reitzel, J. F. Pickett and others.

SANBORN, N. D.—The Barnes County Telephone Company has been incorporated in this State, with a capital stock of $25,000, by D. F. Siegfried and others.

NEVADA, OHIO.—The Nevada Telephone Company has been incorporated, with a capital stock of $30,000, by A. Swartz and others.

ALDEN, OKLA.—The Alden Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The directors are H. S. Sturgis, C. J. Carpenter, of Alden; E. H. Stewart, of Carnegie, and Fred Beasted, of Sayre.

CHATTANOOGA, OKLA.—The Comanche Telephone Company has been incorporated with a capital stock of $5,000 by T. E. and F. O. Hibbard, of Snyder, and W. S. White, of Mt. Peck.

DUKE, OKLA.—The Hollowman Coraba Independent Telephone Company has been incorporated with a capital stock of $3,200. The incorporators are: J. H. Hollowman and Frank D. Franks, of Russell; W. D. Branson, James D. Moore, Calvin G. Hukill and N. D. Tennison, of Duke.

GUTHRIE, OKLA.—The Shawnee-Tecumseh Telephone Company has been incorporated with a capital stock of $100,000. J. W. Rubey is president of the company.

OKLAHOMA CITY, OKLA.—Articles of incorporation have been filed for the Columbia Electric Company with a capital stock of $25,000 by A. J. McMahan, of Oklahoma City; Arthur V. Allen and A. C. Allen, of Chicago, Ill.

PORTLAND, ORE.—Articles of incorporation have been filed for the Portland, Eugene & Eastern Railway Company with a capital stock of $1,000,000, for the purpose of building an electric railway from Portland to Salem, Eugene, Yaquina, Prineville and Ontario, with branches to numerous towns. The total mileage contemplated is more than 800 miles. It is proposed to develop the water power of the Mackenzie, the Santiam and the Deschutes rivers and streams in central Oregon to generate electricity to operate the system planned. The incorporators are J. O. Story, J. C. Bracher, George A. Welch, E. M. Hall and John McNary.

BEAVER FALLS, PA.—The Beaver Falls & Koppel and the Beaver & Lawrence Electric Railway Companies have been chartered in the Beaver County courts. The Beaver & Lawrence line will run from North Sewickley to Beaver Falls and the Beaver & Koppel Railway will extend from Beaver Falls to Koppel, a distance of 10 miles. The incorporators are T. P. Simpson, S. L. Tone, C. W. Gibbs, W. J. Horgan and B. S. Johns

EASTON, PA.—Articles of incorporation have been filed for the Clymer Power Company by Leo S. Clymer and B. F. Fackenthal. The company proposes to manufacture gas and electricity.

CLOVER, VA.—The Piedmont Telephone Company has been organized with W. H. Dorin president, Dr. R. H. Fuller vice-president and G. B. Gibson secretary and treasurer.

SHAW LAKE, WIS.—The Bashaw Valley Telephone Company has been incorporated, with a capital stock of $10,000, by A. E. Allen, J. M. Smith and Eugene Smith.

HAILEYBURY, ONT.—The Silver Belt Electric Railway Company has been granted a charter to construct an electric railway from Latchford north to Cache River.

Legal.

AWARD APPROVED.—By [illegible] Court sustained Judge Charles M. Rogers in his finding that the Columbus Board of Public Service, of Columbus, Ohio, legally could award a contract for turbines for the municipal light plant to the Allis-Chalmers Company. A test suit was filed by City Solicitor George S. Marshall at the request of the Westinghouse Company, which claimed that the Allis-Chalmers turbines had not been in operation for two years, as required in the specifications.

RIGHT TO OWN LIGHT [illegible] Court, has handed down an opinion that the town of North Birmingham, Ala., has no right to own and operate an electric lighting system. Such an authority exceeds that given by the constitution or any act. L. R. Posey sued for personal injury at [illegible] the failure of the town to [illegible] the lower court, Justice Dowdell says: "Our conclusion is that the defendant had not the power [illegible] the charter powers, to engage in the operation of an electric light plant. It follows that the act was ultra vires and resulting injury fixed upon the corporation no liability."

Obituary.

MR. LOUIS J. TOWNSEND, of Berwick, Pa., died Nov. 30, after a long illness. He was manager of the Berwick Electric Light Company and identified with various interests in the town. He was a prominent Mason and was 37 years old.

MR. M. F. TYLER.—We regret to note the sudden death of Mr. Morris F. Tyler, one of the pioneers in modern electrical industries, and president of the Southern New England Telephone Company. The cause of death was apoplexy. Morris Franklin Tyler was born in New Haven, Aug. 12, 1848. His father, Morris Tyler, was a wholesale manufacturer of boots and shoes in New Haven, who served his native city as Councilman, as Alderman and as Mayor, and his State as Lieutenant-Governor in 1871 and 1872. The son studied at Yale University, where he was graduated A. B. 1870, A. M. 1873 and LL. B. 1873. Adopting the profession of law he was admitted to the bar immediately after taking his bachelor degree at Yale University Law School. He opened a law office in New Haven, July 1, 1873. His early political affiliation was with the Republican party, but the incidents attending the campaign between the Republican candidate for President, James G. Blaine, and Grover Cleveland, the candidate of the Democratic party, led him to vote with the Democrats, and from that time he had remained independent in politics. In March, 1883, he was elected president of the Southern New England Telephone Company, and the great growth of this enterprise occurred under his management. He served as executive secretary to Governor Hobart B. Bigelow, of Connecticut, in 1881and 1882. He was instructor in jurisprudence in Yale University, 1893-94; full professor of law, 1894-99, and treasurer of the corporation, 1899-1904. He was a member of the Union League, Grolier and Yale clubs, of New York City, and of the Quinnipiack and Graduates' Club, of New Haven. Mr. Tyler was a man of strong personality and keen judgment. He had strong views upon the subject of the obligations to the public by these corporations, and was the first president of one of them, the Southern New England Telephone Company, to issue new stock to stockholders at a figure considerably in advance of par, thus anticipating legislation of that import. He was a lover of literature and nature, a professional man by education and a corporation manager by choice. He was married Nov. 5, 1873, to Delia Talman, daughter of Victor Gifford and Georgiana Audubon, of New York City, and of the five children born of this marriage four are living. The children living are Victor Morris Tyler, secretary of the Southern New England Telephone Company; Ernest Franklin Tyler, an artist in New York City; Leonard Sanford Tyler, and Audubon Tyler.

Personal.

MR. W. J. MOORE, assistant professor of electrical engineering at the Stevens Institute of Technology, has resigned in order to accept a professorship in the North Carolina State College of Agriculture and Mechanical Arts.

MR. JAMES N. COX, who for several years has been superintendent of the Nashville district of the Cumberland Telegraph & Telephone Company, has resigned his position to become general manager of the Gainesboro Telephone Company.

MR. OLIVER M. DIALL, superintendent of the Lockport Gas & Electric Company, has been appointed general manager of the Lockport Light, Heat & Power Company, which is a consolidation of the former company and the Economy Light, Fuel & Power Company. The new company will take charge Jan. 1.

PROF. W. E. GEYER, head of the physics department at the Stevens Institute of Technology, and Prof. John B. Webb, the professor of mathematics and mechanics, have been retired on the Carnegie Foundation. Prof. Geyer was the first occupant of the chair of applied electricity when established in 1884.

MR. CHARLES BLIZARD, third vice-president of the Electric Storage Battery Company, read a paper on "Development in Storage Battery Practice" before the Telephone Society of New York on Nov. 26. The subject is one with which Mr. Blizard enjoys a most intimate familiarity, from long experience in all departments.

MR. SOICHIRA SHIMUDZU, who has for the past three years been in the engineering department of the Allis-Chalmers Works at Cincinnati and Milwaukee, will shortly sail for Japan, where he will take a position on the engineering staff of the Shibaura Engineering Company, one of the many important interests of the celebrated Mitsui family.

SAWYER-PIKE.—The marriage took place at Cleveland, Ohio, on Dec. 4, of Mr. Leroy P. Sawyer, manager of the Buckeye Electric Company, with Miss Jessamine A. Pike, daughter of Mrs. L. D. Pike, at whose residence the ceremony was performed. Among those present were Messrs. Willits Sawyer, of New York; Ernest Houghton, of Chicago, and B. G. Tremaine, H. A. Tremaine, F. S. Terry and S. E. Doane, of the National Electric Lamp Company. The happy pair will visit Texas, Louisiana and Nebraska and make their home in Cleveland in January.

MR. WILLIAM E. GRIFFIN has been appointed general superintendent of the Rochester Railway Company and its connecting lines. Mr. Griffin [illegible] Railway Company from the time work was started on the road, five and one-half years ago.

The management of the Ontario Light & Traction Company will pass out of the control of the officials of the Rochester & Eastern Rapid Railway [illegible] of Rochester, who has been consulting engineer for the Canandaigua Gas Light Company, will be made superintendent of the lighting companies.

MR. WILLIAM CRICHTON, for many years well known throughout the United States as representing the interests of the Hart Manufacturing Company, of Hartford, Conn., and who established the English branch of the business in London, which has been so entirely successful under his care, has arrived on the *Lusitania* for a visit to the United States of some weeks' duration. Mr. Crichton has been in England for three years and has succeeded in establishing the Hart switch in many of the very best hotels and public buildings in that country, where the quality of goods is appreciated more than the price. Mr. Crichton will be a good deal in Hartford during his stay, but will also visit New York City and his own family in Washington, and will doubtless have an opportunity also of seeing many of his old acquaintances.

MR. WM. B. HALE, who is well known to electrical engineers in Chicago and elsewhere through his former connection with the Western Electric Company, is now located in Mexico as a consulting electrical engineer, making a specialty of examining and appraising existing properties and estimating on projected electrical engineering work in Mexico for American and other investors. Heretofore those in the United States interested in Mexican propositions have been obliged to send an expert the long journey to Mexico to look over the ground and make a report, with considerable resulting delay and expense. Mr. Hale has been in Mexico for several years and was for some time general manager of the telephone company in Mexico City. From his wide engineering experience, knowledge of the Spanish language and familiarity with the country, he is in an excellent position to furnish trustworthy reports on engineering matters in Mexico. He is also prepared to supervise electrical installations in any part of the republic. His offices are 1 A Independencia, No. 6, City of Mexico.

Trade Publications.

ARC LAMPS.—Circular No. 1092, of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., treats of enclosed arc lamps designed for use on constant-voltage alternating circuits.

RAILWAY MOTORS.—Direct-current railway motors, rated at 40 hp and 500 volts, are fully described in Circular No. 1089 of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

WATT-HOUR METER CALIBRATORS.—Bulletin No. 1097, of the Fort Wayne Electric Works, Fort Wayne, Ind., is devoted to portable calibrators for watt-hour meters, full instructions for the use of these instruments being given.

"INSULATINE."—The Insulatine Company, of 1 Broadway, New York City, has just issued a small pamphlet relative to its waterproofing and electrical sealing cements, paints and compounds, which are set forth therein in detail.

GAS PRODUCERS.—Section III of Catalogue A, of the Wile Power Gas Company, Rochester, N. Y., gives an excellent discussion of the advantageous features of gas for engine fuel, and describes machinery for producing gas by the suction process.

RAILWAY CAR CONTROL.—In its circular No. 1091 the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., gives an extended illustrated description of the unit-switch system of multiple control for governing the various motors of a train simultaneously.

AIR BRAKES.—Emergency valves for straight air-brake equipments are fully dealt with in Bulletin No. 1515 of the Allis-Chalmers Company, Milwaukee, Wis. Pneumatic governors for maintaining the supply of air at the required pressure are described in Bulletin No. 1514 of the same company.

NELSON VALVES.—The Nelson Valve Company, of Chestnut Hill, Philadelphia, has just issued a handsome large octavo catalogue and price list "H" in paper cover giving a good deal of data as to its improved gate and globe valves for steam, water, gas, air and ammonia. There are 52 pages of text.

STEAM TURBO-GENERATORS.—An elaborately illustrated description of Curtis steam turbo-generators has been issued by the General Electric Company, Schenectady, N. Y., as Bulletin No. 4531. The bulletin contains information concerning the constructive details of both the turbines and the generators.

AUTO TRANSFORMERS FOR LAMP CIRCUITS.—Single-coil transformers for maintaining equal voltages in three-wire and five-wire circuits when the supply is obtained from a two-wire circuit are discussed fully in Circular No. 1081 of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

GAS ENGINES.—The Lazier Gas Engine Company, 190 Main Street, Buffalo, N. Y., has issued an attractive catalogue, together with numerous blue-prints, devoted to its vertical gas engines of the multiple-cylinder type. It is stated that a hp-year produced by the simple steam engine costs $[illegible], while if produced by gas engines, it costs $[illegible].

GAS AND GASOLINE ENGINES.—Bulletin D, of the Jacobson Machine Manufacturing Company, Warren, Pa., has for its subject the Jacobson gas and gasoline engine as built for stationary and portable use. The description of the principles of action of this type of engine and of its constructional details is well written and is unusually complete.

ELECTRIC CONTROLLER & SUPPLY COMPANY, of Cleveland, Ohio, has issued a booklet, 6 by 3¼ inches, devoted to electric drive and to the application of magnetically operated unit switches to the control of motors that are frequently and rapidly reversed. The text is clearly written, accompanied by good illustrations, and the get-up of the pamphlet in imitation leather cover is neat and artistic.

LAMP FIXTURES.—The Nernst Lamp Company, Pittsburg, Pa., has issued a well-prepared catalogue devoted to an extremely neat line of lamp fixtures. In the design of these fixtures great care has been exercised to make them scientifically correct for the best distribution of light and, at the same time, to follow out the best artistic treatment of the day. The aim has been to obtain plain, lasting elegance rather than elaborate ornamentation.

CHASE-SHAWMUT COMPANY, of Newburyport, Mass., has issued bulletin and price list No. 101 descriptive of its stage lighting appliances of the "Cushing" type. It is small and convenient in form, and clear in its information, and should be of service to all interested in these matters. It is one of a series issued by the company. Its immediate predecessor, No. 100, deals with National Electrical Code fuses, cut-outs and fittings, railway cut-out boxes, pocket test lamps, etc.

INCANDESCENT LAMPS.—The Franklin Electric Manufacturing Company, Hartford, Conn., has published Bulletin No. 4, giving convincing arguments concerning the merits of Novi anchored-filament lamp and Femco reflector lamp. In the latter lamp the reflector is a part of the lamp itself and is not a separate adjunct, and the light in a downward direction is greatly multiplied. It is stated that the light in the useful direction is thereby increased more than 100 per cent.

ARC LAMPS of the enclosed direct-current type intended for operation on constant voltage circuits are illustrated and described in Bulletin No. 1099, of the Fort Wayne Electric Works, Fort Wayne, Ind. The lamps are designed for either 110 volts or 220 volts; in the former case the current may range from 4.5 to 5.5 amperes, and in the latter from 2.75 to 3.5 amperes. Bulletin No. 1101, of the above firm, deals with the "multiple" system of street arc lighting using enclosed type of alternating-current lamps.

ELECTRIC CONTROLLING DEVICES.—With the title, "The Navy Bulletin," the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a 48-page pamphlet designed for the information of manufacturers of electric motors and motor-driven machinery who supply apparatus to the Navy Department. The Cutler-Hammer company has made a special study of this branch of the electrical industry, and the pamphlet illustrates various types of controlling apparatus of its manufacture which are purchased by the several naval bureaus.

WATER TUBE BOILERS.—The Rust Boiler Company, Pittsburg, Pa., has issued in pamphlet form a report by Prof. Wm. Kent of a series of tests on a Rust water-tube boiler. At full load of 335-hp the boiler was found to have an efficiency of 75.5 per cent, while at a load of 700-hp the efficiency was 69 per cent. Prof. Kent stated that the efficiency results were within three per cent of the highest that are theoretically possible with Pittsburg coal in any boiler fitted with any kind of stoker, and not provided with an economizer.

THE BRISTOL COMPANY, of Waterbury, Conn., has issued three new bulletins, covering its electrical instruments: Bulletin No. 61 describes recording voltmeters, which is in 12 pages, illustrated, and is very complete; Bulletin No. 62 describing recording ammeters, lists a new form of portable instrument, which is now being manufactured, and is very attractive in its make-up. Bulletin No. 63 covers a line of recording wattmeters and is somewhat larger than the others, having 19 pages. This bulletin, besides illustrating the new portable form of wattmeter, also shows a very complete list of single, two-phase and balanced three-phase alternating-current instruments, something that was absent from former bulletins. These catalogues will be appreciated by engineers, who are usually in a quandary as to the best type of instrument applicable to the loads for which they intend to design, and will be found very helpful by them.

FRICTION CLUTCHES.—A friction clutch designed for the heaviest work, with particular regard for simplicity, durability and ease of adjustment, is described in Allis-Chalmers Company's Bulletin No. 4001, entitled "The Reliance Friction Clutch." All the usual objections have been overcome, it is said. Ordinarily, for example, the pulley hub of a friction clutch is cut down to economize space on the shaft, and the bearing surface supplied will not properly carry the strain of a tight belt. The strain of the Reliance friction clutch, on the contrary, has a very even distribution, it being made with either three or six arms, arranged in sets of three. Each of the sets is connected with an equalizing ring by toggles, and this ring is free to move sideways, so as to equalize the strain on the three arms. The pressure, also, instead of being regulated with springs, can be set according to the load the clutch has to carry, by means of adjusting nuts and eye-bolts.

WEST SHORE RAILROAD.—The electrification of the West Shore Railroad between Utica and Syracuse has been closely watched. Special attention has been attracted to it on account of its 60,000-volt transmission line, the adoption of an inverted, protected third-rail, and the hydro-electric development from which power is supplied. In Bulletin No. 4546 the General Electric Company, Schenectady, N. Y., has issued a handsomely bound pamphlet of 24 pages, in which the installation is very completely described. The bulletin is profusely illustrated with views

of the trains, interior of the cars, transmission lines, exterior and interior of sub-stations, plans of the buildings and wiring diagrams and details of the track construction. Not the least interesting feature of the pamphlet is a comparison of two train sheets, one showing the operation before electrification and the other after, where the increase in traffic with the same track capacity is very strikingly shown. The bulletin cannot fail to be of interest to all steam railroad engineers as well as those actively engaged in electric traction.

ALLIS-CHALMERS ENGINES.—The Allis-Chalmers Company, of Milwaukee, is issuing a bulletin on "Compound Corliss Engines," which contains, besides illustrations of each type, many facts of interest to power users throughout the country. "So far as we are aware," it is stated, "the first compound Corliss engine designed for power purposes was built in the shops of this company, and to our Mr. Edwin Reynolds, who for nearly half a century has been so prominently identified with the history of this type, should be given credit for introducing the principle of compounding into general Corliss engine practice. The earliest Corliss engine was built in 1848, and twenty-eight years later the famous 'Centennial' engine, which was supposed to embody in its design and construction the very highest development of the engine builder's art, was nothing more than a pair of simple engines. The first Reynolds-Corliss engine, built in 1877, marked the beginning of an epoch in the history of the steam engine. The first compound Reynolds-Corliss was built three years later and is still in regular operation."

DIRECT CURRENT INDICATING INSTRUMENTS.—Direct current indicating instruments, Type D, manufactured by the General Electric Company, Schenectady, N. Y., are constructed upon the well-known D'Arsonval principle, and designed for switchboard use. Bulletin No. 4552, recently issued by the company, describes and illustrates their construction, and gives dimension diagrams of instruments and shunts, full-sized views of the scales, and data regarding catalogue numbers, capacities, prices, etc. Damping is obtained by means of Foucault currents generated in an aluminum frame on which the coil is wound. The magnets are carefully hardened and aged, and an unusual high torque, combined with light moving elements and small magnetic air gap, make reasonable the manufacturer's claim of long life with continued accuracy. The frame is pivoted in a jewel bearing, and the whole assembled in a round cast-iron case, which protects it from stray fields and renders the instrument dust-proof. The standard finish of Type D instruments is dull black with raised portions of polished copper.

Business Notes.

THE R. THOMAS & SONS COMPANY has moved its New York offices to 227 Fulton Street, Glackner Building, where it has fitted up fine offices and a sample room for its well-known wares on the tenth floor. The home office of the company is at East Liverpool, Ohio.

WILE POWER.—The Wile Power Gas Company, manufacturer and engineer of producer gas installations, has moved its general offices from the Cutler Building, Rochester, N. Y., to its works at 1688-92 Columbus Road, Cleveland, Ohio, where all communications in future should be addressed.

THE CENTURY ELECTRIC COMPANY, of St. Louis, has increased its business to such an extent this year that it has found it necessary to move to very much larger quarters. The middle of this month it will move to Olive and Nineteenth Streets, where it will occupy the entire building, which will quadruple its present space and facilities. The offices and the shipping department will take up the first floor and the other three floors and the basement will be devoted wholly to manufacturing purposes.

ALLIS-CHALMERS MOTORS.—Messrs. Bray and Kates, Arlington Heights, Ill., have recently purchased Allis-Chalmers electrical machinery for a small lighting and power plant, in which is included a 50-kw engine type direct-current generator and a line of the new type "K" direct-current motors, recently put on the market, the largest being 30 horse-power. The growing demand for direct-current motors to be applied to the individual drive of various machines has led to a number of important changes in both mechanical and electrical design of the motors formerly used. The type "K" motor has been developed to meet the requirements of individually motor-driven machines. It is manufactured in thirteen different frame sizes and for each size there are a number of ratings, the output of a given frame being proportional to the speed. Type "K" motors are suitable for all classes of work where either a constant or variable-speed direct-current motor is required. For general driving of machinery or for variable-speed work, shunt-wound machines are used. For cases where a large starting torque combined with the constant speed characteristic of the shunt motor is required, compound-wound motors can be furnished. For crane and hoisting service, series wound motors are supplied.

OLD ENGINES.—The proof of excellence for all things is service, whether it be the wise provisions of a policy which have brought desired results, or the design and workmanship of a line of engines. Allis-Chalmers engines have been in service over a quarter of a century, and yet so well are they built for their work that reports like the following are not by any means unusual. In October, 1895, a 26 in. x 48 in. Allis-Chalmers engine was erected and started for the Memphis Street Railway Company, Memphis, Tenn., which ran for 22 hours out of the 24 for six years without one cent for repairs. At the end of this period new cup leathers were furnished for the vacuum pots and they continued to run for six years more, when new exhaust valve stems were furnished and a new packing rim. The Kennedy Valve Manufacturing Company, of Elmira, N. Y., has had an Allis-Chalmers engine, 14 in. x 42 in., in service for eight years during which time it cost three cents for repairs, and the engine is in as good condition to-day as when it was purchased. The Wauconda Flour and Feed Mills, of Wauconda, Ill., have had an Allis-Chalmers Reynolds Corliss 12 in. x 36 in. engine in service 27 years, which runs quietly and gives good service every day. In the Carthage municipal light plant of Carthage, Mo., two Allis-Chalmers Corliss engines of the girder type, 16 in. x 36 in., speed 120 r.p.m., have been in service almost eight years, and are still in fine condition with almost no repairs. These engines, it is stated, have made 120 revolutions per minute every night in the year for eight years without intermission.

Weekly Record of Electrical Patents.

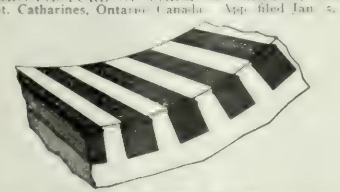
UNITED STATES PATENTS ISSUED DEC. 3, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

872,324. MAGNETIC WEDGE; S. R. Bergman, Lynn, Mass. App. filed April 10, 1907. Covers wedge devices for retaining conductors in slots in the core structures of dynamo electric machines.

872,349. MOTOR CONTROLLING SYSTEM; John D. Hilder, New York, N. Y. App. filed July 28, 1905. Motor-controlling system adapted to the operation of electric motors, particularly for hoisting motors in which the motor is frequently started, stopped and reversed.

872,351. MANUFACTURE OF CALCIUM CARBIDE, ETC.; J. Critz King, St. Catharines, Ontario, Canada. App. filed Jan. 5, 1904. The



872,324. Magnetic Wedge.

production of calcium carbide by passing it through a zone of fusion and discharging the reduced product therefrom as a pig, so that the pig is devoid of crust.

872,352. ELECTRIC FURNACE; J. Critz King, St. Catharines, Ontario, Canada. App. filed Jan. 5, 1904. Relates to modifications of the above.

872,400. ELECTROMAGNETICALLY OPERATED MECHANISM; Johan M. Andersen, Boston, Mass. App. filed Jan. 20, 1906. Relates to electromagnetically operated mechanism for effecting the operation of remote devices through a single pilot circuit.

872,432. ELECTRICAL APPARATUS; C. J. Klein, New York, N. Y. App. filed March 18, 1907. Has a push-button switch adapted for use as a molding switch and a removable connecting member, whereby the switch may be installed within a wall box.

872,474. ELECTRICAL MEASURING INSTRUMENT; W. E. Sumpner, Birmingham, England. App. filed Oct. 19, 1905. A power-factor indicator to show the phase relation between the current and voltage in an alternating-current circuit, whether it is single phase, two phase or three phase.

872,513. OIL SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed July 30, 1904. Relates to double-throw switches of the type employed in starting alternating-current motors or any other circumstances where a definite sequence of circuit connections is required; designed to prevent the making of the connections in the wrong order.

872,515. AUTOMATIC MOTOR CONTROL APPARATUS; G. H. Hill, Schenectady, N. Y. App. filed May 21, 1906. Provides means whereby the intervening device for controlling the automatic operation of a controller is made flexible, so as to automatically adjust itself to meet the requirements of different load conditions.

872,523. GRAB BUCKET HOIST APPARATUS; S. H. Libby, East Orange, N. J. App. filed March 7, 1906. Means for controlling the motors which operate the holding and closing ropes. Designed to simplify the control apparatus and render the operation of the hoist convenient and certain.

872,524. HOIST-CONTROLLER; S. H. Libby, et al., East Orange, N. J. App. filed March 7, 1906. Relates to modifications of the above.

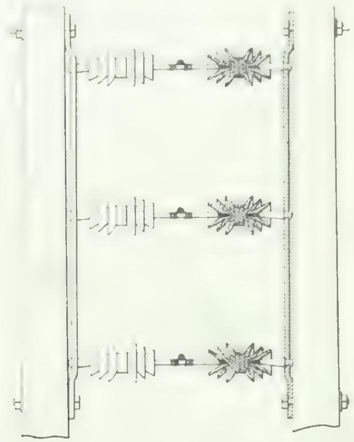
872,535. FREQUENCY CHANGER; Jakob E. Noeggerath, Schenectady, N. Y. App. filed Dec. 4, 1905. In combination, two alternating-current circuits of different frequencies, two rotary converters, one supplied with alternating-current from one of said circuits and the other supplying alternating-current to the second circuit, and electrical connections between the direct current to the other.

872,549. CURRENT-CONVERTER; Leonard Wilson, Schenectady, N. Y. App. filed Jan. 4, 1906. In combination, an inverted rotary converter, an alternating-current generator mechanically connected to said converter and having its armature in series with the alternating-current side of the converter, and means for independently varying the field strengths of both machines.

872,550. INDUCTION MOTOR; Ernest F. W. Alexanderson, Schenectady, N. Y. App. filed Nov. 9, 1905. In combination with an induction motor, means for connecting the primary winding of the motor for producing simultaneously two different numbers of poles, the secondary of said motor being arranged to offer a low resistance path for currents induced by the greater number of poles and a high resistance path for current induced by the smaller number of poles.

872,559. ALTERNATING-CURRENT MOTOR; Friedrich Eichberg, Berlin, Germany. App. filed Dec. 18, 1905. The method of operating a single-phase motor of the commutator type which consists in starting the motor by short-circuiting the armature through brushes displaced from the line of primary magnetization and supplying to the armature through brushes displaced substantially 90 electrical degrees from the short-circuiting brushes a current adapted to produce a magnetic field displaced from the primary magnetization and after the motor is up to speed bringing the armature short-circuit and primary magnetization into line.

872,563. CONTROL SYSTEM; G. H. Hill, Schenectady, N. Y. App. [illegible]



872,569.—System of Insulation for High-Voltage Electric Conductors.

motors of a system is eliminated from a circuit, the control system shall be changed so as to give the most advantageous operation of the remaining motors.

872,569. SYSTEM OF INSULATION FOR HIGH-VOLTAGE ELECTRIC CONDUCTORS; F. M. Locke, Victor, N. Y. App. filed April 9, 1907. Vertical rods are fixed between horizontal cross-arms and embody separate spool-like structures of petticoated porcelain.

872,570. RAILWAY SWITCHING AND SIGNALING APPARATUS; W. Macomber, Buffalo, N. Y. App. filed March 15, 1904. Mechanism of the type adapted to cause alternate actuation of a part by successive closures of a circuit.

872,572. ELECTRIC METER CASE AND SUPPORT; Thomas E. Murray, New York, N. Y. App. filed July 13, 1907. Provides a meter case and support adapted to prevent induced energy from being obtained without recording on the meter dial.

872,581. ALARM APPARATUS; L. W. Pennington, Worcester, Mass. App. filed Dec. 15, 1905. An apparatus for producing either an audible or visual alarm upon the movement of one of its members, which may be produced by the turning of a door knob or a similar actuation.

872,613. RAILWAY SIGNALING AND APPARATUS; F. L. Dodgson, et al., Buffalo, N. Y. App. filed Nov. 27, 1905. A train-stop device for applying air brakes if an engineer passes a danger signal, or in case of any breakdown in the mechanism or the cessation of line current.

872,623. INDICATING DEVICE; W. A. Hall, Lynn, Mass. App. filed June 6, 1906. Means for indicating the circuit conditions of an electrical transformer or regulator of the type in which certain coils or turns of the transformer are cut in or out by a rotary switch mechanism.

872,631. AUDIBLE WARNING SIGNAL FOR RAILWAY CROSSINGS; C. D. Anderson et al., Louisville, Ky. App. filed May 27, 1907. Makes use of special contact plates adjacent to the track rails and engaged by a depending brush carried by the motor trucks.

872,656. ELECTRICALLY HEATED CAN CAPPING MACHINE; M. H. Johnson, Utica, N. Y. App. filed April 5, 1907. Can capping machine in which joints are welded by an electric current.

872,670. METERING PANEL BOARD; A. C. McWilliams, Chicago, Ill. App. filed May 8, 1906. Panel boards for office buildings adapted to enable the operating electrician to connect the various consumption circuits with the supply mains or bus-bars through any desired meter.

872,674. SAFETY GUARD FOR TROLLEY WHEELS; F. J. Nolan, New York, N. Y. App. filed Nov. 26, 1906. Patentee arranges a sheet metal hood of inverted V-shape overhanging trolley wire.

872,704. MOTOR-CONTROL SYSTEM; W. J. [illegible] Motor-control system specifically adapted to "three-high rolling mills" where it is necessary to receive and support the material to be rolled.

872,708. INDUCTION-MOTOR; Bernard A. Behrend, Norwood, Ohio. App. filed Aug. 31, 1906. In a rotor, a laminated core, conductors located in said core, short-circuiting rings for said conductors, said rings having integral fan blades extending therefrom toward and into engagement with the end laminæ of the core, and means for clamping the rings and laminæ together.

872,713. SIGNALING SYSTEM; C. W. Coleman, Westfield, N. J. App. filed June 22, 1906. Provides means for actuating a signal by liquefied gas and will thus increase the number of operations of the signal that can be obtained from a given stored supply of gas.

872,720. CONTROLLER OPERATING MECHANISM; C. Fleming, Norwood, Ohio. App. filed Jan. 31, 1907. A controller for electric motors comprising fixed and movable contacts, means which, when released, tends to move the movable contact to "off" position, and two locking devices for said means.

872,724. SYSTEM OF DISTRIBUTION; E. M. Gerry, Norwood, Ohio. App. filed Oct. 19, 1905. Means for automatically regulating the field excitation of a synchronous machine in response to a change in the power factor of the circuit to maintain the power factor constant.

872,756. INSULATOR; F. C. Scherer et al., Columbiana, Ohio. App. filed Oct. 19, 1906. A two-part insulator having a ledge to receive a conductor and having a threaded cap retaining said conductor in the groove.

872,759. ELECTROLYTIC SHIP BOTTOM PROTECTOR; J. H. Schoenberger et al., Allegheny, Pa. App. filed Sept. 14, 1906. Means for electrically protecting the outside of a ship's bottom without sheathing the same, by the use of electrodes.

872,798. SIGNALING SYSTEM; C. W. Coleman, Westfield, N. J. App. filed May 1, 1906. Provides means for actuating a signal by liquefied gas that will avoid leakage of the gas and thus increase the number of operations of the signal that can be obtained from a given stored supply of gas.

872,802. TROLLEY; G. Ehmann, Canton, Ohio. App. filed June 19, 1906. The harp of the trolley wheel is swiveled on a vertical axis on the pole by a ball-bearing connection.

872,824. ELECTRIC TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed March 16, 1905. Means to translate current reversals into Morse characters and relay said characters on a second line.

872,829. ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, Bronxville, N. Y. App. filed June 1, 1903. Provides an automatic release which is adapted for the movable levers of switches, rheostats, etc., under abnormal conditions. Relates to mechanical details.

872,878. ELECTRODE; B. J. Winsom, Virginia City, Nev. App. filed Oct. 3, 1906. Relates to electro-metallurgical apparatus having positive terminals used in the precipitation of precious metals from cyanid or like solutions.

872,893. ELECTRIC DAMPER REGULATOR; J. D. Bowne, New York, N. Y. App. filed Nov. 15, 1906. Damper regulators of the type having an electric motor as the operating means, said motor being adapted to control the movement of the damper and also throw an electric switch affecting the motor circuit.

872,898. TROLLEY HARP; J. L. Chase, Ayer, Mass. App. filed July 18, 1907. The trolley harp has integral upwardly extending ears which have a function to guide the wheel against leaving the wire.

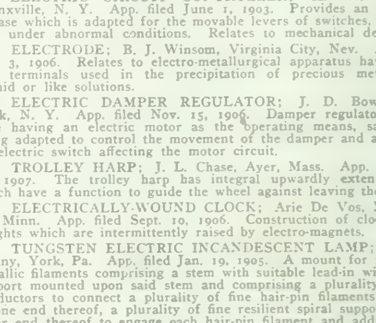
872,909. ELECTRICALLY-WOUND CLOCK; Arie De Vos, Minneapolis, Minn. App. filed Sept. 10, 1906. Construction of clock having weights which are intermittently raised by electro-magnets.

872,936. TUNGSTEN ELECTRIC INCANDESCENT LAMP; John A. Heany, York, Pa. App. filed Jan. 19, 1905. A mount for refractory metallic filaments comprising a stem with suitable lead-in wires and a support mounted upon said stem and comprising a plurality of short conductors to connect a plurality of fine hair-pin filaments in series at one end thereof, a plurality of fine resilient spiral supports at the other end thereof to engage each hair-pin filament and additional intermediate steadying means for the filaments.

872,938. SYSTEM OF CONTROL; G. H. Hill, Schenectady, N. Y. App. filed Oct. 31, 1904. System of motor control adapted for systems embodying a plurality of motors arranged to be grouped in various relations. Has means whereby the entire number of motors of the system may be grouped in series and in different ways so as to avoid supplemental resistance.

872,939. SYSTEM OF MOTOR CONTROL; G. H. Hill, Schenectady, N. Y. App. filed April 7, 1906. Relates to modifications of the above.

872,985. ART OF PRODUCING ALUMINUM AND OTHER METALS; H. S. Blackmore, Mount Vernon, N. Y. App. filed Sept.



[illegible]—[illegible] W[illegible] Clock.

23, 1904. Process of producing metal which consists in exposing a substance containing a metal and oxygen to electrolysis, while employing an electrode containing a carbide of a different metal decomposable thereby and capable of liberating the metal therefrom.

872,991. CONTROL APPARATUS; A. T. Crocker, Schenectady, N. Y. App. filed Jan. 9, 1905. Provides means for limiting and checking the movements of the controller drum in accordance with circuit requirements by means of electrically operated ratchets and detent devices acting thereon.

872,993. INSULATOR; A. S. Deem, Reading, Pa. App. filed July 6, 1907. A cleat insulator having two parts, one of which has depressions in its face, and the other of which has projections adapted to force the wire into said depressions.

[illegible] HYGROMETER FOR REGULATING HUMIDIFYING AND HEATING SYSTEMS; Stuart W. Cramer, Charlotte, N. C. App. filed Sept. 3, 1907. An automatic humidifier having a wet and a dry bulb thermometer, and electrical connections whereby differences in the mercury level complete certain circuits.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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NEW YORK, SATURDAY, DECEMBER 21, 1907.

CONTENTS.

THE MOONLIGHT SCHEDULES.

We publish this week, as a supplement, the moonlight schedules for 1908, prepared by Mr. H. W. Frund, the well-known central station manager, who has done this useful work for many years past for his fellow executives and for the public and municipalities interested. The supplement is accompanied by a brief article from Mr. Frund, pointing out one or two features worthy of note. The appreciation of these schedules is shown each recurring December by the anticipatory requests received for them, and by their adoption by the National Electric Light Association. Fortunately central stations and municipal plants of whatever size tend more and more to day circuits and operation all around the clock; but the fact remains that a vast number of city contracts are governed and determined by such schedules, and that with them as a basis a very large proportion of the lighting of American streets is done.

UNIFORM ILLUMINATION.

Elsewhere in this issue Mr. Wohlauer gives an interesting discussion of the uniform distribution of illumination over a plane. It is mainly from the theoretical standpoint and takes up somewhat extensively the question of so modifying the distribution of the illumination curves as to meet the condition of uniformity on the working plane. The polar curve of the distribution required for this condition is easily deduced, but, unhappily, it becomes asymptotic and in practice only a small portion relatively near the origin can be utilized practically. Mr. Wohlauer points out that by proper design of the reflector close approximation to the theoretical form can be reached over a fairly wide angle. One of the chief difficulties of realizing such a result in reflector design is that the sources are not point sources, and are not in practice uniformly placed with respect to the reflector owing to differences in the shade holders and in the lamps themselves. Accurately designed, reflectors are very sensitive to changes in the position of the source, and the commercial variations in this are large enough to be disturbing. Within this limitation one can get very satisfactory results. Of course, the actual distribution curve is generally made up of two superimposed curves—the free natural curve of the source, and that of the reflected radiation. In most so-called distributing shades the former is a pretty important factor in the case.

From the standpoint of economy of operation, the problem develops some interesting features. Light received at angles near the horizontal has a very small effective component, and the luminous flux is, therefore, inefficiently applied. In other words, there will be a certain angle beyond which it will not pay to go in practice in widening the distribution, however uniform it may be. Also, there is a limitation set by practical necessity, in that at large angles the flux is much more likely to be intercepted by obstacles and to come from useless directions. In a large room, lighted from numerous sources, the

practically valuable illumination comes from a very few, and a summation of the light received from the whole number is likely to lead to much larger values of the illumination than can ever be realized. As Mr. Wohlauer points out, therefore, a definite point of "cut-off" must be taken from which the illumination from one source becomes zero and the work is transferred to its neighbor. The avoidance of bad cross-shadows leads to similar limitation. In actual illumination of large rooms this is a very important matter, as is also the avoidance of the quasi-specular reflection from many surfaces at large angles of incidence. In such rooms also, lighted in the way Mr. Wohlauer suggests, the boundary conditions due to walls and windows cannot for a moment be forgotten. The effect of large unshaded windows and of dark sidewalls is very considerable, even when the general illumination is pretty uniform. These and other disturbing conditions make uniform illumination very hard to get, even when the requisite reflectors are available.

Probably the most difficult space to light properly is a counting room or school in which first-class illumination is demanded at each and every point. A uniform value of the illumination over the assumed working plane is by no means sufficient to meet the practical requirements of this case. The cross-shadows must be eliminated or modified in direction, and the sources must not be unpleasantly within the field of vision at any point. In a school the situation is simplified by the fact that the desks of all face the same way. In a counting room, the desks probably will be put in arbitrarily without the slightest reference to the position of the lamps, and no matter how strong and uniform the illumination on the assumed working plane may be, there will be complaints from people who insist on getting in their own shadows. Clerical work is likely to be done with a pen almost as fine as a crow-quill and with ink which does not write black, so that the illumination must be raised beyond the point suitable for most work. Another difficulty with both schools and counting rooms is the trouble that comes on at dusk when artificial lighting must help out or replace daylight. This usually implies a shift in the general direction of the light and also a radical change in its color. If the curtains can be drawn, the trouble from the second cause ceases, but it takes great adroitness to avoid that from the first. The change is often, however, progressive, the desks near the windows having good natural light long after those well within the room require some artificial light, and the tendency is to economize by leaving the curtains up. We mention these things to make it clear that the actual conditions of good lighting imply far more than the uniform distribution of an adequate amount of illumination. It is a very useful thing to get this, however, and we hope that Mr. Wohlauer's investigations will tend to improve the design of reflectors, especially for the more recent forms of illuminants. The line now available is good in so far as it goes, but as yet inadequate in variety.

A Directive System of Wireless Telegraphy.

The article by Messrs. E. Bellini and A. Tosi, on page 1203 of this issue, describes in a very clear and interesting manner some experiments on directive wireless telegraphy carried out between three coast stations of the French Government. At the first stage of wireless telegraphic development all efforts are turned to making the outgoing waves as powerful as possible and the incoming waves as readily detected as possible. In the stage of development already reached, there are too many waves coming from different sources, and the problem is rather how to detect the particular one desired and to suppress all the rest. It has been known for some time that electromagnetic waves coming from a given point on the horizon would be capable of affecting a pair of antennas in the line of arrival, while incapable of affecting a similar pair in a line perpendicular thereto, *i. e.*, a line parallel to the wave front. This plan has been utilized both with open and closed multiple antennas to locate the azimuth of a distant radiant. This method is elaborated in the article to the extent of employing a permanent structure of two closed receiving antennas in mutually perpendicular planes, acting on a movable secondary circuit, so as to swing about a pivot, and determine the azimuth of the distant radiant. The principal value of the experiments reported in the article lies in the quantitative measurements of the power emitted and received by a vertical closed antenna loop. It is shown that the electric and the magnetic intensities in the waves make a double circle dumbbell diagram or sinusoidal diagram, while the powers are as the products of these two components, or form a double elliptical dumbbell diagram. It is open to debate, however, whether the electrolytic receiver responds more to current than to power. It would appear more probable, from the investigations already published, that this receiver depends almost entirely on the power.

The Speed of Light.

There are two general methods known for determining the speed of light in free space. One is a direct optical method, such as the method of revolving mirrors. The other is an indirect electrical method, such as the method of determining the capacity of a condenser both in electrostatic and electromagnetic measure and taking the square root of the ratio. The indirect method has the advantage of working with instruments that are primarily independent of the human eye, but has the disadvantage, on the other hand, of involving certain assumptions as to the equality of the speed of light and of electromagnetic disturbances. The optical measurement which is generally regarded as the most precise was made by Newcomb and Michelson in 1882, and gave as the result 299,860 ± 30 kilometers per second in free space. The assigned probable error was only 30 in 299,860, or 1 in 10,000; but this applies to errors of observation, and unknown constant errors might have crept in to the measurements. The electrical or indirect measurements have been in course of execution for fifty years by many different physicists. The first result, obtained by Kohlrausch and Weber in 1856, was 310,800 kilometers per second. Since then the results have been nearer and nearer to 300,000 kilometers per second, sometimes a little more than this round number, and sometimes a little less. It has been hard to say whether the best numerical results was less or more than 300,000.

The last number of the *Bulletin* of the Bureau of Standards contains a long paper, by Messrs. Rosa and Dorsey, on a recent series of electrical measurements of this velocity v. The series appears to be the most complete and thorough yet undertaken, and involved several condensers of different forms as well as of different dimensions. The measurements were made by placing the condenser in a Wheatstone bridge, and comparing its apparent resistance against a resistance coil. If all the quantities are accurately measured at the time of balance, the only outstanding uncertainty is that of the precision of the international ohm, the absolute measure of which enters into the

result. The final result attained by Messrs. Rosa and Dorsey is 299,710 kilometers per second in free space, within an uncertainty of 1 part in 10,000, or to the same order of precision as the optical measures above referred to. We may say, therefore, that the mean of the best optical and best electric measurements, to date, for the speed of light in free space is about 299,800 kilometers per second. This number is within 60 of the optical result and within 90 of the electrical result, the optical being the larger.

It does not follow that interest should cease in the determination of the optical and electrical measurements of light speed as soon as these measurements concur to a satisfactory degree. It will always be valuable to have careful measurements of the light speed. It is quite conceivable, for example, that the electromagnetic properties of the ether may be subject to some variations either in time, or in space, or in both. In other words, we have no positive assurance that the velocity of light is absolutely the same in all parts of the universe now, or that the velocity now is the same as when the world first evolved. Perhaps it would be more wonderful if it always and everywhere remained constant, than if certain small systematic variations occurred. The solar system, as a whole, is believed by many astronomers to move in space through a distance of about a billion kilometers per annum. Consequently a series of measurements of v taken at regular intervals of time is important as forming a historical record of the properties of space traversed.

The Rolling of Thunder.

Occasionally it happens that, in a nearby thunderstorm, we see a brief vivid flash of lightning, followed very swiftly by a single, sharp peal of thunder, followed in its turn by fainter echos and reverberations of sounds reflected from earth and sky. More commonly, however, the thunder peal is not sharply defined and steadily diminishing in intensity with time. It is usually discontinuous in intensity, with sudden variations, sounding like shot rattling successively on a window pane. The echo in such cases rattles also. This acoustical phenomenon we commonly call the rolling of thunder. The phenomenon is so common that it pervades poetry, and poets who fervently invoke rolling thunder, are not supposed to be the most keen or precise observers. It has been suggested at various times that the rolling of thunder was due to reflection from discontinuous boundaries, or was an echo phenomenon. The interesting article by Mr. D. S. Carpenter, which appears on page 1211 of this number, tends to show that this is not the case; and that, on the contrary, rolling in thunder is due to the primary sounds of successive discharges or flashes. When we see a relatively prolonged lightning flash, we witness, in reality, a number of discontinuous discharges following down the same path, and the sounds of these successive explosions come to us like the rattle of a rapid-fire gun, only less rhythmically.

Many photographs of lightning flashes have been obtained, at different times, which collectively demonstrate that lightning discharges are frequently discontinuous. One such photograph, for example, appeared [illegible] for October, 1899. This discontinuity is quite different from oscillation. It is very doubtful whether long lightning flashes are ever oscillatory. As has been pointed out by several enquirers into the subject, it is probable that long lightning flashes have too much resistance in the long wire of heated air to permit of oscillation. Very short induced flashes are, for the same reason, bound to be oscillatory unless extra resistance becomes included somehow in the discharge path. A mile of arc discharge must have enough resistance, even on the most generous allowances of vapor conduction, to damp out the oscillations from the most ambitious lightning flash. If a rain cloud were highly conducting, like a sheet of metal, or even like the salt water ocean, we might expect a discharge to occur suddenly, vigorously, and once for all, until time had elapsed sufficient to generate a new electric quantity by agglomeration of rain drops. We know that when electrified water vapor particles coalesce into larger rain drops, the potential of their accumlated electric charges goes up very rapidly, and this is apparently sufficient to account for the production of lightning discharges on a large scale. But rain clouds are feeble conductors, and when the electric stress is relieved by discharge at one point, through a lightning flash, it takes time for the electric stresses to equilibrate in the cloud. In the course of a few thousandths or hundredths of a second a fresh quantity of electricity may accumulate partly by more local production of raindrops, but perhaps mainly by retarded conduction through the cloud body, until a new flash or discharge occurs through the same hole in the air or air-path; because the heat in the flash takes an appreciable time to disperse. If before the air-path has sealed off electrically, by cooling, a new charge has accumulated at the top end in the cloud, a new discharge will break through the still hot path. This process may be repeated many times, unrhythmically. If the wind blows the hot vapor path across the observer's plane of vision, the successive discharges will form to his eye a parallel multiple lightning flash. Mr. Carpenter's article shows that such flashes must be expected to produce discontinuous changes in the thunder peal, or rolling thunder.

As suggested in the article, it is very desirable that organized observations should be directed to this subject. It would be possible to employ, under a veranda, some summer night, when a thunderstorm commences, a revolving camera, geared with a phonograph, in such a manner that multiple flashes will be identified with multiple thunder peals in a manner capable of being analyzed subsequently at leisure. By employing two or more such recording stations, operating simultaneously, so as to procure records of flash and thunder at several places, the subject might be thoroughly investigated and our present theories converted into reliable experiences. The article alludes to explosion points at discharge bifurcations. This suggests another possibility as a goal to research. Perhaps nowhere do we produce so great volume-watts, or horse-power per cubic inch, of matter (air), as in a violent lightning flash. The energy in ergs per cubic centimeter of air in the path of the discharge must be great during the continuance of the flash, and the time-rate of arrival of this energy or its suddenness must also be very great. Jointly, the power in ergs per second per cubic centimeter must be enormous. This might be expected to product effects in matter more far-reaching than the steady arc, or the vacuum tube, or the electric furnace, can reveal. We might look for something more than the mere ionization of air. As a matter of pure speculation, we might look for a rupture of the very ions themselves. In other words, it would be conceivable that matter might be created or destroyed in a big lightning flash. These explosions in the path of a lightning discharge may be very valuable phenomena to analyze in the laboratory.

Death of Lord Kelvin.

William Thomson, Lord Kelvin, died at his home in Glasgow, Scotland, Tuesday evening, Dec. 17. For some months his health had been slowly but surely failing and his friends realized that the end was approaching, which was hastened by worry through an illness of Lady Kelvin. He was born in June, 1824, at Belfast, Ireland, and was the son of Dr. James Thomson, a man of remarkable ability and a great mathematician of his day. Lord Kelvin left no heir and his title becomes extinct.

Lord Kelvin will in the history of science take place with Newton, Leibnitz, Laplace and Helmholtz, and is perhaps the last in a line of philosophers in direct descent from Aristotle. In an age of specialists, he was the greatest specialist in innumerable branches of science, but nevertheless his towering

Kelvin

intellect escaped the fetters which [illegible] development and exacting specialization imposes upon its devotees. The activities of Kelvin were so great that a mere enumeration of his more important work is only practicable. As a mathematical physicist, he was one of the founders of the science of thermodynamics and the mathematical theory of electricity, and to him more than any other is due the modern development of the ether theory. For the past half century, no great question has arisen in science to which Kelvin did not give heed, and often the world waited upon his opinion as that of a final arbiter. While his fame ages hence will rest upon his purely intellectual achievements, he was perhaps best known to the world at large for his work on the transatlantic cable and the long line of apparatus he devised for scientific and industrial purposes. It was William Thomson's studies showing the scientific practicability of submarine telegraphy that brought the project of laying a transatlantic cable to a commercial stage; and it was his invention of the mirror galvanometer and the syphon recorder that placed submarine lines on a parity with land lines with respect to practical operation.

To merely catalogue in part other inventions, we have from him besides laboratory instruments for the absolute measurement of electrical quantities, the line of instruments of laboratory accuracy for industrial use; the ship's binnacle, which in a short time replaced all other forms of the mariner's compass on the ships of the world; the types of sounding apparatus for the assistance of navigation near shore and for sounding the greater depths of the ocean; and the seismograph.

Moonlight Schedules for 1908.

By [illegible]

In presenting lamp lighting schedules for street lighting work, to be used for 1908 (being the twenty-first annual publication to the readers of Electrical World), it must be borne in mind that these schedules differ from others in vogue, particularly what is usually called "The Philadelphia Moonlight Schedule," namely, "Light one half hour after sunset and one hour before moonset. Extinguish one hour after moonrise and one hour before sunrise."

It would interest many people if they knew how wide the range of variation is, in possible lighting schedules. There are at least seven standard schedules with 152 variations. There are certainly more than that extreme number of changes on which city contracts are based, a fact often forgotten by people who quote rates from one city to apply in arguments elsewhere.

The salient feature that has made "Table No. 1" popular and extensively used is the fact that it is practically an every and all night schedule at 3000 hours per annum against all night at 4000 hours per annum. Table No. 2 excells and practically made void the Philadelphia table by giving more lighting hours before midnight and dispensing with lighting after midnight, especially on the three nights immediately before full moon; making an approximate difference of 200 hours per annum, counting the Philadelphia table at 2200 hours per annum, and No. 2 table at 2000 hours per annum.

The lighting schedules for 1908 are based on mean local time as given in the calendar for 1908, and are calculated for Latitude 40° North, being nearly that of Philadelphia, and adapted to the following cities and states: New Jersey, Delaware, Maryland, West Virginia, Pennsylvania, Kentucky, Ohio, Indiana, Illinois, Missouri, Kansas, Denver, Colo., Salt Lake City, Utah, Carson City, Nev., and Tehama. Cal.

For adjoining states north or south of above the error may be 10 minutes, to be added or reduced from time given for lighting or extinguishing by this schedule.

In towns where standard (railroad) time is used, proper deductions or addition must be made. As will be noted, the schedules are grouped on the form of a supplement for regular and more convenient reference.

Southwestern Electrical & Gas Association.

An executive meeting was called to order on Dec. 4, at the office of Secretary Stichter, Juanita Building, Dallas, Tex., with President H. T. Edgar in the chair; the following members were in attendance: Messrs H. T. Edgar, Fort Worth; W. B. Tuttle, San Antonio; J. P. Crerar, Denison; J. D. Oliger, Cleburne; J. F. Strickland, Dallas; A. E. Judge, Tyler; H. M. Moore, Austin.

A communication was received from Mr. W. W. Freeman, secretary of the National Electric Light Association, New York City, suggesting closer co-operation between the various local organizations, which would tend to mutually benefit all concerned. The president, Mr. H. T. Edgar; the secretary, Mr. R. B. Stichter, and Mr. J. A. Myler, Jr., manager of the Dallas Gas Company, were appointed a committee of three to arrange for

THE ELECTRICAL WORLD'S

MOONLIGHT TABLES FOR 1908

COMPILED BY H. W. FRUND

These schedules are made up on local mean time. Where standard time is used, and it varies considerably from sun time the proper deduction or addition must be made.

JANUARY, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

FEBRUARY, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

MARCH, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

APRIL, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

MAY, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

JUNE, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

JULY, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

AUGUST, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

SEPTEMBER, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

OCTOBER, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

NOVEMBER, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

DECEMBER, 1908

Table No. 1 — Frund's Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

Table No. 2 — Standard Moonlight System

Date	Light	Date	Extinguishing
[illegible]	[illegible]	[illegible]	[illegible]

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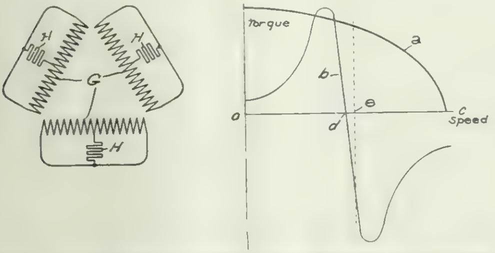
City, suggesting closer co-operation between the various local organizations, which would tend to mutually benefit all concerned. The president, Mr. H. T. Edgar; the secretary, Mr. R. B. Stichter, and Mr. J. A. Myler, Jr., manager of the Dallas Gas Company, were appointed a committee of three to arrange for

all papers to be read at the next meeting, proposed to be held at El Paso, in May.

The secretary was instructed to gather such information as directed by the president of the association, regarding taxes, both ad valorem and special; cost of street improvements, donations, etc., as would be of benefit to the association, and the executive committee requested that all members of the association give the secretary every aid possible in the procuring of this information. This information is to be compiled and filed in the office of the secretary for the future use of the members of the association only.

Induction Motor with High Starting Torque.

On Dec. 3, a patent was granted to Mr. E. F. W. Alexanderson for a high-efficiency induction motor which possesses a high starting torque. There are two primary windings, one of which is arranged for twice the number of poles as the other. The secondary is arranged to offer a low-resistance path for the currents produced by the lesser number of poles and a high-resistance path for the currents produced by the greater number of poles, as indicated in Fig. 1. The motor is started by using both primary circuits simultaneously, under which conditions the rotor is subjected to the two torques shown in Fig. 2. At the speed point *d* the torque due to the



FIGS. 1 AND 2.—ROTOR WINDINGS AND TORQUE-SPEED CHARACTERISTICS.

greater number of poles is zero, while that due to the lesser number has a large positive value; at the speed point *e* the former torque assumes a negative value just equal to the positive value of the latter torque, so that the resultant torque reduces to zero. Consequently, with a certain load, the rotor would reach a speed somewhat below *e*, the particular speed depending upon the load. It will be noted that this speed is approximately synchronous speed for the greater number of poles, so that the winding giving the lesser number of poles may be open circuited and yet the speed will not be altered to any great extent, and the motor will operate as an ordinary induction motor with a short-circuited secondary.

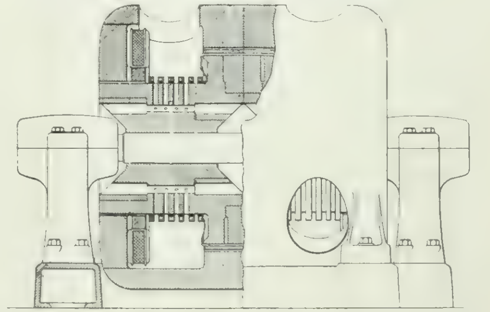
Massachusetts Institute of Technology.

At a meeting of the corporation of the Massachusetts Institute of Technology, held on Dec. 11, Acting-President Noyes presented his annual report on the progress of the past year and the larger problems of future development which the institute is facing. The membership of the faculty has been increased from 78 to 86, and the number of instructors and assistants from 121 to 124. The total registration of students is now 1410, compared with 1397 at the same time last year. The number of foreign students now forms 5.7 per cent of the whole. The three largest courses are mechanical, civil and electrical engineering, with 226, 210 and 200 students, respectively. The largest increase is in mining engineering. The average age of students entering is 18 years 11 months.

President Noyes emphasized the point that the general principles which should determine the character of the four-year course of study is a liberal education, confining the professional training to a thorough education in the principles of the fundamental sciences and in scientific methods. The aim should be, he says, to provide for specialization in the fifth year graduate course, eliminating from the fourth year curriculum the most technical branches of study. The selection of a permanent president, and the consideration of future location, new facilities and more extended summer work were also touched upon as important pending matters.

Ventilation of Unipolar Generators.

Although the armature structure of a unipolar generator revolves in a uniform magnetic field and is not subjected to eddy current and hysteresis losses and it need not be laminated, yet there are considerable losses in the conductors on the armature and at the friction surfaces of the rings, and hence the rotor must be well ventilated. The accompanying illustration shows a form of rotor construction proposed by Mr. J. E. Noeggerath, and covered by a patent issued Dec. 10. The rotor body is composed of superposed cylindrical members shaped so as to form an air chamber within the body of the rotor and provided with passages extending to the surface of the rotor. With this construction free passages are afforded



NOEGGERATH UNIPOLAR GENERATOR.

for air through the body of the rotor, and, since this air is thrown outward by centrifugal force when the machine is running, thorough ventilation is obtained. Moreover, radial passages from the air chambers within the rotor body are arranged with their outer ends adjacent to the collector rings, so as to afford efficient cooling for the rings, which in operation are heated not only by the current through them but also by brush friction.

The Demands of Architecture Upon Illumination.

One of the most interesting, and probably most instructive, papers presented before the Illuminating Engineering Society was read by Mr. Bassett Jones, Jr., at the meeting of the New York Section on Dec. 12. The paper discussed at great length the relation of architectural principles to illuminating engineering practice and showed that the illuminating engineer who considers only the scientifically practical side of the profession is necessarily doomed to ultimate failure, for he will not be able to obtain the recognition that the importance of his work deserves.

After describing the nature of aesthetic as a judgment of feeling rather than of knowledge, and giving an outline of the basis on which the feeling of the beautiful is formed, the author showed how beauty is embodied in architecture, and explained the principles of architecture.

The architect's conception of the whole arrangement must include the lighting. The light that must be provided, its tone, its intensity, its quality is a feature of his mental conception, and it is the ideal illumination that the engineer must seek to approximate. The question as to the proper location and ar-

rangement of fixtures resolves itself into the question as to [illegible] the structure, its constructive lines and the points where they originate and end—these are to be brought out in relative prominence, and to do this properly the individual responsible for the lighting must be able to discern and select these features and modify his illumination accordingly. The illuminating engineer who hopes to cope with the lighting features of architectural problems must be familiar with architecture, and particularly with the use of color in decoration; for the aesthetic value of color arrangements depends on extreme nicety of contrast, and color contrast is very susceptible to variations in tone and intensity of light, particularly at the low intensities very generally desirable from an artistic standpoint.

Mr. Jones explained that his statements were intended to apply solely to the illumination of buildings erected with due attention to the architectural beauties and not to cover spaces, such as warehouses and offices, where beauty is of no importance whatsoever.

Illuminating Engineering Society Discusses Special Street Lighting at Chicago.

The Chicago Section of the Illuminating Engineering Society had an informal meeting Dec. 12 to engage in a topical discussion of the special lighting of down-town streets. A number of the principal streets in Chicago have recently organized property owners' associations for the purpose of carrying out special spectacular lighting. The meeting was held in the breakfast room of the Grand Pacific Hotel. The discussion was participated in by Messrs. F. J. Pearson, N. R. Stansel, R. W. Bingham, J. R. Cravath, W. R. Bonham, Albert Scheible, John C. D. Clark, A. L. Eustice, L. G. Shepard, R. F. Pierce and others. The discussion was opened by an account of the engineering development of the Dearborn Street work to date by Mr. J. R. Cravath, consulting engineer for that association.

On Dearborn Street it was at first proposed to use ornamental posts supporting a cluster of globes with incandescent lamps, and the series tungsten lamp was recommended. Later a sentiment sprung up among the property owners in favor of the flaming arc lamp. The engineer's plans, as first drawn up, called for one flaming arc for every 50 lineal ft. of street, the posts being alternated. Later, for economical reasons, the lighting committee decided to recommend placing lamps alternately on every other street railway pole on each side of the street, making about one lamp to every 100 to 125 lineal feet of street. Even with one lamp for every 50 lineal feet of street, a height of 25 ft. was considered absolutely necessary to avoid excessive contrasts between the illumination near the post and the illumination midway between posts, while with the plan now under consideration of having one lamp for every 100 to 125 lineal feet of street, the contrasts in the illumination would certainly be so excessive as to produce a gloomy effect between lamps unless some scheme could be devised which would distribute the light from the flaming arc over a larger area than at present. The flaming arc, with ordinary opal globe, throws too large a proportion of its light in the vicinity of the post to produce anywhere near even street illumination. To overcome this, a method of deflecting and spreading the downward rays from the lamp had been considered, which would consist in using a hemisphere instead of a spherical globe under the arc and placing in this hemisphere a couple of conical deflectors of opal or prismatic glass, which would intercept some of the downward rays and reflect them in a direction nearer to the horizontal. Recently a simpler plan has been proposed of using a special double Holophane hemisphere for changing the distribution of light. This double hemisphere, as proposed, would have the diffusing and reflecting prisms between the inner and outer hemispheres and the two hemispheres would be sealed together dust-tight, so that the lamp trimmer would have only a smooth inner and outer surface to keep clean. It had not, [illegible] been determined definitely whether this plan would be feasible, and whether it would be used. It was felt that unless some such plan for widening the distribution of the light from the flaming arc could be adopted, the results with lamps so far apart and only 25 ft. high would be disappointing.

Mr. F. J. Pearson said that he had made some calculations on a similar street lighting proposition for a board of park commissioners and had independently arrived at the same conclusions as Mr. Cravath; namely, that to get good results, the flaming arc lamps should be placed about 50 ft. apart and 28 ft. to 30 ft. high, with poles alternated from one side of the street to the other. He believed it would be a mistake to place them as far apart as now proposed on Dearborn Street. It is also important to keep these lamps high, so as not to interfere with show-window displays.

Mr. R. W. Bingham described briefly a new inverted gas mantle burner which is to be tried for special street and boulevard lighting, the idea being to place a cluster of these on a post.

Mr. R. F. Pierce suggested that on streets lined with high buildings, such as those in the down-town district of Chicago, it is desirable to have an illumination which will bring out the impressive height of the buildings. He suggested that in order to secure the necessary height of lamps to give good distribution from the flaming arcs, they should be hung on short brackets from the buildings themselves. It was suggested by some of the speakers that the best way to determine some of these points is to make trial installations. Alderman Francis W. Taylor, chairman of the Dearborn Street lighting committee, at the close of the discussion, however, expressed himself as opposed to anything not a uniform system for lighting the down-town streets of Chicago. He thought that illuminating engineering was an exact enough science so that engineers should be able to fix upon the best system, and that then the various improvement associations should all adopt the same plan. This seems to be the idea of the various associations at the present time, as the other associations are waiting to see what Dearborn Street adopts.

December Meeting of the A. I. E. E.

At the meeting of the American Institute of Electrical Engineers, held on Dec. 3, there were presented three papers dealing with the generation and utilization of steam.

A paper by Mr. Walter S. Finlay discussed the ratio of heating surface to grate surface as a factor in power-plant design. The author stated that the above ratio has been given a fixed value based on the production of the maximum useful effect. It seems that there has been hitherto an undue subordination of total plant costs to maximum efficiency in heat transformation.

Lately, the opinion has been advanced that considerable increase in output can, without great sacrifice in economy, be obtained by proportional increase in the grate area. This idea is based upon the possibility that combustion and heat distribution and transfer could be much improved under the new conditions, when in increasing the grate area careful attention is given to details of design most conducive to these features. Other conditions being favorable, and with a belief in the correctness of this theory, a second stoker was added to each of the 18 boiler furnaces in the Fifty-ninth Street plant of the Interborough Rapid Transit Company, in New York. Such a design gave the possibility of operating within the range of the original single-stoker boiler together with the higher range of the double stoker.

The second stoker, which was installed below the mud-drum, has an area of about 80 per cent of that of the original stoker. The lower stoker is constructed practically within a so-called "Dutch oven." The two stokers can be operated with only a little more complication than existed in the single type. Tests showed that the double-stoker operation covers the entire range of the single-stoker operation and adds an increase of output proportionate to its larger grate surface, with only a slight loss in economy, and that an increase of 71 per cent in output was accomplished with no loss in economy.

The author showed that in the case of a plant costing $125 per kilowatt of equipment, including turbo-generators and boilers equipped with stokers, the following saving might be effected by the use of double grates: First cost, 19.6 per cent; total plant charges, from 5.64 per cent at 100-per cent load factor to 7.54 per cent at 50-per cent load factor. In the case of a $150 plant the savings would be as follows: First cost, 20.8 per cent saving; total plant charges, from 7.06 per cent at 100-per cent load factor, to 9.26 per cent at 50-per cent load factor. He concluded that the remarkable effect that the grate area and heating surface ratio, when furnace design is carefully considered, may have upon first cost and total annual costs of a plant, should certainly place this particular feature well up in the list of subjects for careful investigation and should make it a point of primary and fundamental consideration in advanced design.

A paper by Mr. Henry W. Wait described the results obtained with an exhaust-steam turbine plant at the Wisconsin Steel Company's Mill at South Chicago. The turbine uses the exhaust steam from a reversible engine which drives the blooming rolls. The steam passes first to the receiver which absorbs the shocks of steam, thence to the steam accumulator, and from there to the turbine and condenser.

The accumulator, or regenerator, is a very interesting piece of apparatus, and is virtually the same as the more recent Rateau regenerators built in Europe. It acts as a heavy flywheel, absorbing or giving up energy in accordance with the requirements. When the engine is running, the exhaust steam comes from the engine through the receiver and is delivered to a number of pipes immersed in the water in the regenerator. These pipes or ducts are perforated with a number of small holes, spraying the steam, so to speak, in through the mass of the water in the regenerator. A greater or less proportion of steam is condensed in passing through the water and gives up heat to the mass of water in the regenerator. It is usual to operate the regenerators at about atmospheric pressure. In other words, the steam coming to the regenerator will usually have a temperature of 212 deg. F. and will tend to heat the water to just that temperature. If the engine stops and the supply of exhaust steam discontinues, there is a large mass of water heated to 212 deg. F., and if there is a continuous load on the turbine, the flow of steam through the turbine to the condenser will tend to make the pressure fall off slightly in the regenerator, and 212 deg. F. will then be slightly above the boiling temperature of water at this lower pressure, so that the mass of water begins to give off steam and to act like a boiler running at approximately atmospheric pressure. If, now, the engine starts again, steam will be delivered to the accumulator at a temperature slightly above that to which the water has fallen, due to the cooling effect of the evaporation of the steam for supplying the turbine, and the mass of water will again absorb heat from the exhaust steam.

In actual practice it is more convenient to run the regenerator at a pressure of a pound or two above the atmosphere, as in this case the piping is not under vacuum so that so much care does not have to be exercised to avoid air leaks. However, in certain cases, it is desirable to run below atmospheric pressure. In this way the power of the primary engine may be augmented by letting it operate at a partial vacuum. Plants are actually running with a delivery pressure to the turbines as low as 6 lbs. below atmosphere. At the Wisconsin Steel Company's plant, during normal operation, the pressure ranges from about one to two pounds above atmosphere; when the engine is exhausting heavily it runs up to about three pounds. The lower limit of pressure, when the reducing valve opens, is about atmosphere.

The primary engine operates at an average indicated horsepower of 1010 when actually running; if the total energy in one hour were distributed evenly over the hour, the average indicated horse-power would be 820. The turbine is of the Rateau type, direct-connected to a continuous-current generator of the commutating-pole type. The condenser and air pump are of standard type.

During three months when the steel plant was running at nearly full rating, the turbine delivered an average of 188,300 kw-hours per month, or 51 per cent of the total possible kw-hours if run at its rated load the entire time. The operating expenses are at the following rates, based on the above output: Oil, waste, etc., 0.002 cents per kw-hour; attendance, 0.074 cents per kw-hour; maintenance and miscellaneous, 0.011 cents per kw-hour; total operating, 0.087 cents per kw-hour; fixed charges, 0.212 cents per kw-hour; total cost of energy, 0.299 cents per kw-hour.

The fixed charges are figured on the basis of a cost of $80 per kilowatt. Interest, depreciation, etc., are allowed for at 12 per cent. Nothing is allowed for superintendence, as no additional force is required for this item. The cost being made up so largely of fixed charges, it varies very markedly with the load-factor. In fact, if the plant is run 24 hours a day, the lubrication, attendance, and maintenance are affected to only a slight extent by the amount of load, so that they have almost the same effect as a fixed charge.

A paper by Mr. C. O. Mailloux gave a clear description of the Westover carbon-dioxide recorder, which is used for indicating the percentage of carbon-dioxide in the flue gases of a boiler plant, and thus serves as a means of preventing those losses of fuel which might be termed avoidable. A certain amount of gas of known volume is passed through a solution of caustic soda, after which its volume is again measured in percentage of the original. The diminution of volume is attributable to the loss of carbon-dioxide which has been absorbed by the caustic soda. The latest form of the device is automatic in operation, the mechanism being driven by an electric motor. Continuous separate records of the percentages of carbon-dioxide for any number of furnaces can be made by means of a single system of gas vessels, when the desired gas admission valves and electrically-driven recording devices are operated in the proper sequence.

DISCUSSION.

The discussion was opened by Dr. J. A. Holmes, of the U. S. Fuel Testing Department, Washington, D. C., who stated that during the 10 years from 1895 to 1905 there were consumed nearly three billion tons of coal in the United States. In the mining of this coal nearly 50 per cent was wasted, and of the coal which reached the furnaces not more than 5 per cent of the energy was converted into useful work. The supply of coal is limited, and hence the present generation should carefully avoid all wastes.

Prof. Chas. E. Lucke examined carefully the results reported by Mr. Findlay, and found equal boiler efficiencies for single-stoker and double-stoker operation for nearly equal rates of combustion per sq. ft. of grate area and not for equal quantities of coal burned per hour. He stated that the efficiencies of two boilers should be compared only on equal terms, such as equal flue gas composition. It is possible that the results reported by Mr. Findlay can be attributed to changes in the furnace operation, such as alteration in the rate of combustion or in the draft used.

Mr. Albert A. Cary discussed the various improvements that may be introduced into the construction and operation of furnaces and boilers. He stated that this large field has been only slightly entered. There is room for a considerable change in the present view of the ratio of grate surface to heating surface. Locomotive practice is far ahead of stationary boiler practice. While stationary boiler furnaces are burning from 15 to 30 lbs. of coal per hour per sq. ft. of grate, locomotives are burning from 50 to 100 lbs. of coal per hour per sq. ft. of grate, and while stationary boilers are evaporating from 3 to 6 lbs. of water per hour per sq. ft. of heating surface, locomotives are evaporating from 6 to 15 lbs.

Mr. J. P. Sparrow stated that the New York Edison Company, in conducting tests at high rates of combustion, had burned as much as 44 lbs. of coal per hour per sq. ft. of grate surface. The tests showed that while there is a falling off of combined efficiency at high rates of evaporation, the decrease in efficiency

is not serious, if the higher rate is maintained only at time of peak load.

Mr. J. E. Moultrop expressed the opinion that better results would have been obtained with the single-stoker arrangement if more coal had been used, and especially if the furnace had been re-designed with considerably larger grate area. This plan is the one that is being adopted by the Edison Electric Illuminating Company, of Boston; it eliminates the disadvantage of having two firemen working at opposite ends of a boiler.

Mr. W. F. Wells said that in the Sixty-sixth Street station of the Brooklyn Edison Company the grates were originally installed with a ratio of heating-to-grate area of 68 to 1, but recently the fronts on the furnaces were extended and grates enlarged, giving a ratio of 53 to 1. There was obtained an increased efficiency of 14 per cent.

Mr. W. T. Ray and Henry Kreisinger, of the U. S. Geological Survey, ventured the prediction that in 10 years there will be in successful operation boilers doing several times as much work as at present per cu. ft. of space occupied and per dollar invested, and perhaps simultaneously with a much higher efficiency of conversion from coal energy to steam energy. There seems to be no reason why boilers cannot be so designed as to yield several times as much steam per sq. ft. of heating surface as they now do, and with a considerable increase in economical operation, provided forced draft or induced draft is used. Mr. F. V. Hinshaw remarked that of all fields for improvement in generating station work, the most promising is the boiler plant. To accomplish the desired results, careful study of the furnace and boiler in action is required. The invention of practical carbon dioxide recording instruments has been a great help in this work. The determination of temperatures in various parts of the furnace is an important matter; and the thermoelectric pyrometer has great possibilities of value for this purpose. Instruments for steam metering are also worthy of more attention than seems to have been accorded to them by power station engineers.

In discussing Mr. Wait's paper, Mr. Francis Hodgkinson pointed out that low-pressure turbines are applicable for working not only in conjunction with non-condensing reciprocating engines in which the steam expansion is incomplete, but also in conjunction with engines designed for operating condensing. One very obvious reason for the beneficial results of low-pressure turbines is due to the large temperature drops as low steam pressures are reached, which in the low-pressure cylinder of the reciprocating engine are harmful because of condensation and re-evaporation as the cycles are reversed, which objectionable condition does not exist in the low-pressure turbine.

Mr. J. R. Bibbins stated that low-pressure turbine application resolves itself into two general classes. Firstly, those in which the turbine is unable to use exactly the same quantity of steam delivered by the primary motor, as in the case of the rolling-mill engine discussed by Mr. Wait; and secondly, those in which the turbine utilizes all of the steam from the primary motor and hence operates in some respects as the low-pressure cylinder of a compound or triple-expansion system, such as the case of a non-condensing electric unit, with which the turbo-generator may be operated in electrical parallel without the use of a turbine governor.

Tungsten Lamp Patent.

A patent issued Dec. 3 to Mr. John Allen Heaney relates to a tungsten lamp, the peculiarity of which consists in the use of a plurality of tungsten filaments in the form of hairpins in series, and each filament supported at the loop by a fine spiral spring. The application for the patent was filed Jan. 5, 1905, and the specification refers to another application filed Dec. 29, 1904, in which is disclosed the use of tungsten and other refractory materials for making incandescent lamp filaments. It is stated to be impossible to wind a tungsten filament back and forth on a spiral, as is done in the tantalum lamp; for this reason a plurality of individual filaments are connected in series by conducting supports, which, however, are of such current-carrying capacity that they remain practically cold. Since only dense and homogeneous pure tungsten filaments can be worked at high efficiency, and since such filaments have a high specific conductivity, the inventor found it necessary not only to mount a plurality of such filaments in the form of hairpins in series within the bulb, but also to make the filaments of extremely small cross-section in order that the lamp containing them may be operated upon ordinary commercial voltages, such as 110 volts. Furthermore, owing to the plasticity of the tungsten filament when in use and its brittleness when cold, means must be provided which will allow the filament to be supported without undue strain in the desired position, and this is accomplished by the use of a resilient support at the loop of the filament. The patent includes a description in much detail of the process of manufacture of the tungsten filament.

CURRENT NEWS AND NOTES.

NEW YORK LIGHTING.—Bids were opened on Dec. 10 by Commissioner John H. O'Brien for the lighting of New York City next year. No bids were received for supplying gas, but the city will pay 75 cents a 1000 cu. ft. pending the decision of the courts in the suit of the city against the gas companies. In the main the bids for furnishing electricity were the same as for the present year. Arc lamps will cost the city \$100 each for the first 5000 lamps and \$95 for each additional lamp. Eventually, when the number reaches 7000, the price of all such lamps per year will be \$95 each. Incandescent lamps will cost \$22.50 each all over the city; energy for heat and other purposes, from 7½ to 10 centts a kw-hour, and energy for motors, 6 cents. The city's light bill this year will be between \$3,500,000 and \$4.000,000.

PORTLAND, ORE., LIGHTING.—A report and estimate of expenses of the city lighting department has been submitted to Mayor Lane, of Portland, Ore., by Thomas G. Greene, D. A. Pattulo and M. A. Fleischner, of the Executive Board. It favors a municipal plant for Portland. About \$100,000 yearly is required to pay for electric light furnished by the Portland Railway, Light & Power Company. As the municipality grows, the report states, the expense of this department will increase. In view of this fact, the committee suggests that it would be well to investigate conditions, with the object of establishing a lighting plant, from power furnished by Bull Run River. The report of the committee states that Portland is a poorly lighted city at present, and recommends at least 75 additional arc lamps in various sections for next year. The contract with the Portland Railway, Light & Power Company will terminate Dec. 31, 1908, and the committee believes it would be wise to have immediate action, looking toward the erection of a municipal plant, so as to avoid renewing the present contract.

CENTRAL STATION ACCOUNTING.—Commissioner Maltbie of the Public Service Commission and representatives of the vraious lighting companies in and around New York City held a conference on Dec. 10 on the question of a uniform system of accounts and a special form of annual report. Robert A. Carter, vice-president of the Consolidated Gas Company, and Henry M. Edwards, auditor of the Edison Company, did most of the talking for the companies, while Adna F. Weber, chief statistician of the commission, aided Mr. Maltbie. It developed that the companies were anxious to agree on a uniform system of accounts, and that the National Electric Light Association had taken the matter up and appointed a committee to devise a plan. On the question of a time for making an annual report there was some difference of opinion; the commissioner favoring the middle of the year rather than the end, so that the companies' reports could be incorporated in the commission's annual report. The companies favored the end of the year, as their own reports were made up then and their books balanced, so that much extra labor would be saved. The conference adjourned, subject to call, without a decision.

DOUBLE OVERHEAD.—The local authorities of Richmond, Va., have refused to order the Virginia Passenger & Power Company to put in a double, instead of the single, overhead system, now in use, and have ordered instead the protection of the water mains, etc., by thorough and complete railbonding.

TRANSIT INSPECTORS.—The Public Service Commission in the First New York District has reported to the Civil Service Commission the appointment of 27 transit inspectors at an annual salary of $1,200. In transmitting the notice of appointments, Secretary Whitney said: "On the whole, I want to congratulate the commission upon the exceptionally good men that were turned out by this examination. The men that we have so far appointed, to my mind, are a remarkable set of men, and I know that it is an unexpected gratification to our commission that they were able to obtain good men at the salary offered."

THE GOLDFIELD STRIKE.—Advices from Goldfield, Nev., of Dec. 14, state that electricians, engineers and carpenters in the employ of the Nevada-California Power Company, all of whom are members of the local union affiliated with the American Federation of Labor, have returned to work under the agreement reached between the Federation officers and the Mine Owners' Association. This involves a 10 days' truce at the old wage scale pending the preparation of a new scale. The wife of a miner who deserted the Western Federation and returned to work was badly beaten by union pickets. She had been boarding some of the workmen and had openly expressed antipathy to the Western Federation. No arrests have been made, as only those have any right to a personal opinion in Goldfield who are in sympathy with the local despots.

DAMASCUS DYNAMOS.—A well-known American writer, Dr. Henry van Dyke, explored the oldest living city in the world, Damascus, in his recent trip in the Orient, and found it as much the "typical city of the Orient" as New York is of the Occident. It has electric lamps and trolley-cars, but, as Dr. van Dyke explains, in the January number of *Harper's Magazine,* these modern innovations no more alter its Oriental character than a bead necklace would alter the Venus of Milo. The people seem like characters out of the "Arabian Nights Entertainments," and a man was stabbed to death not 50 ft. from the author as he stood near the Ottoman Bank. Dr. van Dyke was surprised to meet so many Arabians who had been in America, and one citizen of Râshieyâ remarked: "You fellows come from America? What's the news there? Is Bryan elected yet? I voted for McKinley."

INTERESTING IF TRUE.—There have been made lately some extraordinary statements as to very long-distance wireless work, that were not afterwards confirmed. A dispatch from St. Petersburg of Dec. 11 says: "The Kiev station of the wireless telegraph line which the Russian government is constructing to connect Sebastopol with St. Petersburg, has succeeded in picking up Marconi trans-Atlantic messages, including a number of press dispatches, sent from the American side. Messages transmitted from Paris and Casablanca also have been picked up. The wireless system employed has given excellent results. Mr. Taft, the American Secretary of War, was approached while in this city for permission to install wireless communication between Shanghai and Manila. The distance from Glacé Bay, the point at which Marconi wireless messages are started for Irelnad, to Keiv, is approximately 3,750 miles."

A CONDUCTING HORSE.—It is well known that the horse is very sensitive to electrical effects, but this condition has not previously been utilized, except by jockeys and gamblers, in horse races. An ingenious device by which the horse is made a part of an electrical circuit has been reported to the War Department by Lieut. A. C. Knowles, 13th Infantry, at Fort Leavenworth, who has [illegible] to permit telegraphic and telephonic communications between mounted operators. This will permit the mounted operator to transmit messages to his base wherever necessary without stopping his horse and is accomplished by placing a small piece of copper, properly connected to the instrument, against the animal's body, thus completing a ground connection through the horse's hoof. Conversation was carried on without difficulty between two operators separated by five miles, the horses standing in the grass.

GERMAN STRAPHANGERS.—A Marconi wireless message to the *New York Times,* of Dec. 14, says: "Another American importation, after long years of opposition, has fairly fought its way into Germany—the straphanger for street-car passengers who cannot find seats. This familiar trans-Atlantic institution will be introduced for the first time on the new lines of the Berlin municipal street railway system, which has proudly announced that its cars will be of the 'latest up-to-date American pattern, including cross-section seats, reversible, according to the direction the car is traveling, with space at the rear and front where passengers may stand and hold on to straps.' Hitherto nobody has been allowed to jam his way inside a German street car after the seats have been occupied. The law fixes the exact number of six as the limit for those who may stand on the front or the rear platforms, but any conductor who allows a passenger to stand inside is subject to police fines."

LIGHTING IN RIO.—Deputy U. S. Consul-General Joseph J. Slechta writes that the completion of the large power plant which is being constructed some 40 miles from the city of Rio de Janeiro will greatly facilitate the development and extension of the electric tramway system of the Brazilian capital, and it is expected that it will also bring about an immediate reduction in the price of electric lighting, both public and private. The charge for gas is about 8.45 cents per cubic meter. Electricity for ordinary private consumption costs for lighting purposes a little more than 21 cents per kw-hour, and for motor purposes the small consumer pays as high as 11½ cents per kw-hour, the charge diminishing to a minimum of perhaps 5 cents per kw-hour. The city pays about two-thirds of a cent per lamp per hour for its gas illumination and approximately 15 cents per hour for its electric arcs. Inasmuch as the gas supply of the city is controlled by the same corporation which furnishes electricity, and which is soon to have the advantage of an economically operated power plant, there is considerable local interest as to what the new price schedules will be.

CHINESE TELEGRAPH TRAFFIC.—Special advices from Pekin state that the policy of Japan in China is threatening to bring about a new crisis in Manchurian affairs, and, as a result of the course pursued by the Tokio Government, there is danger of Russia's canceling the Russo-Chinese Telegraph Convention signed last October. The failure of China to conclude a corresponding agreement with Japan will have the effect of annulling the agreement made by China and Russia and it may result in a Russo-Japanese convention under the terms of which China will be excluded from the Manchurian telegraph traffic in the same way that the Russo-Japanese postal agreement resulted in the possession of the Manchurian postal service by these two powers. Japan has 10 telegraph stations in Manchuria in violation of the treaty, and she has also committed, it is asserted, other acts of aggression. The Tokio Government maintains that China should concede its original demands: these embrace the recognition of the stations outside the railroad zone and the independence of the entire system of communication, the waiving of telegram royalties, the recognition of the Dalny-Sasebo cable, the granting of cable rights between Dalny and Chefoo, and special rates on the Chinese connecting lines; this last is a special privilege. In connection with this dispute it is interesting to note that the powers have persistently discouraged China from expecting any intervention in the premises. China's plight in Manchuria is aggravated by the commercial distress due to the lack of Chinese currency.

DARK BORDEAUX.—Following the lighting strike at Paris, there has been a similar disagreeable experience at Bordeaux. A cable dispatch from that city of Dec. 13 says: "The city is in utter darkness as the result of a strike of gas men and employees of the electric light company, who are demanding an increase in pay. All business houses have been compelled to close at nightfall."

ST. LAWRENCE WIRELESS.—U. S. Consul Almar F. Dickson, of Gaspé, advises that on Nov. 20, the Marconi wireless stations along the northern part of the Gulf of St. Lawrence were closed until next spring, all the vessels outward now taking the southerly course, making the service needless. The five stations closed are located at Belle Isle, Point Amour, Point Rich, Point au Maurier and Heath Point, Island of Anticosti.

WEATHER AND WIRES.—A severe storm struck both sides of the Atlantic last week, and did considerable damage. In England there was a very general interruption of telegraphic and telephonic traffic and messages from London for Paris came by way of New York in large numbers, over the cable, as direct service via the Channel circuits was impossible. In America, various districts suffered also from gales and snow storms of unusual severity. At Lynchburg, Va., the Southern Bell Telephone Company had 1200 telephones out of service on Dec. 14, the electric light and street railway systems were suspended, and the region around was encumbered with broken poles and wires. In like manner telegraph and telephone wires suffered through Pennsylvania and Delaware; lighting systems were cut out in New Jersey, and around Albany, Syracuse, N. Y., and Northern New York towns, trolley lines were tied up.

CABLE BURN-OUT RECORDS.—Mr. D. W. Roper, assistant operating engineer of the Chicago Commonwealth Edison Company, gave some very interesting information in a paper before the Western Society of Engineers, at Chicago, Dec. 13, on "Unusual Burn-outs in Underground Cables." Descriptions of a few cable burn-outs of considerable magnitude were given. In some of these burn-outs, the heat of the arc spread the trouble so that several ducts were destroyed. A point of special note was made that the burn-outs from internal causes of 9000-volt, 3-phase cables per 100 miles in use have been steadily on the decrease for several years. It is also remarkable that in this 9000-volt system which has been growing steadily and now aggregates 250 miles of cable, only one internal burn-out has been caused by a bad joint. This is considered a remarkable testimonial to the skill and carefulness of the joint makers, when it is remembered under what adverse conditions they must frequently work.

UNDERWRITERS' ELECTRIC ASSOCIATION.—The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held in March, 1908, in New York City. The day and place of the meeting will be announced later. At usual, the provisions of the National Electrical Code as they now exist will be the principal matter for consideration, and it is requested that any desired change in, or addition to, the Code, be forwarded to C. W. Goddard, secretary, 55 Kilby Street, Boston, on or before Feb. 1, 1908, in order that it may be printed in the bulletin, and the committee and other interested parties may thus have opportunity to consider it in advance of the meeting. Final action on suggestions not received in season for consideration by the committee before the meeting, can only be taken by unanimous consent. As heretofore, the meeting will be open to all interested, and such persons are urged to be present and give the committee the advantage of their experience and advice.

NOVEL USE OF FLATIRONS.—The necessity arose recently in a steam power plant to replace a crank pin on the pressure side of a 500-hp cross-compound Russell engine. The new pin was 6 ins. in diameter with a taper of 1/64 in. and had to be fitted tightly into the disc, which was 5 ins. thick with a 12-in. shaft. To expand the disc by heating it with blow torches would have taken too long, besides making a dirty and unsatisfactory job. Several heating units formed of General Electric 6-lb. flatiron cores were grouped around an iron core 3¼ ins. in diameter and placed in the 6-in. hole in the crank disc. In four hours after the current was turned on the disc had expanded sufficiently to allow the crank pin to slip in. Although the heating units from the flatirons were at about white heat all of the time, they were not injured except that the brass tubing on two was slightly melted in one place. The heating units were replaced in the flatirons, and have since been in use for the last three months, one of them being in a laundry where their active service averages 40 hours each week. The man who thought of this novel and ingenious use remains unknown to fame, but with such originality ought to be "heard from again."

THE ECONOMIC WASTE OF ACCIDENTS.—A friend of the American Museum of Safety Devices and Industrial Hygiene has offered a prize of $100 for the best essay on the Economic Waste of Accidents. The committee of award consists of Richard Watson Gilder, George Gilmour and W. H. Tolman. Professor F. R. Hutton, past president of the American Society of Mechanical Engineers, is the chairman of the committee on admission of exhibits for the American Museum of Safety Devices and Industrial Hygiene, which occupies the entire fifth floor at 231 West Thirty-ninth Street, New York. The museum desires exhibits of devices and processes for safeguarding life and limb in connection with wood-working machinery, railway and marine transportation, mining and agriculture, manufacturing of all kinds. One exhibit already consists of specimens of 50 different kinds of dusts illustrating the occupational diseases; accompanying each is the photograph, a microscopic section of the lungs, showing the effect on the worker of coal, iron, brass, steel, wood and other dusts. There are also wax models of lungs and hands illustrating those occupational diseases which attack the bones and skin. All exhibits accepted by the committee on exhibits will be eligible for the gold medal offered by the *Scientific American* for the best device, exhibited at the museum, for safeguarding life and limb. All inquiries regarding exhibits should be sent to Dr. W. H. Tolman, Director, 231 West Thirty-ninth St., New York.

SERVICE COMMISSION EXPENSES.—There has been considerable criticism of the heavy expenses of the Public Service Commission of the First New York district, amounting already to far above $1,000,000 per year. Chairman Willcox says: "It must be understood that the Public Utilities Commission has assumed the duties of the Rapid Transit Commission, the Gas Commission and the State Railway Commission, so far as the latter affect this city. Printed statements of our proposed expenditures have been erroneous. Most of our payroll is, for instance, for our staff of engineers, and not for clerical work, as has been suggested. We are asking of the Board of Estimate $1,095,000, and with the $91,000 which the state will pay, we are spending $1,187,000. Now the last budget of the Rapid Transit Commission was something like $800,000, which the Board of Estimate readily granted. Our budget is $1,095,000, only a trifle more, when one considers that we have succeeded to the duties of the old Rapid Transit Commission as well as those of the Gas and State Railway Commissions. In regard to the item of $25,000 for advertising, I can only say that we must print advertisements for bids, with specifications, which require columns in the daily newspapers. We are at work now on the Fourth Avenue Subway of 23 miles, and this requires a great deal of advertising. Since the inception of the Public Utilities Board we have issued 600 orders in answer to complaints. We ask for $125,000 as extra charge for employees, and this covers the expense of inspectors to investigate complaints regarding traffic during rush hours and later in the evening."

Hydro-Electric Transmission Plant of the Rockingham Power Company.

By J. S. VIEHE.

THE site of the hydro-electric plant of the Rockingham Power Company is located on the Yadkin River at a point about 7 miles northeast of the town of Rockingham, N. C., and 16 miles north of the boundary line between North and South Carolina. With a 50-ft. dam, the total power for delivery to customers is 22,500 kilowatts 11 hours per day, as calculated from government reports. Besides this power there is a large amount available from six to nine months out of the year, which can be used in those industries where the cost of energy is of vital importance and continuous operation for the entire year is not essential. About 11,250 kilowatts is available every day in the year, known as "A" power, and 11,250 kilowatts is available 90 per cent of the time, and known as "B" power.

The market for the energy is located in a very fertile section of the cotton belt served by the main lines of the Seaboard and Atlantic Coast Line Railroads. The various towns are so located as to be economically supplied by two main transmission lines. One of these is to be carried from the power house to Wilmington, a distance of 110 miles, at which point it is expected that 5000 horse-power will be taken as soon as the plant is put in operation, and that this load will increase to 10,000 horse-power in a few years. The route of the line is near and parallel to the Seaboard Air Line track to Wilmington, thus being near all the towns on the railroad. This line is to serve the Scotland Mill 400 horse-power and the Dickson Mill 200 horse-power at Laurinburg, N. C., and about 1400 horse-power to the Dresden, Lumberton and National Mills, at Lumberton, N. C., besides the energy for lighting circuits in these towns, as well as many others located along and in the immediate vicinity of the line. The second line will have its main points of delivery at Rockingham, McColl, Bennettsville, Darlington and Hartsville, furnishing 1400 horse-power to mills in Rockingham, 1600 horse-power to the Marlboro Cotton Mills at McColl and Bennettsville, 2000 horse-power to the Darlington Manufacturing Company, 1500 horse-power to the Hartsville Cotton Mill, and 2300 horse-power to the Carolina Fibre Company, besides energy for lamp and motor circuits in the various towns. The majority of the mills are at present driven by steam, for which reason it is being found that there is a considerable demand for secondary, or "B," power, the mills using the latter being so arranged that steam power can be used in case the power company is unable to furnish electrical energy owing to low water.

The primary, or "A," power is used largely for the supply of public service corporations, who are either unable or unwilling to provide both steam and electrical equipments. A number of mills also take this energy, thus obtaining a reliable supply and enjoying all the benefits of greater production.

The general layout of the development as it will appear when completed is shown in an accompanying engraving from a lithograph which was prepared from plans to indicate the general appearance and relation of the dam, power house, head water, etc. At the point selected for the dam there is a hill on each side of the river, between which the main dam, 1420 ft. long, is carried. The dam, of concrete and large ballast stone, is 50 ft. high, 10 ft. thick at the top and 50 ft. thick at the base. The up-stream face is vertical, the down-stream side being curved to give a long toe. The dam is built in a straight line from shore to shore, and this entire length is used as a roll-away to carry off large volumes of water during freshets. The pondage will extend up-stream about 7 miles, giving an area of water of approximately 2500 acres.

POWER HOUSE.

It will be noted from Fig. 1 that the power house is not located in the main stream, but that the head-water is carried around a hill in a canal to the power house. This canal is a natural one, requiring only a small amount of excavation to give sufficient passage for the water. By this method of development, the power house is protected from floods, and in this particular case a certain amount of head is gained by reason of rapids between the dam and the point where the tailrace enters the river. At the end of this canal is placed the head-gate wall, through which the feeders for the various water-wheels are carried. Just below the head-gate wall is the power house, of brick, built on arches of concrete. The power house is designed to contain six three-phase, 60-cycle, 4000-volt, 3000-kw alternators and transformers for raising the potential from 4000 to 60,000 volts. The transformers, as well as all high-tension apparatus, are to be placed in fireproof compartments. All switches are operated electrically from a central bench-board, thus putting the entire control of the station in the hands of one man. The generator room is 260 ft. x 100 ft. and 40 ft. high, and the portion used for transformers, controlling apparatus, etc., is 160 ft. x 75 ft. and 40 ft. high with three floors. Fig. 2 shows the general arrangement. A traveling crane, running the entire length of the building and operated electrically, is to be used in installing the machinery and also in repairing apparatus.

The transformers are 1000-kw water-cooled units, three connected delta and delta forming a group for each 3000-kw generator. Normally, the station will be operated with transformer-generator units, but a tie-bus is to be provided so that the failure of a certain group of transformers will not necessarily put that generator out of commission.

The exciting current for these alternators is to be derive from three 150-kw, 220-volt generators driven by separate wate wheels.

The first installation will comprise the necessary appa for three 3000-kw alternators or one-half the contemplate

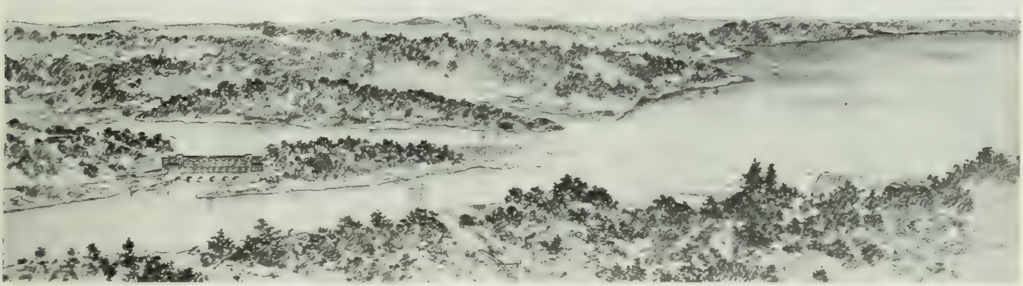


FIG. 1.—HYDRO-ELECTRIC TRANSMISSION STATION OF THE ROCKINGHAM POWER COMPANY AT ROCKINGHAM, N. C.

tion equipment. All of the apparatus will be furnished and installed by the General Electric Company. The waterwheels are of the inward-flow, turbine type, furnished by the S. Morgan Smith Company, of York, Pa. The governors will be of the Lombard type.

TRANSMISSION LINE.

The transmission system, as at present laid out, comprises a total length of line of 200 miles, being arranged in two circuits as noted, one running to Wilmington, N. C., and the other to Darlington and Hartsville, S. C. On account of the great durability of steel, and the small increased cost of steel towers over wooden poles, it has been decided to use galvanized towers throughout on these lines. The towers are of the standard windmill type, 55 ft. to the highest point, where the ground wire is attached, and 45 ft. to the lowest transmission wire. The towers are anchored to the ground by means of extensions on each post. These anchor pieces are of angle iron with cross pieces at the bottom, and are buried 6 ft. in the ground. The three transmission wires are arranged in a triangle, with 7-ft. sides, two wires being in a horizontal plane and one below. Telephone wires are to be strung on the same towers, 6 ft. below the transmission wires, and will connect the power house and all sub-stations on the high-tension line.

On level ground the towers are to be spaced 600 ft. apart, but in hilly country spans as long as 900 ft. will be used in passing from hill to hill. Great care is being used to insure a

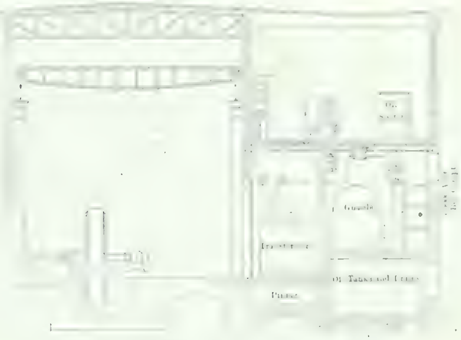


FIG. 2.—CROSS SECTIONAL VIEW OF POWER HOUSE.

certain amount of sag and give sufficient clearance above ground in spans where one support is higher than the other. With the voltage to be used on the line, 60,000 volts, No. 1 copper cable for each conductor is sufficient to carry the electricity. At each sub-station switches are to be placed in the main line by means of which the section of line between that station and the next station can be cut out. By means of these switches, in case of trouble on the line, the section in which such trouble exists can be quickly determined.

A special insulator for this line has been designed by the joint efforts of the company's engineers and the R. Thomas Company's engineers, which, judging from tests, promises to give thorough satisfaction. With this insulator, the ground cable above the transmission wires, and lightning rods on each tower, it is thought that troubles due to lightning will be reduced to a minimum. As it is sometimes difficult to get satisfactory operation of a telephone system when the wires are carried close to 60,000-volt conductors, it has been decided to use a telephone insulator suitable for 10,000-volt work which it is thought will give sufficient insulation to insure good service. At telephone stations a transformer, with secondary grounded, is to be used to protect the user from shocks from the telephone line.

SUB-STATIONS.

In each locality where energy is to be supplied a union substation will be constructed containing transformers, switches and all necessary apparatus for reducing the voltage from 60,000 to a suitable potential for distribution to the various consumers. These buildings are to be thoroughly fireproof in all respects, and are to be provided with oil pump, water pump and means for repairing transformers. On account of the necessary space required for 60,000-volt apparatus, it has been found desirable to arrange the building with two stories, the first con-

FIG. 3.—DAM IN PROCESS OF CONSTRUCTION.

taining the transformers, pumps, etc., and the second story containing both high-tension and low-tension switches, the lightning arresters requiring nearly the full height of the building. The electrical apparatus for these stations is to be furnished by the General Electric Company.

CONSTRUCTION.

The building of the complete works requires the placing of 120,000 cu. yds. of concrete and the excavation of 400,000 cu. yds. of material. Of this amount, about 60 per cent of the concrete has been placed and about 30 per cent of the excavation has been done. The method of building the dam has been by means of building crib coffer dams around each section of the dam and carrying the concrete to this section with two cables strung across the river directly over the work. Railroads built on top of the coffer dams on each side of the main dam serve to convey ballast, stone and concrete from the shore. There are also traveling derricks on these tracks which place the concrete and ballast stone. It will be noted that there are two independent methods of building, the cable method and derrick method, which together give a total capacity of 400

FIG. 4.—UP-STREAM SIDE OF DAM ACROSS THE YADKIN RIVER.

cu. yds. per day. In building the dam, sluice ways 12 ft. sq. have been left at certain intervals to carry the flow of the river when the dam is completed the full width of the stream. When it is desired to fill these holes, timber gates will be let down on the up-stream side and the work of filling in with concrete carried on from the down-stream side.

The concrete is placed in wooden forms, which are wired to the interior of the dam and removed after the concrete is suffi-

ciently hard. For getting all of the material to the site of the development, a spur track was built from the Seaboard Air Line a distance of about 3 miles. This track is owned by the Rockingham Power Company. In an undertaking of this kind the layout of the mixing plant is of great importance, for upon this very largely depends the economy with which the work is accomplished. A rock crushing plant was not required, as an abundance of good gravel is found near the railroad and hauled for about 3 miles over this track. Both sand and gravel are brought to the site in this way. At the end of the track a trestle has been built out over low ground, thus providing space for bins into which the contents of the cars are dumped. The cement is stored in sheds along the track and near this trestle. At the end of the trestle there is a small house from which cement is carried to the lower level through a chute. On the ground underneath the bins small cars are loaded with cement, sand and gravel and then pushed by hand to an elevator, which raises the material to the mixers. After being mixed, the concrete is carried to the work by cable and cars as stated.

At the power house the arrangement for storage of material is much the same as at the dam. The concrete is placed by cable, assisted by stiff-legged derricks. The cable towers are placed each side of the power house, and are so arranged that they can be moved latterly to cover all parts of the structure. About one-half of the total amount of concrete required for the power house has been placed. When the work is in full swing, a force of 1000 men, consisting chiefly of negroes, is required.

No towers have yet been erected for the transmission line, but anchor pieces have been set for approximately 40 miles of line. It is the intention to place the anchor pieces first, and allow the ground to settle before erecting the towers. The clearing is 60 ft. wide for a single line and 90 ft. for a double line. Besides this clearing, any trees which by falling would touch the wires are cut down.

The construction work is under the general direction of the Federal Construction Company, of Boston, the W. R. Bonsal Company being the builders of the dam, power house, abutments, etc. The Rockingham Power Company has its headquarters at Wilmington, N. C. Mr. M. F. H. Gouverneur is president of the company and Mr. C. E. Warner, whose office is at Rockingham, is the company's contract agent. Lockwood, Greene & Company, of Boston, have furnished general plans and specifications for the entire undertaking. The project has been financed by the Colonial Securities Company, of Boston; the Electric Bond & Share Company, of New York, and Hugh MacRae & Company, of Wilmington, N. C.

A Directive System of Wireless Telegraphy.

By E. Bellini and A. Tosi.

A CLOSED oscillator circuit, placed in a vertical plane, does not radiate equally in every direction of the horizontal plane like the open-rod oscillator, or antenna, employed in the usual wireless telegraph system. Lines of electric force detach themselves from the closed oscillator and extend to the earth, such lines being propogated chiefly in the plane of the circuit (Fig. 1); the radiation is zero in a direction normal to the plane of the closed circuit.

In consequence of this, a system which makes use of the properties of closed radiating circuits is of itself alone a directive transmitter system. Since, however, the radiation from closed oscillators is weaker than that from open ones, it was necessary to prove that, when such closed circuits are employed, the distances reached in ordinary radiotelegraphic communication could be easily attained. Further, in actually obtaining radiotelegraphic communication by the employment of closed circuits it was also desirable to make certain that the energy required was not excessive.

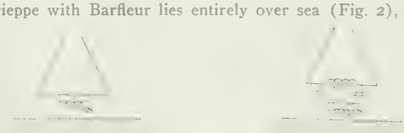
The experiments were made by the authors, thanks to the kind permission vouchsafed by the French Government, between three stations on the Normandy coast. These stations were erected in the neighborhood of Dieppe, Havre and Barfleur, each station being provided with a mast 50 meters in height. Since one mast only was used to sustain the closed radiating circuit, this latter was given a triangular shape (Fig. 3) in place of the circular form of Fig. 1. The symmetrical sides of the triangle were formed of a trellis of nine parallel copper strands, spaced 20 cm apart, each strand consisting of seven wires 0.9 millimetre in diameter. The distance between the upper ends of the trellis forming the armatures of the condenser was 2.5 metres; that between the lower extremities, ending at 2 metres from the ground, about 55 metres. The conductors of the trellis were all joined together at the base, and two wires of the same strand of the trellis served to make connection with the apparatus.

FIG. 1.—CLOSED RADIATING CIRCUIT.

FIG. 2.—MAP OF TRANSMISSIONS.

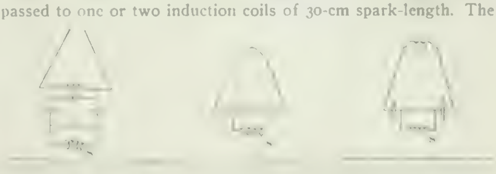
FIG. 3.—TRIANGULAR RADIATING CIRCUIT.

The distance between the Dieppe and Havre stations is about 90 kilometres; that between Dieppe and Barfleur about 170 kilometres. The angle enclosed between the directions Dieppe-Havre and Dieppe-Barfleur is about 23 degrees. The line joining Dieppe with Barfleur lies entirely over sea (Fig. 2), while the transmission Dieppe-Havre has to pass over land the whole way; in consequence, Dieppe can be considered as being radiotelegraphically equidistant from Havre and Barfleur.



FIGS. 4 AND 5.—DIAGRAMS OF ARRANGEMENT FOR EXCITING OSCILLATOR CIRCUIT.

Dieppe was chosen as the transmitting station and Havre and Barfleur as receiving stations. The energy for the transmission was supplied by a storage battery, the current from which, broken by a mercury interrupter of the Foucault type, passed to one or two induction coils of 30-cm spark-length. The receiving stations were equipped for the reception with a Ferrié electrolytic detector connected to an ordinary vertical antenna and to earth.



FIGS. 6, 7 AND 8.—DIAGRAMS OF ARRANGEMENT FOR EXCITING OSCILLATOR CIRCUIT.

Closed Oscillator Circuit at the Transmitter.

Figs. 4 to 8 represent diagrammatically several arrangemen which have been used for exciting the closed oscillator circ of the transmitter, the plane of which was placed in the direc

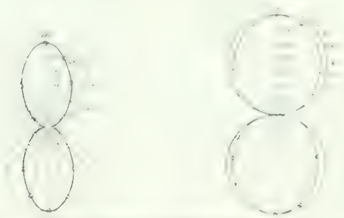
[illegible] kind of transmitter circuit was used, the receiving station was always able to get the signals sent by the Dieppe station; but the arrangements which have given the best results are those shown in Figs. 5 and 6. On turning the plane of the transmitter circuit around its vertical axis the strength of the reception diminished to zero, the limiting angle naturally depending on the strength of the transmission and the sensitiveness of the receiving apparatus. But when the plane of the transmitter circuit was perpendicular to a line from Dieppe to the receiving station, the reception was always strictly zero.

The power employed in the course of the experiments in no case exceeded 500 watts; with the arrangements as shown in Figs. 4, 7, 8 the amount used was considerably less than this.

The energy diagram, *i. e.*, of the quantity of the energy radiated relatively in the different directions throughout any chosen period of time, was traced while the arrangement shown in Fig. 6 was used for the transmission 1. For the reception, a 30-metre vertical wire was erected at a distance of 500 meters from the transmitter, and joined to a Duddell thermo-galvanometer, one terminal of which was earthed. The observations were made in the following manner:

The transmitter circuit was turned through a definite angle, the first position being in the direction of the thermo-galvanometer and the last at 90 deg. from this.

Fig. 9 is the diagram of the energy emitted in the different directions, while the diagram shown in Fig. 10—of which the *radii vectores* are the square roots of the vectors of the energy



FIGS. 9 AND 10.—ENERGY DIAGRAMS.

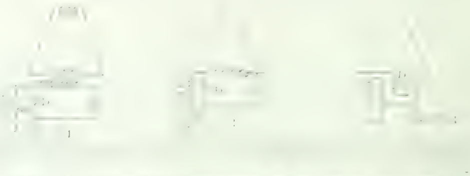
diagram of Fig. 9—is that of the electromagnetic field intensity in the different directions; it is formed of two equal tangent curves which approximate closely to two circles. As a result, owing to the unavoidable errors and the small distance at which the observations were made, it can be said that the diagram of electromagnetic field intensity is composed of two tangent circles, and the energy diagram of two curves whose equation is $I = I_{max} \cos \alpha$.

It is impossible to say from *a priori* considerations which of these two diagrams should be considered for the determination of the variation in the transmitter effect according to the position given to the transmitter; this depends exclusively on the receiver. If this latter responds to the total energy received (as the bolometer, thermo-galvanometer, thermo-couple) it is the energy diagram (Fig. 9) which should be chosen. If, on the other hand, the receiver responds to the maximum intensity of the electromagnetic field (coherer and, probably, magnetic detector) the diagram to be applied is that of the electromagnetic field (Fig. 10). Finally, should the receiver be responsive partly to the total energy and partly to the maximum of the electromagnetic field, a diagram of form intermediate between the two diagrams previously considered would represent the conditions; and probably the electrolytic detector falls under this last classification.

Closed Oscillatory Circuits for the Reception.

A radiotelegraphic transmitting station creates an electromagnetic field which at a great distance is composed of vertical lines of electric force and horizontal lines of magnetic force. An oscillatory circuit, placed vertically in the field produced in this way, will be influenced in a different manner according to the angle which its plane makes with the direction of propogation of [illegible] magnetic fields depend, the one upon the other, it will suffice to examine the influence of either one of these fields; let it be the action of the magnetic field.

If the plane of the receiver circuit be perpendicular to the direction of propagation, the magnetic flux which is enclosed is always zero, and hence the induced e. m. f. is also zero. Conversely, if the plane of the receiver circuit is in the plane of



FIGS. 11, 12 AND 13.—DIAGRAMS OF RECEIVING CIRCUITS.

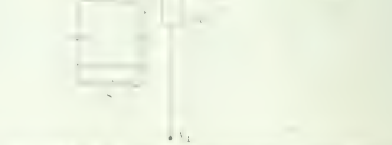
communication, the variation of the magnetic flux reaches a maximum; and in consequence there is a maximum of the induced e.m.f. In intermediate positions the e.m.f. varies according to the cosine of the angle which the direction of propagation of the waves makes with the plane of the closed oscillatory receiver (resonator) circuit. It follows that the diagram of the e. m. f. induced in a closed oscillatory circuit should be formed of two tangent circles; the energy diagram should be the same as that of Fig. 9; the diagram of intensity of reception will be either one or other of the two according to the type of detector used, as previously pointed out.

In order to see if in practice these theoretical predictions

FIGS. 14 AND 15.—DIAGRAMS OF RECEIVING CIRCUITS.

could be realized a series of experiments on the reception was made at the stations of Havre and Barfleur, at both of which the aerial was a closed oscillatory circuit; the Dieppe station transmitted with the ordinary vertical antenna.

At the receiving stations the experiments were from preference made with the arrangements shown diagrammatically in Figs. 11 to 15, always with satisfactory results. The reception attained its maximum when the plane of the receiver circuit was in the plane common to the transmitting and receiving



[illegible] APPARATUS.

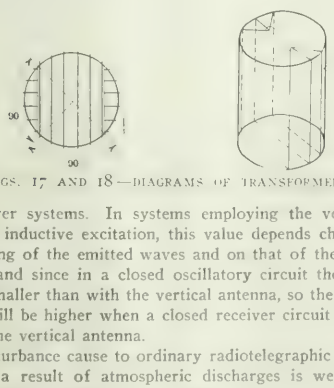
stations; the reception was zero in the direction at right angles to this, and intermediate at intermediate positions.. In some cases a very small angular displacement of the plane of the circuit, with reference to the most advantageous direction, was sufficient to annul the reception.

In reception with a closed circuit it is not possible to fix the limiting angle at which reception is possible; this depends at the same time partly on the intensity of the electromagnetic field and partly on the sensitiveness of the detector employed. With increase of either of these factors the angle of reception increases; and under the same conditions of intensity of electromagnetic field and of sensitiveness of the detector, if a detector be employed which is responsive to the maximum amplitude of the oscillations, an angle will be obtained which is greater than that obtained when a detector which responds to the total energy is used.

The diagram of received energy was made in the same way as that of the energy radiated by a closed oscillatory transmitter circuit. The aerial of the receiver station, at a distance of about 2 kilometers from the transmitter, comprised a closed oscillatory circuit similar to the one already referred to. The Duddell thermo-galvanometer was connected to the closed circuit in the manner shown in Fig. 15. On turning the closed circuit around its vertical axis of symmetry the Duddell gave at each position a deflection proportional to the energy received.

The diagram obtained in this manner is practically identical with that of the transmission shown in Fig. 9. As a result, in the case of the reception also, the conclusion can be drawn that the diagram of the electromagnetic field utilized is represented by two tangent circles; and that the diagram of the energy is formed of two tangent curves represented by Fig. 10, and the equation of which is $E = E_0 \cos^2 a$.

In wireless telegraphy, in order to allow of as many communications as possible and of the individual independence of the stations, considerable use has been made of syntony. The degree of syntony depends upon the damping of the transmitter



FIGS. 17 AND 18—DIAGRAMS OF TRANSFORMER.

and receiver systems. In systems employing the vertical antenna and inductive excitation, this value depends chiefly upon the damping of the emitted waves and on that of the receiving antenna; and since in a closed oscillatory circuit the damping is much smaller than with the vertical antenna, so the degree of syntony will be higher when a closed receiver circuit is used in place of the vertical antenna.

The disturbance cause to ordinary radiotelegraphic communication as a result of atmospheric discharges is well known; closed oscillatory circuits are, however, owing to their properties of syntony and directivity, much better protected against atmospheric discharges than is the case with systems using the vertical receiving antenna.

Closed Oscillatory Circuits for both Transmission and Reception.

After having experimented with closed oscillatory circuits separately for the transmission and for reception, a series of tests was carried out between Dieppe, Havre and Barfleur, using exclusively the closed oscillatory circuits both at the transmitting station (Dieppe) and at the receiving stations (Havre and Barfleur).

On suitably orienting the transmitter circuit and regulating the emitted energy, a point was reached where it was possible to send signals at will to either one of these receiving stations without the other one receiving any signals. The reception was quite regular and satisfactory at the two receiving stations, with a maximum of 500 watts employed for transmission.

The results obtained in this way demonstrate that, although the employment of closed oscillatory circuits necessitates the expenditure of a somewhat greater amount of energy than is required with the ordinary systems with vertical antenna, this energy is in no way excessive. It is certainly not exorbitant if the conditions in localities like the English Channel, where wireless telegraph stations are numerous, are taken into consideration.

In these regions, where the adoption of a dirigible system is imperative at present, the ordinary stations use an amount of energy which considerably exceeds what is required. This is done with the object—which each station endeavors to accomplish—of making its own transmission prevail over that of the other stations.

With the employment of closed oscillatory circuits and the same amount of energy the disturbances to radiotelegraphic communication could be, if not entirely eliminated, at least almost completely overcome. The extra energy employed would be compensated in other directions—in the diminution of the damping of the emitted waves and by a syntony much superior to that of the ordinary systems. The experiments made by the authors have demonstrated still further the marked immunity which a closed receiver circuit enjoys as regards transmissions emanating from other stations.

Although in employing the closed circuit at Havre and Barfleur no other signals were received besides those of Dieppe, when the ordinary antenna was used, signals were received from other stations on the English side, or from ships navigating the channel. In the course of these same experiments confirmation was obtained of the great reduction made possible in the effects produced by atmospheric discharges.

Variation of the Direction of Communication.

The system of wireless telegraphy which has just been described presents certain real advantages when it is a question of effecting communication in one invariable direction; but when the direction of communication has to be varied the matter becomes rather complicated from the mechanical point of view. In reality there are two methods which at once suggest themselves as possible means for realizing such a variation. The first method consists in turning the aerial about its axis of symmetry until its plane is in the direction of the desired communication; but this—apart from the mechanical difficulty of such a proceeding—occasions a great loss of time, so that in no case could a good radiotelegraphic service be carried out in this way. The second method is that of equipping the station with several equal circuits, spaced at equal angular distances from one another, and using only that circuit which points in the desired direction. This arrangement, however, necessitates the employment of numerous circuits if a sufficiently close approximation is required; and the presence of several circuits, one close up to the other, may cause trouble as regards the emission of waves. The employment of either of these arrangements thus presents serious inconveniences. It was therefore desirable to find a means of varying the direction of communication which should not require the rotation of the circuit and also not complicate the aerial arrangements at the station.

The solution of the problem has been arrived at by the authors, and consists in the employment of two closed circuits, situated in two vertical planes at 90 deg. to one another, and special apparatus now to be described.

Taking first of all the transmission for consideration: if either one or other of the circuits be excited, the transmission takes place principally in the plane of the circuit so excited. If, however, both circuits be excited simultaneously, the transmission takes place mainly in an intermediate direction, the orientation of which depends upon the intensity and phase relation of the two excitations. As a result, an apparatus which is capable of continuously varying the intensities and phase difference is one which will allow the direction of emission of the waves to be varied.

Several forms of apparatus have been experimented with, but the best results have been obtained with the following: For inductive excitation the apparatus is diagrammatically represented by Fig. [illegible] An [illegible] transformer T provided with two secondary windings at right angles to one another (m_1, n_1), each winding being connected to one of the closed oscillatory

circuits. The primary of the transformer (S_1), internal to the secondaries and joined to a capacity of the spark-gap, is movable on its vertical axis. Owing to this arrangement the excitation of the two circuits depends upon the angle which the plane of the primary winding makes with the planes of the two secondaries; that is to say, with the planes of the two aerial circuits. On turning the primary through 360 deg. the transmission itself is rotated through 360 deg.

In order that the angular displacements of the transformer primary and of the direction of transmission shall always be maintained equal, the transformer has been constructed as indicated in Figs. 17 and 18.

The two secondaries consist each of ten turns of stout wire wound round a cylinder, perpendicular to its ends, of which one is shown in Fig. 17; these windings cover the whole external surface of the cylinder, each one extending over one-quarter of the circumference; the cylinder is hollow internally. The primary is wound around another smaller, coaxial cylinder, perpendicular to its ends in a similar way and also occupying one-quarter of the circumference; at the upper end the windings are radial (for mechanical convenience), those at the lower end diametral. The cylinder is of a size such that it will conveniently go inside the larger cylinder on which the secondaries are wound.

The primary winding consists of a single turn of three wires in parallel, spaced as shown in Fig. 17, and of the same wire as is used for the secondaries.

For direct excitation the arrangement employed is shown in Fig. 19. A continuous spiral is wound on a toroid; four points of this winding, at the extremities of two perpendicular diameters, are connected in a fixed manner to the four extremities of the two aerial circuits. The spark-gap and the capacities (symmetrically arranged) are joined to the two movable contacts on the toroid, maintained invariably at 180 deg. from one another. In shifting the movable contacts the intensities and phases of the excitation of the two circuits are varied, and in consequence the direction of transmission is varied. The two instruments have been used separately for transmitting from Dieppe to either Havre or Barfleur.

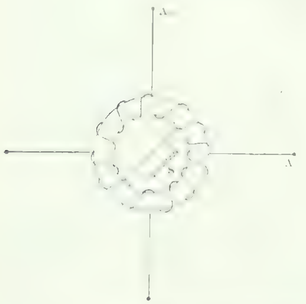


Fig. 19.—Arrangement for Direct Excitation.

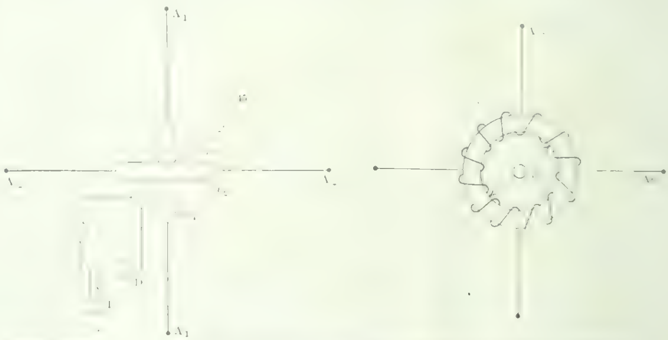
Turning now to the reception, the arrangements here are similar to those for the transmission, as is shown diagrammatically in Figs. 20 and 21, where the apparatus (R) for the reception are connected—as in the case of the transmission—to the two closed circuits, which are at 90 deg. to one another.

In considering Fig. 20, the difference between this and Fig. 16 consists in the following: (1) substitution of the detector for the spark-gap; (2) the secondaries of the transformer of Fig. 16 are the primaries of the transformer of Fig. 20; (3) the primary of Fig. 16 is the secondary of Fig. 20. Still dealing with Fig. 20, it can be seen that when the two closed circuits are encountered by the waves emitted by the transmitting station, each primary winding produces a magnetic field of intensity proportional to the e. m. f. of the closed circuit to which it is connected; the resultant field will have the direction perpendicular to the transmitting station. As a result, when the plane of the movable secondary of the transformer is at right angles to the resultant magnetic field, this plane coincides with that of the transmitting station and the reception will be at its maximum; on displacing the movable secondary coil from its position of maximum reception the latter diminishes down to zero. It can be seen, therefore, that by the use of this arrangement it is possible to receive signals whatever the direction of the transmitter; that is to say, it is possible to vary at will the direction from which the reception shall be permitted.

If several transmitting stations are working simultaneously, the receiving station equipped with the apparatus here described will receive the signals from the station with which it wishes to communicate without being troubled by other transmissions. Finally, the position of maximum reception of the movable coil indicates the direction of the transmitting station (the radiant point). In this way and with this apparatus the bearings of quite a number of wireless telegraph stations in the channel have been determined. The practical realization of the receiving apparatus has been effected in following the same principles which have been applied in the transmitting apparatus, so far as the cylindrical surface provided with windings is concerned. A special tuning device for the receiver has been adopted so as to allow of adjustment for different wave-lengths.

The authors only commenced this investigation a short time ago, and for this reason the system is doubtless capable of undergoing further improvement.

Although the experiments were carried out with the aid of provisional apparatus, on account of the modifications continually being introduced, nevertheless the results obtained have been decisive and such as to enable a successful future for the system to be forecasted.



Figs. 20 and 21.—Diagrams of Receiving Arrangements.

Multiple Wire Windings.

By Charles R. Underhill.

Windings for various electrical purposes often consist of several wires wound simultaneously, the wires forming separate circuits, or with their terminals connected together to act as one conductor. When the wires are grouped as one circular strand, the winding is more effective than when the wires are wound on side by side in the form of a ribbon, owing to the greater pitch in the latter case.

It is well known that, all other things being constant, the winding having the highest efficiency will contain the greater number of turns for a given resistance; but a piece of wire having a given resistance may be so arranged in a corresponding winding space that there will not be one effective turn. The non-inductive resistance coil is one example, but to suit the purpose of this article we will consider an iron core wound longitudinally and uniformly with insulated wire. It is apparent that the turns in this case are not effective for magnetizing the core longitudinally, in the ordinary sense.

In an ideal case the conductor would be at right angles to the longitudinal center of the winding, as in Fig. 1, but in all practical windings, and particularly in the multiple-wire type, there is a tendency of the conductors to incline toward the longitudinal center of the winding. This inclination depends upon the diameter of the turn, the diameter of the insulated

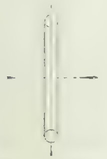


FIG. 1.—IDEAL TURN.

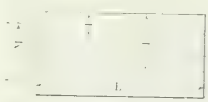


FIG. 2.—DIMENSIONS OF WINDING.

wire, and the number of wires wound simultaneously side by side. It is important always to consider the inclination of the average turn, as the inclination is greater for the inner turns, and less for the outer turns, as compared with the diameter of the turn.

The volume of an ordinary winding in the form of a hollow cylinder may be expressed, $V = \pi MLT$ (1). The dimensions of M, L and T are indicated in Fig. 2. The resistance which

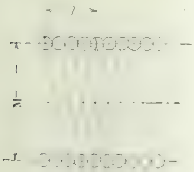


FIG. 3.—FOUR WIRE WINDING.

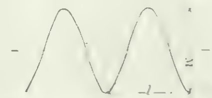


FIG. 4.—PITCH WHEN $l = M$.

may be contained in this winding volume is proportional to the ohms per unit volume for the wire.

In an ideal case the number of turns, N, would be determined by $N = \frac{TL}{g^2}$ (2), where g is the diameter of the insulated wire; but while (2) may hold near enough for many cases in practice, it is important to consider the inclination of the turns, referred to above, when dealing with certain cases. Referring to Fig. 3, the inclination of the turns of a four-wire

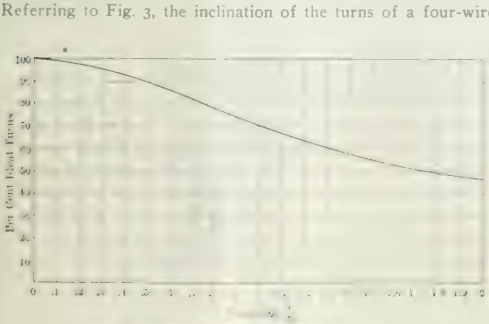


FIG. 5.—[illegible]

winding will be appreciated. In this case the number of turns cannot be calculated directly by (2), but the ratio, r, may be determined by $r = \frac{M}{(n^2g^2 + M^2)^{\frac{1}{2}}}$ (3), where n represents the number of wires side by side [illegible] (3) becomes

$$r = \frac{M}{(g^2 + M^2)^{\frac{1}{2}}} \quad (4)$$

(4) also holds for any type of winding.

The number of turns in any winding of this type with any number of wires and with any pitch is

$$N = \frac{rTL}{g^2} \quad (5)$$

Substituting the value of (4) in (5),

$$N = \frac{MLT}{g(l^2 + M^2)^{\frac{1}{2}}} \quad (6)$$

When $l = M$, the pitch would appear as in Fig. 4. When M is as great as compared with l, the ratio, r, will be near unity, but when l is greater than M, r has a low value. In Fig. 5 is shown the percentage of turns for various ratios of l to M, the resistance remaining constant.

There are other conditions affecting the turns, as, for instance, the imbedding of the wires, but as this is very slight in actual practice, for the smaller sizes of silk and cotton insulated magnet wires, it has been neglected in this article.

The Uniform Illumination of Horizontal Planes.

By Alfred A. Wohlauer.

It has been demonstrated in several text-books on illumination (for instance, in "Practical Illumination," by Lansingh and Cravath) that the illumination thrown on a horizontal plane from a light-giving source can be calculated by means of the equation

$$I = \frac{C_p}{h^2} \cos^3 a \quad (1)$$

where

I = foot-candle illumination on surface

h = perpendicular distance, in feet, from lamp to surface

a = angle between ray and perpendicular

C_p = candle-power in a given direction.

For uniform illumination

$$I = I_0$$

a constant value; and, therefore, the equation of the polar curve or the photometric curve for the light-giving body is

$$C_p = [illegible] \quad (2)$$

This gives a curve such as represented in Fig. 1, and as derived recently by E. W. Weinbeer, in *Elektrotechnischer Anzeiger* [illegible].

Thus it follows that in order to obtain a uniform illumination on a horizontal plane with one lamp, it is necessary that the

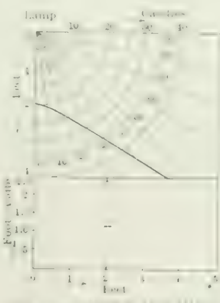


FIG. 1.—[illegible]

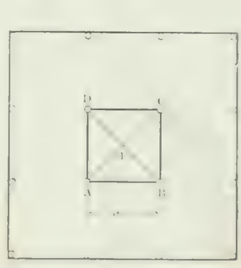


FIG. 2.—HORIZONTAL PLANE [illegible] UNIFORMLY ILLUMINATED.

lamp with or without reflector shall have a polar curve of the shape represented in Fig. 1.

Heretofore very little consideration has been paid to these relations in the construction of the lamps or in the design of reflectors. For this reason a coincidence of the above theoretically correct curve with actual lamp curves is merely accidental

* [illegible]

and is realized only for a small angle. This is apparent from the curves published so far, and, in many instances, the use of the reflector destroys the effect which the lamp itself might have produced.

The area of uniform illumination with one lamp is limited, as it is not practicable to design lamps or reflectors so that their polar curves will follow indefinitely the theoretical curve shown in Fig. 1. At some point the curve has to depart from the theoretical course. It is, therefore, impracticable to illuminate uniformly with a single lamp a greater area than one enclosed by an angle of, say, 25 degrees for incandescent lamps and 50 degrees for arc lamps. We can uniformly illuminate, for instance, a table or a desk with one incandescent lamp only when the angle of uniform illumination covers the area of the plane in question.

In order, therefore, to illuminate uniformly larger areas, a number of lamps must be employed and so arranged, and with polar curves of such a shape, as to produce the desired effect. The problem of these relations is discussed in what follows, and for sake of simplicity light reflected from walls and ceiling is neglected.

The area to be illuminated, for instance, a large square horizontal plane, as shown in Fig. 2, may be divided into a number

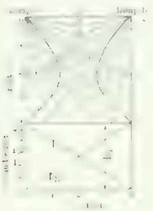


FIG. 3.—UNIFORM ILLUMINATION ALONG THE LINE AB.

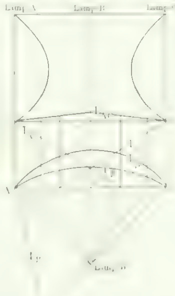


FIG. 4.—ILLUMINATION ACROSS THE DIAGONAL AC.

of squares. At each intersection a lamp is placed at a certain distance above the plane, preferably suspended vertically downward and provided with a reflector. The polar curves of the lamp units will have to be such as to produce a uniform illumination for the whole area.

In order to simplify the matter, at first only the space between two lamps, A and B, will be considered and the conditions studied existing in a vertical plane through two lamp centers along one side of a square (Fig. 2). The problem thus involved is to illuminate uniformly the line AB on the plane by the lamps A and B above it.

The simplest way of effecting this is indicated in Fig. 3, where the illumination curve of each lamp has its maximum equal to the desired uniform illumination, I_0, just below the lamp and inclines in a straight line to zero just below the other lamp. It is obvious that such a combination gives a uniform illumination along the line AB.

If d = distance of lamps,

h = perpendicular distance in feet from lamp to surface or height of suspension,

I_0 = desired illumination,

α = angle between ray and perpendicular,

C_p = candle-power in a given direction,

then it can easily be shown that the equation for the illumination curve is: [illegible]

$$[illegible] \qquad (3)$$

and [illegible] formula (1)

$$[illegible]$$

therefore,

$$[illegible]$$

the equation for the polar curve of a lamp in the present case.

Such a curve is plotted in Fig. 3 for $h = 4$, $d = 4$, $I_0 = 2.5$, and gives a general idea of the simplest form of a polar curve for uniform illumination of horizontal planes with a number of lamps.

The relation

$$\frac{d}{h} = K$$

is of importance and deserves consideration. For reasons of practicability, as previously mentioned, the area of uniform il-

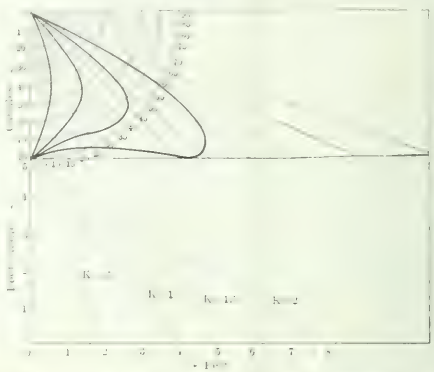


FIG. 5.—SHOWING POLAR CURVES OF LAMPS SUSPENDED EQUALLY HIGH, BUT AT VARYING DISTANCES, YIELDING THE SAME UNIFORM ILLUMINATION.

lumination with one lamp was limited, and similar considerations demand here that the factor K should not exceed values which cannot be realized in practice. Fig. 5 indicates how the polar curves change for different values of K, if I_0 and h are constant. In my opinion, a value of $K = 2$ is hardly practicable, and K having a value of about 1.5 may be considered as the limit of practicability.

In engineering problems of illumination, K may be kept constant and d and h varied in the same ratio. Using then the same polar curve, different intensities of illumination can be obtained; or changing the candle-power of the illuminant the

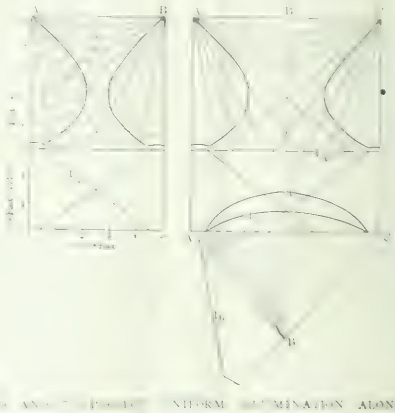


FIG. 6.—ANOTHER [illegible] UNIFORM ILLUMINATION ALONG THE DIAGONAL.

scale of the polar curve must be a different one. However this may be worked out, it is evident that the two lamp units with such polar curves produce a uniform illumination along the line AB between the foot of the perpendiculars of the plane; four of them, A, B, C *and* D, uniformly illuminate the outline of the square $ABCD$ (Fig. 2).

The point of intersection of the diagonals, E, however, would

receive somewhat higher illumination, since the illumination due to one lamp will be at this point

$$\frac{I_E}{4} = .2925\ I_o,$$

as can be easily determined. For uniform illumination, however, this value should be

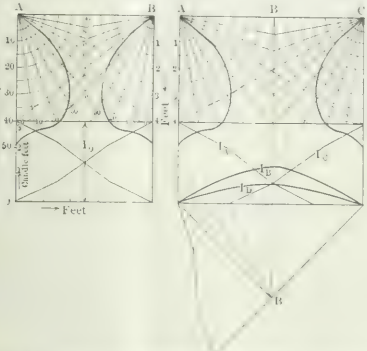
$$\frac{I_E}{4} = .25\ I_o$$

due to the fact that of the total illumination contributed by four lamps, each gives 25 per cent.

The four lamps actually produce an illumination in E

$$I_E = 1.17\ I_o$$

i. e., 17 per cent more than the desired uniform illumination. The illumination along the diagonal AC varies as graphically



FIGS. 8 AND 9.—ANOTHER METHOD FOR UNIFORM ILLUMINATION.

determined and indicated in Fig. 4. The variation is comparatively small and could be neglected in view of the light reflection from the walls and ceiling. It is, however, possible to produce a still more uniform illumination, if the illumination curves due to the light of an individual lamp have a shape as indicated, for instance, in Fig. 6.

In some cases, as, for instance, where a room with low ceiling is to be illuminated, and where the available lamps are of too high a candle-power, it may be necessary, in order to obtain the desired illumination, to place the lamps further apart.

The distance, d, between two lamps may then become so great that the light thrown from one lamp towards the other would not illuminate the area below the next lamp if the factor K is kept within the limits of practicability. In such cases the individual lamp alone must yield uniform illumination for an area just below the lamp, or in other words, the polar curve must conform with the law established above and expressed by equation (2) for an angle corresponding to this area. Beyond that angle the illumination curve may practically again be assumed as inclining in a straight line and passing through zero, where the uniform illumination of the next lamp sets in, as indicated in Fig. 6.

Thus the illumination curve, as well as the polar curve, consists of two parts, the equation of which may be omitted as too complicated for practical use. Such a combination, however, will enable perfect uniform illumination over the whole area.

If we denote

a = the radius of area uniformly illuminated by one lamp,

ϕ = angle for this uniform illumination measured between ray and perpendicular,

then the value

$$a = h\ tan\ \phi$$

subject to the same limitations as discussed above for the uniform illumination with one lamp, must be

$$a = .085d$$

in order to secure the desired illumination I_o at E, the point of intersection of the diagonals.

This can be easily derived mathematically from Fig. 7, which

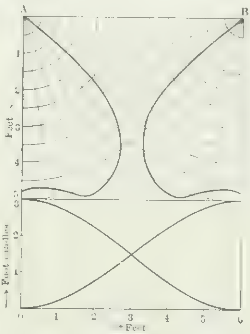
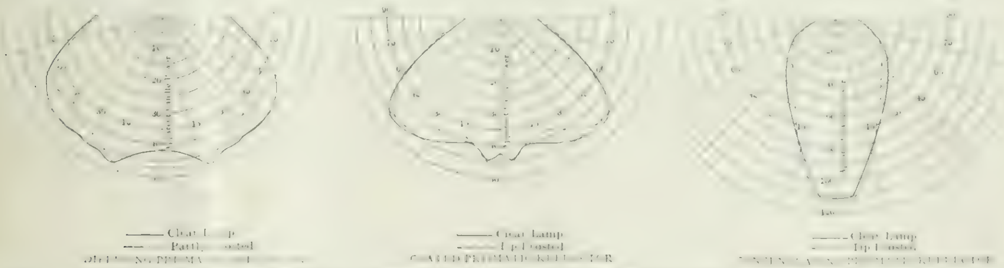


FIG. 10.—GENERAL CASE.

graphically shows that in such a case the illumination is practically uniform over the whole area. The curves I_b and I_d indicate the light thrown from the lamps B and D on the diagonal AC.

It is beyond the scope of this article to discuss in detail these graphical constructions and mathematical determinations as represented, for instance, in Figs. 4 and 7. They could be made the subject of a special paper and are used here only to assist in the proof of the statements.

There are other means to effect uniform illumination, some of which are indicated in Figs. 8, 9 and 14; they are, however, still more complicated, and their equations rather unhandy for practical use.



FIGS. 11, 12 AND 13.—DIS[illegible] LIGHT IN VERTICAL PLANE ABOUT A [illegible]-WATT [illegible] LAMP [illegible] BY HOLOPHANE REFLECTORS AND A PRISMATIC REFLECTOR.

The general case of an illumination curve yielding uniform illumination is represented by Fig. 10, which can be expressed by the equation

$$[illegible] \qquad (5)$$

where d = distance between two lamps

[illegible] distance from lamp abscissa

c = a constant to be determined in every individual case, [illegible] equal 0, [illegible] illumination curve is a straight line.

Substituting, according to Monasch*, for equation (2)

[illegible]

pose, the general equation for a polar curve would be

[illegible] (6)

from which all the possible ways of uniform illumination could be derived.

We have demonstrated that in order to illuminate uniformly large horizontal planes a number of lamps must be employed and their light so distributed that the lamps in their combination produce uniform illumination. The different possibilities have been theoretically discussed and a conception has been formed as to the shape of the polar curves.

It now will be interesting and useful to observe to what an extent the theoretical requirements are fulfilled in practice. To this end a number of tests were made by the Electrical Testing Laboratories under my personal direction.

An up-to-date illuminant, a 40-hefner candle "Just" tungsten lamp, was selected and tested under a number of different conditions, as unfrosted, tip-frosted and entirely frosted, and in connection with a number of reflectors. The same lamp was used for all the tests, the distance from the photometer kept constant, etc., so that the clearest insight into the prevailing conditions was gained.

A few of the results of the tests are reproduced in Figs. 11 to 13. In Figs. 14 to 16 three of these experimental curves are supplemented by curves obtained from theoretical considerations. The experimental curves are in full line, while the theoretical curves are dotted.

The comparison reveals that it is reasonable to expect that uniform illumination of horizontal planes can be realized in practice, in accordance with the laws derived above. The deviations are slight, the greatest occurring at the upper end, which is due to the fact that the illumination curve of one lamp passes through the zero mark where the maximum illumination of the next lamp sets in. This necessitates that the polar curve must return to zero also. In other words, no light should be emitted in the horizontal direction, or in the case of incandescent lamps, reflectors must be used so designed that all the light is utilized below the lamp in accordance with the theoretical requirements discussed above. Therefore, if it is desired to illuminate the upper parts of a room, the lamps must be placed at the proper height.

It is interesting to note further that the distance, *d*, between two lamps could be made the same in all three cases which have been selected in order to compare theory with practice. It shows that the same number of lamps are used to illuminate the same area, the variation being only in the height of the suspension and in the intensity of illumination. Or, in other words, it is possible in practice also, to vary the intensity of uniform illumination by simply changing the reflectors and the height of suspension. It verifies also the recognized fact that the higher the lamp is suspended above the surface, the less the illumination obtained thereon; concentrating reflectors are required for a higher suspension, while for low-ceiling rooms more diffusing reflectors are necessary.

For high suspension—high being a relative term with regard to the candle-power of the lamp—and for concentrating reflectors, the illumination curve is always a straight line, while for rooms with low ceilings one often is compelled to introduce the more complicated illumination curves if small lamp units are not available or too expensive in their total cost.

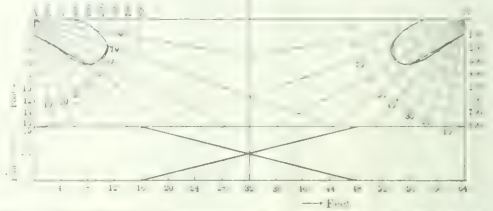
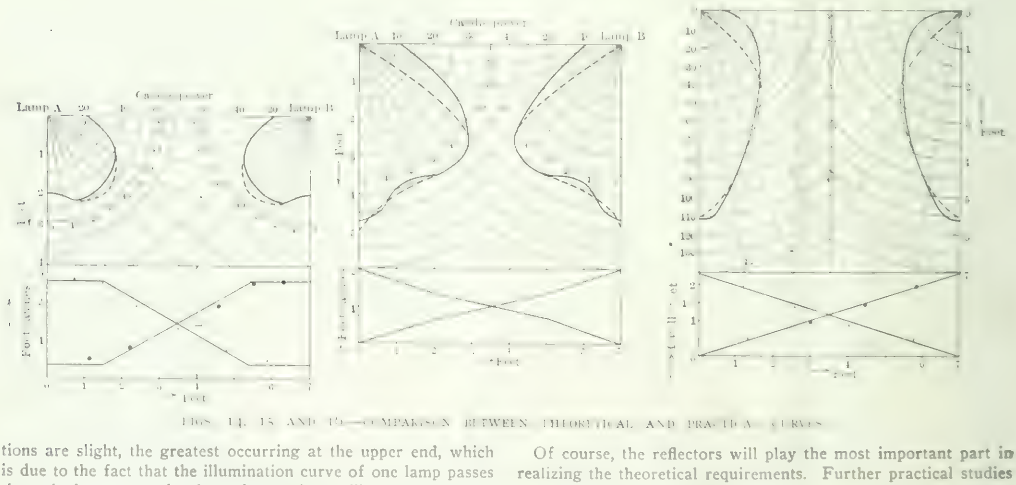


Fig. 17.—Uniform Illumination by Two Enclosed Arc Lamps.

Otherwise the tests show that it is possible to meet the theoretical requirements with the existing sources of light fairly well. This is demonstrated here for the tungsten lamp; a comparison with other lamps, for instance, Nernst lamps with U-shaped filaments and tantalum lamps, etc., would reveal that the conditions are equally promising.



Figs. 14, 15 and 16.—Comparison between Theoretical and Practical Curves.

Of course, the reflectors will play the most important part in realizing the theoretical requirements. Further practical studies are being made along this line in order to effect the desired results in a more systematic way.

In conclusion it will be interesting to call attention to the uniform illumination of very large areas, such as streets, public squares, etc., by arc lamps especially adapted for that purpose. The enclosed arc lamps, for instance, curves of which are shown in Fig. 17, taken from Monasch's book, are not very far from realizing the theory in an ideal way. Fig. 17 shows that with the lamps suspended 20 ft. from the ground and placed 64 ft. apart, an almost ideal uniform illumination will be obtained at a height of 4 ft. above the ground.

*E. Monasch "Elektrische Beleuchtung," 1906.

The Rolling of Thunder.

By D. S. Carpenter.

THE rolling of thunder has generally been attributed to the fact that the different portions of the path which the lightning discharge traverses are unequally distant from the point of observation. As the intensity of sound varies inversely as the square of the distance of the source from the observer, and as the various points of the path which become in turn the source of the sound are unequally distant, in the case of a uniform single discharge, the sound would gradually

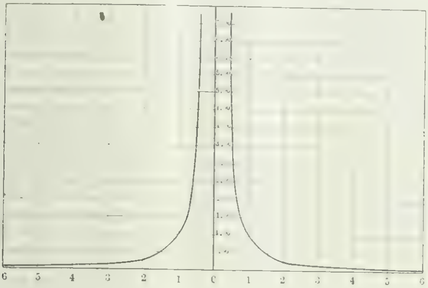


FIG. 1.—LOCUS OF EQUATION $y = \frac{1}{x^2}$

decrease in intensity as the sound waves from the more remote portions of the path of the discharge reach the ear. This view must necessarily require that the transitions be gradual, and that there be none of the extremely abrupt changes in the sound which are so characteristic of thunder. But lately much time has been devoted to the study of the phenomena of lightning, and information has been gained which throws much light on the character of the lightning flash.

Photographs of lightning taken with a moving camera show that the lightning flash is made up of several discharges or rushes which follow one another in quick succession and pass over practically the same path. It is evident that some of these discharges must be of much greater magnitude than others, and that the intervals of time intervening between them must vary greatly in length.

Dr. Waller, of Hamburg, has secured some very interesting photographs of lightning discharges, employing a camera mounted on a vertical axis and rotated at a uniform rate by clockwork. These were taken from a small cabin erected on the roof of a high building. This cabin was provided with windows on all sides, so that an unobstructed view of all parts of the sky was obtained. These photographs show that the lightning flash is composed of several individual discharges. The time intervals between these discharges, calculated from the movements of the apparatus, were very irregular. On his photographs, the first and last discharges appeared to be the brightest. The time intervals between the discharges obtained

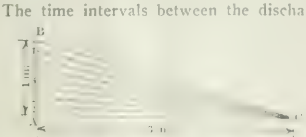


FIG. 2.—RELATIVE POSITIONS OF FLASH AND OBSERVER IN THE CASE OF THE FLASH FROM LINE TO GROUND.

in one flash of six discharges were .131, .068, .075, .119 and .103 seconds, respectively.

Mr. Alex Larsen, of Chicago, has also obtained some very fine photographs of lightning with a moving camera. The "Annual Report of the Smithsonian Institution" for 1905 contains a very good account of his work. His photographs also represent the lightning flash as composed of several separate discharges, as many as 40 being counted in one flash. He estimated the duration of this flash of 40 discharges as .624 second. A marked difference in the magnitude of the individual discharges which compose the flash is clearly shown by all these photographs.

Fig. 2 of the above report illustrates this point. This flash consists of 14 discharges. Two heavy discharges, separated by a short-time interval, occur at the beginning of the flash. These are separated from a third heavy discharge by an interval of about a fourth of a second, during which no discharges are apparent. The remainder of the flash is composed of discharges of much less intensity.

Prof. Trowbridge, of Harvard University, has apparatus

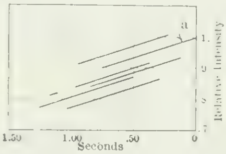


FIG. 3.—RELATIVE INTENSITY AT THE POINT OF OBSERVATION OF THE SOUNDS OF THE INDIVIDUAL DISCHARGES THROUGHOUT THEIR WHOLE EXTENT.

with which he is able to produce a difference of potential of 3,000,000 volts, obtaining sparks 7 ft. long. These sparks exhibit some of the characteristics of lightning discharges. Side discharges and brushes occur at the points where the discharge branches. He has also shown that a phenomenon of an explosive character occurs whenever a powerful spark forks, and concludes that there is an explosion at each point where the lightning discharge forks. It is true that at certain points in its path a phenomenon of the nature of an explosion occurs. The records of the instances where persons have been struck

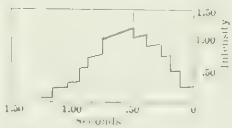


FIG. 4.—INTENSITY OF SOUND OF THE THUNDER AT EACH INSTANT.

by lightning clearly indicate that there is an explosive effect where the discharge leaves the body. Many cases have been recorded where the shoes and stockings have been blown off the feet. It is somewhat difficult to explain this phenomenon. He thinks that these explosions may be one of the causes of the rolling of thunder. It seems probable that the sound of these side discharges and explosions would appear as iregularities only in the sound, and would not be of sufficient magnitude to produce a very great increase in the loudness of the sound,

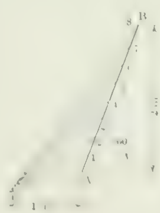


FIG. 5.—RELATIVE POSITIONS OF FLASH AND OBSERVER IN THE FLASH FROM CLOUD TO CLOUD.

except very long branches as to a cloud or to ground, which must be treated as individual discharges in the immediate vicinity of the main discharge.

Tesla has produced sparks said to be 70 ft. in length with Tesla coils, but these discharges have characteristics quite different from lightning.

These researches show that the lightning flash is composed of several discharges. Accepting this view, the rolling of thunder can be explained as follows: If we let y represent the

intensity of the sound and x the distance from the source to the point of observation, the relation between intensity and distance is given by the equation $y = \frac{1}{x^2}$.

For simplicity we will consider the discharge as uniform throughout its length, as variations due to lack of uniformity, forking, etc., in general produce only slight irregularities in the curve representing the relative intensity. This curve is shown in Fig. 1.

The rate of change of the slope is $\frac{d^2y}{dx^2} = \frac{6}{x^4}$. As the distance to the source of the sound increases, this very quickly assumes a very small value. This means that if the flash is quite distant, the variation in the distances of the various portions of the path from the point of observation will have little effect upon the intensity and loudness of the sound.

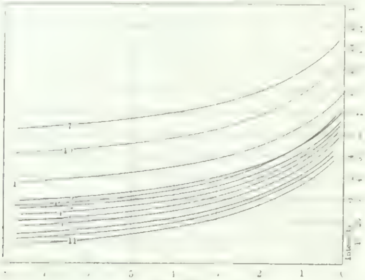


FIG. 6.—RELATIVE INTENSITY AT THE POINT OF OBSERVATION OF THE SOUND OF THE INDIVIDUAL DISCHARGES THROUGHOUT THEIR WHOLE EXTENT.

This curve is the locus of the equation $y = \frac{1}{x^2}$. The branch to the left of the axis of ordinates applies to Fig. 2, where the source of sound is represented as to the left of the observer. Where the source of the sound is represented as to the right of the observer, as in Fig. 5, we would use the branch to the right of the axis of ordinates.

Considering all the available data, the probable value of the velocity of sound is 331.7 meters per second at 0 deg. C. The temperature at the time of year during which thunderstorms

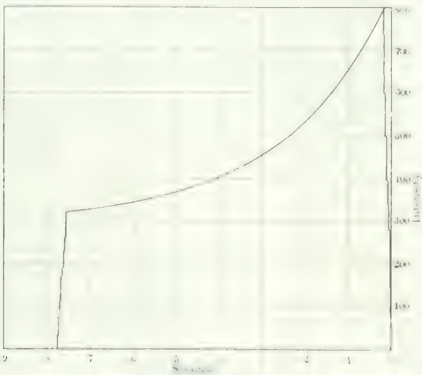


FIG. 7.—INTENSITY OF THE SOUND OF THE THUNDER AT EACH INSTANT.

prevail may be taken as 32 deg. C. Correcting the velocity of sound for this change in temperature by means of the formula

[illegible]

we obtain a velocity of 350.67 meters, or 1150.5 ft. per second.

To develop the theory, we will choose the simplest possible case and assume that the flash takes place from cloud to ground, the discharge being one mile long, and striking the earth three miles from the observer, we would then have the conditions represented in Fig. 2. As the distance of B, the most remote portion of the path, is only .162 mile greater than that of the nearest point, A, assuming the velocity of sound as 1150.5 ft. per second, the report from a single discharge will be only .745 second long. Assuming K as the intensity of the sound from A, and assuming that the discharge is uniform for simplicity, we can easily calculate the relative intensity of the sound from the various points of the path and draw the corresponding curve. The variations due to lack of uniformity, etc., will then be apparent. The discussion of these will be taken up later.

We will let the abscissas represent the time it will require for the sound from the various points to reach the observer at C, after that from A reaches him. Dividing AB into eight equal parts, and making our calculations, we get the values given in Table I. Plotting these values, we get curve a, Fig. 3, for the first discharge of this flash.

For

[illegible]

$x = -3.162 \frac{dy}{dx}$ [illegible]

From this it is seen that there is only 36 minutes between the tangents at the beginning and end of curve a, Fig. 3. So curve a, Fig. 3, will appear as a straight line in the figure.

I

	[illegible] Miles	[illegible] Intensity	[illegible] Sound to Reach C after [illegible] Reached It.
CA	[illegible]	000 K	.0000 Sec.
[illegible]	[illegible]	[illegible] K	.0046 "
C2	[illegible]	[illegible] K	[illegible] "
[illegible]	3.023	.984 K	.1058 "
[illegible]	[illegible]	[illegible] K	.1886 "
[illegible]	3.064	958 K	.2944 "
[illegible]	[illegible]	[illegible] K	[illegible] "
[illegible]	[illegible]	[illegible] K	[illegible] "
C8	[illegible]	900 K	[illegible] "

We will assume that the flash is composed of six discharges separated by the time intervals given by Dr. Waller, and also that the ordinates of the points at the beginning of the curves represent the relative intensity of the sounds from A for the various discharges. Combining the curves in Fig. 3, we get the curve in Fig. 4.

For a more general case, we will assume the conditions represented in Fig. 5, considering the flash as a discharge from cloud to cloud. The point A is one mile from the observer at C, and the flash, AB, is two miles long. Making our calculations as before, we have Table II.

II

	Length Miles	Relative Intensity	[illegible] Seconds for Sound to Reach C after Sound from A Has Reached It.
CA	[illegible]	1.000 K	.000 Sec.
[illegible]	[illegible]	[illegible] K	.665 "
[illegible]	[illegible]	[illegible]	[illegible] "
[illegible]	[illegible]	[illegible] K	2.414 "
C4	[illegible]	.333 K	[illegible] "
[illegible]	[illegible]	[illegible] K	[illegible] "
[illegible]	[illegible]	.210 K	[illegible] "
[illegible]	2.411	.172 K	6.47 "
[illegible]	2.646	[illegible] K	7.55 "

The report from a single discharge is 7.55 seconds long.

Assuming that the flash is composed of 12 discharges separated by the time intervals .0338, .0026, .0156, .0130, .0117, .0221, .0078,

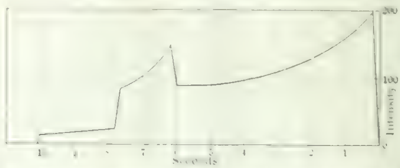


FIG. 8.—INTENSITY OF THE SOUND OF THE THUNDER AT EACH INSTANT WHEN THE SOUND FROM A SECONDARY DISCHARGE IS SUPERIMPOSED UPON THAT OF THE MAIN DISCHARGE.

.0117, .0091, .0065 and .0065 second, and that the ordinates of the points at the beginning of the curves in Fig. 6 represent the relative intensity of the sound from A for the various discharges, we can plot the curves in Fig. 6 for these dis-

charges. Combining these curves we get the curve in Fig. 7.

From the curves in Figs. 4 and 7 we see that the report from a lightning discharge increases in intensity with great rapidity and reaches a maximum value in an extremely short interval of time. It then diminishes very rapidly at first, then gradually, then very rapidly to a zero value. The irregularities occurring in the first and last portions of the curve, where the curves in Fig. 6 begin or end, would probably not be apparent to the ear, except in the case of flashes at a short distance from the observer.

Very often secondary discharges occur, due to the release of charges when the first flash occurs. The sounds from these will reinforce those from the first flash, as the secondary discharges will take place in the vicinity of the first, generally, giving rise to another maximum. In this case the curve would have a second peak, as shown in Fig. 8.

Having given the photograph of a lightning flash with a moving camera, the distance to one end of the flash, its length and relative position with respect to the observer, a curve representing the relative intensity of the report from beginning to end can be drawn, and by getting a record of the report with suitable apparatus at the time of the flash, much light would be thrown on the nature of the flash. Great care would be necessary in recording incidental circumstances.

Torque Analysis of Induction Meters.

By A. R. DENNINGTON.

Measuring instruments based on the induction principle are extensively used on alternating-current circuits, and a study of the production of the torque is, therefore, not unwarranted.

In the induction type of ammeter and voltmeter use is made of the so-called "shading coil," which is merely a conductor of

FIG. 1.—INDUCTION AMMETER OR VOLTMETER, FLUX IN AIR GAP

very low resistance surrounding a part of the cross-section of the magnetic circuit.

In Fig. 1, assume that N and S are the two poles of a magnetic circuit fitted with shading coils, A and B. Consider that the magnetic flux is a maximum in the direction indicated by the arrows and begins decreasing. At the instant the flux is a maximum no current will flow in the shading coils A and B and the density will be nearly uniform all over the pole faces. As the magnetism begins to decrease, a current is induced in the shading coil, which tends to oppose the change and hence to

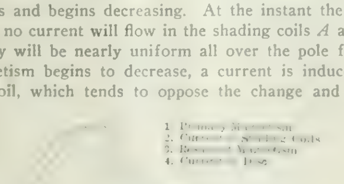


FIG. 2.—CURVES OF MAGNETISM AND INDUCED CURRENTS

cause the magnetism included by A and B to lag behind. As the magnetism in the main circuit passes through zero the currents in A and B reach their maximum values, and consequently there is an appreciable flux threading through these coils in the direction indicated. As the magnetism through the main circuit reverses and begins to increase in value in a negative direction, the flux included by A and B decreases and reaches a zero value when the m. m. f. of the exciting coils is great enough to neutralize that of the induced currents in the shading coils. The flux through the shaded section then begins to build up in a negative direction, but this tendency is opposed by the induced currents. At the maximum value of the flux the shading coils have no effect, but the magnetism in the shaded sec-

FIG. 3.—RELATION OF INDUCED CURRENT AND MAGNET POLE, UNSHADED SECTION INDUCING CURRENT IN DISC.

FIG. 4.—RELATION OF INDUCED CURRENT AND MAGNET POLE, SHADED SECTION INDUCING CURRENT IN DISC.

FIG. 5.—RELATION OF INDUCED CURRENTS AND MAGNET POLE, UNSHADED SECTION INDUCING CURRENTS IN DISC.

tion reaches a maximum slightly later than in the unshaded portion because of the effect of hysteresis and the magnetizing action of the induced currents building up more rapidly than the magnetism begins to decrease. This is shown in Fig. 2, as are the various curves of magnetism and current.

When the flux in the primary circuit is passing through zero

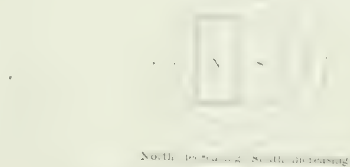


FIG. 6.—RELATION OF INDUCED CURRENTS AND MAGNET POLE. ZERO TORQUE

in a positive direction, as shown in Fig. 3, that which is affected by the shading coils has a negative value; hence the current in the disc will have a tendency to strengthen the reverse field and react upon it so as to receive a side push in the direction of the arrow. This continues until the magnetism in the shaded portion is reversed and becomes an increasing north pole. The rate of increase in the shaded section will be greater than in the unshaded section for a part of the cycle because the magnetism in the unshaded part is nearer its maximum value, and hence is not on as steep a part of the curve; the conditions shown in Fig. 4 will, therefore, exist, and there will be a thrust in the direction indicated. After the flux reaches its maximum value and begins to decrease, the conditions shown in Fig. 5 will exist.

When the magnetism in the unshaded portion reaches zero

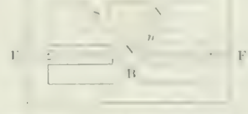


FIG. 7.—MAGNETIC CIRCUIT OF INDUCTION WATT-HOUR METER

and begins to reverse, the rate of change is greater than in the shaded portion, the current induced in the disc is a maximum, but the field on which this current reacts is getting near the zero value, and there comes an instant when the rate of charge of the two fields is equal and opposite, $a\,b$, Fig. 2, and at this instant the torque drops to zero. These conditions are

shown in Fig. 6. The torque drops to zero twice in each cycle, [illegible]

In order to compensate for the increase in permeability, and thus maintain a nearly uniform scale, the inductor is made of a spiral shape. As the magnetic density increases, the radius at which the force acts is shortened and the area of the plate under the pole is reduced so that the resultant torque is made proportional to the current.

In the induction watt-hour meter the shading coils are un-

FIG. 8.—RELATION OF INDUCED CURRENTS AND POLES FOR FIRST QUARTER OF CYCLE.

FIG. 9.—RELATION OF INDUCED CURRENTS AND POLES FOR SECOND QUARTER OF CYCLE.

necessary because the flux set up by the pressure coils and that set up by the current coils may be made to differ in phase, and thus give a shifting field.

Let *N* and *S*, Fig. 7, represent projections on the frame of the meter which carries the current coils. The coils on these projections are wound in opposite directions so that the instantaneous polarities are opposite. The projection *B* is to carry the pressure coil. It will be necessary to secure a magnetism in *B* out of phase with that in *N* and *S* in order to obtain a reaction between the induced currents and the fields to cause a rotation of the disc in a given direction. The pressure coil on *B* will have a high inductance, so the magnetism will lag nearly 90 deg. in time phase behind the pressure across the terminals. This pressure, however, in the main circuit is what causes the current to flow and if the power-factor is unity, the current and magnetism of *N* and *S* will be in phase with the pressure.

Assume the current in the exciting coils of *N* and *S* to be a maximum and that the power-factor of the circuit is unity. The magnetism in *B* will be changing at its greatest rate, and hence will have its zero value. At this instant there will be currents induced in the disc, due to the pole *B*, and these will react upon the poles *N* and *S* so as to urge the disc toward the right. As the magnetism in *N* and *S* decreases, the flux through *B* will increase, causing a north pole to be formed at *N'*, and this becomes a maximum when the values of *N* and *S* pass through zero. As the current in the exciting coils of *N* and *S* reverses, the value of *N'* decreases and reaches zero when *N* and *S* have reached a maximum in a reverse direction. The action throughout one cycle is given by Figs. 8, 9, 10 and 11. In these figures the eddy currents are shown around the stronger poles only. The flux from the pole set up by the pressure coil will add to the flux to or from that one of the poles due to the series coils which has opposite polarity. The markings of the poles *S* and *N* in Fig. 7 have been reversed in Figs. 8 to 11, inclusive, because the pole *N'* is shown on the same side of the disc as *N* and *S* for the sake of clearness.

Regulation is accomplished by means of one or more perma

FIG. 10.—RELATION OF INDUCED CURRENTS AND POLES FOR THIRD QUARTER OF CYCLE.

FIG. 11.—RELATION OF INDUCED CURRENTS AND POLES FOR FOURTH QUARTER OF CYCLE.

nent magnets which act as magnetic drags by setting up eddy currents in the moving disc. The currents induced are proportional to the speed of the disc and hence, as the field is constant, the retarding force is directly proportional to the speed. There is, however an I^2R loss due to these currents which increases as the square of the speed and this has a tendency to increase the retarding action. The relative effect of friction is reduced for the loads giving a high torque, and this is usually sufficient to counteract the effect of the loss mentioned above.

The finer adjustment is usually made by means of coils which may be arranged to include more or less of the magnetic circuit or to have greater or less effect by change in resistance. When a short-circuited coil is placed so as to include the lines of force, it causes the magnetism to lag, and in this manner a perfect adjustment may be made so the meter will register correctly with loads of different power-factors. With non-inductive load, the flux in series and shunt magnetic circuits should differ by 90 deg.

As shown in Figs. 8 to 11, inclusive, the torque on the disc is due to the reactions of the induced currents set up by the series coils on the field set up by the pressure coil. Any variation in current or pressure will, therefore, vary one or both of the urging forces and cause a change in speed proportional to the change in the product of the two fields.

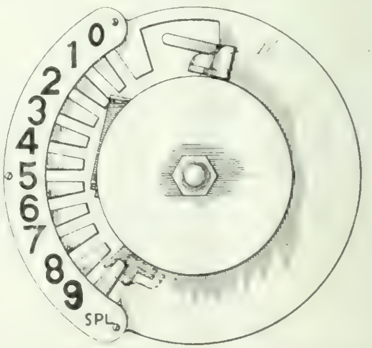
Friction may be compensated for by the use of adjustable shading coils as shown at *E* and *F*, Fig. 7. Changing the position of one of these loops will change the amount and phase of the leakage flux across the air-gap *n*. This will have the same effect as a shading coil on one side of the polar projection and the disc will tend to move toward the loop including the greater number of lines of force.

Increasing the frequency, other things remaining unchanged, will increase the induced currents in the disc, while the magnetic intensity in the poles will be decreased. The net result will be a small tendency for the meter to run too rapidly. As a remedy for this, a copper strip, or damper, may be placed near the disc and moved so it is more or less in the field set up by the eddy currents in the disc. The nearer the damper is to the induced currents the greater will be the retarding effect, because it will act as a secondary of a transformer and will tend to reduce these currents.

New Telephone Patents.

AUTOMATIC EXCHANGE DEVICES.

With automatic exchanges it is frequently necessary to provide a dial device at the sending station such that it is not readily stopped or interfered with during its return movement after a setting. On this line is an invention of F. A. Lundquist, of Chicago. This may be best explained by reference to the cut



LUNDQUIST DIAL FOR AUTOMATIC EXCHANGES.

The fingerpiece *D'* is pulled around until opposite the slot of the desired digit. The fingerpiece is movable and may thus be pushed into the slot. The return motion now begins, and the whole fingerpiece passes out of sight and reach behind the dial plate.

AUTOMATIC RINGING.

In the endeavor to simplify and reduce the operator's work on each connection, a large amount of work has been done on the subject of automatic ringing. With this improvement the [illegible]

maybe the mere starting of that operation. The ringing current is cut off automatically upon the response of the station. This cut-off is accomplished by a limit relay, which fails to operate under energization by the normal ringing current, but which will operate positively when the ringing current becomes increased, due to the transmitter circuit at the station being cut across the line.

Heretofore the control relay, the coil of which is in the ringing circuit, has always been electromagnetic. It has, therefore, had a reducing effect upon the ringing current. Mr. W. W. Dean has patented a system in which this control relay is non-inductive, the contacts being controlled by the varied expansion of a hot wire in the circuit. The patent for this system is assigned to the Dean Electric Company.

CABLE JUNCTION BOX.

A cable junction box with cable terminal attachment has been patented by Frank B. Cook, of Chicago. The junction box is formed of sheet metal, with a cast mounting bracket. Cable nozzles are secured to the bottom, and the front of the box, which is bolted on, is sealed by a rubber gasket. Splicing may be done within the box, and if it is desired to bring out pairs to a terminal, a plate is removed from its gasket on top of the junction box, thus uncovering a hole. A cable terminal may then be bolted on in lieu of the plate. This terminal is provided with a removable cover to facilitate connection, a rubber gasket serving to seal the terminal.

FUMIGATOR.

L. S. Shrader, of New Albany, Ind., has produced a fumigator for telephone instruments. This consists of a box, with an aperture through which the small end of a transmitter mouthpiece will pass, and with a slot, closed by the lid of the box, in which the receiver shell may be placed. The fumigator is mounted with the instruments in place and disinfectant is burned within it.

TRANSMITTERS AND RECEIVERS.

Mr. H. E. Booth, of Salt Lake City, has made an invention to tone down the sound from a receiver. He extends the cap along the line of the receiver length so as to provide a considerable cavity between the diaphragm and the earpiece. Immediately behind the earpiece in this cavity he places an auxiliary cavity of some porous substance, such as several layers of cloth. This, he says, makes the reproduced tone clearer and protects the ear from any loud reports in the receiver.

The antiseptic idea has taken form as an individual mouthpiece, at the hands of Anna Bebout, of St. Louis. Her invention provides a folding mouthpiece constructed after the manner of collapsing drinking cups, which may be carried in the pocket. This mouthpiece may be inserted in a transmitter by the owner in lieu of the public one.

STEP-BY-STEP SYSTEM.

S. A. Norstrom is also the inventor of a step-by-step party line system, a selecting mechanism being located at each station. The operating magnets are polarized and there is introduced a reversed current arrangement to permit of very quick action of the stepping action.

We now have at hand two later patents bearing on this same system. As usual, there is located an electrochemical device at each station, all of which are to be synchronously manipulated from the central office by current impulses sent over the lines. With this system there is an arrangement for synchronizing the stations at will. To this end, the ratchets are moved by either of two pawls. To synchronize, the ratchets are all advanced to within one step of normal by one pawl and there they stop, as the tooth corresponding to the next step is omitted. It is to be understood that enough impulses are sent out to insure the position of the ratchets at the dead point. One step by the second pawl then advances all to normal.

TELEPHONE SET.

A telephone wall set has been patented by W. W. Dean in which all working parts to be included in the box are mounted together as a self-contained mechanism. This comprises a metal shelf, supporting the bells, ringer mechanism, coil, hook switch, etc. This shelf is to be screwed to the backboard, and the box swings up to cover it and provide a writing shelf, the metal shelf above mentioned serving as the bottom of the box. The completed set has the appearance of the usual standard wall set. Mr. Dean has assigned his patent to the Kellogg Switchboard & Supply Company.

Letter to the Editors.

Calibration of Polyphase Wattmeters and Watt-Hour Meters.

To the Editors of Electrical World:

Sirs:—Referring to the communication from Mr. Frederic Lange, on the subject of switchboard instruments, in your issue for Dec. 7, page 1115, I note that he raises again the ghost of the long-dead contention that two single-phase independent wattmeters on a polyphase circuit are easier to calibrate than a polyphase meter.

Besides the increased accuracy and convenience obtained by using a polyphase meter on a polyphase circuit, it will be found that one polyphase meter can be calibrated just as quickly as two single-phase meters, if not more quickly. In calibrating polyphase wattmeters or watt-hour meters it is not necessary to use a polyphase circuit. A single-phase circuit is sufficient, connecting the shunt circuits of the meters in parallel, and the series circuits in series, then proceeding as for single-phase meters.

For various other reasons against using a single-phase meter on polyphase circuits, I beg to refer to an article of mine on page 536 of the Electrical World for Sept. 14, 1907.

Pittsburg, Pa. Paul MacGahan.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

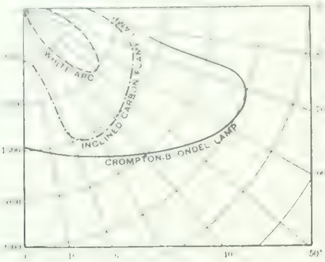
Interpole Machines.—A. Rothert.—An article in which the author distinguishes between such cases in which the commutation of direct-current [illegible] improved somewhat by interpoles, and the more serious cases in which good commutation [illegible] only by the introduction of interpoles. In the latter case the machine, should be designed at once as a perfect interpole machine, while in the former case it is possible to add interpoles simply to existing machines without further changes of the design.—*Elek. Zeit.*, Nov. 14.

Interpole Machines.—[illegible] in which the author shows that construction of direct-current machines with a number of interpoles one-half that of the real poles, reduces the extra cost by more than one-half, and that for this reason this method is specially suitable for smaller machines. The author refers to the heating of the interpole winding and gives [illegible]

Lamps and Lighting.

Flame Arc Lamp.—[illegible] arc lamp which has been in use for some time in Continental Europe and which is also made now on a commercial scale in

a long and curious-shaped flame of great intensity, emitting light of a pale yellow or primrose color, which is most pleasant to the eye. The color is a mean between the orange-colored light given by most of the inclined-carbon lamps and the white light of the ordinary arc. Fig. 1 gives the curve of candle-power distribution for this lamp, also for an ordinary white arc lamp and an inclined-carbon flame lamp. The high candle-

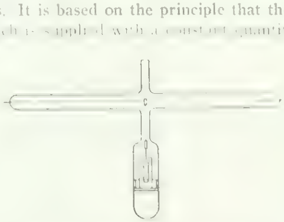


[illegible]

power of the new lamp, in directions near to the horizontal line, is of value for lighting streets, open spaces, factories, buildings, etc., where it is advisable to have an even distribution of light.—Lond. *Elec. Eng'ing*, Nov. 28.

Tantalum Lamp.—L. H. WALTER.—The General Electric Company of this country has developed a process for increasing the resistivity of tantalum for the purpose of producing a high-voltage tantalum lamp. If the filament is heated, by passing a current through it for 15 minutes in an atmosphere of nitrogen at a pressure of 15 millimeters of mercury the resistivity is increased about four times the original value, and reaches about 44 microhms per centimeter cube. The author has applied this method to the filament of an ordinary tantalum lamp. While he confirms the rise of resistivity, he finds that the mechanical properties of the filament are also changed; the formerly ductile, strong, flexible and springy filament now becomes exceedingly brittle and the tensile strength is very low. The author thinks that there is some promise in the proposition of Siemens & Halske to employ a tantalum filament in series with a carbon filament (preferably graphitized carbon) in the same globe. A high-resistance lamp is thereby obtained with only a short length of metal wire, and the efficiency is good. Moreover, the combination of positive and negative temperature coefficients results in the lamp taking practically the same current when hot and when cold.—Lond. *Electrician*, Nov. 22.

Measuring Vacuum.—G. BERNDT.—An illustrated description of an instrument for measuring the degree of a vacuum. It is said to be suitable, for instance, in the manufacture of incandescent lamps. It is based on the principle that the temperature of a wire which is supplied with a constant quantity of heat per



[illegible]

unit of time increases with increasing vacuum, because the loss of heat by conduction decreases. The best arrangement is to heat the wire by passing an electric current through it. The instrument is shown in Fig. 2, the silver wire being stretched along a tube and loaded in its center with a copper or aluminum disc which is suspended between the poles of a permanent horse-shoe magnet so as to provide an excellent electromagnetic damping. It [illegible] temperature of the wire will depend on the vacuum and according to the temperature the sag of the wire will vary. This action was observed by means of a microscope.—*Elek. Zeit.*, Nov. 21.

Metallic-Filament Lamps.—NIETHAMMER.—In using metallic-filament lamps the author has found that quick, small variations of the supply voltage, amounting to one or two per cent or less, are more easily perceptible to the eye in the case of metallic-filament lamps than in the case of carbon-filament lamps, especially with alternating-current networks without storage batteries. This is due to the thinness of the filaments and their small heat inertia. Metallic filaments follow the variations of current far more quickly than carbon filaments, and the author doubts whether it is possible to operate metallic-filament lamps at a frequency of 25 without causing a disagreeable flicker.—*Elek. und Masch.*, Nov. 25.

Nernst Lamp.—In a paper by J. Koenigsberger on the conduction of electricity in solid bodies and the electronic theory, the question of the nature of the conduction in the Nernst lamp filaments is touched upon. The opinion is expressed that the conduction is not of a purely electrolytic nature. In the discussion which followed, Nernst said that at temperatures of 1400 to 1500 deg. C. the conduction is without doubt distinctly of an electroyltic nature, as can be shown experimentally. But at higher temperatures, such as 2000 deg. C., electrolytic conductivity becomes of less importance and amounts to perhaps only one per cent of the total conductivity. At such high temperatures the peculiar observation is made that the nature of the oxides is of small importance; above 2000 deg. C. all oxides or mixtures of oxides have approximately the same conductivity. This fact also indicates that the conduction is not purely electrolytic at such high temperatures.—*Phys. Zeit.*, Nov. 15.

Power.

Electric Air Drill.—W. L. SAUNDERS.—His full illustrated paper presented before the American Institute of Mining Engineers on a new electric air drill and its advantages. The most surprising revelation of all in connection with this electric air drill is "the now indisputable fact that it takes only from one-third to one-fourth of the power, at the power house, to drive it to do the same work as a simple pneumatic drill. This is accounted for by the fact that the same air is used over and over, and that all of its elastic force is availed of in both directions instead of exhausting the charge for each stroke at full pressure. There are also no large clearance-spaces to fill anew at each stroke, as these spaces are never emptied. A valuable feature of the electric air drill, is the ability to yank the bit free if stuck in a hole and immediately continue its work. When the bit of the ordinary air or steam drill sticks in the hole, the drill stops and the drill runner must free the bit as best he can. Ordinarily the feed is run up and down, the drill is hammered and things are coaxed in various ways until the bit is free. When the bit of the electric air drill sticks, the motor and the pulsator pistons do not stop." At Idaho Springs, Col., a mine shaft was put down 67 ft. in 24 shifts and the total energy cost was $24.00 for the entire work.—*Mining Bulletin of the Am. Inst. Mining Engineers*, November.

Electric Driving of Rolling Mills.—J. BRUNSWICK.—An article on the electric driving of rolling mills, on the basis of a report of Geyer.—*L'Industrie Electrique*, Nov. 25.

Steam Turbine.—J. ZWONICEK.—An illustrated description of his type of steam turbine.—*Elek. und Masch.*, Nov. 24.

Traction.

Rail Corrugations.—A. T. ARNALL.—An article on the cause of corrugations on tram rails. On a curve the outer rails have to cover a greater distance than the inner rails. The friction will be a mixture of rolling and sliding. On the outer rail there is rolling friction only, yet modified in the following way. The rolling body produces a deformation of the surfaces in contact, and a certain sliding friction is set up between them, as they recover their original forms. Mathematical analysis shows

that if the speed of the wheel exceeds a certain critical velocity, the wheel must be free from contact with the rail for certain intervals of time. If this is admitted, it is evident that as a car rounds a curve there are all of the elements necessary for a torsional vibration of the wheels and axles. The drag on the inner wheel forced by the slip twists the axle against the frictional resistance caused by the wheel which does not slip. The loose contact gives frequent opportunities for the wheel to free itself, and the wheel flies backwards, to be caught up again, resuming contact with the rail. By "backwards" is here meant the direction opposite to the rolling motion; it, therefore, gives a forward push to the metal displaced on the rail surface. "The action of the wheel may be very closely imitated by pressing the end of the middle finger in a nearly vertical position on the table and pushing it stiffly forward. In general it will not slide, but progresses in a series of little jumps. The outer wheel of a tram car on a curve moves in the same way. There is a rolling motion in addition, but it does not interfere with the vibration due to the rubbing and twisting of the axle. It has the effect of spreading out the corrugations, and bringing fresh parts of the wheel into contact." The only part of the car having any influence on the result is the piece of axle clear between the wheels. It is useless to attempt to stop the vibrations, since they arise from mechanical conditions which are practically beyond control, but the desired end could be attained if their effects on the rail did not accumulate. Probably a sufficient variation in pitch would be produced by a small increase or reduction in the diameter of one axle on every car, or it might be necessary to use axles of three or four different diameters. Further investigation is necessary before the precise value of the axle diameter on the corrugations can be determined, but it is believed that a fuller knowledge of the influence of this factor in the problem will lead to a remedy being found for the present costly and troublesome nuisance.—Lond. *Electrical Engineer*, Nov. 29.

Electric Traction.—H. S. Knowlton.—An article of a general nature on organization problems in the electrical equipment of a steam railroad.—*Eng'ing Magazine,* December.

Wires, Wiring and Conduits.

Graded Cables.—The paper by A. Russell, which was abstracted in the Digest last week, elicited a very extended discussion. Prof. J. A. Fleming, who opened it, stated that compressed air might be used as a dielectric even for cables; its dielectric strength increases approximately in proportion to the pressure, so that at 14 atmospheres it compares with oil as a dielectric. He also gave some interesting comparisons of the size of dielectrics for storing the same amount of energy and called attention to the falling off of dielectric strength of materials after prolonged use. Mr. Nisbett of the British Insulated & Helsby Cables, Ltd., criticized Mr. Russell's premises, and doubted his conclusions. Since receiving a proof of the paper he had insulated a 7/16 and 37/16 cables with the same number of papers, and covered the insulation with copper foil. The 7/16 cable broke down at 53,000 volts, and the 37/16 at 37,000 as a mean of several tests. This pointed to exactly the opposite conclusion to that of Russell and Jona. He could make with paper insulation a cheaper cable than the Jona's graded cable, and it would withstand the same tests. He also pointed out the necessity of testing cable at a voltage at least sufficiently high to pierce a layer of air the same thickness as the dielectric. Mr. W. H. Patchell referred to some successful experience in the United States with a 20,000-volt cable, in which varnished cambric was used between the copper and paper insulation. Mr. O'Gorman defended the graded cable. He had checked Mr. Russell's mathematics and found them correct, but he raised the point whether it is safe to assume that the strain is proportional to the stress in a cable dielectric. His remarks included a vehement attack on British cable-makers for neglecting the graded cable. Mr. Archibald Campbell and Mr. C. C. Paterson, both of the National Physical Laboratory, suggested alternative methods for measuring the dielectric strength of solids. Mr. C. P. Sparks, engineer-in-chief of the County of London Electric Supply [illegible] of his experiences with rubber-insulated cables, and said that it was wrong to suggest that cable-makers are people without enterprise or scientific knowledge. From his dealings with them he knew they spend much time and money in developing improvements, and he believed that the British firms continue to be the leaders of the cable industry. Four communications with regard to the paper were received. Mr. E. Jona described an experiment which showed that the partial breaking down of a dielectric does not take place when, theoretically, it should occur, and gives as his experience that theories based solely on the potential gradient are "deficient," representing the partial truth only. Mr. F. J. Howe had employed graded cable with success for the leads from the high-voltage transformers to the test tanks at Johnson & Phillips' works. It is used at a pressure up to 50,000 and occasionally 70,000 volts and its dimensions, which are given in detail, correspond closely with Mr. Russell's formulæ. Dr. C. C. Garrard, of Ferranti, Ltd., has had trouble with fine high-tension fuses, which he attributed to electrostatic discharge, owing to the small diameter and consequent high potential gradient. Prof. J. T. Morris suggested as a substitute for graded cable the insertion of thin conducting layers dividing up the dielectric into two or three equal parts, and the connection of these conductors to tappings from the transformer supplying energy to the cable, so as to keep these sheaths at the desired intermediate potential.—Lond. *Electrical Eng'ing,* Nov. 21.

Aluminum for Conductors.—J. B. Sparks.—An illustrated article on aluminum as a substitute for copper for electrical energy transmission purposes. The author shows that aluminum may be expected to compete very favorably with copper for use in low-tension cables. But for use in high-tension three-core cables the price of copper would have to be abnormally high or the price of aluminum abnormally low in order that the aluminum cables could show any advantage. It is also shown that aluminum has every chance of becoming even more widely used than copper for overhead work. The author finds that for equal conductivities and for such prices of the two metals as cause the conductors, for equal conductivities, to cost the same (that is, when the price per ton of aluminum wire is just double the price of copper wire), an aluminum overhead line will cost about the same as a copper line. If aluminum is cheaper than copper for equal conductivity, an aluminum line will generally be the more economical.—Lond. *Electrical Review,* Nov. 15 and 22.

Insulation.—Huss and Germann.—An article giving some notes on insulation and insulation testing, with respect to line insulation, oils, varnishes, ageing and heating, and marble.—Lond. *Elec. Engineer,* Nov. 8.

Fuses.—R. Hundhausen.—An illustrated article on standardization of fuses by means of special apparatus.—*Elek. Zeit.,* Nov. 21.

Electrophysics and Magnetism.

Resonance in Alternating-Current Circuits.—F. Grunenbaum.—A mathematical article in which the author shows that the simple condition for voltage and current resonance, namely $LC\omega^2 = 1$ (L being the self inductance, C the capacity and $\omega = 2\pi$ times the frequency), is valid only if the alternating-current circuit contains no iron. It ceases to be valid if the self-inductance coil surrounds iron or if it has an appreciable resistance. The resonance condition is different according to whether the self-inductance or the capacity is regulated. The author speaks of "relative resonance." The conditions for the different cases are mathematically formulated and the results [illegible]

Electrochemistry and Batteries.

[illegible] on his work in the fixation of atmospheric nitrogen by means of [illegible] which were produced by a special system of inductance coils and condensers. On account of the high first cost this system was unsuccessful, and the author then undertook to develop a new system in which an arc is used [illegible]

two concentric carbon rings which act as electrodes. By means of a magnetic field perpendicular to the plane of the rings the arc is deflected and is caused to rotate within the annular space between the two rings. This system is said to be quite successful, a yield of 525 kg. of nitric acid being obtained per kw-year. The method, however, has not yet been introduced to industrial scale. The same method was also used in experiments of Brion, while the Badische Anilin und Soda Fabrik uses a quiet continuous arc several meters in length enclosed within a tube of suitable diameter, the air being passed through the tube from one end to the other. The specific yield of nitric acid is stated to be higher with this arrangement than with the Birkeland-Eyde process.—*Electrochemical and Met. Ind.*, December.

Electric Smelting of Copper Ore.—J. W. Richards.—The great bulk of all copper ores are sulphide ores, and in many cases the sulphur and iron present are sufficient heat producers to allow of the smelting of the ore simply by the aid of their oxidation, which is the principle of pyritic smelting. The only field for electric furnace processes appears to be in the smelting down of ores carrying too little sulphur and which require, as usually treated, the use of carbonaceous fuel to assist fusion. Whenever such fuel is expensive, and electric power may be obtained at a low price, an electric-furnace process may be possible and profitable. Such conditions may easily occur in the vicinity of copper mines where large water powers are available. The author gives an example of the treatment of Chilean copper ore and shows that in case of very cheap electric energy great savings are possible in some localities by using the electric furnace, valuable ferrosilicon being obtained as a by-product of the process.—*Electrochemical and Met. Ind.*, December.

Electric Traction in Spain.—The Railroad Company of Southern Spain will introduce electric traction on a portion of 22 kilometers length on a single-track line from Linares to Almeria, the total length of which is 230 kilometers. Five electric locomotives are to be used. This line has a uniform grade of 2.75 per cent and the steam locomotives are too slow in ascending this grade. Three-phase current will be used, the transmission voltage being 5500. Each locomotive is rated at 230 kw, and two locomotives will be used per train.—*L'Industrie Electrique*, Nov. 25.

Rapid Electro-Analysis.—F. C. Fray.—For rapid electro-analysis thorough stirring and circulation of the electrolyte is important. For this reason one or both electrodes are usually rotated. The author obtains the same result without rotating any electrode by using two concentric cylinders as electrodes and producing a magnetic field perpendicular to the electric lines of force. This is done by a solenoid wound around the cell, the same current producing the magnetic field and the electrolytic action. Under these circumstances the electrolyte will be set into rapid rotation.—*Jour. Am. Chem. Soc.*, Nov.

Galvanizing.—A. Sang.—A paper on old and new methods of galvanizing, discussing the familiar methods of hot galvanizing and electroplating, with remarks on pickling. The chief part of the paper is devoted to description of the "sherardizing" process of Cowper-Coles.—*Proceedings Engineers Soc. of Western Penna.*, November.

Induction Furnace.—V. Englehardt.—The conclusion of his long and profusely illustrated paper on the electric induction furnace and its application in the iron and steel industry. The author discusses in detail the development of the Kjellin furnace and of the Roechling-Roednhauser furnace.—*Elektrotechnische Zeitschrift*, Nov. 14, 21.

Units, Measurements and Instruments.

Photometer.—A description of a new selenium photometer of German make, in which a selenium cell is alternately illuminated by the standard lamp and by the lamp under test. The arrangement is shown in Fig. 3, where *S* is the selenium cell which is given an oscillating movement so as to pass directly from the illumination from the lamp *i* to the illumination from the lamp *I*. Both *i* and *I* are fixed on the photometer bench, while *b* and *c* the two mirrors which reflect the rays of the two lamps in the same direction, so that the oscillating selenium cell is successively lighted by the two lamps. The selenium cell *S* is in series with a battery and a galvanometer. If the two illuminations are equal the current in the circuit is constant and the needle of the galvanometer remains at rest. If the two illuminations are unequal, the needle vibrates. By moving the photometer box or one of the lamps a balance is obtained in the ordinary way. The galvanometer is calibrated to 6 milliamperes, but only the values between 4 and 6 or 5 and 6 are

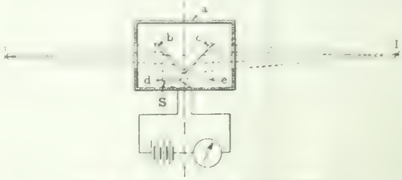


Fig. 3.—Diagram of Photometer.

marked on the scale. The greater part of the scale is suppressed and it is said that the measurements are thereby rendered more accurate. If a zero method is preferred to a deflection method, the selenium cell may be connected in series with the battery and the primary of a transformer, whose secondary winding is connected to an alternating-current galvanometer.—Lond. *Electrician*, Nov. 22.

Photometry.—M. Lauriol.—A paper presented before the International Photometric Committee in Zurich on the photometry of sources of light of different colors. The author recommends the use of a prism of gypsum or porcelain, the sharp edge of which is opposite to the observer. The two sides are illuminated by the two sources of light, without using any mirrors, lenses, etc. It is thought that in this way many sources of error due to the action of the light on the retina of the observer are eliminated, and it is recommended that a photometer based on this principle should be carefully studied. It is believed that when measured in this way, the law holds true, that if two sources of light are equal to a third one, they are also equal themselves, but this rule needs further confirmation by experiment. It would be important to find a standard which in its color is as nearly equal to sunlight as possible.—*Zeit. f. Beleucht.*, Nov. 10.

Alternating-Current Watt-Hour Meter.—An illustrated description of an alternating-current watt-hour meter of British make. It is of the induction type, the moving part being an aluminum disc. The special feature of the instrument is a magneto vibrating footstep-bearing to reduce friction to a minimum. It is shown in Fig. 4. When an alternating current is in the coil *U*, the armature *J*, being in an alternating mag-

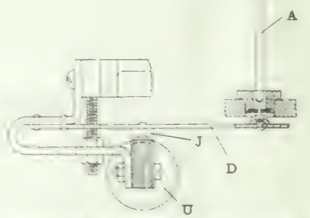


Fig. 4.—[illegible]

netic field, will vibrate. This vibration is communicated to the flat spring *D*, and thence to the jewel bearing and spindle *A*. The action is similar to tapping an instrument to get the highest accuracy of the reading. By this means the meter is enabled to start with a very small current, and the friction is reduced to a minimum, so that the readings will be extremely accurate on light load.—Lond. *Electrician*, Nov. 22.

Induction Meters.—R. Ziegenberg.—An illustrated article on induction meters and the principle of their operation, with descriptions of various recent constructions.—*Zeit. f. Beleucht.*, Oct. 20 and Nov. 20.

Electrical Equipment of the Stuyvesant Theater, New York City.

One of the most complete electrical equipments ever built for a modern playhouse has been installed in the Stuyvesant Theater, New York. The interior illumination is most restful and pleasing, and much of the artistic treatment has been produced in accordance with suggestions from Mr. Belasco, who has a reputation as a most particular manager in the production of plays and in the acquisition of proper lighting and dramatic effects.

The stage is equipped with 84 arc and incandescent pockets, each of which is rated at 50 amperes. The pockets are placed

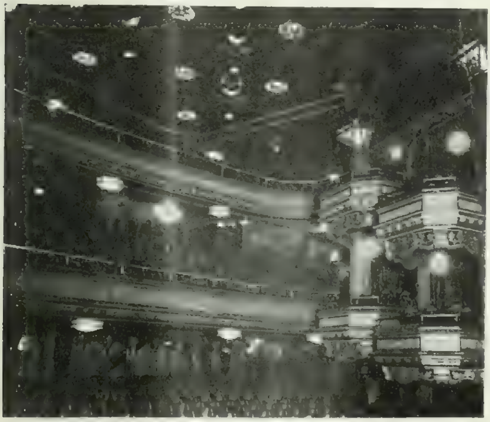


FIG. 1.—INTERIOR VIEW OF STUYVESANT THEATER FROM STAGE

in the stage floor and in the floor of the spot-light gallery, erected for this particular purpose.

The entire lighting is controlled from a back-connected theater switchboard, of modern construction, all switches being controlled individually, collectively, or in any combination desired at will. The board is made of highly polished Monson slate, with the various operating levers, gang shafts and sectional shafts mounted thereon. It is supported on a heavy, angle-iron frame about 2 ft. from the proscenium wall on the lighting bridge. The switchboard floor consists of a large slab of white marble, and is approximately 12 ft. from the floor.

The dimmer handles and shafts are mounted directly above the board and can be manipulated similar to the switchboard section. The dimmers, which are of the well-known Ward Leonard type, are mounted above the stage switchboard, and are operated by means of steel rod drives.

A junction box is installed directly underneath the marble switchboard floor. It is divided into sections and provided with large doors for the purpose of easily getting at the wiring. The wires in this box are tagged and numbered for convenience in making repairs quickly. The center of distribution for the auditorium and stage lamps is located underneath this junction box, so that should a fuse in any section or circuit blow, another can be easily inserted. This is a serviceable feature, as the house electrician does not have to search and waste time in locating fuses and trouble. From this center of distribution all circuits radiate to the various outlets in the auditorium and stage.

The stage arc lamp pockets are of the most recent type. A three-wire circuit of No. 5 wire is run to the main center of distribution from each pocket and this circuit is protected by a 50-ampere fuse. The incandescent lamp pockets are similar in construction and wiring and are arranged with dimmers on each outside wire, so that one half of the section may be separately dimmed from the other half.

The lighting bridge is a special novelty, and on each side of the stage there are mounted eight, 50-ampere arc lamp pockets, making a total of 16 for both sides, for the purpose of concentrating a powerful illumination upon the stage.

There are five borders, each consisting of 72 white, 60 red, 60 blue and 65 amber incandescent lamps, all of 32 candle-power. There is also a large panorama border of 220 32-cp lamps, arranged in a semicircle. The border lamps are fed from a 48-strand flexible border cable carried in conduit from the main center of distribution to the gridiron, whence the wires drop directly over each border, terminating in a splicing and pull box. Near the end of the pull box, each border cable is securely fastened on the steel border cable by means of a 2½-in. split wire grip laced in the center, so that it is impossible to pull the cable away from the splicing box. Specially designed sheave wheels are also provided for the purpose of having the slack constantly taken up, so that the raising and lowering of the cable will not in any way interfere with the props or scenery. This also guards the cable against mechanical injury. The borders are suspended from four large strain bolt insulators, secured to steel cables running up to the gridiron so that they are perfectly insulated.

The double border strips have wires with slow-burning insulation. The wiring is so arranged that each border is divided in two sections. And consequently one half can be operated from the stage switchboard separately from the other half, in order to get the lighting effect desired.

The foot-lights are made up of four rows of colored lamps, the number of which is approximately the same as in each border.

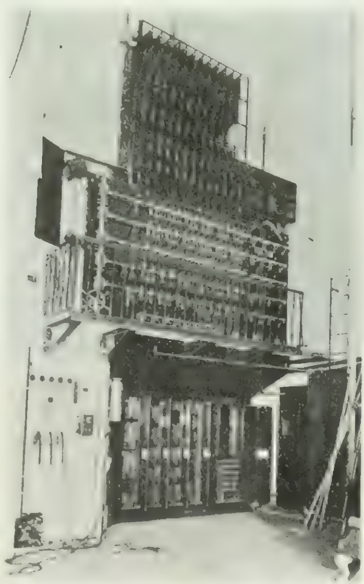


FIG. 2.—STAGE SWITCHBOARD, PANEL BOARD AND DIMMERS

Instead of the usual galvanized metal gutter, the lamps are wired in conduit with iron boxes, and so arranged that each circuit runs down to the apron of the wiring gutter which is about 32 ft. long and is arranged with sliding covers for the purpose of getting at the different circuits, so that should a wire break through accident, or a short circuit be caused by mechanical injury, repairs can be made in a very short time. All circuits from this wiring gutter built in the apron of the stage terminate in the center of distribution, and the main leads run to the main switchboard through dimmers and are controlled in sections or all together. To the left of the board there is a five-compartment signal cabinet with the wiring so

[illegible] lamp compartment, a lamp will flash at a distant point, and at the same time will indicate on the signal cabinet that the signal has been received, at the stage, each fly gallery, rigging loft, on the opposite side of the stage or in the musicians' pit, as the case might be.

In addition there are speaking tubes and buzzers running to each of the above-mentioned points, should the signal cabinet fail to work. There are also mounted on the signal cabinet 24 buzzers for signals to the occupants of the dressing rooms, and six chimebells distributed throughout the auditorium, lobby, ladies' and gentlemen's retiring rooms, for the purpose of notifying persons there that the curtain is about to rise. The electricity for the bell and telephone system is supplied by a motor-generator situated in the chief electrician's room, where the main meter and distribution board is also located. The latter is a large marbleized slab switchboard with angle-iron frame and enclosed with steel sides and doors, and with a rolling shutter in front. There are five meters, eight motor, and nine three-pole lighting switches mounted thereon. There

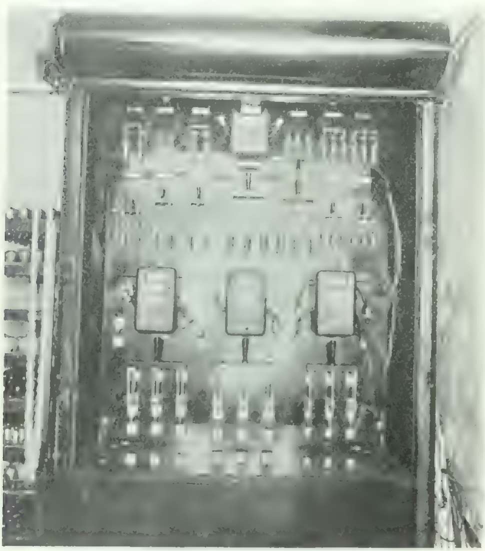


Fig. [illegible]—Main Meter and Distribution Board.

are two 1500-ampere main feeder switches, for the control of the entire circuits throughout the building, each of which is connected to a separate service from the illuminating company's mains. The 1,500,000-circ. mil feeder leading to the theater board runs in iron conduit underneath the auditorium floor to the main center of distribution behind the stage, where it connects with two sets of busses.

The front-of-house panelboard controls 38 circuits for all exit, stairs, lobby and front-of-house lighting, and this panel is supplied by a separate connection from the Edison company's service.

Perhaps the most novel and pleasing feature of the lighting scheme is found in the auditorium dome. There are approximately 400 incandescent lamps installed behind octagon-shaped Tiffany art glass panels in the ceiling of the auditorium, the light being diffused through these panels, which are decorated with shields bearing coats of arms of famous dramatists, authors and nations which have contributed mostly to dramatic art. Among these is a shield bearing the coat of arms of Stuyvesant, after whom the theater is named.

The other lighting fixtures are for the main part of the concealed type and in no case are the lamps visible in the [illegible] glass in the auditorium of antique design which have 36 32-cp lamps concealed in each. All balcony and box lamps are concealed in bowl-shaped fixtures of Tiffany glassware, specially unique and novel in design, imparting to the entire decorations a rich, soft, soothing and harmonious tone.

The theater is also equipped with a Stromberg-Carlson intercommunicating set of telephones wired in iron conduit, with 34-strand special telephone cable, and so arranged that no cross talking is possible under any conditions.

In the basement of the theater is installed a triplex, direct-connected, 25-hp fire pump of the latest type and a switchboard is installed for the automatic control of the motor. The motor is also provided with a hand starter, speed regulator and a pressure regulator which starts the motor as soon as the pressure is below the requirements of the fire department; besides this there is a Gamewell fire alarm system directly connected to the city fire-engine house.

For the heating and ventilating system there are installed an 84-in. blower which forces the hot or cold air to the auditorium, and a large exhaust fan in the dome of the auditorium, for the purpose of ventilating the entire house. The fans are of the Howard & Morse type, and are direct-connected to C. & C. motors of the enclosed type. In the center of the stage is a large electric elevator for lowering all properties to the basement and sub-basement for storage. The elevator is equipped with controlling devices and is provided with a mechanical safety clutch. The total travel is 32 feet.

The electrical equipment was installed by Messrs. Nimis & Nimis, of New York City, and is the first installation in New York City put in under the recent rules for theater wiring framed by the National Board of Fire Underwriters.

Application of Variable Speed Induction Motors to the Making of Matches.

By S. A. W[illegible].

A complete Allis-Chalmers power equipment consisting of two 300-kw generators direct-connected to Reliance engines, a 110-kw generator direct-connected to a high-speed engine; a five-panel switchboard, 24 5-hp variable-speed induction motors and a number of constant-speed machines for distribution throughout the plant, was recently sold to the Diamond Match Company for its branch factory at Oshkosh, Wis., all of the apparatus being designed for three-phase, 60-cycle, 440-volt service. The unusual feature of this installation is the fact that the match machines, which have always heretofore been group driven, in this new plant will each be driven by a 5-hp, 1200-r. p. m. Allis-Chalmers induction motor, 24 machines comprising the initial installation. It was shown by careful tests that individual drive in this plant will decrease the required energy at least 1 horse-power per machine by eliminating the use of a mechanical speed changer as well as the long countershafts joining the groups of machines in the older installation.

In the process of forming the matches, 72 sticks are made at each stroke by as many cutters. These sticks are then forced into countersunk holes of a plate conveyor from which they project at right angles, similar to the bristles of a brush. The motion of the conveyor is intermittent, depending on the speed of the machine. The travel being just sufficient to preserve a row of holes for each stroke of the cutters. While the sticks are in position in the conveyor they are in turn dipped in molten paraffin and a composition which forms the head. The matches must be dried before packing and to accomplish this end, the conveyor makes a number of loops exposing the matches to fans.

The test showed that .65 ehp is required to drive the speed changer alone; the machine proper consumes 2.5, 2.7 and 3.4 ehp at speeds corresponding to 160, 194 and 220 strokes of the cutters. Five-hp motors were, therefore, chosen as being of the proper size for the work. It should be explained that speed reduction becomes necessary only during damp weather in order to allow the matches a longer interval in which to dry.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Commercial reports indicate little change, but there was greater confidence as regards the business situation after Jan. 1. Just now, holiday trade monopolizes attention. In some sections, it exceeds that of last year, although the aggregate sales do not compare favorably with those of the latter period. Jobbing and wholesale lines are seasonably quiet, while manufacturing operations are curtailed pending the resumption of normal demands. Among the industries a feature is the continuance of the better feeling in iron and steel, accompanied by some inquiries for near future wants. Production is, however, being restricted. Building has shown a heavy falling off, and all materials are dull. During the month of November, building activity fell off sharply, the decrease being 39 per cent from October and 32.5 from November, 1906. Railway earnings for the first week of December show a loss of 8.1 per cent, as compared with the same period in 1906. Mercantile collections are more prompt, but money rates continue high and further engagements of gold raise the total movement about $103,000,000. In financial matters, the country is making gradual approaches to the normal. Advices from the country are more satisfactory. Western banks are showing an increased disposition to pay out currency. Some inquiry for mercantile paper is noted on the part of interior banks at leading Western cities, and some money is beginning to return to Chicago. Preliminary foreign trade returns for November are in excess of a year ago, breadstuffs and cotton exports gaining equally. Prices of many commodities show further strengthening from the low points reached at the height of the stringency in November, but the level of prices is now below a year ago. Sentiment in the iron and steel trade, as noted above, is quite favorable. New business in pig iron, however, is very slight, and prices are weaker. The weekly blast furnace output declined 29 per cent in one month. Business in structural material is fair, and additional orders are pending. The production of copper is being still further restricted, but European holders display considerable pressure to sell on a declining market. Prices were marked off about ⅜ cent during the week, and the closing quotations were 13⅛ cents for Lake, 12⅞ cents for electrolytic, and 12⅝ cents for casting stock. Business failures tend to increase slightly in number, the aggregate for the week ending Dec. 12, as reported by *Bradstreet's*, being 284, as against 272 in the week previous and 220 in the corresponding week of last year.

CHOCOLATE FACTORY PLANT.—The various plants of Walter Baker & Company, Ltd., at Dorchester, Mass., devoted to the manufacture of chocolate and cocoa products, are now operated electrically from a central power plant which is especially well suited to show the economies of electrical distribution. A considerable group of buildings is served from the central plant, no one of which requires enough power to make it an easy matter to select a very economical individual power plant equipment, yet as a whole requiring an output large enough to insure a [illegible]. The mills comprising the Baker group are all large and have until lately been operated by separate steam plants and line shafting. The change over from several individual plants using line shafts to a central power plant transmitting electrical energy was decided upon three years ago, and has only quite recently been fully carried into effect. The new power station of the Walter Baker Company stands on the bank of the Neponset River, from which its ample supply of circulating water is available. The engine room is 60 ft. x 80 ft., while the boiler room has practically the same floor area. The material used in construction is brick on concrete foundations. The plant was designed for [illegible] horse-power in boilers and 1750 kilowatts in generating apparatus. The principal units in the station are two large Allis-Chalmers vertical cross compound engines, [illegible] in. stroke, operated at 120 r. p. m. and direct connected to 750-kw Allis-Chalmers generators. There are in addition two smaller units consisting of 18 in. x 26 in. simple horizontal engines, each direct connected to Allis-Chalmers 125-kw alternators operating at a speed of 177 r. p. m. The electrical generators deliver three-phase alternating current at 600 volts, which is transmitted directly to the mills for lighting and power use. The circuits to different mills have recording meters. Induction motors are used, there being over 100 machines, ranging from 1 to 75 horse-power, installed. These motors are arranged for either individual or group drive. The arrangement for lighting the group of works buildings is quite elaborate. It is done on a two-wire system at 110 volts, the voltage being reduced from the power feeders by transformers at each mill. These feeders are carried to the various mills through a steel bridge from the power plant, first to the Baker mill, then over a bridge across the Neponset River to the Webb mill, then through a subway 200 ft. long under Washington Street to the Pierce mill, and the others of the group.

LA CROSSE DAM FINISHED.—J. G. White & Company have just successfully finished the closing of the new dam for the La Crosse Water Power Company on the Black River, at Hatfield, Wis. This is a concrete structure 50 ft. in height at the center, by 400 ft. long. The first concrete was laid early in August, and it has taken barely four months to place the entire mass of 24,000 yards. There are still under construction the power house, which is located two miles below the dam, and the canal betwen the dam and the power house. The installation will have 16,000 horse-power, ultimate capacity, and will supply La Crosse and Winona with energy over 90 miles of transmission lines. The pressure will be 45,000 volts.

POWER IN WASHINGTON.—Donald Fletcher, of Tacoma, and Manager N. H. Latimer, of the Dexter Horton Bank, of Seattle, have applied to the commissioners of Pierce County for right to construct lines transmitting electric energy along all highways in Pierce County, stating that they are arranging for the erection of a large power plant on Cle Elum River, in Kittitas County, where the government is now constructing a big dam to get water to be used for irrigation purposes. Mr. Fletcher declines to discuss the details of his plans, but it is understood that he has completed the financing of the big project and is ready to begin construction work as soon as the necessary franchises are obtained.

WESTINGHOUSE IN MEXICO.—American interests have captured a contract for the first electrification of a steam railroad in Mexico. The contract, which was obtained by the Westinghouse Electric & Manufacturing Company, was let by the Compania Minera Las Dos Estrellas, a British concern, which operates one of the largest mining properties in the famous El Oro mining territory. A broad-gauge line, now operated by steam and running from the mines to the town of El Oro, will hereafter be worked by means of big electric locomotives. The electric equipment will be built in Pittsburg, while the mechanical part of the engines will be turned out by the Baldwin Locomotive Works.

BAHAMA LIGHTING.—Sir W. Grey-Wilson, Governor of the Bahamas, who has been abroad on a vacation, arrived at New York last week on the White Star liner *Oceanic*. He said that while abroad he had specifications drawn for a new municipal lighting plant for Nassau, and that the contract for the construction would be awarded to an American company. The governor bestowed much praise on American enterprise, and declared that the contract would be let soon in New York City.

ORIENTAL TROLLEYS.—The Bureau of Manufactures, Washington, reports that an American consul in the Orient advises that one of the railroad companies there is considering the project of an electric street railway in one of the cities of the region in question. He suggests that it would be well for American manufacturers of and dealers in street railway material and supplies to communicate with the company referred to.

MARCONI WIRELESS.—The Austro-American Steamship Company, Limited, has recently arranged to equip its fleet with the Marconi wireless telepgraph system, and the first of these to be fitted up is the *Laura*, which arrived lately in New York.

[illegible] of the Seattle, Wash., city lighting department, is preparing for an extension of the forces at work on the city's power plant at Cedar Lake and River, and expects to deliver electricity in Seattle from the new power house by June. While the state's action in meeting the payment due on the first of the year was in doubt there was grave apprehension that the work might have to be stopped altogether, and although the state is paying only $100,000 of the $200.000 it agreed to put up on Jan. 1, this sum will be sufficient to insure that the enterprise will be carried on without interruption. The additional $100,000 worth of bonds will be paid for on May 1, and the state officials believe that they will be able to pay over the final $200,000 in the $600,000 bond purchase at that date, although the third and last instalment is not due until July 1 next. Mr. Youngs says: "With this money on hand we can rush the construction work on the Cedar River plant. Thirty-five men are at work on the pipe line from the lake to the power house site, and this number will be increased. Work on the transmission line to the city also will be started shortly, and the power house will be ready to receive the machinery by the time it arrives here from the East. We expect to have the power plant complete and the transmsision line ready to carry the electricity to Seattle in June." At present the city electric light and power plant is loaded to the limit, and consequently little extension work is being done by the department in the city, all the energies being bent on the production of more power. At the "peak load" from 5 p. m. to 8:30 p. m. the 3000 horse-power plant now in use is strained to fulfill its obligations. The new plant will give the city 15,000 horse-power. To give outlet for this surplus energy a good deal of extension wire work will be needed in the city, but as most of the connections can be made with feed circuits now existing, the work in the city will be nursed along until the second payment from the state is made in May, when a large force will be engaged in installing distributing circuits in Seattle.

ALLIS-CHALMERS ENGINES.—Operating electric railways with direct current transmitted at 1200 volts pressure is, at the present time, of special interest, owing to the absence of the high-tension wiring and the now familiar sub-stations. A pioneer road to operate its line on this plan, which is said to have proven entirely feasible, is the Indianapolis & Louisville Traction Company. This system is 41 miles long, connecting Seymour, the southern terminus of the Indianapolis, Columbus & Southern Traction Company, with Sellersburg, the northern terminus of the Louisville & Northern Railway & Lighting Company. The power house is located at Scottsburg, being about the center of the route. The feeding pressure at the power station is 1200 volts between the single No. 0000 grooved trolley and the rails. Two Allis-Chalmers engines of the well-known, heavy-duty type, 26 in. x 48 in., operating non-condensing at 120 r. p. m., drive in pairs four 300-kw, 600-volt generators, with armatures mounted commutator to commutator on the engine shaft, the combined e.m.f. being 1200 volts. In addition to operating its cars at this pressure, the company maintains a line from Sellersburg to Louisville, a distance of 14 miles, at 600 volts pressure; consequently cars are now being run successfully over sections of trolley fed with current both at 1200 and 600 volts.

WESTINGHOUSE CONTRACT.—The Westinghouse Electric & Manufacturing Company has taken a contract for the apparatus for the Penn & Franklin Street Railway Company, which will build a road between Pittsburg and the Westinghouse works at East Pittsburg, a short route in competition with the two lines of the Eastern Pittsburg Railways Company, of the Philadelphia Company, which now run there. The contract is worth $150,000. The receivers report a very satisfactory revival of inquiry for electrical [illegible]

Financial Intelligence.

THE WEEK IN WALL STREET.—[illegible] stock market were on a reduced scale and renewed bearishness prevailed in connection with speculative sentiment due to high rates for money and resulting liquidation in holdings in both the standard railroad and industrial stocks. The declaration of scrip dividends by the Western Union Telegraph Company and the Atlantic Coast Line Company also had a bad effect. The extreme heaviness of the Gould stocks, including Western [illegible] and Missouri Pacific broke to the lowest figures they have seen in a long time. When the announcement was made on Wednesday that the Western Union would pay the regular quarterly dividend in stock, that security had a feeble rally. All of the traction and electric stocks were weak, and little business was transacted. Lower prices are recorded in most cases, the heaviest declines being in General Electric, which receded 5½ points, closing at 110½; Westinghouse common declined 5 points, closing at 42½. The preferred issue of Westinghouse, on the other hand, made a gain of 4 points, the closing quotation being 70. After a sharp recovery, the curb market, during the latter part of the week, lost fully half of the improvement, there being sharp setbacks in Standard Oil and American Tobacco. Following are the closing quotations of Dec. 17:

NEW YORK.

	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	—	—	[illegible]	[illegible]	[illegible]
[illegible]	—	—	[illegible]	—	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electric Boat pfd......	—	—	Western Union Tel.....	56	55½
[illegible]	—	—	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]

BOSTON.

	[illegible]	[illegible]		[illegible]	[illegible]
American Tel. & Tel....	102¼	101	Mass. Elec. Ry. pfd....	38	37
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Edison Elec. Illum..,...	205	208	New England Telep....	105	—
[illegible]	[illegible]	—	[illegible]	[illegible]	—
[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]

PHILADELPHIA.

	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			

CHICAGO.

	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	—	—
[illegible]	[illegible]	—	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			

*Asked.

WESTERN UNION FINANCES.—The directors of the Western Union Telegraph Company, following the recommendation of their executive committee, declared the quarterly dividend of 1¼ per cent last week in the form of treasury stock instead of in cash. The statement of earnings for the quarter ended Sept. 30, 1907, and the statement, partly estimated, for the quarter ending Dec. 31, 1907, which were made public at the close of the meeting, reflect a substantial loss caused by the strike of operators. The report of the executive committee discussed the late strike in considerable detail, the loss of business due to it, and the increase in salaries. The report says: "The property of the company is in first class condition throughout the entire country; the present employees are faithful and efficient and with the passing of the financial depression our revenues will rapidly increase. Although it is believed, as indicated, that business will soon resume and earnings become normal, nevertheless, in view of the present depression, it seems the part of conservatism not to pay cash, but to make a dividend of 1¼ per cent, payable in stock." Of the authorized capital of $100,000,000 the company has still $2,630,000 in the treasury unissued, and it is with this that the dividend is to be paid. Each stockholder will receive 1¼ per cent of his present holdings. The following tables show the earnings for the quarter ended Sept. 30 and for the quarter (partly estimated) ending Dec. 31.

	[illegible]	Changes
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Inc. $2,072,388
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Inc. [illegible]
[illegible]	[illegible]	Inc. [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

DIVIDENDS.—Directors of the Duluth Edison Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Jan. 1. Directors of the Hestonville Passenger Railway Company have declared the regular semi-annual dividends of 2 per cent on the common stock and 3 per cent on the preferred stock, payable Jan. 1. Directors of the United Gas Improvement Company have declared the regular quarterly dividend of 2 per cent, payable Jan. 15. The guaranteed quarterly dividend of 1¾ per cent on the capital stock of the Manhattan Railway Company will be paid Jan. 2. The Westinghouse Air Brake Company has declared a regular quarterly dividend of 2½ per cent, an extra dividend of 2½ per cent and a stock dividend of 25 per cent of the $3,000,000 increase. Directors of the E. W. Bliss Company have declared the regular quarterly dividend of 2 per cent on the preferred stock and 2½ per cent on the common, both payable Jan. 1. Directors of the Otis Elevator Company have declared a regular quarterly dividend of 1½ per cent on the preferred stock, payable Jan. 15.

WESTERN ELECTRIC STOCK.—An offer has lately been made by the American Telephone & Telegraph Company to the minority stockholders of the Western Electric for the purchase of their holdings. The Western Electric is paying out but 8 per cent in dividends, while actually earning several times 8 per cent. It has $15,000,000 stock outstanding, of which $9,012,100, or 60.08 per cent is owned by the American Telephone Company, while $5,987,900 is held by the public and is distributed among some 600 or 800 stockholders, a considerable number of whom are employees of the company. The greater portion of the outside stock is owned in and about Chicago. The proposed plan amounts to an offer on the part of the American Telephone Company to pay for the 59,679 shares of minority stock either by $13,472,775 in cash, of $14,969,750 in 4 per cent convertible bonds. The offer puts a value of 90 on the bonds to be taken from the $50,000,000 now in the treasury as part of the $150,000,000 issue of 4 per cents, of which a syndicate took $100,000,000 some time ago.

ST. LOUIS CONSOLIDATION.—The long-expected lighting consolidation at St. Louis has at last happened. The North American Company, through the Union Electric Light & Power Company, which it controls, has acquired by purchase the Laclede Power Company and the Edison Electric Illuminating Company of St. Louis. In order to acquire the property, the Union Electric Light & Power Company increased its capital stock on Dec. 2 from $10,000,000 to $18,000,000 and its bonded indebtedness from $10,000,000 to $18,000,000. The purchase price has not been made public, but it is officially stated that not nearly all of the proceeds derived from the sale of the new stock and new bonds of the Union Electric Light & Power Company will be used for the acquisition of the new property. With the purchase of these properties, the North American Company is now in control of all the lighting and power companies and the street railway systems of St. Louis.

BALTIMORE LIGHTING DEAL.—Local Baltimore papers call attention to the fact that by disposing of the telephone plant for $300,000, subject to the mortgages on the property, the Consolidated Gas, Electric Light & Power Company gets control of its competitor in the lighting field for a comparatively small outlay of cash. The terms of the lease provided for the Consolidated taking all of the Baltimore Electric common stock, par $50, at $10 a share, the total amount being $2,500,000, and guaranteeing the dividends on the $1,000,000 of 5 per cent preferred stock outstanding, as well as guaranteeing the interest and principal of the $2,500,000 of 5 per cent bonds outstanding. It cost the Consolidated $500,000 to get the Electric Company's stock, and as a result of the telephone deal it gets back $300,000, thus making the net cost of the control of the Baltimore Electric only $200,000.

WESTINGHOUSE PLANS.—A special dispatch from Pittsburg, of Dec. 17, says: "According to intimations given out at the close of the six-hour conference to-day between President George Westinghouse and the receivers of the Westinghouse Electric & Manufacturing Company, Feb. 1 will probably see the discharge of the receivership. Mr. Westinghouse will ask [illegible] bonds to take up the outstanding convertible bonds, and provide sufficient working capital. By [illegible] New York [illegible] $7,000,000 of [illegible] taken by the stockholders, and the subscription of that sum was practically assured at to-day's meeting. The plan is understood to provide for placing Mr. Westinghouse at the head of the board of directors for the operation of the plants, while the fiscal affairs of the company will be put in the hands of a committee."

GENERAL ELECTRIC IN DEMAND.—It is noted from Boston that there has been a most substantial investment buying of General Electric stock during the last three months. The list of stockholders has increased 42 per cent since Jan. 1, 1907. At the present time the company has upward of 7700 stockholders, against 5400 at the beginning of the year. Over 1000 have been added in the last four months. At the opening of the year the average holdings per stockholder were 117 shares, against 83 shares on the first of the month. The broadening of its stockholding constituency will naturally be of material assistance to the company in any future financing.

WESTINGHOUSE AIR BRAKE.—The directors of the Westinghouse Air Brake Company have declared the regular quarterly dividend of 2½ per cent, and an extra dividend of 2½ per cent. Acting upon the authority voted them by the stockholders the directors voted to increase the capital stock from $11,000,000 to $14,000,000, out of which increase a stock dividend of 25 per cent was declared. In declaring a stock dividend of 25 per cent, the directors of the Westinghouse Air Brake Company stated that fractional shares will be represented by scrip, upon which no dividends will be made until exchanged for full shares.

KEYSTONE TELEPHONE.—The Keystone Telephone Company of Philadelphia (combined companies) reports for October and four months, compared as follows:

	1907	1906		
October gross	$88,558	$80,848	Inc.	$7,710
Expenses and taxes	48,288	44,741	Inc.	3,547
October net	$40,270	$36,107	Inc.	$4,163
Four months gross	349,160	316,491	Inc.	32,669
Expenses and taxes	183,730	178,166	Inc.	5,564
Four months net	$165,430	$138,325	Inc.	$27,105

HUDSON RIVER POWER.—The statement of earnings of the Hudson River Electric Power Company for October shows gross earnings amounted to $110,880.77, while operation cost $57,359.66. Net earnings were $62,521.11. Gross earnings for October, 1906, were $76,774.99 and operating expenses were $52,730.03, giving net earnings of $24,044.96. The increase in net earnings for October this year compared with the net earnings of October, 1906, was no less than 160.02 per cent, probably one of the best records for the whole country.

LONDON UNDERGROUND NOTES.—It was stated at the office of Speyer & Company last week that holders of about $14,000,000 of London Underground Electric five per cent notes, out of a total issue of $16,550,000 notes, had already availed themselves of the firm's offer and had sold their December coupon to Speyer & Company. This is about 85 per cent of the total American issue, and it is understood that approximately the same amount of sterling note holders have already accepted the similar offer of Speyer Brothers in London.

OYSTER BAY LIGHTING.—On the application of the Nassau Light & Power Company, to the Public Service Commission of the Second District, for an authorization of the acquirement of $35,000 capital stock of the Oyster Bay Electric Light & Power Company, an order has been issued by the commission granting the petition. The stock of the Oyster Bay Company was actually purchased by the Nassau Light & Power Company in 1905, without applying as required by law to the commission of gas and electricity.

POTOMAC ANNUAL.—The annual report to Congress of the Potomac Electric Light & Power Company has been received by the House of Representatives. It shows the gross revenues to be $1,010,552.67 and operating expenses $503,620.70. The surplus after operating expenses and fixed charges are deducted is $357,637.54. The value of the company's property Dec. 31, 1906, is fixed at $8,500,000.

NIAGARA LIGHTING.—The Public Service Commission, second district of New York, has granted a hearing on the petition of the Niagara Falls Lighting Company for authority to issue [illegible] capital stock and [illegible] mortgage for [illegible] and to issue $300,000 bonds under said mortgage; also for permission to construct an electric light, heat and power plant in the city of Niagara Falls.

GENERAL ELECTRIC DEBENTURES.—Application has been made to the New York Stock Exchange to list $13,000,000 5 per cent convertible [illegible] of the General Electric Company.

GENERAL NEWS

Construction News.

[illegible] president and general manager.

[illegible] proposition to issue $10,000 in bonds to improve the municipal electric light [illegible]

HUNTSVILLE, ALA.—The Huntsville Railway, Light & Power Company is planning to duplicate its plant now in operation, which will [illegible] placed orders for new machinery.

PRESCOTT, ARIZ.—[illegible] for operating the mine.

ARGENTA, ARK.—The managers of the municipal electric lighting plant are contemplating the establishment of a commercial service and furnishing electricity for the street railway system. A. J. Trotier is superintendent.

EUREKA, ARK.—The Citizens' Electric Company contemplates about three miles of line extension the coming year. George Tilles is treasurer [illegible]

FORT SMITH, ARK.—The Fort Smith Light & Traction Company submitted a bid to the City Council offering to furnish 250 arc lamps of 2000 cp for $55 per lamp per year. The Board of Public Affairs recommended the acceptance of the contract for 181 lamps.

HOPE, ARK.—Extensive additions and improvements are contemplated to the municipal electric light plant, which include the installation of two boilers, another engine and dynamo, and the construction of a new power house. A new water works system will also be built. Charles M. Richards is superintendent.

LITTLE ROCK, ARK.—The Penitentiary Board is considering the question of making improvements to the electric light plant at the state penitentiary.

MORRILLTON, ARK.—A new boiler, engine and dynamo have been installed in the local electric light plant, which is owned by W. H. Ashley.

AZUSA, CAL.—Plans have been prepared for the new building to be erected by the Home Telephone Company in this place, and it is expected work will soon commence on the construction of the same.

CHICO, CAL.—On November 29 the De Sabla power plant, of the California Gas & Electric Corporation, was damaged by a 24-in. gate valve on one of the pressure mains giving way. The flood caused by the break necessitated shutting down the plant temporarily. Until the damage is repaired energy for Chico and surrounding territory is being supplied from the Centerville and Colgate plants and also from the system of the Northern California Power Company.

GRASS VALLEY, CAL.—The Sultana Mine Company is contemplating installing a large electric plant in connection with its mine.

LAKEPORT, CAL.—The Lupoyoma Development Company has acquired a controlling interest in the Kelseyville National Gas Company and in the Lake County Electric Power Company, by which it has obtained the franchises and the rights held by one company in Lakeport, and the source of power supply owned by the other company in the gas wells in Kelseyville. George P. Lowe, of San Francisco, has made exhaustive tests of the Kelseyville gas and finds that it is not suitable for lighting purposes, nor for domestic uses, but can be used for furnishing power for operating the electrical plant. Orders have been placed for part of the machinery and poles. The principal machinery will be ordered from the East. George P. Lowe, of San Francisco, and B. H. [illegible]

LOS ANGELES, CAL.—The Board of Supervisors has granted the [illegible] along the Los Angeles aqueduct at points where it crosses the county [illegible] the Edison Electric Company. The electric energy furnished will be used [illegible]

MERCED, CAL.—[illegible] templating the construction of a new hydro-electric plant. H. H. Adams [illegible]

NEEDLES, CAL.—[illegible]

OCEANSIDE, CAL.—[illegible] furnish electricity for pumping for irrigation purposes. The company [illegible] and manager.

PASADENA, CAL.—[illegible] to vote on the proposition of issuing $200,000 in bonds for an additional municipal and commercial lighting system for the municipal electric light [illegible]

REDDING, CAL.—An official of the Noble Steel Company states that the electric furnaces at Heroult have been started up again for the production of ferrosilicon and that it is expected operations will be continued indefinitely. Production at Heroult has been suspended temporarily owing to the necessity of getting all of the power company's trans- [illegible] accomplished the current required at Heroult will again be turned on and continued without interruption. The steel cells for the battery of charcoal furnaces to be installed at the electric smelter are in process [illegible] latest design for the extraction of all of the by-products to be obtained by the destructive distillation of wood. The magnitude of the charcoal industry to be created by electric smelting operations on the Pit is fore- [illegible]

RIVERSIDE, CAL.—Work will soon commence on the construction of the electric railway which is to connect Riverside and Colton. The road will be about nine miles in length.

SAN FRANCISCO, CAL.—The Northern California Power Company is contemplating the construction of a hydro-electric station having an [illegible]

SAN FRANCISCO, CAL.—The Northern Electric Railway Company has filed a certificate of increase of bonded indebtedness, the proceeds to be used for general development and improvement purposes. The directors of the company are Henry A. Butters, Louis Sloss, P. B. Lilienthal, E. J. de Sabla, W. P. Hammon and David S. Edwards.

SOUTH SAN FRANCISCO, CAL.—W. J. Martin, of the South San Francisco Land & Improvement Company, has been awarded a franchise by the Board of Supervisors to erect a transmission line for the distribution of electricity for lamps and motors in this township.

UKIAH, CAL.—The Eel River Power Company, which has been working on a power line from the Eel River to Ukiah, has suspended operations for the winter, and Ukiah will be unable to get power from that source until next spring.

VENTURA, CAL.—A franchise has been granted to Julian P. Jones [illegible] railway covering the territory from this city to the Ortega ranch in the [illegible]

AGUILAR, COL.—Messrs. Hawkins & Barnett, of Pueblo, have se- [illegible] diately commence work on construction of same. The plant will furnish electricity for lamps and motors to several coal mines adjacent to Aguilar. The cost of the plant is estimated at $25,000.

BERTHOUD, COL.—The Northern Colorado Power Company is planning to replace the present direct-curren street lighting system with an alternating-current system. William J. Preston is local manager.

CANON CITY, COL.—The Colorado Heat & Power Company has placed a contract with the Westinghouse Machine Company, of Pittsburg, Pa., [illegible] other Westinghouse turbines installed some time ago.

DURANGO, COL.—The Standard Light, Power & Water Company is planning to construct a 2000-hp hydro-electric plant next year. M. Har- [illegible]

LAS ANIMAS, COL.—The contract for the construction of the power plant for the U. S. Naval Hospital at (new) Fort Lyon has been awarded [illegible]

LOVELAND, COL.—At a recent meeting of the Chamber of Commerce the question of establishing a municipal electric light plant was con- [illegible]

SALIDA, COL.—The Salida Light, Power & Utility Company is contemplating the construction of a hydro-electric plant, a 10,000-ft. water [illegible]

LITCHFIELD, CONN.—A new 100-hp boiler has recently been in- [illegible] Jenkins is manager.

MOODUS, CONN.—The Neptune Twine Mills have installed an elec- [illegible] will follow in their footsteps.

ROCKVILLE, CONN.—The Rockville Gas & Electric Company is ex- [illegible]

substation in operation on Jan. [illegible]. Electricity for operating the system will be purchased from the Springfield Street Railway Company, and will be transmitted from the power house at Springfield at [illegible] volts. The present power plant will be abandoned.

WAUREGAN, CONN.—The Wauregan Company is contemplating installing a new lighting system in its plant.

WILMINGTON, DEL.—The Board of Water Commissioners on Dec. 9 awarded to the Wilmington City Electric Company a contract for a term of three years as follows: For six arc lamps at the Potter Reservoir, for $64.92 per lamp per year; electricity for incandescent lighting as required at the Sixteenth Street property, including renewal incandescent lamps, at the rate of 4½ cents per kw-hour; electric energy for the operation of motor at the Sixteenth Street property on any one of the following propositions: First, 4 cents per kw-hour up to 25 hours per month of the connected load (this with a 75-hp motor would be 1400 kw-hours), all in excess and up to 2800 kw-hours at 3 cents; all in excess of 2800 kw-hours per month at 2½ cents; or, second, $1 per month per horse-power connected and 1½ cents per kw-hour for all electricity used. The bid of the Wilmington Light, Heat & Power Company was 5 cents per kw-hour.

WASHINGTON, D. C.—Arrangements have been made by the signal corps in the army to obtain an increase in the telephone system at the interior posts. It is proposed to install 2452 instruments at a cost of $112,3[illegible].

WASHINGTON, D. C.—Specifications are on file at the office of the Electrical World, 239 West Thirty-Ninth Street, New York, N. Y., for the equipment for the heating, lighting and power plant for the U. S. capitol and congressional buildings, bids for which will be received at the office of Elliott Woods, superintendent U. S. capitol buildings and grounds, until Jan. 15.

DE LAND, FLA.—The Electric Light & Ice Company is changing its service from 125-cycle, 1150-volt to a 60-cycle, 2300-volt, three-phase system and will establish a day service. E. L. Hon is treasurer and manager.

JACKSONVILLE, FLA.—An additional 1500-kw Allis-Chalmers steam turbine has been purchased for the municipal electric light plant to be delivered May, [illegible]

QUINCY, FLA.—J. B. Price, superintendent of the municipal electric light plant, writes that it is proposed to expend about $10,000 in the near future to improve the city plant. A new boiler of 150-hp, one 75-kw, alternating-current, 2300-volt generator and engine will probably be installed.

TALLAHASSEE, FLA.—The Board of Managers of the municipal electric light plant proposes to establish a day service about April 1, 1908. C. H. Ellis is superintendent.

TAMPA, FLA.—The Tampa Electric Company is contemplating making improvements to its electric light system, which will include the installation of new dynamos and other equipment [illegible] laying new track. A 350-hp boiler has recently been installed.

CALDWELL, IDAHO.—The Caldwell Power Company contemplates installing three 100-kw transformers in its plant. R. V. Sebree is secretary.

EMMETT, IDAHO.—The Emmett Power & Water Company is planning to change from steam to water power in the spring. W. A. Marshall is local manager.

CARTERVILLE, ILL.—H. C. Hope, owner of the Carterville electric light plant, writes that he will probably purchase a 100-kw, alternating-current, 1100-volt, 60-cycle generator, belted type, to be installed in the electric plant.

DELAVAN, ILL.—The Royal Light & Power Company is considering the installation of tungsten lamps on its street lighting system. W. H. Few is manager.

HARRISBURG, ILL.—Charles D. Stilwell, manager of the People's Water & Light Company, writes that the company is planning to make substantial enlargements and extensions to its plant the coming year, plans for which are not yet completed.

HARVARD, ILL.—The Harvard Electric Light & Power Company [illegible]

LA HARPE, ILL.—The La Harpe Electric Light & Power Company [illegible] direct-current generators having a rating of 40-kw each. A. L. Blythe is manager.

MEDORA, ILL.—Frank Watson, owner of the Medora electric light [illegible] the near future.

MEREDOSIA, ILL.—[illegible] the Meredosia electric light plant, expects to install a complete new plant [illegible]

PALMYRA, ILL.—A new direct-connected unit has recently been installed in the municipal electric light plant. Earl Gates is superintendent.

QUINCY, ILL.—[illegible] Quincy Traction Company have voted to increase the capital stock of the company from [illegible]

Edward Yates, of Pittsfield, president; H. C. Simon, of Virden, vice-president; F. W. Knollenberg, of Quincy, secretary and treasurer.

SHEFFIELD, ILL.—The Sheffield Electric Light Company contemplates making some improvements to its plant during the year 1908. H. W. Booth is manager.

WINCHESTER, ILL.—The Winchester Electric Light Company is planning to establish a 24-hour service, beginning about July 1, 1908. Harry Gordon is manager.

ANDREWS, IND.—The Andrews Home Light & Power Company recently purchased a dynamo from the Huntington Light & Fuel Company, which will soon be installed in the plant, and will enable the company to meet the increased demand made upon it.

CROWN POINT, IND.—The Crown Point Electric Company is planning to increase the output of its plant by the installation of a 300-kw turbine. F. H. Keeney is manager.

DECATUR, IND.—The directors of the Ft. Wayne & Springfield Traction Company are considering plans for the extension of the line south to Berne, early next year.

DECATUR, IND.—The city is contemplating replacing the present street lighting system with an alternating-current system in the spring. M. J. Mylott is superintendent.

FARMERSBURG, IND.—The Torr Electric Company contemplates installing a larger engine in its plant in the near future. A. D. Torr is manager.

FERDINAND, IND.—The Ferdinand Electric Light Company is contemplating installing a larger battery in its plant the latter part of next year. William R. Sauer is manager.

GARRETT, IND.—Plans are being contemplated for making extensive additions to the municipal electric lighting system, which include the installation of an engine, generator and a new arc lighting system.

RIDGEVILLE, IND.—The Ridgeville Electric Light, Heat, Power & Water Company contemplates the installation of a 30-kw turbine in its plant. S. C. Lay is manager.

SOUTH BEND, IND.—The Indianapolis, Logansport & South Bend Railway Company has been granted a franchise by the County Commissioners to construct and operate an electric railway along Michigan Avenue from the southern border of the county to a point a short distance south of the city, where the railway will enter a private right of way.

TERRE HAUTE, IND.—The syndicate headed by Frank M. Fauvre, a capitalist and coal operator, of Indianapolis, which proposes to erect a large power-house in the coal fields of Vigo County, is securing the right of way and franchises in the towns and cities to place high-tension wires in the streets and alleys thereof. It is stated that energy can be transmitted as electricity by wire from the Indiana coal fields more cheaply than can be shipped to Indianapolis to be used in a plant.

WASHINGTON, IND.—An injunction suit has been filed in the circuit court to prevent the sale of the Washington municipal electric light plant, advertised for December 16. The complaint alleges that a sale cannot be made at this time without sacrificing the city's interests, and that 80 per cent of the voters do not want the sale made. This action will likely delay the receiving of bids for the plant temporarily.

WINONA LAKE, IND.—We are informed that the Winona Electric Light & Water Company is in the market for a 500-kw, turbo-generator set. The machine is wanted immediately.

WELEETKA, I. T.—We are informed that the Weleetka Light & Water Company is planning to install another boiler having the same capacity of the present one, and either an 80,000 gallon tank or standpipe for the city water works, or a second pump for direct pressure. D. F. Campbell is manager.

BELLEVILLE, KAN.—Plans are being considered to substitute oil for fuel for steam purposes in the municipal electric light plant. E. A. Jackson is manager.

KANSAS CITY, KAN.—Application has been made to the City Council for a 30-year electric light franchise. The proposed new company is composed of a number of merchants in the city, who propose to erect a plant and furnish electricity to merchants and private citizens. It does not ask for city lighting. H. F. Wulf, Henry McGrew, Max Holzmark, Thomas Wood and Joseph McGrew are interested in the project.

TOPEKA, KAN.—The Council committee on gas and electric light has adopted a resolution, which will soon be placed before the City Council, directing the Mayor to call a special election to be held in the [illegible] to be used for extending and remodeling the municipal electric light plant.

COVINGTON, KY.—The City Council has directed that an ordinance providing for the sale of a telephone franchise be drawn up and that the right be advertised for sale. The Fitzsimmons Telephone Company has been seeking a franchise here for some time and there are several others who may decide to bid.

COVINGTON, KY.—President James C. Ernst, of the Union Light, Heat & Power Company, [illegible] that the bid contemplated that the contract should be renewed annually [illegible]

[illegible]

right of way between Paducah and Mayfield, and terminals in the latter city.

BATON ROUGE, LA.—The City Council on Dec. 3 awarded a contract to Krumbhaar & Aiken, of New Orleans, for the construction of the sewerage pumping station, which will be operated by electricity. The Baton Rouge Electric Company has submitted a proposition to the Council offering to furnish electricity to operate the station at 5 cents per [illegible]

FRANKLIN, LA.—The dynamos for the new electric light plant have arrived. The work of remodeling the plant and installing the new [illegible]

HOUMA, LA.—The town is negotiating with the Houma Lighting & Ice Manufacturing Company for the purchase of the plant to be operated by the municipality. The committee appointed to interview the company in regard to the purchase of the plant reported that it was agreed that each side was to appoint an appraiser to place a value on the plant. The Mayor has been authorized to consult with an expert electrician.

LECOMPTE, LA.—The city has accepted the plans of C. Scott Yeager, of Alexandria, La., for the installation of an electric light plant to cost [illegible] been selected to supervise the construction of the plant.

THIBODEAUX, LA.—[illegible] proposition to do away with steam power and substitute gas producer outfits in the municipal electric light plant; changing the present system to alternating-current and installing larger units. A. R. Staunton is superintendent.

VIDALIA, LA.—The citizens are contemplating the installation of a new street lighting system to replace the system now in use. L. A. [illegible]

ASHLAND, ME.—[illegible] completed.

FRYEBURG, ME.—The Fryeburg Electric Light Company contemplates changing from steam to water power and building one mile of new line. C. E. Harris is secretary and manager.

TURNER, ME.—Aubrey Willard has leased the electric light plant owned by E. L. Staples for one year.

BALTIMORE, MD.—The United Railways & Electric Company will construct a new power house at its plant on Pratt Street, at a cost of $30,000. The Noel Construction Company has the contract.

POCOMOKE CITY, MD.—The Stevenson Electric Light Company will install a 100-hp boiler in its plant next summer. R. P. Stevenson [illegible]

PORT DEPOSIT, MD.—The Port Deposit Electric Company contemplates replacing the present street lamps with 40-cp tungsten series lamps. Walter Flint is manager.

DANVERS, MASS.—The 500-hp Shephard engine in the municipal electric light plant was destroyed by an explosion, Dec. 10, causing a loss of about $5,000.

EASTHAMPTON, MASS.—The Water Commissioners are considering the question of installing electric motors at the pumping station, to take the place of the steam equipment now in use.

[illegible] templates replacing its present street lamps with enclosed arc lamps next [illegible]

NATICK, MASS.—The State Board of Railroad Commissioners has given its approval to an order adopted by the Natick Board of Selectmen, granting the Boston & Worcester Street Railway Company the privilege to build and operate an electric railway on several streets in Natick.

WINCHENDON, MASS.—The Winchendon Electric Light & Power [illegible] F. W. Nourse is manager.

EATON RAPIDS, MICH.—Extensive additions and improvements are contemplated for the municipal electric light plant, which will include [illegible]

[illegible]

GRAND HAVEN, MICH.—The city contemplates making extensive improvements to the municipal electric light plant, including the installa- [illegible] regulators and necessary switchboards. Bids have been received for the above equipment, but contract has not yet been awarded. The cost of the [illegible]

HOLLAND, MICH.—The city is contemplating adding a 500-kw [illegible] is manager.

HOBART, MICH.—The citizens are contemplating installing an additional engine and alternator in the municipal electric light plant. O. L. [illegible]

HOWARD CITY, MICH.—The Howard City Electric Light & Power [illegible] its plant, which will include the installation of new switchboard, possibly new generators and additional boiler; also rebuilding of its lines. L. W. Greene is owner and manager.

KALAMAZOO, MICH.—The Kalamazoo Home Telephone Company has commenced work on the construction of its underground conduit system in this city.

MOUNT PLEASANT, MICH.—The Harris Electric Company will install a new generator in its plant and change the system from single [illegible]

MUSKEGON HEIGHTS, MICH.—The City Council has contracted with the Muskegon Traction & Light Company to furnish the city with electric light for one year. The city is contemplating the establishment of a municipal electric light plant.

PAW PAW, MICH.—The municipal electric lighting system is being rebuilt and an entire new plant is being installed, which is expected to be completed and in operation by April, 1908. William H. Mason is city clerk.

PETOSKEY, MICH.—J. E. [illegible] electric light plant, writes that new [illegible] plant to take the place of the ones now in use.

PORTLAND, MICH.—The managers of the municipal electric light plant contemplate installing the meter system in public places, and will charge 4, 5 and 6 cents per kw-hour for electric service. F. L. Jenkins [illegible]

FAIRBAULT, MINN.—The old Scott mill property, which was recently purchased by a twin city firm, is to be converted into a large electric plant to furnish electricity in Faribault and Northfield, for manufacturing and other purposes. A concrete dam is to be built, which will furnish 400 horse-power.

PIERCE, MO.—A new engine and dynamo are now being installed in the municipal electric light plant. G. W. Solomon is superintendent.

ST. LOUIS, MO.—The Wooley Electric Company, of which Fred [illegible]

ST. LOUIS, MO.—The residents of Overhead Park, St. Louis County, being unable to secure electricity otherwise for residence and street lighting, have formed a stock company for the purpose of installing a [illegible]

SEDALIA, MO.—[illegible] the installation of a 700-hp water tube boiler in its plant. E. R. Audler is manager.

SHELBINA, MO.—The citizens are contemplating putting a new boiler in the municipal electric lighting plant next year. E. P. Weaver is superintendent.

SMITHVILLE, MO.—Harry Gordon, owner of the Smithville electric light plant, contemplates replacing the [illegible]

HARVARD, NEB.—Carl Parker has purchased an interest in the electric light plant and has assumed local management.

OMAHA, NEB.—H. E. Babcock and F. Jaeggi are interested in the [illegible] estimated at $4,250,000 by George Sturtevant, 279 Dearborn Street, Chicago, Ill.

TEKAMAH, NEB.—The new electric lighting plant is nearing completion and is expected to be in operation early in January.

WEST STEWARTSTOWN, N. H.—[illegible] tending its transmission lines to Beecher Falls, Vt., and expects to have the work completed before the first of the year.

ATLANTIC CITY, N. J.—Plans for the placing of the overhead electric lighting wires in the city in underground conduits have been submitted to the City Council by the Atlantic Electric Light & Power Company. The company proposes to remove the wires on the Boardwalk and place the whole system in conduits within two years, laying the conduit under the sidewalks to avoid the necessity of opening newly paved streets. [illegible] the plan and virtually assured the company a renewal of a ten-year contract to light the city.

NEWARK, N. J.—The Balbach Smelting & Refining Company has commenced work on the construction of a new power house at its plant on the meadows. The building will cost about $8,000.

NEWARK, N. J.—James J. Seymour, Jr., has been engaged as con- [illegible]

to investigate conditions at the county jail to determine whether it would be commercially profitable to establish an electric light plant there.

PITMAN, N. J.—Charles W. Denny has secured the contract to build the power house for the Gloucester County Electric Company in this town, at a cost of [illegible].

PRINCETON, N. J.—R. M. Anderson, assistant treasurer Princeton Theological Seminary, writes that it is proposed to install a central heating and lighting plant next year and to have it ready for the opening of the school in September. The contract for the work will be let late this winter or early in the spring. The Richard D. Kimball Company, 6 Beacon Street, Boston, Mass., has prepared the plans and will have charge of the work.

ALBUQUERQUE, N. M.—The Santa Rosa Telephone Company will put in a telephone system here connecting with the Santa Rosa exchange.

ALAMOGORDO, N. M.—M. H. Fisher, owner of the Alamogordo electric light plant, has completed arrangements with D. Burney, who has a ranch one mile west of the town, to furnish electricity to operate a pump in connection with an artesian well. Mr. Fisher is now building a hydro-electric plant in the Fresnal Cañon, which when completed will give him 2200 horse-power to dispose for pumping and other purposes.

AUBURN, N. Y.—Owing to the Auburn Light, Heat & Power Company having submitted a bid larger by $200 this year than last for the illumination of the county buildings, a resolution has been introduced before the Board of Supervisors calling for bids for the installation of gas engines and dynamos for the purpose of lighting the county buildings.

DAVENPORT, IOWA.—The Independent Light & Power Company has decided to increase its capital stock to $1,000,000. The company now has a plant under construction.

FALCONER, N. Y.—E. W. Jordan, owner of the Falconer electric light plant, contemplates the installation of gas engines and furnishing continuous service, and also a direct-current service for power purposes. W. E. Cowden is manager.

HOOSICK FALLS, N. Y.—The Town Board has contracted with the Hoosick Falls Illuminating Company to light the streets and avenues of the village of Hoosick Falls. The contract calls for 14 arc lamps, 6.6 amperes, at $800 per year. Provision is also made for four 32-cp incandescent lamps to cost $80 per year. The company agrees to furnish additional incandescent lamps at $20 each per year, and additional arc lamps for $60 each per year.

KATONAH, N. Y.—The Public Service Commission in the Second District has granted the application of the Katonah Lighting Company to construct an electric light system in the town of Bedford, Westchester County, and to issue $20,000 in capital stock.

LOCKPORT, N. Y.—James C. Horning, of Castile, will construct an electric light and power plant at Lamont to furnish electricity to light Silver Springs, Castile and Gainesville. The cost of the plant is estimated at $40,000, bids for which will probably be called for about April 1. Charles E. Collins, of Philadelphia, Pa., is engineer.

NEW YORK, N. Y.—John H. O'Brien, commissioner of Water Supply, Gas and Electricity, on Dec. 10 awarded contracts for supplying the city with electricity as follows: The Edison Electric Light & Power Company and the New York Edison Company for electric lighting in Manhattan; the Westchester Lighting Company in the Bronx; the Edison Electric Illuminating Company in Brooklyn; the Queens Borough Gas & Electric Company in Queens, and the Richmond Light & Railroad Company in Richmond. The cost of lighting the city this year will amount to between $3,500,000 and $4,000,000. The price for arc lamps will be $100 per lamp per year for 5,000 arc lamps of 450 watts; all lamps over that number, $95. When the city has 7500 of these arc lamps the cost will be $95 each. Incandescent lamps will cost the same as last year—$22.50 each per year. Electricity for public buildings for heat and other purposes will cost from 7½ to 10 cents per kw-hour, and for power purposes 6 cents per kw-hour.

ROCHESTER, N. Y.—The Board of Contract on Dec. 12 awarded the contract for lighting the new convention hall to James McDonnell, for [illegible].

WATERTOWN, N. Y.—The Common Council on Dec. 3 voted to [illegible] and values of the Watertown Light & Power Company and testify for the city at the [illegible] session of the Public Service Commission.

SALISBURY, N. C.—[illegible] contracted with the Southern Power Company, of Charlotte, for three 100-kw transformers, sub-station and motor generator set for operating the street railway system. The company will furnish electricity for city and commercial lighting and power purposes. Work will commence on the construction of the [illegible] receive energy from the Southern Power Company in about 90 days. The lines are now erected within four miles of Salisbury. H. W. Frund is manager.

CLEVELAND, OHIO.—[illegible]

the small stations so that they might be arranged quickly [illegible] to supply any part of the town that desires the service.

COLUMBUS, OHIO.—The Board of Public Works has granted the Cincinnati Northern Traction Company a lease authorizing it to erect a high-tension transmission line on the canal property passing through the municipalities of Hamilton, Middletown, Franklin and Miamisburg. The company is to pay 6 per cent on a basis of $1,000 per mile on the property occupied.

COLUMBUS, OHIO.—Bids will be received until Dec. 30 by Edward F. McGuire, secretary Board of Public Service, for furnishing and delivering on or before Jan. 15, 1908, at the municipal electric light plant, Dublin Avenue, wire cable to be used in connection with a 1000-kw generator and motor driven exciter.

FREMONT, OHIO.—The Fremont Yaryan Company contemplates the installation of a new engine, generator and boilers in its plant. B. J. Shockley is superintendent.

JEFFERSON, OHIO.—The Jefferson & Warren Telephone Company has increased its capital stock from $80,000 to $100,000.

NEWTON FALLS, OHIO.—The Electric Light & Power Company is contemplating the construction of a new power house and boiler house. J. W. Carr is owner and manager.

TOLEDO, OHIO.—A mortgage for $100,000 in favor of the Commercial Savings & Trust Company has been given by the Citizens' Lighting & Heating Company to secure a bond issue of that amount. The mortgage covers the company's property at Michigan Street and Jefferson Avenue, its tunnels, rights of way and other privileges. The proceeds of the bond issue are to be used in constructing the system proposed by the company.

PORTLAND, ORE.—The contract with the Portland General Electric Company for street lighting will expire Dec. 31, 1908, and the report of the committee on street lighting submitted to Mayor Lane, Dec. 8, advises that some action be taken looking toward the establishment of a municipal electric light plant, to be operated either by water power or by the garbage crematory plant. The estimate of the committee for street lighting for the coming year is $99,875. This is based on an increase of 75 new arc lamps for next year. The city is now paying at the rate of $63.60 per lamp per year.

PANAMA.—Bids will be received until Jan. 6, by Lieut.-Col. H. F. Hodges, U. S. A., purchasing officer, Isthmian Canal Commission, Washington, D. C., for furnishing engine and generator, switchboard, etc., as per circular N. 408.

FRANKLIN, PA.—The Borough Council on Dec. 13 awarded the contract for the additional engine and generator for the municipal electric light plant to the Allis-Chalmers Company for $8,600.

EASTON, PA.—The Common Council on Dec. 6 voted to authorize the city officials to contract with the Westinghouse Electric Company to install a new street lighting system at a cost of $13,000.

PHILADELPHIA, PA.—It is said that the stockholders of the Johnstown Telephone Company will be asked, at the annual meeting to be held Jan. 20, to vote an increase in the capital stock of the company from $600,000, to $1,000,000 for the purpose of making extensive improvements to the system.

PHILADELPHIA, PA.—The Bell Telephone Company, of Philadelphia, has filed with Governor Stuart a notice of change of name to the Bell Telephone Company of Pennsylvania, due to the absorption of the Pennsylvania Telephone Company and the Delaware & Atlantic Telephone Company, and an increase in its capital stock from $30,000,000 to $60,000,000. The new company will operate in Pennsylvania, east of the Alleghany Mountains, and in Delaware, Virginia, New Jersey, Maryland and District of Columbia, and will have its headquarters in Philadelphia.

PITTSBURG, PA.—Plans are being considered by the City Council for utilizing the Allegheny municipal electric light plant for lighting the entire municipality of Greater Pittsburg.

READING, PA.—The supply, janitors and repairs committees of the School Board are considering the question of installing an independent electric light plant in the administration building at Eighth and Washington Streets to furnish electricity to light the two high schools. The estimated cost of the plant is $5,000.

SHARON, PA.—The [illegible] Company has rearranged its rates for lighting mercantile houses and residences. The minimum monthly bill to business houses has been reduced from $1.50 to $1.11, less 10 per cent for cash within ten days. Electricity consumed for lighting on an average of one hour and twenty minutes a day or forty hours per month, each lamp, will be [illegible] to be charged at 5.5 cents per kw-hour, with a discount of 10 per cent if [illegible] annual number of lamps connected, and flat irons and cooking outfits are not to be rated in the lighting current. Lamps for display windows will be charged, if desired, at the rate of 40 cents a month for each [illegible] o'clock on week days, with the exception of Saturdays, when they are to [illegible]

[illegible] given out that this was not a change in the controlling interest of the company, nor was it a merger of the company with any other company, but the action was solely a business proposition to increase the earning [illegible]

SALT LAKE CITY, UTAH.—D. M. Griffiths, of Salt Lake City, has filed an application to appropriate 10 cubic feet of water per second from Stairs Gulch Creek, a branch of Big Cottonwood Creek. The power developed will be used to generate electricity for lighting and power purposes.

ASHLAND, VA.—It is reported that the City Council has accepted the proposition submitted by the Western Union Telephone Company to [illegible]

DANVILLE, VA.—At a recent meeting of the Common Council a proposition was considered to secure the services of a consulting engineer to look into the question of the erection of a new municipal electric light plant.

PUYALLUP, WASH.—The Morse Manufacturing Company has installed a dynamo in its plant to furnish electricity to light the homes of the employees of the company as well as the residences of the managers and the mills.

PUYALLUP, WASH.—Fuller & Manley, of Tacoma, have been authorized by the City Council to draw up plans and estimates for the cost of a municipal electric light plant. The estimated cost of operating the [illegible]

TACOMA, WASH.—Donald Fletcher has filed a petition with the County Commissioners asking for a franchise to erect transmission lines along the highways and roads of Pierce County for the transmission of electricity from a proposed power plant on the Cle Elum River above Cle Elum Lake. Mr. Fletcher proposes to erect a large power plant to furnish electricity for lighting and power purposes in the counties of Pierce, Kittitas and King.

WALLA WALLA, WASH.—The Washington-Oregon Traction Company has applied to the City Council for a franchise for the privilege to construct its lines through certain streets of the city. The company agrees to begin construction work within four months, providing it negotiates [illegible]

CHARLESTOWN, W. VA.—The corporation of Charlestown is asking for bids for lighting the town for one year from Feb. 1, 1908. Bids will be received until Jan. 1.

APPLETON, WIS.—The City Council has decided to ask the Railroad Commission to fix the rate for electrical energy for public and private use, and also for gas for fuel and illuminating purposes. The city's contract with the Wisconsin Traction, Light, Heat & Power Company expired Dec. 1. The city is paying $65 per lamp per year for street arc lamps, which is not considered unreasonable, but the rate for commercial of 10 cents per kw-hour is considered too high.

IOLA, WIS.—The planing mill and electric light plant owned by [illegible] a loss of about $5,000.

[illegible] contract with the Minneapolis Electric Motor Company, of Minneapolis, Minn., for the complete equipment of an electric lighting plant. A three-phase plant with a rating of 60 kilowatts will be installed. 60 kilowatts.

CLARESHOLM, ALB.—The Town Council is making arrangements to take over the electric lighting plant here owned by the Claresholm Electric Company. Address W. Moffat, mayor.

EDMONTON, ALB.—The site selected for the civic power plant is five miles up the river from this city. Plans and specifications are now being prepared for the buildings and transmission lines. R. R. Keely is city engineer.

FRANK, ALB.—The McLeod Electric Light & Power Company will install the electric plant here formerly in use at McLeod. The Rocky Mountain Cement Company has also made application for a franchise to light the town, but the application has been held over to see what kind of service the McLeod company will give.

McLEOD, ALB.—The electrical machinery being installed by the Black Diamond Coal Mines Company includes the following: two electric generators of 105 and 250 kw respectively, and three boilers of 150 horse-power each. Manager Underwood states the company will spend [illegible]

NELSON, B. C.—The Canadian Pacific Railroad is making preparations to electrify certain lines around Nelson, and Lorne Campbell is now looking into the matter and states his plant at Bonnington Falls [illegible] of more units can be increased to 36,000 horse-power. At first it was intended to electrify the line only on the heavier grades, but from information received by Mr. Campbell it appears that the company intends to electrify all its lines in the vicinity of Nelson. It is probable that the trolley system will be adopted.

VANCOUVER, B. C.—The British Columbia Electric Street Railway Company has purchased from the Vancouver owners the charter for the line to run from this city to Blaine, Wash. This will be a portion of the proposed electric line between Vancouver and Seattle. Ad- [illegible]

LISTOWEL, ONT.—The Town Council contemplates purchasing the plant of the Listowel Gas & Electric Light Company to be operated by the town. The value of the entire equipment of the plant, which operates 26 street arc lamps, has been placed at $1,276. The Council has decided not to renew the lighting contract, which has expired, and the town will be in darkness for several months.

New Industrial Companies.

THE CHURCHILL ELECTRIC TIME SWITCH COMPANY [illegible] to automatically turn off show-window lamps, sign lamps or an entire lighting system. The incorporators are: E. E. Churchill, secretary, H. H. Churchill and H. P. Voris.

[illegible] POWER COMPANY [illegible] been incorporated with a capital stock of $120,000 for the purpose of manufacturing gas engines and gas producers. The incorporators are: Cyril J. Atkinson, J. H. Zimmerman and E. C. Stern.

THE MONTAGUE CITY ALUMINUM CARBON & BRICK COMPANY, of Turners Falls, Mass., has been incorporated with a capital stock of $150,000 to produce aluminum from the clay beds at Montague City. The officers of the company are: C. P. Wise, president; W. C. Davis, vice-president; W. H. P. Gilmore, secretary and treasurer.

THE THERMO ELECTRIC SIGN COMPANY, of Camden, N. J., has filed articles of incorporation with a capital stock of $105,000. The incorporators are: E. M. Lyons, J. V. A. Kimmey and Charles A. Hunter. The company proposes to manufacture electric signs.

Obituary.

CAPTAIN JOHN T. FITZPATRICK [illegible] Lancaster, S. C., where he had been for several days with relatives. Captain Fitzpatrick was a member of the firm of T. M. Fitzpatrick & Brother, of Washington, Ga., and had been actively engaged for the past few years in the development of the water power of northeast Georgia, and especially the power at Anthony Shoals, which he and his brother acquired two years ago at a cost of $35,000. Captain Fitzpatrick was for many years and until his death the commander of the John T. Wingfield camp of Confederate veterans. He was 64 years old and is survived by one brother and four sisters.

Legal.

LIABILITY OF COMPANY FOR INJURY TO WORKMAN BY STARTING UP OF MOTOR WHICH HE IS REPAIRING.—A workman in a cement factory, upon noticing that the brush of one of the motors was out of the brush holder and that the holder was dragging on the commutator, and knowing that, in that condition, the motor would soon burn up and destroy valuable machinery, went to the foreman and told him the condition of the motor; but the foreman refused to have the motor stopped to put it in order, on account of the work that was being done by it at that time. The workman then went to the electrician in charge of the electrical department and told him that if he did not go up there and attend to the motor it would be burned out in a few minutes. The electrician examined the motor and then had a talk with the foreman nearby, after which he told the workman to watch the motor for a few minutes and then stop it, and he would see that no one would start the motor or interfere with it until the workman had fixed it. The workman went down into the basement and threw the switch which stopped the motor. He told the person in charge of the [illegible] until orders to that effect were given. The workman then returned to the motor and commenced to make the necessary repairs. In doing so he reached in to feel whether the oil plug was tight or not, where it had been leaking, and at the same time some one started the motor, resulting in injury to the workman's hand which necessitated amputation. No evidence was given as to who started the motor, but the switchman claimed that he did not do it. It was held that the workman and electrician were not fellow servants, so as to preclude the workman's right to recovery, and he was awarded a verdict of $7,500. Marquette Cement Manufacturing Company vs. Williams, Supreme Court of Illinois, 82 [illegible]

[illegible] COMPANY NOT BOUND TO MAINTAIN GUARD [illegible] ITS HIGH-CURRENT WIRES [illegible] severe snowstorm and hung down into one of the streets of the city of Lancaster, Pa. It came in contact with a wire belonging to a light and power company and the insulation wore off at the point of contact so that [illegible] wire, killing a small boy who chanced to walk against it. It was claimed [illegible] a screen or guard above its wires to prevent contact with the wires above [illegible]

erection of guards was a reasonable precaution, nor that it was customary nor practicable to maintain them, and it was held that the company could not be charged with negligence by reason of its failure to erect such a screen or guard. While companies using electricity are held to the highest degree of care, it was said by the court that it could not be left to the jury, drawn from the ordinary walks of life, to determine, without evidence, whether the failure by an electric company to guard its wires would constitute negligence. Stark vs. Lancaster Light, Heat & Power Company, Supreme Court of Pennsylvania, 67 At. Rep. 909.

Personal.

MR. W. S. HULSE, consulting engineer, has moved his office in New York City to 44 Broad street.

MR. HENRY DOCKER JACKSON, of Boston, Mass., has been retained by the city of Brockton, Mass., to make a report on the conditions existing on the main water supply pipe of the city, with particular reference to electrolysis and methods for overcoming it.

MR. H. F. MILLER.—Mr. H. F. Miller, formerly the Columbus (Ohio) manager of the Bell Telephone Company, has been made vice-president of the company which has purchased the Maryland Telephone Company of Baltimore. It was sold by the Baltimore Electric Company, the stock of which is controlled by the Consolidated Gas & Electric Light and Power Company. The purchase price is given as $300,000. The company will be operated as an independent, with an affiliation with the Bell it is said. No president has been named because the directorate is incomplete. Mr. Miller as vice-president is in charge of the property. He has been in the telephone business for many years. He originally came from the South. He had charge of the Bell interests at Springfield, Ohio, before going to Columbus in 1903. He was there two years, then went to Dayton to take charge of the Independent Company. After a year he returned to Columbus to take up some work for the Citizens' Company. For a year or more he has been gathering data on the independent telephone business of the United States, and especially on the automatic service, such as is used in Columbus, for a large English syndicate. During this work, Mr. Miller has been living in Cranford, N. J.

MR. H. W. CLAPP.—On December 14, Mr. H. W. Clapp was tendered an informal luncheon at the Engineers' Club, by some of his business friends in New York. Mr. Clapp has recently accepted a position in the electrical organization of the Southern Pacific Company and will shortly remove to San Francisco, so that his friends took this occasion to express their regret at his departure from New York and to wish him success in his new field. Among those present were the following: W. J. Clark, manager traction department; T. Beran, manager New York office; J. G. Barry, manager railway department; W. B. Potter, engineer railway department, all of the General Electric Company; A. R. Whaley, general superintendent electric zone, New York Central & Hudson River R. R. Company, and C. L. Bardo, superintendent electric zone; J. S. Doyle, superintendent car equipment Interborough Rapid Transit Company; H. N. Latey and F. R. Slater, of Latey & Slater Company; W. H. Sawyer, engineer Ford, Bacon & Davis; J. R. C. Armstrong, electric engineer New York City Railway; Alexander McIver, superintendent equipment, New York City Railway; W. C. Campbell, assistant superintendent equipment, New York City Railway; F. V. Greene, Westinghouse Air Brake Company; A. H. Sisson, St. Louis Car Company; J. G. Buehler, president and treasurer Columbia Machine Works, New York City; C. S. Hawley, Consolidated Car Heating Company. During the five and a half years he has spent in and about New York Mr. Clapp has been engaged in some of the most important electric railway propositions as special representative of the railway engineering and construction departments of the General Electric Company. Mr. Clapp has given particular attention to the installation and operation of the rolling equipment used in the electrification of the New York Central Railroad and to the cars for the Interborough Rapid Transit Company's system. He also equipped the cars for the West Jersey & Seashore Railroad, which it will be remembered was an installation of peculiar interest, because of the short time in which the contract was executed. Mr. Clapp has had long experience in railway matters. He is a son of F. Boardman Clapp, managing director of the Melbourne (Australia) Tramway and Omnibus Company. Before coming to America Mr. Clapp was for four years superintendent of motive power of the Brisbane Tramway Company, Brisbane, Australia.

Business Notes.

BLAKE SIGNAL COMPANY.—Mr. James Goldmark, 83 Warren Street, New York City, has been appointed local agent for its specialties by the Blake Signal & Manufacturing Company, of 246 Summer Street, Boston.

THE LORD ELECTRIC COMPANY announces that Mr. W. P. Cosper, well known to the railroad trade, has made arrangements to act as its agent in the Atlantic coast states, and will make his headquarters at its office, 213 West Fortieth Street, New York City. Mr. Cosper has had a long and successful acquaintance with the industry, having been associated with the Garton-Daniels Company and later with the Electric Service Supply Company.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED DEC. 10, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

873,005. KNIFE SWITCH; H. P. Ball, New York, N. Y. App. filed April 5, 1905. Relates to a method of constructing terminal clips of a knife-blade-switch of metallic stampings, which are compressed or crimped together into a unitary structure.

873,006. RHEOSTAT; H. P. Ball, New York, N. Y. App. filed Dec. 21, 1905. Provides a [illegible] closing device adapted to be protected against injury from abnormal load conditions or careless handling. The usual no-voltage and overload magnets are disposed co-axially of the pivot of the operating handle.

873,017. TROLLEY WIRE [illegible] App. filed Feb. 21, 1907. The trolley wire has a grooved upper edge [illegible]

873,021. ELECTROTHERAPEUTIC SYRINGE [illegible] electrodes.

873,036. TRANSFORMER; J. J. Frank, Schenectady, N. Y. App. filed May 1, 1907. Construction of transformer having a [illegible] and a plurality of [illegible] said core. Has series connections between each sec[illegible] a non-inductive circuit.

873,053. ELECTRIC CONDENSER; F. S. Koch, Chicago, Ill. App. filed [illegible] conducting and non-conducting materials. Has a metal core adapted to be [illegible]

873,061. ELECTRICAL CONTROL APPARATUS FOR STEAM GENERATORS [illegible] of fuel or the draft in steam generators by means of the rise and fall of steam pressure in the generator, within a predetermined range.

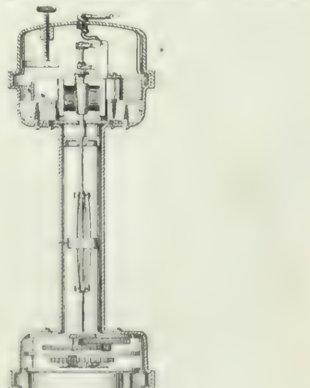
873,064. SYSTEM OF MOTOR CONTROL [illegible] tady, N. Y. App. filed April 6, 1907. A system of control for a [illegible] speeds.

873,066. MAGNETO-ELECTRIC DUMB BELL; James Moore, Manchester, [illegible] with hollow heads, one containing a spring motor and the other containing a magneto-generator driven by the motor. The circuit of the magneto has its terminals in the handles of the separate bells, [illegible]

873,072. DYNAMO-ELECTRIC MACHINE; J. E. Noeggerath, Schenectady, N. Y. [illegible]

with holes extending from said chamber to the surfaces of said members.

873,098. METER; E. Schattner, Schenectady, N. Y. App. filed March 24, 1905. A form of meter having an aluminum plate and a plate of [illegible] placed in a central conducting solution [illegible]

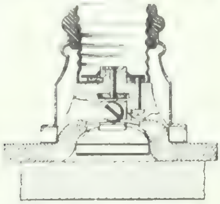


[illegible]

[illegible] into place.

[illegible] ductor comprising a plurality of insulated sections, and sources of alternating voltage connected each end of each section and earth and arranged to supply to adjacent sections relatively opposite potentials with respect to earth.

[illegible]



[illegible] of accumulator in which plates of treated wood are employed to contain the electrolyte and separate the lead electrodes.

[illegible] APPARATUS FOR USE IN STARTING AND CONTROLLING ELECTRIC MOTORS; A. Taylor, et al., Manchester, Eng- [illegible] pole switch designed to prevent the current being turned on too [illegible]

[illegible] TWO-WALL [illegible] a spiral conductor with threaded tips at its extremities where the connections are desired.

[illegible] FIELD COIL SUPPORT [illegible] volving field for alternating current generator in which the windings [illegible]

[illegible] TRANSFORMER [illegible] Jan. 15, 1906. A cooling means for transformers of large kilowatt [illegible] former, by which every part is effectively cooled.

,171. MOTOR CONTROL SYSTEM; W. J. Richards, Norwood, Ohio. App. filed Sept. 29, 1906. Relates to rolling mills and mine-hoisting machinery in which the motors must be frequently and quickly reversed. Has a control system comprising a generator and a motor, the armature of which is exclusively supplied by the generator, said armature being controlled.

,177. SYSTEM OF MOTOR CONTROL; W. F. Schneider, Norwood, Ohio. App. filed March 25, 1907. Provides means by which [illegible] ent results at different times. Is used in train service where dif- [illegible]

[illegible] STATIC ELECTRIC MACHINE [illegible] Neb. App. filed Apr. 22, 1907. Complete mechanical construction [illegible]

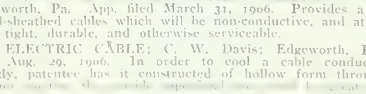
[illegible] JOINT FOR METAL-SHEATHED CABLES; C. W. Davis, Edgeworth, Pa. App. filed March 31, 1906. Provides a joint for metal-sheathed cables which will be non-conductive, and at the same time tight, durable, and otherwise serviceable.

,216. ELECTRIC CABLE; C. W. Davis; Edgeworth, Pa. App. filed Aug. 29, 1906. In order to cool a cable conductor more quickly, patentee has it constructed of hollow form throughout its [illegible]

,220. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, Orange, N. J. App. filed Nov. 23, 1903. A reversible galvanic battery of the type in which nickel hydroxid is opposed to finely-divided electrolytically active iron in an alkaline [illegible]

,253. COIL FOR ELECTRICAL APPARATUS; P. MacGahan, Pittsburg, Pa. App. filed Oct. 18, 1905. A meter coil including a plurality of spiral conductors which are assembled between the end [illegible]

,263. ELECTRIC CIRCUIT CONTROLLER; W. A. Paris, Edge- [illegible]



[illegible] turning the drum to its off position when both solenoids are energized.

[illegible] CONTROLLER [illegible]

[illegible] CONTROL SYSTEM FOR ELECTRIC MOTORS; [illegible] Aspinwall, Wilkinsburg, Pa. App. filed April 4, 1906. Provides [illegible]

[illegible] ELECTRIC APPARATUS [illegible]

[illegible] returning the aforesaid device to its initial position upon the in- [illegible]

,298. ELECTRIC MOTOR CONTROL; W. Cooper, Wilkinsburg, Pa. [illegible]

[illegible] ELECTRICAL DROP [illegible] lever is engaged and released by an armature, so that the armature [illegible] release it.

[illegible] ELECTRICALLY OPERATED COAL HOIST [illegible] son, et al., Pittsburg, Pa. App. filed Jan. 15, 1906. Has a magnetic clutch power transmitting apparatus, whereby power may be transmitted economically from a driving to a driven member.

,317. ELECTRIC HEATER; M. Landry, Merced, Cal. App. filed [illegible] arranged resistance conductor.

,328. PROCESS OF PRODUCING SILICIDS; E. F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. Relates to the production of ferosilicon in an electrical furnace.

,351. SYSTEM OF CONTROL; F. Darlington, Pittsburg, Pa. App. filed March 3, 1906. Has means by which the movement of one or more electric motors may be caused to correspond in direction and to be accurately proportional in extent to the movements of a master controller.

,362. LOCK-OUT SWITCH FOR PARTY TELEPHONE LINES; Oscar F. Forsberg, Chicago, Ill. App. filed Oct. 5, 1906. Relates to construction having step by step ratchet operated device.

[illegible] GROUND PLATE [illegible] Aug. 5, 1907. Has a shell enclosing an inner plate to which the conductor to be grounded is connected. The shell is covered with an absorbent and conducting material.

,382. STORAGE BATTERY GRID; J. Marx, Buffalo, N. Y. App. filed Jan. 2, 1907. A grid for a storage battery consisting of a framework provided with a series of superposed and horizontally [illegible] said bars.

,414. ARC LAMP; W. E. Daniels, Chicago, Ill. App. filed July 21, 1906. A lamp adapted for streets and parkways and including an inclosed arc and regulating mechanism all surrounded by a globular shade.

,415. ARC LAMP; W. E. Daniels, Chicago, Ill. App. filed Dec. 31, [illegible]

[illegible] TROLLEY AND HARP THEREFOR [illegible] Los Angeles, Cal. App. filed Aug. 8, 1907. The trolley wheel is [illegible] of deviating from the normal plane of its rotation.

,456. WIRE CARRYING CROSS ARM, AND INSULATOR THEREFOR; E. C. Ottinger, Dec'd, Newport, Pa. App. filed April 12, 1906. Patentee makes the telegraph pole cross arms logitudinally divided so as to clamp insulating bushings between them. The bushings are corrugated where they engage the conductor so as to grip it more positively.

,468. AUTOMATIC BLOCK SIGNALLING SYSTEM FOR ELECTRIC RAILWAYS; P. Townsend, Dec'd, New York, N. Y. App. filed June 29, 1906. A block signalling system for electric railways in which a direct current is impressed upon each block section and utilized to control translating devices governing the action of the signals.

,503. RECEPTACLE FOR THE DRAIN WATER OF REFRIGERATORS, AND ALARM THEREFOR; A. Casale, New Haven, Conn. [illegible] pan attains a certain weight.

,508. ELECTRO-DEPOSITION OF COPPER AND OTHER METALS; S. O. Cowper-Coles, London, England. App. filed Nov. 12, 1906. Improvements in the electro-deposition of copper or other metals from solutions which have to be maintained in an oxidized state, as for example, the deposition of copper from a cupric solution.

,522. THIRD RAIL; R. K. Eddowes, Philadelphia, Pa. App. filed Dec. 7, 1906. A third rail having an outer body portion supporting the conducting member face downward and insulated therefrom.

,587. RAIL MAGNETIC BRAKE; V. L. Ochoa, New York, N. Y. App. filed Feb. 23, 1907. From the frame of the trucks, there de- [illegible] duce a magnetic pole face adjacent to the track rail.

,588. PARTY-LINE TELEPHONE SYSTEM; Norman S. Page, New York, N. Y. App. filed Jan. 17, 1907. Complete diagram of circuits.

,638. BURGLAR ALARM; C. Van Bergh, Winnipeg, Manitoba, Canada. App. filed June 6, 1907. Among other features of a burglar alarm, patentee has a photograph which is stated to "give the alarm," as for instance, by calling "Help," "Police," with the intermittent ringing of an alarm bell.

,648. MAKING IRON FROM METALLIC SULFIDS; R. H. Aikes. [illegible] covering metallic copper or nickel or the alloys of these metals.

,660. BATTERY CONNECTION; G. P. Blow, La Salle, Ill. App. filed April 11, 1907. A construction of dry battery in which there are no screw connections or binding posts of any sort; makes use of spring plates extended from the electrodes and adapted to establish the circuit connections.

[illegible] TROLLEY HEAD [illegible] 45 per cent to either side of the normal running position.

[illegible] ELECTRIC TROLLEY [illegible] filed Aug. 14, 1905. A trolley of the toggle lever type adapted for [illegible] grooved pulley.

[illegible] ELECTRIC [illegible] SYSTEM [illegible] without assistance and avoid certain conditions incident to previous [illegible]

[illegible] ROTATING BRACKET FOR THE SUSPENSION OF ELECTRIC WIRES; C. E. Buckbee, Flushing, Mich. App. filed [illegible]

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NEW YORK, SATURDAY, DECEMBER 28, 1907.

CONTENTS

WILLIAM THOMSON, LORD KELVIN.

Every great leader of men, whose life history is associated with an advance of the world, is endowed with some vivifying idea, some creative impulse, which is his mission to communicate, and which constitutes his message to mankind. Without this power to communicate an idea, a man may be preeminent as a doer of great personal deeds, but not as a leader. William Thomson, who has just left us, was both. The achievements of his own power were numerous and great. They were more than sufficient to give him renown throughout the civilized world. But he accomplished much more. In the course of a long and active life he exerted by his personality a marked and perceptible influence on the mental attitude of the English-speaking race. The message which he imparted was the importance of mathematics when applied to engineering. William Thomson's father, Prof. James Thomson, was a distinguished mathematician, and was appointed to the chair of mathematics at Glasgow University in 1832, an appointment which he held until his death in 1849. William, born in 1824, inherited his father's mathematical ability, and united it with a keen, practical engineering instinct. His first papers, produced at the age of 17, when a student at the University of Glasgow, were directed to the mathematical theory of heat. He went immediately afterward to study at Cambridge and distinguished himself there in applied mathematics. At Cambridge, he graduated in 1845 as second wrangler, and was appointed in the following year to the chair of natural philosophy at Glasgow University, when only 22 years of age. At that time there were scientific men in England, as well as in Europe. There were also engineers. But the scientists paid very little attention to engineering, and engineers were too busy to heed the remote and abstract work of the scientists. There was almost as little communication between these two sets of workers as though they respectively occupied different planets. William Thomson was trained as a scientist, but always looked upon science through the eyes of a man seeking to apply the forces of nature. Practical suggestions, useful deductions, opportunities for definite measurement continually appear in his writings.

His work in electricity commenced with electrostatics. In the pursuance of this work from its mathematical side, he designed a series of electrometers for the measurement of electrostatic quantities. He demonstrated mathematically that the discharge of a condenser must necessarily by oscillatory in character when the resistance of the discharging circuit falls below a certain critical value. Following his investigations into discharges, he developed electromagnetic theory mathematically and in- [illegible] notably the reflecting galvanometer and the gravity electromagnetic balance. About the year 1855, the Atlantic cable became seriously discussed as a commercial undertaking, and Thomson gave his attention to the mathematical theory of electromagnetic signals along submarine cables. His results completely over-

turned existing ideas among the electricians of those days, and revolutionized the industry of manufacturing long submarine cables. This was an epoch in British industry. It had been confidently believed that the formulas and equations of scientific men could only thrive in the atmosphere of a college laboratory, and that they would wither and die sterile when transplanted into a factory. Yet, when certain directors had courage enough to attempt the application of Thomson's mathematics to cable manufacture, the new ideas were found hardy enough to reap a great harvest for the practical men. Steadily from that time industries have opened their doors to prospective scientific ideas, and all engineers now recognize the importance to their business of a knowledge of applied mathematics. To us and to our time this idea seems trite and self-evident; but when Thomson first came to the chair of natural philosophy at Glasgow, the proposition would rarely have escaped ridicule.

In his journeys across the ocean, Thomson was swift to note practical needs and defects on vessels at sea. In whatever he examined, he took a keen interest. His first endeavor was to submit what he saw to mathematical analysis, in order to understand the subject as fully as possible. Then his instinct was to develop and supplement the knowledge in a practical way. He examined the mariner's compass, a device that sailors had used for hundreds of years with hardly any change. Iron ships were springing into existence to the great disturbance of the compass needle and bewilderment of the navigator. Thomson worked to the basis of the subject and brought out his structural modification of the compass, a model that is far superior to the type it displaced, and which has come into almost universal use. He looked into navigation and elaborated Sumner's method for computing the position of a vessel from a pair of observations capable of being made at times other than the occupied noon hour. He saw the cumbrous hempen rope sounding machine which occupied several hours over a single deep sounding, and he substituted the pianoforte wire, which enabled a similarly deep sounding to be made in about one-eighth of the time, and devised means whereby shallow-water soundings could be made without stopping the ship. To nearly every department of physical science Thomson made notable contributions. In his early lifetime the doctrine of the conservation of energy was a novel and debated subject. His work in the obscure phenomena of heat did much to cement the foundations of that doctrine, as well as to place the applied science of thermodynamics on solid ground.

Queen Victoria knighted Thomson in 1866, the year of the completion of permanent submarine telegraphic communication between the United States and Great Britain. She also created a barony for him in 1892. Although he was thus honored by a peerage, yet, in a sense, Thomson conferred more honor on the peerage than the peerage was capable of reflecting upon him. A title in such a case is a cloud rather than a luster to fame. His life and work were prominent among the graces and glories of the Victorian age. Thomson was twice elected to the presidency of the Institution of Electrical Engineers in Great Britain, and was also an honorary member of the American Institute of Electrical Engineers and of the National Electric Light Association. He several times visited America and always expressed his admiration of American enterprise, energy and practical quality. His lectures in Baltimore on "Molecular Dynamics and the Wave Theory of Light" have become classic. His jubilee at Glasgow in 1896, to commemorate the fiftieth year of his service as professor in the university, was attended by a remarkable gathering of scientific men from all parts of the world. He has left to us his papers, his scientific discoveries, his inventions, and his apparatus. But he has left to us, in addition, the spirit of investigation not merely for the sake of knowing, but also for the sake of doing and of serving our fellows. A host of men in all parts of the world carry on the work which he initiated for England and for the speakers of English. That work is the translation of the quantitative laws of the universe, the thoughts of Nature, into living ideas and into mechanical realizations for the benefit of all who live now or shall live hereafter.

Dividends.

It is an interesting fact that the dividends and interest declared and payable on and after Jan. 1, on securities quoted in New York, reach the enormous total of over $190,000,000. This, of course, is far from representing the total yield from stocks and bonds dealt in by the various exchanges all over the country, but is impressive enough as it stands, and the amount is about $10,000,000 more than a year ago. There is no reason to believe that it will not be $10,000,000 more in January, 1909, for the railroads and industries of the country are more likely to have a good year in 1908 than in the periods of depression and discouragement that have marked 1907. In addition to that, the policy of economy and retrenchment wherever not pushed too far should bring with it a larger net than heretofore, helped by lower and more reasonable prices for raw materials and supplies in general. It is a great mistake to suppose, as does President Gompers, of the united labor unions, that high prices and high wages mean high profits all around. Indeed, the converse is often nearer the truth, and labor is often a laggard in the struggle to keep up with the advancing prices that mark up the cost of living. All that is needed is that the wage fund shall not be impaired relatively to the scale of other things that enter into the political economy and social economy of a nation.

Elsewhere we print a very respectable list of the electrical dividends declared during the current week. The list is by no means complete, as it includes only what may be termed the dividends that are advertised. But they are symptomatic and show a general maintenance of rate. Even where dividends have been passed, the policy of prudence is avowed as to ensuring an early return to a distribution of the profits earned. A great many people owning these stocks as new purchasers are now receiving a larger return on their savings than they ever enjoyed before, and in due time they will find their capital increased by the reestablishment of normal values, whether of bonds or of stocks.

Power in the Piedmont.

Nothing gives a more striking idea of the industrial development of the New South than such reports of its power developments as are given in our columns this week. The cotton manufacturers have been turning homeward at an astonishing rate within the past decade and the general availability of water powers in the Piedmont region gives prospect of steady prosperity. As is well known, the Southern Appalachian region is one of very heavy rainfall, the largest in the country save for a portion of the Coast Range across the continent. The

streams descend rather abruptly to the coastal plain and the chances for cheap power development are of the best. It is worth noting that the electrical power already used in Southern mills rises to about 75,000 kilowatts (which exceeds in fact the amount used in the New England mills) and the total power used in the mills is about 225,000 kilowatts. The work of the Southern Power Company in utilizing the natural advantages of the Piedmont is far-reaching in its influence, and the Great Falls plant described in our columns takes rank not only as the largest hydro-electric plant in the South, but as one of the largest in the country. Thirty thousand kilowatt plants are and always will be scarce, since rich as our country is in water powers, it takes an unusual combination of large flow and high head to generate this amount of power. The Great Falls plant involves no difficult or sensational engineering. The hydraulic features of the system were determined by the fortunate topography, and it was possible to construct a very simple and convenient plant with the wheel cases actually built into the retaining wall of the forebay, giving ideal conditions for close regulation. The high head available, 72 feet, insures an economical hydraulic and generating plant and the whole installation impresses one as singularly effective and workable.

An interesting feature of the transformer plant is the fire-extinguishing equipment which is arranged to pour a stream of carbon dioxide gas into any transformer case. The case can also be emptied of oil by a channel into the tail race in case of fire. We are not aware that the efficacy of carbon dioxide in fighting a transformer fire has ever been tried out in practice, but on general principles it ought to be pretty effective, as oil needs a very liberal supply of oxygen for its combustion.

It is interesting to note that another plant nearly as large as that at Great Falls is already under way and that the power utilized and on the road to utilization by the Southern Power Company aggregates about 150,000 kilowatts. Were it not for the high freight rates, it is safe to say that the Piedmont region would rapidly become the cotton manufacturing center of the country. The rising cost of fuel must steadily act to drive manufacture into regions of cheap power, while cost of living and climatic conditions are decidedly in favor of the South. The mills that work up native cotton ought in the nature of things to be near the cotton supply, and if cheap power were reinforced by cheap transportation, the South would quietly come into its own. Enterprises such as are being carried out by the Southern Power Company are a national benefit, and the more we have of them, the better. It is not generally known that the Southern states have recently passed the New England states in the horse-power used in manufactures —with much of its water powers still to be utilized like this.

The Most Economical Shape of Winding for Electrical Measuring Instruments.

An interesting solution of a problem in the design proportion of electrical measuring instruments of the moving-coil type is given by Mr. A. P. Young, on page 1247 of this issue. The author shows that a coil revolving in a magnetic field of uniform density exerts the maximum torque per unit weight when it is circular in shape. An examination of the author's equations, or a little consideration of the physical facts upon which they are based, will show that the torque exerted by a coil in a uniform field varies directly with the area which the coil surrounds, quite independent of its shape. The weight of the coil evidently varies directly with its length. Thus, the maximum ratio of torque to weight is found when the shape of the coil is such that its area bears a maximum ratio to its length. It is seen at once, therefore, that the coil should be circular.

A comparison of the solution given by the author and the one outlined above, brings forward the two definitions of torque. That is to say, torque may be considered as the tendency to rotation produced by a pivoted conductor conveying current in a magnetic field, as has been done by the author, or it may be treated as that quantity by which speed must be multiplied in order to obtain mechanical power, as tacitly assumed above. A coil of any shape in a uniform field making one complete revolution in a certain time will have generated within it an e. m. f. which will vary directly with the area of the coil. The product of this e. m. f. and the current gives the power, which divided by the speed of rotation indicates the torque. Since for a certain value of current and a chosen number of turns, the e. m. f. and the power vary directly with the speed, the torque is independent of the speed. The torque, however, varies with the e. m. f. for constant speed, and hence the average torque varies directly with the area surrounded by the coil.

Parallel Operation of Alternators.

On page 1243 of the present issue there is given an instructive discussion of the parallel operation of alternators, by Mr. Waldo V. Lyon. The author has based his demonstration on the assumption of constant synchronous reactance of the armature circuits, and has properly called attention to the fact that his discussion has definite limitations. Certain of the characteristics of synchronous alternators and motors can be determined with a good degree of accuracy by the use of methods involving the assumption of constant synchronous reactance. In applying the methods, however, one should not forget the conditions under which the limitations are reached. Neglect to consider the limitations imposed by the cumulative inaccuracies in the assumption of constant synchronous reactance with decrease in the field strength of one alternator in parallel with another of constant field strength, has led the author to conclude that if the field circuit of the first alternator is opened, the entire load is removed from its prime mover, and its speed increases to at least the no-load value. The fact is, however, that so long as the alternators are held in step by the "synchronizing current" the power which each receives from its prime mover is in no wise affected by the variation in the field strengths, because the division of load between the prime movers is determined solely by mechanical considerations relating to the relative rates of supply of energy to them. If the load which the prime mover attempts to deliver to the alternator with the weakened field represents a torque greater than the "synchronizing current" can maintain, then this alternator no longer remains "in step" and it "drops the load." It is not proper to infer that the torque of the "synchronizing current" is zero when the field curcuit is open. As a matter of fact an alternator with projecting field poles can carry a considerable load when its field circuit is open, the magnetomotive force of the lagging wattless current supplied from other alternators serving for exciting the field mag-

National Electric Light Association.

At the Washington convention of the National Electric Light Association last June, the Class "D" members (manufacturers) of the association made a most attractive exhibition of electrical apparatus and appliances. During the convention these exhibitors got together and offered to relieve the association of the troubles and responsibilities connected with the organization and maintenance of such exhibits at the annual conventions. The executive committee of the association approved a plan whereby the Class "D" members were to recommend annually an "Exhibition Committee" of their number. This committee, upon recognition by the president, would elect its own chairman, and organize to conduct the work pertaining to manufacturers' exhibits at the convention.

A nominating committee was formally appointed consisting of Mr. Geo. F. Porter, chairman, Atlantic Insulated Wire Company; Mr. T. G. Whaling, Westinghouse Lamp Company; Mr. Alex Henderson, American Circular Loom Company. The ticket presented by this committee to the Class "D" members has been approved by a mail ballot and accepted by Mr. Dudley Farrand, president of the N. E. L. A. This committee, known as the "Exhibition Committee," is as follows: Mr. F. H. Gale, General Electric Company; Mr. J. C. McQuiston, Westinghouse Companies; Mr. H. P. Heger, Allis-Chalmers Company; Mr. Rodman Gilder, Crocker-Wheeler Company; Mr. H. M. Post, Western Electric Company; Mr. C. P. Frey, Western Electrical Instrument Company; Mr. Benj. Wall, Metropolitan Engineering Company; Mr. James I. Ayer, The Simplex Electric Company; Mr. S. E. Doane, National Electric Lamp Association.

On Dec. 6, the committee met in the association rooms in New York, and elected Mr. F. H. Gale, chairman. A committee on by-laws and rules was appointed, and preliminary plans regarding the convention next June were discussed. The committee is, of course, subject to the executive committee of the association, and will co-operate fully with the president and other officers in making arrangements for the convention.

Development of Hudson River Power.

The application of the Hudson River Power Company for further privileges has been approved by the Public Service Commission of the Second District of New York State. The company proposes to extend its plant and to issue $3,232,000 5 per cent 40-year gold bonds to cover the expense for the proposed improvements and extensions. The opinion is by Commissioner Decker, and in it the policy of the commission is defined. Considerations set forth in the opinion include: "An order by the commission authorizing the issue of a portion of the bonds covered by a mortgage carries no implication of consent upon a future application as to all or any of the remaining bonds provided for in such mortgage. An application to issue additional capital involves the following, among other principal considerations: The purposes to which the proceeds arising from the sale of the securities are to be applied. The amount reasonably necessary for the consummation of such purposes. The character of the securities proposed to be issued. Whether any proposed construction or extension is likely to create unhealthful conditions, or otherwise constitute a public nuisance, infringe upon the vested rights or impede the necessary operations of other public service corporations, or interfere with the flow of water in a navigable stream to the extent of impairing its public use. Whether there is a reasonable prospect of fair return upon the investment proposed, to the end that securities having apparent worth, but actually little or no value, may not be issued with the sanction of the commission. Whether its new construction or improvement appeared feasible as a business proposition, but without reaching and announcing a conclusion that the proposed construction or improvement actually constitutes a safe or attractive basis for investment."

The Hudson River Electric Power Company proposes to construct and operate a storage dam, power dam, and electrical power plant on the Sacandaga River. It also plans to construct and operate electrical transmission lines for the proposed plant to Saratoga, Ballston, Mechanicsville, Troy, Albany, Watervliet, Schenectady, and Amsterdam. It intends to issue 3232 40-year gold bonds of $1,000 denomination, each bearing interest not to exceed 5 per cent per annum.

The company has agreed to sell to the state within three and one-half years the property and improvements involved in the storage dam, at a price not to exceed the amount of capital annually invested. By this agreement the state is to construct a much larger dam, which would benefit materially the company in its operation on the river below the storage site, including insurance of a steady supply of water in dry seasons.

Under a rule prescribed by the commission, the order to be issued in this case will contain provisions requiring the company to report under oath the sale, or sales, of the bonds authorized, the terms and conditions of such sales, and the amount realized therefrom; to make a verified report at least once every six months, showing in detail the use and application by it of the moneys so realized until such moneys shall have been fully expended.

Meeting of Pittsburg A. I. E. E. Branch.

At a meeting of the Pittsburg Branch of the A. I. E. E., held Wednesday, Dec. 4, in the lecture hall of the Carnegie Institute, Mr. J. H. Schoeff, of the Westinghouse Electric & Manufacturing Company, abstracted Mr. Armstrong's New York paper entitled "Comparative Performance of Steam and Electric Locomotives," emphasizing important points in the paper. Among them were the facts that at higher speeds the electric locomotive develops comparatively more tractive effort than the steam locomotive, and that the former is superior on mountain grades for hauling freight. He estimated the time a steam locomotive is idle during the day on account of standing at stations, at blocks, etc., and stated that on account of having to keep up steam all the time, the locomotive lost on an average 400 lbs. of coal per hour.

Mr. A. W. Gibbs, general superintendent of motive power of the Pennsylvania Railroad Company, sent a letter touching on some of the points along which the steam locomotive designer was working, as follows:

"You should bear in mind that the present capacity of the steam locomotive is largely a question of the capacity of the fireman to adequately stoke it, and this is the principal reason why there is a prevailing feeling that the older smaller locomotives were proportionately better than the modern large ones. The introduction of a mechanical stoker, which is probably a question of but a short time, will materially change this condition.

"Furthermore, considering an increase in the capacity of the road by whatever power is found most advantageous, will still leave the choke at the usual place, viz., the terminals. Moreover, the capacity of existing lines, especially double-track ones, is governed very largely by the presence on the line of trains having several rates of speed. While the use of a locomotive which will make high speeds with heavy trains will enable movements to be made which might not be made with a locomotive of slow speed, nevertheless what would most largely tend to economy of the movement is unification of the speeds. Finally, in considering the use of locomotives having sufficient power to maintain high speeds with heavy loads, it should not be overlooked that the construction of the electric locomotive as a vehicle which will maintain such high speeds without damage to track still requires attention."

Mr. Malcolm MacLaren, formerly of the British Westinghouse Company, discussed the subject of steam versus electric locomotive limitations. He compared the 1200-volt direct-curent and the alternating current systems. He showed that for some speeds and work the former is more economical, but, on a whole, discouraged the use of the high-voltage direct current system.

Mr. W. Cooper, of the Westinghouse Company, discussed the subject of steam versus electric locomotives from the control standpoint. He called attention to the fact that the electric trains can be braked by means of electrical control, while on some steam roads great trouble is experienced from hot brake shoes and wheels, the heat becoming so intense in some instances as to crack off the wheel flanges. He also pointed out that it is possible to run trains of practically any length by an arrangement of electric locomotives distributed through the train and controlled by one man, which is impossible with the steam locomotive.

Mr. N. W. Storer stated that it is not practical for steam roads to change over all their equipment at once from steam to electric, but that it would pay to electrify a great many terminals and mountain divisions with steep grades. Upon one occasion he was snowed up in a Northern Pacific train for several days with very little to keep him warm. The principal trouble seemed to be the inability of the locomotive to keep up steam on account of the severe cold. He pointed out that if the train had been propelled by an electric locomotive no delay would have been experienced, as the colder the motors the more efficiently they work.

Mr. C. F. Scott called attention to the greater cleanliness of the electric locomotive and pointed out that all the limitations of the steam engine have been exceeded by the electric locomotive. He had just received word from Indianapolis that an electric locomotive in use in that neighborhood now makes an average run of 586 miles per day.

Electrical Energy Transmission in Central Colorado.

At the time of the last convention of the Colorado Electric Light, Power and Railway Association, held at Denver in September. President George B. Tripp referred to the extensive electric transmission work under way in that state. As a matter of general interest, therefore, information has been compiled for a map of the central part of Colorado which shows some of the principal transmission lines built and projected. This map is shown in Fig. 1.

The oldest hydro-electric transmission system in the state is that of the Telluride Power Company, marked No. 2 on the map. Feeding into the same mining district, and interconnected with it, is a more recent project, the Animas Power & Water Company, which has a water-power plant on the Animas River, near Rockwood.

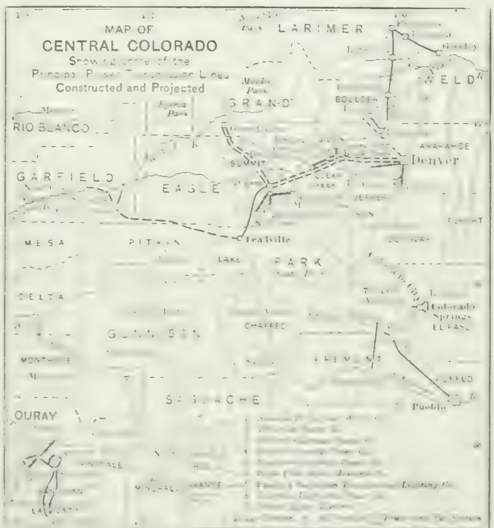
The next important transmission line to be built in Colorado after the Telluride Company began operations was that from Canyon City to Cripple Creek (No. 8), which is about 26 miles long. The power plant is operated by steam and is located near coal mines at Canyon City. It supplies most of the electric energy in the Cripple Creek mining district, where the price of coal is very high.

Another line originally built to supply energy to the Cripple Creek district is that now owned by the Pueblo & Suburban Traction & Lighting Company (No. 7). This has a water-power station in the mountains a short distance from Victor in the Cripple Creek region. There is also a transmission line in the opposite direction to Pueblo. The line to Pueblo, however, is unused much of the time because the energy can be sold to better advantage in the Cripple Creek district where coal is expensive. Coal is cheap at Pueblo, and should occasion require, sufficient apparatus could be put in at Pueblo to feed energy back to Victor.

In the Colorado Springs district is a system (No. 6) which is supplied with energy principally by the Pike's Peak Hydro-Electric Company, which has a water power with 2200 ft. head at Manitou. This feeds at Colorado City into a triangular network owned by the Colorado Springs Electric Company, which distributes the electricity. The Colorado Springs Electric Company also has a steam plant at the coal mines at Roswell and a sub-station at Colorado Springs. At the latter place it also maintains a steam plant for supplying a limited amount of exhaust steam for heating purposes.

A third interesting example of a steam power station located at coal mines and transmitting long distances is the recently finished plant of the Northern Colorado Power Company at Lafayette. This plant supplies energy to 11 towns. These towns are all located in highly-cultivated river valleys a short distance from the foothills. While coal is not high in price in these towns, the size of the plants in towns of from 2000 to 10,000 inhabitants is not such as to be conducive to economy, hence the reason for the transmission system. This plant is also to supply electric energy to the Colorado & Southern Railroad between Denver and Boulder.

The most ambitious project for energy transmission in Colorado is that of the Central Colorado Power Company. The lines proposed and under construction are those numbered 3 on the map. Construction has been begun on a station near Glenwood, a plant near Boulder and a power house in Gore Cañon. This company's plans cover future developments amounting to 75,000 kilowatts. Only a small part of this, however, is to be developed soon. The transmission lines are to be on steel towers with spans of varying length; the spans, between peaks where plenty of sag can be allowed, being as long as 3000 ft.. The towers will carry two circuits of copper conductors on suspension link insulators and two steel ground wires. The voltage is to be 50,000, 87,000 or 100,000, according to the way the transformers are connected. From Gore Cañon to Denver a duplicate line is planned. At the Boulder station water storage is provided, which can be used during high



MAP OF TRANSMISSION LINES.

peak loads—an important point in a plant located near such a market as Denver. The Central Colorado Power Company has been engineered by Curtis & Hine, of Colorado Springs, who are also engineers of the Animas Power & Light Company.

The United Hydro-Electric Company, with a plant at Georgetown, supplies energy to several lines of towns in the Cripple Creek district.

The Summit County Power Company, in which Mr. Henry L. Doherty is interested, is projecting a system having a water power plant at Kokomo, to supply energy to mines in the Dillon and Breckenridge district. It will thus be seen that Colorado is very active in energy transmission work, both from water-power plants and from steam plants located at or near coal mines.

Cornell A. I. E. E. Meeting.

At the regular meeting of the Cornell University A. I. E. E. Branch, held in Sibley College, on Friday evening, Dec. 6, an audience of 273 was present. The speaker of the evening was Mr. W. N. Smith, electric traction engineer of Westinghouse, Church, Kerr & Co. Mr. Smith's paper, which was the first formal institute paper presented before the Cornell University Branch, was entitled "Practical Aspects of Steam Railway Electrification."

The speaker dwelt particularly upon the necessity of a study of electrification from all points of view. In the discussion Prof. H. W. Hibbard, head of the railway mechanical engineering department of Cornell University, expressed his appreciation of this kind of treatment of the problem. Prof. Hibbard felt that to a certain extent the steam railroad man has been ignored in the electrification problem. He emphasized that there is no antagonism to electrification on the part of steam railroad men, where the conditions seem to warrant its introduction. He did not feel, however, that electrification should be forced upon steam railroads, but rather that it should be adopted as necessary when conditions fully warrant such adoption. The steam railroad man is first and foremost a transportation engineer regardless of the source of motive power.

Prof. V. Karapetoff discussed the problem from the standpoint of power supply, comparing the steam locomotive to a "power plant on wheels." He also drew attention to the gasoline-electric car as having a bearing upon the subject of the evening. The informal smoker after the meeting was an important feature of the occasion, and was largely attended. Simple refreshments were served by the entertainment committee, and music was supplied by local talent. The text of Mr. Smith's paper will appear in due course in the *Transactions* of the institute.

Meeting of the Cleveland Section of the A. I. E. E.

The second regular monthly meeting of the Cleveland section of the American Institute of Electrical Engineers was held Monday evening of last week in the Electrical Engineering Building of Case School of Applied Sciences, following an informal dinner at the Rathskeller. The subject for the evening was "Transmission and Distribution Systems of the Cleveland Electric Illuminating Company," being a paper presented by Mr. Wallau. Both direct and alternating currents are produced at the central station. Direct current is furnished to the territory adjacent to the station on Canal Street. A sub-station on Seventeenth Street is equipped with rotary converters and transformers, to enable the company to furnish direct current at the proper potential to patrons.

Mr. Wallau said that there should always be spare cables installed to take the place of any that may break down, so that there may be no interruption of the service. Rotary condensers (over-excited synchronous motors), he said, had been installed on the premises of some patrons where the amount of service warranted, and others are installed in the sub-stations. The condensers should always be located in the vicinity where low power factor is the rule.

Three-phase feeders are used for the lighting circuits, so that energy may be supplied to small motors.

Mr. Lewis, who opened the discussion, described a number of other interesting points in connection with this system. His remarks were really an elaboration of the matter brought out in the paper. He has been associated with the author in the engineering work of the company.

Mr. Ricker referred to the question of grounding the neutral, which had been brought up, and gave an account of experiences that had come under his observation. A superintendent of a large plant in the East considers the importance of the neutral ground rather doubtful, he said. Breakdowns and interruptions of service are likely to result. Speaking of the use of an auxiliary discharge-gap, Mr. Ricker said that it has been known to cause oscillations that produce very high momentary voltages, the result of which is sometimes a discharge from an unexpected point.

In replying to some of the questions asked, Mr. Wallau said that the neutral was grounded in the first place as a means of safety to the men. While the grounding has led to some trouble with return currents over the wires, it has also resulted in smooth working of the automatic circuit breakers. The static dischargers consist of three 23-volt lightning arresters connected in series and connected with the ground with slight resistance, about 6½ ohms, current capacity, 500 amperes. The resistors consist of concrete blocks with metal strips set in and connected in multiple between the neutral point and the ground.

The low power-factor of the system, he said, is due to the large number of induction motors. Often motor salesmen sell motors of too high a rating, and such machines demand an excess of wattless current.

Motor-generator sets can not be installed on the premises of patrons, because of the attention they require. In the sub-stations the rotary condensers increase the power-factor very materially. Some of the condensers used were designed especially for the company, while others are not of special design.

Lightning arresters are installed on poles where the lines are connected to the underground cables, in order to prevent lightning disturbance from entering the cables at all. He believes this a better plan than having the arresters at the sub-stations. Since railway tracks were well bonded and the lighting lines arranged so that the cables were positive to the rails, there has been little variation in the potential from that cause.

American Copper Production.

The U. S. Geological Survey has just given out some interesting figures as to copper production in this country in 1906. They are summarized below:

Production of copper:		
Smelter output....................pounds..		917,805,682
Value of domestic production of copper....		$177,595,888
Mine production....................pounds..		916,971,387
[illegible]	[illegible]	
Lake .... do ..	205,6[illegible]8,382	
Casting .... do ..	33,459,413	
Total:		
Domestic ....pounds..		887,682,387
Domestic and foreign........ do ..		1,079,052,409
Total ore treated................short tons..		19,743,000
Average yield of copper..........per cent..		2.15
Copper ore treated..............short tons..		18,000,000
Average yield of copper..........per cent..		2.50
Imports, in terms of refined copper..pounds..		215,402,841
Exports, in terms of refined copper... do ..		446,750,711
Consumption:		
Electrical purposes ....pounds..	340,000,000	
Brass manufacture .... do ..	210,000,000	
Copper sheets, etc................ do ..	35,000,000	
Castings, etc. .... do ..	100,000,000	
Total ....pounds..		685,000,000
Prices of refined copper:		
Electrolytic ....cents per pound..		19.30
Lake .... do do ..		19.55
Castings .... do do ..		19.[illegible]0
World's production..................pounds..		1,596,973,700

The bulk of the copper of domestic origin turned out by the smelters in 1906 was derived from approximately 19,743,000 tons of ore. This tonnage represents the quantity of ore which reached the copper smelters during the year either directly in smelting ore or indirectly—for example, in the form of concentrates—and it includes a considerable quantity of ore which was not mined expressly for its copper content. Ores in which the copper is of subordinate importance comprise dry or siliceous gold and silver ores, lead ores carrying sufficient copper to make its recovery profitable, cupriferous zinc and pyritic sulphur ores the "cinders" of which are subsequently smelted for copper, and ores mechanically concentrated for values other than copper. Ores of this class can not be separated sharply from distinctly copper ores, and the figures representing their quantity (1,700,000 tons) are only approximate.

Of the total ore tonnage approximately 5,021,000 tons, or about 26 per cent, were of sufficient richness or of so favorable

metallurgical character as to be smelted without concentration. The remaining 14,722,000 tons were concentrating ores, from which were produced 2,985,000 tons of concentrates, the average concentration being slightly under 5 into 1. A small quantity of copper was produced without the mining of any ore by the treatment of mine waters, and included with the concentrating ores is a small tonnage extracted by leaching processes. In both cases the copper was recovered from solution by replacement of scrap iron, and the resulting "precipitate," or cement copper, which may be regarded as a high-grade concentrate, went into the smelters.

Luncheon to Mr. Arthur Williams.

At the Engineers' Club, New York City, on Dec. 18, a luncheon was given to Mr. Arthur Williams, chief inspector of the New York Edison Company, by his colleagues on the board of the American Museum of Safety Devices and Industrial Hygiene, in recognition of the decoration of Oficier de l'Instruction Publique conferred upon him by the French government. Mr. Williams, who is a past president of the National Electric Light Association and of the New York Electrical Society, was actively connected with the preparation of the "public welfare" exhibit made by his company at the Milan Exposition with great éclat and afterwards transferred to Paris, where it again attracted considerable attention. He has also taken an active and sympathetic part in the creation of the new Museum as an agency for the protection of the life and limb of the great American army of industrialists.

The luncheon was given in the banquet hall of the club, and while brief was a most enjoyable affair. No fewer than 60 attended, including Messrs. R. W. Gilder and R. U. Johnson, of the *Century Magazine;* S. E. Moffett of *Collier's Weekly;* Walter C. Kerr, a trustee of Cornell University; Prof. F. R. Hutton, of Columbia University; Dr. A. C. Bumpus, of the American Museum of Natural History; Rev. Percy S. Grant; H. G. Stott, president American Institute of Electrical Engineers; Dudley Farrand, president National Electric Light Association. All the electrical interests were represented, including a number of Mr. Williams' associates headed by Messrs. N. F. Brady and T. E. Murray. The technical press was also out in force. Dr. W. M. Habirshaw was present wath several other personal friends of the guest, and Mr. G. H. Guy appeared for the New York Electrical Society.

The following exercises were presided over by Mr. T. C. Martin, and the presentation of the order was made by Dr. W. H. Tolman, on behalf of the French Republic. Brief but admirable speeches were made by Dr. Josiah Strong, president of the Museum, and Mr. John W. Lieb, Jr., who gave a most interesting account of the insurance work of the New York Edison Company on behalf of its employees. Mr. Martin announced that the Travelers' Insurance Company, of Hartford, had taken a large space in the Museum which is soon to be opened to the public, this space to be called the "Industrial Chamber of Horrors," including examples of defective apparatus and appliances that have actually caused loss of life and limb. The Holophane Company has also equipped the Museum gratuitously with its globes and reflectors and laid out a lighting scheme in consultation with the consulting engineer. An appeal was made at the close of the luncheon for a small equipment of tools for the museum shop or laboratory, similar to that in the Munich Museum. Copies of the gold medal founded in the new Museum by the *Scientific American* were circulated for inspection.

Satisfactory Report on Westinghouse Electric.

Haskins & Sells, certified public accountants, in compliance with the request of the receivers have made an audit of the books and accounts of the Westinghouse Electric & Manufacturing Company, which was made public after the meeting of the creditors, last week. The consolidated and condensed statement of income of the Westinghouse Electric & Manufacturing Company, and subsidiary manufacturing companies in the United States, shows a balance available for the payment of interest and dividends for the seven fiscal years ended March 31, 1907, and for the seven months ended Oct. 31, 1907, as follows:

	7 mos. ended Oct. 31, 1907.	Total for 7 years and 7 mos. ended Oct. 31, 1907.	Average per annum for 7 years and 7 mos. ended Oct. 31, 1907.
Sales	$22,265,322	$181,723,643	$23,963,557
Cost of sales	19,334,540	154,411,675	20,361,979
Net earnings	$2,930,782	$27,311,968	$3,601,578
Other income	869,833	5,328,929	702,716
Total income	$3,800,615	$32,640,987	$4,304,294
Inventory adjustments, etc.	717,393	3,951,961	521,137
Net income applicable to int. and div'ds	$3,083,222	$28,688,936	$3,783,157

The credits made to the company's surplus account during the seven years and seven months ended Oct. 31, 1907, which are not included in the statement of earning and expenses, because they cannot be considered as income applicable to the payment of interest and dividends, being of an extraordinary and unusual nature and not dependent upon the regular operations of the business, are as follows:

Premium on capital stock sold during the period	$5,884,150
Profit on stocks and bonds sold during the period	1,465,890
Profit on real estate sold	84,200
Profit on exchange of assenting capital stock for non-assenting capital stock under terms of reorganization of 1892	2,357
Unclaimed dividends	126
Profit through adjustment of Sawyer-Man Electric Company accounts previously charged off (prior to the year 1901)	143,987
Miscellaneous	67,516
Total	$7,648,247

The charges made by the company against its surplus account for items of an extraordinary nature, which were not applicable to the income, prior to determining the amount available for interest and dividends, and which are not included in the income statement, have been as follows:

Interest	$6,682,414
Dividends on stock	14,384,632
Depreciation of sundry stocks and bonds, consisting principally of stock of Consolidated Electric Light Company, U. S. Electric Lighting Company, Multiphase Motor Company, Electro Magnetic Traction Company and Manhattan General Construction Company	1,290,177
Amount charged off in connection with closing up the Walker Company matters	981,056
Special charges for depreciation in addition to those included in the operating expenses	807,876
Premiums and commissions on debenture certificates purchased	45,535
Amount paid Westinghouse Glass Company for purchase of lease of property required by Allegheny Foundry	12,234
Fire loss, Chicago stock	18,210
State tax on increase of capital stock	25,111
N. Y. Stock Exchange fee for increase capital stock	650
Services of Trust Company in connection with capital stock Consolidated Electric Lighting Company	500
Cost of moving lamp factory from Pittsburg to New York	100,161
Devising and installing accounting system	52,000
Commissions on issues of capital obligations	780,000
Legal services and expenses in connection with the issue of capital obligations	14,418
Discount on ten-year collateral notes	202,703
Discount on convertible bonds charged off	158,333
Amount paid Geo. Westinghouse for payments made in the interest of the company to various officers, engineers and other employees of Electric Company, in addition to their regular salaries paid by the company during last 10 or 12 years	400,000
Miscellaneous	15,058
Total	$26,091,079

The increase in the surplus account of the Westinghouse Electric & Manufacturing Company and subsidiary manufacturing companies in the United States during the seven years and seven months ended Oct. 31, 1907, has amounted to $10,246,104, as follows:

Net income available for interest and dividends	$28,688,936
Other profit and loss credits	7,648,247
Total credits	$36,337,183
Charges made against surplus account	26,091,079
Balance being the increase in the surplus account	$10,246,104

The creditors and stockholders of the Westinghouse Electric & Manufacturing Company who have been working out the details of the plan for raising new capital and restoring the company to its stockholders, after a long conference last week announced the organization of a committee of creditors, of which James N. Jarvie, representing the National Bank of Commerce and other financial institutions, was made chairman.

[illegible] of the National Park Bank; James N. Jarvie, representing the National Bank of Commerce and other financial institutions; Albert H. Wiggin, vice-president Chase National Bank; F. H. Skelding, president of the First National Bank of Pittsburg; Charles A. Moore, of Manning, Maxwell & Moore; Neal Rantoul, of F. S. Moseley & Company, of Boston. A seventh member residing in Chicago is to be added.

Electrical Energy from Wind Power.

According to U. S. Consul-General Richard Guenther, of Frankfort, in Germany wind motors as power generators for use in agricultural and industrial pursuits are rarely met with, but in Denmark their use has increased very greatly. The consul-general continues: Since 1897 the Danish Government has contributed about $28,000 for equipments and has even lately erected an experimental station at Askoc. A technical writer describes these experiments, which were made on the initiative of the Danish government, and also some of the electric works in Denmark which generate electricity by means of wind motors. According to his statements, motors with four wings have given the best results, as a smaller number of wings does not fully utilize the wind power, while a larger number acts detrimentally upon the wind current between the wings.

If a medium large wind motor is used with a wing surface of about 48 sq. meters (1 sq. meter equals 10.764 sq. ft), 8 horse-power is obtained at a wind velocity of 6 meters per second (1 meter equals 3.28 ft.). At a velocity of 8 meters the horse-power is more than doubled. A wind with a velocity of 8 meters per second is no rarity. The weather reports classify it as No. 3, while the highest wind velocity is No. 12. Since 1903 there has been in existence the Danish Electricity Company, as a result of whose agitation 30 larger and smaller wind-power electrical equipments are in operation in Denmark.

CURRENT NEWS AND NOTES.

CHILEAN WIRELESS.—The German Wireless Telegraph Company is negotiating with the Chilean government for the establishment of a wireless telegraph system required to connect Valparaiso and Punta Arenas.

NORTHWESTERN ELECTRICAL ASSOCIATION.—This body will hold its next annual meeting at the Hotel Pfister, Milwaukee, in the club room, on Jan. 15 and 16. Mr. R. N. Kimball, of Kenosha, Wis., is the secretary and treasurer.

LORD KELVIN'S REMAINS IN WESTMINSTER.—In a London dispatch it is stated that the body of Lord Kelvin has been interred in the nave of Westminster Abbey, upon the petition of the Royal Society. Other great leaders in science now lying there are Newton, Herschel and Darwin.

TELEPHONY IN CUBA.—At Havana, on Dec. 18, Fernandez de Castro, president of the Agrarian League, presented to Governor Magoon, on behalf of the league, a petition requesting the modification of the existing telephone law, so as ultimately to end the present telephone monopolies, which, the petition says, confine the telephone services within the boundaries of their respective municipalities. The league asks that unrestricted telephonic communication throughout the island be permitted and that all private lines be free from taxation.

WIRELESS IN THE ARMY.—Wireless telegraph experts at the U. S. Army station at Fort Omaha have, according to a dispatch from Omaha, made discoveries in the wireless field which permit of comparatively long distance telegraphing from very short towers. Among the possibilities of the new system is telegraphing to and between moving trains. On Dec. 18 messages were sent over a distance of 20 miles by using towers less than 20 ft. in height. The experts believe this distance can be lengthened very materially without increasing the height of the towers.

McGILL UNIVERSITY.—It is noted from Montreal, Canada, that the appeal for a $1,000,000 endowment fund for McGill University, to be subscribed by the citizens of Montreal, has been lost sight of in the trying circumstances through which the university has passed, in consequence of the burning of the Engineering and Medical buildings. This fact was brought out at the last meeting of McGill Corporation when the annual report was submitted. According to the report $1,000,000 would now no more than make good the actual loss sustained in consequence of the fires, and another $1,000,000 is required to provide sufficient revenue to balance the existing deficits. With regard to the financial aspect of the two fires, the sums received from the insurance companies aggregated $636,000, while the cost of the new Engineering building alone, with an additional story on the Workman building adjoining, and the demolition of the burned structure, is estimated at $512,000, without equipment.

NEW YORK STREET CARS.—The fact that New York City is very badly in need of more electric street cars on the tracks is clearly brought out by the report made to the Public Service Commission by Mr. A. W. McLimont, electrical engineer, working in conjunction with Mr. Bion J. Arnold, retained as consulting expert. An investigation has been made of the power houses, barns and 1600 of the 1900 cars. Of the cars examined, 105 were filthy, 401 had flat wheels, 786 rattled noticeably, 249 were without headlamps, 102 with broken glass, 1006 with noise from the gears. Mr. McLimont says: "My investigation of this property leads to the conclusion that the rolling stock equipment, car house repair facilities and lack of an effective system of repair, maintenance and repair departments are responsible for the undesirable service being given by the companies, inasmuch as the rolling stock affects it."

NEW YORK TROLLEY ACCIDENTS.—During September, October and November the street cars, elevated, steam and subway trains in the city of New York have killed 155 persons and have seriously injured 500 more. These figures are compiled from the reports filed with the Public Service Commission by the traction and railroad companies themselves. Prior to the inauguration by the Public Service Commission of its system of accident reports there was no adequate way of determining the number of people killed yearly within the city limits by the traction companies. The exact figures compiled from the reports would indicate that there have been between 600 and 700 persons killed every year, and that at least 2000 people have been maimed annually. It is needless to say that a large part of this is due to causes utterly beyond the control of the companies. The number of employees injured fell from 603 in October to 150 in November, showing what can be done by the exercise of more care on the part of the individual.

OCEAN WIRELESS.—A special dispatch from Copenhagen of Dec. 18 says that Prof. Valdimar Poulson, inventor of the undamped or continuous system of wireless communication, has maintained steadily wireless telephonic connection between his station at Lyngby, near Copenhagen, and the Weissensee station at Berlin. The distance between the two points is over 240 miles, but it stated that the messages were transmitted with clearness and accuracy. "I shall open a wireless telephone service to America, via Ireland, in February," said Prof. Poulson, "a service that will be open for the use of the public." The professor has officially notified the American Legation that he intended to establish a transatlantic wireless telephone service. A recent dispatch from Berlin said that a German company had been telephoning wirelessly from Nauen to various places in Germany 50 to 60 miles distant, and that the conversations had been conducted with clearness and precision. A London dispatch, dated Dec. 20, states that the German Ministry of War has bought the rights of Poulson's wireless telephone.

TOKIO TROLLEYS.—The municipality of Tokio, Japan, bought the local street railway system last week.

TELEGRAPH TO LHASSA.—The Chinese government has sanctioned the construction of a telegraph line into Lhassa, the capital of Tibet, and the residence of the Dalai Lama, the supreme head of the Lamaist hierarchy. This innovation was recommended by the Chinese resident at Lhassa, who, since the advent of the British expedition of 1904, has been working for the enlightenment of the Tibetans.

ELECTRIC EXAMINATIONS.—The U. S. Civil Service Commission, Washington, D. C., will conduct examinations in January for electrician and "lampist" at the St. Louis Custom House, salary, $1,000; electrical assistant, U. S. Signal Service at large, $900; mechanical and electrical draftsman, one at $1,200 and one at $1,500 in the office of chief of ordnance, U. S. War Department, and first-class steam engineer, custodian service, Omaha, Neb., $1,200, and for similar vacancies as they occur, from $1,200 to $1,600.

UNDER THE HUDSON.—Electric cars are now running under the Hudson River, between New York City and Hoboken, in the McAdoo tunnels or tubes. The cars will be run through the tubes for the next two weeks merely as a test of the electric system, signal scheme, and general control. The plan will also make certain whether any additional bracing is needed in the tubes themselves, although Chief Engineer Charles Jacobs is certain that there will be no difficulty of this sort. The cars, of a special model designed for the tunnel service, have already been tested on the lines of the Manhattan Elevated system and found satisfactory.

N. E. L. A. BULLETIN—The December issue of the *Bulletin* of the National Electric Light Association contains in addition to Association notes and the "Question Box," an article by Mr. F. H. Plaice on "Day Service in Small Towns" and another by Mr. L. B. Marks on "The Place of Illuminating Engineering in Central Station Practice." A note signed by Mr. W. H. Blood, Jr., points out the uses of the *Bulletin*, and another, by Mr. Paul Lupke, suggests the publication therein for discussion a paper each month similar to those presented before the annual convention. Mr. Blood also, in a letter to the membership, asks for certain data on insurance policy forms.

THE MINNEAPOLIS SITUATION.—The value of the Minneapolis General Electric Company's local property is $4,937,712, as estimated by D. C. and William B. Jackson, and city engineer Rinker. For nearly a year there has been a dispute between the company and the city as to reasonable rates for service. The company seeks a definite franchise which will enable it to finance its operations. It asks a rate schedule that will pay a fair return upon the investment. The city wants the rate-making power surrendered to it by the company, and the lowest schedule of rates. There has been much discussion of rates, which is far from being settled, but there is a general feeling now more favorable to the company.

PUBLIC SERVICE LAW.—It is stated from Albany that the governor is generally satisfied with the working of the Public Service Commission law, and believes that it will meet any condition that may arise. But there are a few passages where the change of a word or a sentence is needed to clarify the meaning. It will also be necessary to change certain portions in regard to the supervision of lighting companies to make the procedure conform to that which prevails in dealing with the railroads. As to enlarging the commission's work by including telephone and telegraph companies, Governor Hughes will have something to say after further consideration. There is no doubt that the law is susceptible of great improvement.

CAR LIGHTING.—The next monthly meeting of the American Society of Mechanical Engineers will be held Tuesday evening, Jan. 14, in assembly room No. 1 of the Engineering Societies Building, at 29 West Thirty-Ninth Street, New York. The subject will be "Car Lighting," the presentation being made by Mr. R. M. Dixon, president of the Safety Car Heating & Lighting Company, and will treat of the general subject of lighting of trains, showing the relative economies in the several systems, electric and gas. There will be in operation exhibits of different methods, such as the Pintsch mantle, the vapor mantle system, a new acetylene system, and several varieties of axle lighting by electricity, with their regulating and governing mechanism.

FRENCH LIGHTING DEVELOPMENT.—According to *L'Electricien* there were in France, on Jan. 1, 1906, no fewer than 1413 electrical generating stations, supplying 2912 localities, whereas the total number of gas works in France at the same date was only 824, serving 1209 different localities. Four out of the 87 departments contained over 100 places with a supply of electricity, viz., Aude, 176; Isère, 166; Doubs, 103, and Herault, 100. The department of Isère had the largest number of generating stations, 60 in all; and the Basses Pyrénées comes next with 43, due to the presence of water powers. More than two-thirds of all the works generate their electrical energy by hydraulic power, either alone or in conjunction with steam or gas engines, but 831 works have only water power. In 942 plants, the current generated is continuous, while 256 generate three-phase current, and 157 produce single-phase alternating current.

LIGHTING IN PARIS.—From time to time the shifting negotiations as to new plans for lighting Paris have been noted in these columns. The terms of the concession for the future supply of electricity in the city of Paris, drawn by the Municipal Council, have now, according to the *Journal de Débats*, been approved by a decree of the president of the requblic. The period from Nov. 1 of the present year until Dec. 31, 1913, will be one of transition. The committee of the companies which have the sectional monopolies (secteur or district systems) will furnish the entire public and private supply energy at a fixed price. In the first six months the concessionaires, after approval of their agreement, will have to form a company, with a capital of $10,000,000, which will assume the name of the Compagnie Parisienne de Distribution d'Electricité. The concession will begin on Jan. 1, 1914, and terminate on June 30, 1940, with rights of reëntry on the part of the city at any date after June 30, 1924, on certain fixed terms.

ELECTRICITY IN TURKEY.—U. S. Special Agent W. A. Graham Clark says of conditions in Turkey: "Trade in Turkey suffers from several restrictions. In sending telegrams, for instance, every sentence has to be studied by the censor at Constantinople, and no message is allowed in cipher. Even consuls cannot use codes except when telegraphing direct to their governments or to their embassy at Constantinople. The cost is doubled by having to be sent first to Constantinople and then forwarded, and of course the normal cost is greatly increased by the prohibition of business codes. Electricity is regarded with suspicion, and telephones are prohibited throughout the Ottoman Empire. In this particular they are far behind the Chinese, whose leading merchants in the large cities are as familiar with the telephone as the merchant in the United States, and use it almost as freely. At Constantinople I was informed that the Sultan had just authorized one telephone line, and if this is so it will doubtless be followed by others within a short time. Several Turkish cities have gas works, but Damascus is the first city in the empire to have electric light. The electric lamps and an electric street-car system were only started in Damascus in the early part of this year, but already Beirut and other towns have obtained authorizations for similar projects."

RENSSELAER POLYTECHNIC INSTITUTE announces that it has inaugurated courses in electrical and mechanical engineering, leading to the degrees of electrical engineer and mechanical engineer. The recent gift of one million dollars by Mrs. Russell Sage insures laboratories in these branches of engineering unsurpassed by those of any school in this country.

NEW N. E. L. A. MEMBERS.—The December *Bulletin* of the National Electric Light Association gives the following list of new applications for membership during November: Citizens' Light, Power & Water Company, Ketchikan, Alaska; Consumers' Company, Limited, Coeur d'Alene, Idaho; the Electric Company, Huron, S. D.; Equitable Electric Light Company, Lake Geneva, Wis.; Jefferson Light, Heat, Power & Water Company, Jefferson, Iowa; Napa Valley Power Company, Calistoga, Cal.; Shore Electric Company, Red Bank, N. J.

REGULATION OF WIRELESS.—At Washington, D. C., on December 18, the U. S. Senate removed the injunction of secrecy from the treaty now pending before it that was adopted by the nations participating in the convention at Berlin on Nov. 3, 1906, providing certain international regulations for the operation of wireless telegraphy. Twenty-six nations took part in the convention. The regulations provide for the use of electric waves of uniform length by ships and shore stations, the publication of the charges for wireless telegrams and the establishment of an international bureau for the settlement of the accounts between ships and stations.

ELECTRIC MOTOR EQUIPMENT IN FOUNDRIES.—In a paper presented at the recent New York meeting of the American Society of Mechanical Engineers, Mr. A. D. Williams outlined the important advantages of electrical distribution of energy for foundries. For most purposes it is best to employ electric motors directly for the work to be performed. There are certain advantages in using compressed air for moulding machines. In order to avoid the expense of and loss in long air-lines, it is desirable to install small motor-driven air compressors. The disadvantageous leakage of hydraulic service systems can be prevented by using an electrically driven pressure pump and employing oil as the pressure fluid.

RADIUM CURES.—Writing to a London paper which recently published an article saying that the hopes the doctors entertained when radium was first discovered had received no measure of fulfilment, apart from some action on skin diseases, Sir William Ramsay says: "I must ask you to give publicity to the fact that the rodent ulcer, a terrible disease which chiefly attacks the face, can be cured with certainty by exposure for a few minutes at intervals to rays emitted from radium bromide." In this connection it is stated that the authorities of Middlesex Hospital, who are pursuing investigations as to cancer, are extremely well satisfied with the results obtained by radium in the treatment of this disease. They do not claim it is a specific in all cases, but say the percentages of successful treatments is notable.

DIVIDED RESPONSIBILITY.—Mr. A. H. Smith, vice-president and general manager of the New York Central Railroad, has been acquitted of manslaughter in connection with the wreck of the electric train at the Woodlawn curve, and the consequent loss of life. Justice Kellogg in his charge analyzed the testimony and said he did not believe one man capable of personally supervising such a system as the New York Central. Some of his powers, said the justice, had to be delegated to subordinates and to hold the general manager guilty of criminal negligence would be gross injustice. Justice Kellogg said the technical testimony was of little value as against the testimony of practical engineers. "It was humanly impossible," said the justice," for this defendant to know every switch, block signal circuit and curve of the system. Of necessity, the most he could do was to provide a general scheme for traffic and the safety of passengers. He must delegate some duties to others. I take it that we have not a great many complaints to make against the railroads. They seem to serve the people fairly well. But there are altogether too many accidents on railways. This is unfortunate. I hope that the general officers of such roads will take the matter in hand. I think this case has brought about good results in that it has brought to the attention of the railway officials the need for more care, especially in the matter of the restrictions of speed."

POWER IN THE SIERRAS.—According to advices from Fresno, Cal., Mr. Frank H. Short had proceeded to Washington to present to the department of agriculture the side of the case of the mountain power plant companies, claiming that unless restricted concessions are granted covering development work in the Sierra forest reserves power development companies now nearing completion will have to abandon their projects. Mr. Short intends to present the subject in such shape as to bring the matter up for Congress for helpful legislation. Not only do the forestry bureau regulations now require that the permits demand a charge for the use of water, but these permits are subject to revocation and are terminable in 40 years' time. Under these conditions the power companies would have to earn an added amount to pay the charges and to obtain returns on their investments. This burden, it is represented, would ultimately, fall on the water users in higher rates. Mr. Short says: "It is the old story of a government attempting to lay down domestic regulations from a distance of 3000 miles. The government does not understand conditions here and it must be enlightened. Taxes imposed by the government on power plants would not aid the county one whit. The money would go to Washington. But on the other hand, the companies would be forced to raise their charges for electric energy and the citizens wold have to pay the money." Mr. Pinchot's argument as government forester that all permits issued should be terminable, because if they are not, there is danger that the government's resources will gradually be lessened, might hold good in respect to coal beds or forests, but electric power is permanent and the fact that it is developed does not mean that there will be any less electricity available 40 years hence than there is to-day.

TELEPHONE TROUBLES.—In connection with complaints made against the Wisconsin Telephone Company at Milwaukee, some interesting data have been collated by Mr. W. F. Burgess, based on elaborate tests. His opinion is that the troubles arose chiefly from party lines, and the absence of correct methods on the part of the users. He suggested as a remedy that a time limit be placed upon the conversations over such 'phones. While he was assisting in an investigation of the Chicago company last year, he said that a case was brought before the hearing where a teacher of language gave half-hour lessons over the 'phone to her pupils. The telephone was of the four-party line variety. "One of the chief troubles in the Milwaukee telephone situation is that office men hire out desk room in their offices, with use of the telephone. This is common in Milwaukee, and the result is that there are three or four business men in one office, who use the same telephone. The outgoing calls in such a case are numerous, and a person trying to get connections on such a line, will find it always busy. People who do not understand the situation, blame the operator and claim that she wilfully gives them the busy signal. They then begin to complain and say that the operator is overworked, and that she has too many telephones to care for. The truth of the matter is, that the operator has an easier time of it when she can get the party, than she does when giving the busy signal. First she is required to test the line and, when she is informed by a click, that the line is in use, she has to plug in another jack, thus doubling the usual operations. Is it reasonable to expect that an operator will do more than is absolutely necessary? The telephone, which is so much used, should have a double track system, that is, a line for incoming calls and another for outgoing calls."

Southern Water Power Developments.

THE comparatively restricted area within a radius of a hundred miles about the City of Charlotte, N. C., known as the "Piedmont region," contains more than half the spindles and looms of the South. Within this fertile belt are located 360 cotton mills, operating 4,744,458 spindles, 110,258 looms and 2717 knitting machines. In the past decade there has been an increase of 160 factories, 3,123,243 spindles and 66,285 looms, due largely to the application of electric drive.

The abundant water powers for which this region is noted are now in a fair way to be adequately utilized for the purpose of driving the cotton mills of the district by electricity in place of steam, which is rapidly being superseded. There is at the present time more electricity used in the section about Charlotte for driving cotton mills than in New England, the old-time rival of the Southern spinning mill industry.

It is no longer necessary to locate mills in the low river bottoms away from the railroads in order to obtain cheap water power. Electric energy is transmitted from the streams to the factories which have been built on convenient sites along the railroads, and amid healthful surroundings. Electricity was first introduced into cotton mills at Columbia and at Anderson, S. C., in 1894. Now out of a total of 300,000 horse-power used by the cotton mills of the South, more than a third is in the form of electricity. The possibilities for future development in the Piedmont region, according to the estimates of experts, amount to an aggregate of 2,000,000 horse-power.

The Southern Power Company, one of the first corporations which realized the value of the unused power here, came into the section a few years ago, availed itself of the rights of the land owner to use water flowing through his lands, bought up land along the banks of the rivers, built dams, made reservoirs, and erected plants for the generation of electricity, which it distributes over hundreds of miles of transmission lines to the factories and the small towns throughout the region. Electrical energy is now distributed to Charlotte, N. C., the company's headquarters, from the Catawba River, 18 miles away, for operating street railways and for feeding lamp and motor circuits. Other towns in the vicinity where energy from the same source is available are Concord, Rock Hill, Kanapolis, and Statesville. The company charges $20 per horse-power per year for energy used 11 hours a day, six days a week. Steam power, under most favorable conditions, costs twice as much.

The Southern Power Company already has in operation two large electric plants, one called "Catawba" is rated at 10,000 horse-power and the other known as the Great Falls Plant has a rated output of 40,000 horse-power. The company is now carrying out plans for the development of 200,000 horse-power. It controls nine separate sites in the Piedmont section, where rapids occur between the head waters and the lowlands over a distance of 110 miles in all, and with an aggregate fall of nearly 1000 ft. A new plant, rated at 40,000 horse-power, is building at Rocky Creek, and another, rated at 24,000 horse-power, is building at Ninety-Nine Island, near Spartanburg. Similar developments are planned for Harseford Shoals, Lookout Shoals, Mountain Island, Landsford, Fishing Creek and Wateree.

Of the different power sites, controlled by the company, the one known as the "Great Falls" of the Catawba River offered the best opportunity for the initial development; so the work was begun here first. A railroad 12 miles in length was built to connect the Great Falls site with the railway centers of the state and to furnish transportation facilities for material of construction.

Before development, the Great Falls comprised a series of falls and shoals having a total head of 176 ft. over a distance of 8 miles, for the full utilization of which three separate developments will be required. The middle one, with a head of 72 ft. and receiving the run off from a drainage area of 4200 sq. miles, is known as the Great Falls Station and has just been placed in service. It is located on one side of an island, known as Mountain Island. A low spillway dam was erected across the river at the head of the island to deflect the entire volume of the river into the western channel. Across the western channel near the foot of the island is built a 30-ft. spillway dam, this dam deflecting the water into an almost natural canal which carries it about 1¼ miles, at which point is located an enormous retaining wall across the natural valley. Built into this retaining wall are eight 5200-hp hydraulic turbines of the twin horizontal type, enclosed in steel cases 15 ft. in diameter by 19 ft. long. Two of the waterwheels were built by the Holyoke Machine Company and the other six were built by the Allis-Chalmers Company. Steel feeder pipes of 7/16 in.

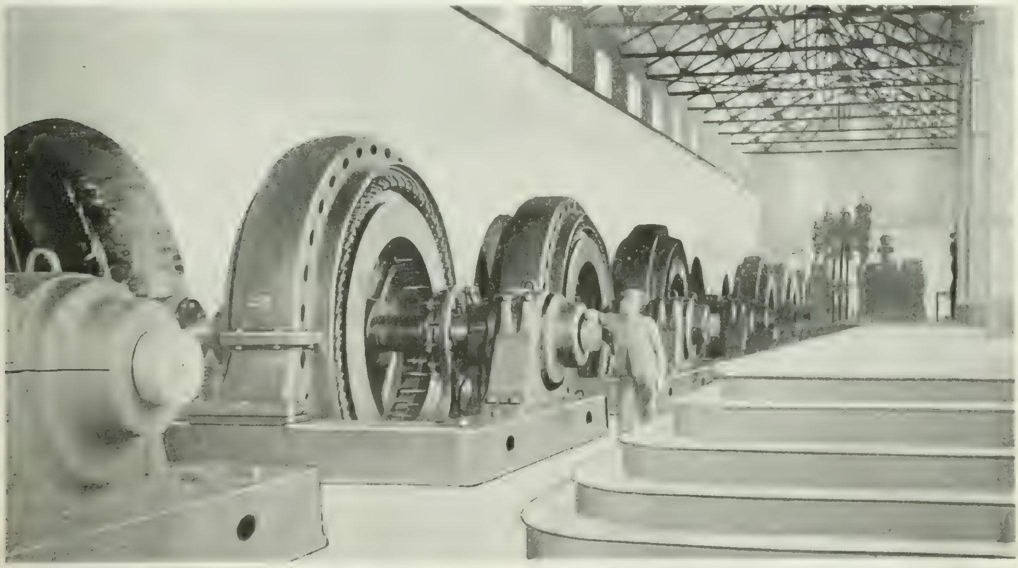


FIG. 1.—GENERAL VIEW OF GENERATOR ROOM.

plate are encased in the retaining wall, these feeder pipes being elliptical in form at the intake; dimensions, 16 ft. x 18 ft., gradually narrowing down to 15 ft. in diameter where the feeder enters the wheel case. The draft tubes are also built of 7/16-in. sheet steel, and are 11 ft. in diameter at the wheel case, gradually increasing to the point of discharge, where they are elliptical in shape, 11 ft. x 18 ft. A special feature in this construction is a tunnel extending the entire length of the power house through the retaining wall and just back of the turbine cases. By this method of construction the usual outboard water bearing is replaced by an oil bearing, which may be easily gotten at and inspected. This tunnel also makes it much easier to get at any part of the wheels when necessary. This tunnel is 10 ft. in width and has an I-beam trolley overhead for carrying material to and from the power house.

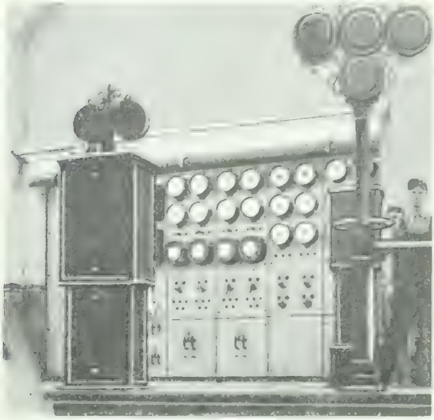


FIG. 2.—SWITCHBOARD.

FIG. 3.— OIL-FILLED, WATER-COOLED TRANSFORMERS.

Arched openings from the power house enter the tunnel at several convenient points. The wheel cases are supportd on a very heavy steel foundation built up of 24-in. I-beams. Both bearings are ring oiling, ball and socket, of the generator type. They are rigidly connected to the head, the outer bearing being designed to take up the end thrust of the wheels. The gates are of the swivel type and so designed as to give the maximum efficiency at approximately three-quarter gate, which represents full load on the generators.

The two turbines for operating the exciters, also of Allis-Chalmers design, are similar in construction, being rated at 700 horse-power at 450 r. p. m. under a working head of 72 ft. At the intake the feeders for the exciter turbines are 6 ft. x 9 ft., gradually tapering to 6 ft. in diameter at the wheel case.

FIG. 4.—HIGH TENSION OIL SWITCHES.

All feeder pipes are equipped with manholes and vent pipes. The draft tubes are 5 ft. 6 ins. in diameter at the case, flaring out to 10 ft. in width at the discharge end.

The 5200-hp turbines are direct connected to 3000-kw, 60-cycle, three-phase, 2300-volt generators and the two exciter turbines to 400-kw, 240-volt direct-current generators.

The switchboard is mounted on a gallery which stands about 6 ft. above the main station floor, thus giving ample space below for all cables, which are placed in racks on either side, the direct-current cables being on one side and the alternating-current cables on the opposite side. Behind the switchboard is the transformer house in which are placed four banks of transformers, each bank consisting of three 2000-kw oil-insulated, water-cooled transformers, which step up the potential to 44,000 volts.. The transformer casings are designed to withstand a pressure of 150 pounds and are equipped with relief valves connected to a vent discharging outside of the building. The transformers are mounted on flanged wheels and stand in their respective compartments on rails supported on concrete pedestals as shown in Fig. 3, which also illustrates the

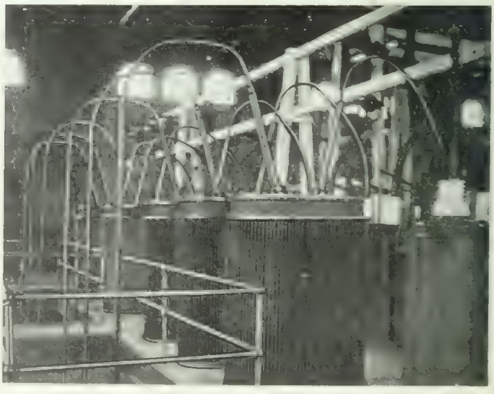


FIG. 5.—SERIES TRANSFORMERS AND CHOKE COILS.

manner of shifting the transformers by means of the transfer car running on a track in front of the transformer compartments. A pipe system through which carbon dioxide may be admitted in case of fire connects all the tanks. The gas generator and pressure tank are placed in the basement and in addition to the transformer connections a pipe extends to the second story so that any apparatus on this floor may also be deluged in carbonic acid gas in case of necessity. The oil for the transformers may be supplied by gravity feed or by a pressure feed from a tank outside. By reversing the direction of rotation of the pump the oil may be withdrawn from the transformers and after passing through a filter, returned to the storage tank. Connections are also provided for discharging the oil into the tail race. An electrically-driven triplex pump supplies oil to the high-tension apparatus on the second floor of the transformer house through two pipe leads terminating in hose bibs in floor boxes.

Each generator is controlled through an instrument post and switch pedestal. Each post is equipped with an ammeter, voltmeter, wattmeter and field ammeter and in addition there are two synchronizers, two frequency indicators and four bus-bar voltmeters distributed among the several posts. Each control pedestal is equipped with a remote-control switch for operating an oil circuit-breaker, one field switch, a rheostat hand wheel,

FIG. 6.—POWER HOUSE, RETAINING WALL AND GATE HOUSE.

an eight-pint voltmeter receptacle, a meter shunt and a lamp reflector.

The main switchboard contains two transformer panels, two double-circuit feeder panels, one station panel and two blank panels. Concrete slabs are used in the low-tension bus and oil-switch structure, the cells in the sub-structure containing the oil switches and the bus-bars being housed in compartments above these. The bus-bars are cut into two sections by an oil circuit-breaker; and each section may be further divided by means of selector switches. The bus-bars are connected to the low-tension side of the step-up transformers by means of two 1,000,000-circ. mil lead-covered cables per phase.

The high-tension transformer leads are taken through wells in the floor of the second story and connect through oil switches to the high-tension busses or feed direct to the line. The current for operating the high-tension circuit-breakers is obtained from oil-insulated series transformers. Oil-insulated choke coils are placed between the transformers and the oil switches to relieve the former of the strains due to surges in the line. Lightning arresters of the single-pole, low-equivalent type are installed.

Four sets of outgoing lines are used for distributing the energy, a double steel tower being used for supporting this line. This line was described in the May 23 issue.

Besides the Great Falls station, the Southern Power Company has ordered six 5200-hp and one 700-hp twin horizontal turbines, which will be exact duplicates of the Great Falls turbines for the new Ninety-Nine Island station. This station will be located on the Broad River nine miles above Blacksburg, S. C. Work is now being pushed on this development and everything will be rushed as rapidly as possible to completion. The other developments will be taken up in order and completed as rapidly as possible.

When all of the developments of this company are completed they will have carried out not only the largest power scheme in the South, but one of the largest in the world.

Notes on the Parallel Operation of Alternators.

By Waldo V. Lyon.

When two alternating-current generators are operating in parallel there will frequently exist a certain "cross" or "interchange" current between the machines, which may be harmful or useful depending upon the condition from which it arises. It is the purpose of this article to discuss as fully, and yet as simply as possible, the cause and effect of this interchange component of the armature current. Although the discussion will be limited to the case of two identical alternators, the methods used are perfectly general in their application. The results, however, are more easily attained and, since they illustrate the salient features of the problem as well, the complication introduced by considering the general case does not seem warranted. Furthermore, the work is applied to single-phase alternators or to one phase of polyphase machines with balanced loads. In the latter case the machine constants are taken for one phase between line and neutral. If the alternator is mesh-connected it must be reduced to the equivalent star-winding. The discussion has all of the limitations that are inherent in the synchronous impedance method for calculating the regulation of alternators.

Let us suppose that at some instant the induced e. m. f.s of the

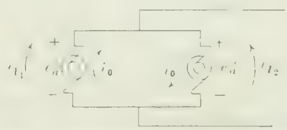


FIG. 1.—ARRANGEMENT OF ALTERNATORS.

two alternators are e'_a and e''_a, and that their signs are as indicated in Fig. 1. It is then evident that in going around the series circuit through the armatures there will be a resultant e. m. f., $e_0 = e'_a - e''_a$ tending to send a current clockwise around the circuit; that is, in conjunction with e'_a, but in opposition to e''_a. Designate this interchange current by i_0, and the other component of the armature currents by i_{l1} and i_{l2}. The latter are the external components which are supplied to the load and are in conjunction with e'_a and e''_a, respectively. The total current in the armature of the first alternator will, therefore, be $i_1 = i_{l1} + i_0$, while in the second it will be $i_2 = i_{l2} - i_0$.

If the axis to which all vectors are referred is the common potential difference at the terminals of the alternators, the *vector equations* may be written by replacing these instantaneous values of currents and voltages by their corresponding *vector* values. Thus the vector equations are:

$$E_0 = E'_a - E''_a$$

$$I_1 = I_{l1} + I_0 \qquad (1)$$

$$I_2 = I_{l2} - I_0 \qquad (2)$$

The external current is the sum of the armature currents, viz., $(I_1 + I_2)$.

When alternators are operating in parallel perfectly, that is, with no interchange current, their e. m. f.s are not only *in phase*, but also *equal* in *magnitude*, for if these two conditions do not exist there will be a resulting voltage $(E'_a - E''_a)$, which will produce an interchange component in the armature currents. In general, when there is an interchange component, the armature currents are not in phase with the external current.

Suppose that for some reason the armature currents become

and I_2 in Fig. 2. The vector expressions for these currents are:

[illegible]

If this phase displacement of the armature currents is of a permanent nature the magnitude of the vector components of I_1 and I_2 may be experimentally determined with the proper instruments.

The induced armature voltage of each alternator is the potential difference at its terminals plus the armature impedance drop. so that the equations for these voltages will be:

[illegible] as shown in Fig. 2.

The vector difference of these two voltages is the resultant e. m. f. acting in the series circuit through the armatures of the alternators; that is, $E_0 = E'_a - E''_a$ or $E_0 = (r + jx_a) [(i_1 - i_2) + j(i'_1 - i'_2)]$. In a circuit whose impedance is equal to that of the combined armature impedances of the alternators a certain current, I_0, would flow if a resultant e. m. f., E_0, were impressed upon it. The magnitude and phase of I_0 would be determined by the equation:

$$I_0 = \frac{E_0}{2r + j2x_a} = \tfrac{1}{2}[(i_1 - i_2) + j(i'_1 - i'_2)]$$

That is, the interchange component of the armature currents is always equal to one-half of their vector difference. The expression for the external component of the armature current of the first alternator is given in equation (1), which, when written in its complete vector form, becomes:

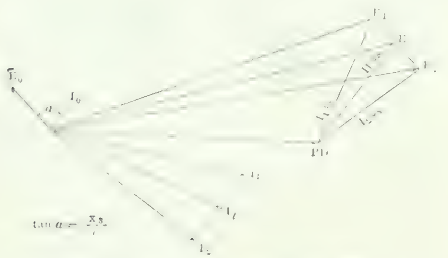


FIG. 2.—VECTOR DIAGRAM OF CURRENTS.

$$(i_1 + ji'_1) - \tfrac{1}{2}[(i_1 - i_2) + j(i'_1 - i'_2)]$$

and this reduces to:

$$I_{l1} = \tfrac{1}{2}[(i_1 + i_2) + j(i'_1 + i'_2)] \qquad (3)$$

The vector expression for the external component of I_2 is the sum of the armature current and its interchange component; that is:

$$I_{l2} = \tfrac{1}{2}[(i_1 + i_2) + j(i'_1 + i'_2)] \qquad (4)$$

The current in the external circuit is the vector sum of the armature currents and is:

$$I \text{ [illegible]} [(i_1 + i_2) + j(i'_1 + i'_2)] \qquad (5)$$

Equations (3) and (4) show that the external components of the armature currents are in phase and that one is equal to the other, and equation (5) shows that these external components are also in phase with the external current.

Since there are no necessary assumptions made concerning the cause of this result other than the equality of armature resistances and of armature reactances, there are no limitations placed upon its application. Therefore, the currents in the armature may be separated for convenience into two components, and if the load supplied by the alternators is constant, one of these, the external component, is fixed both in magnitude and phase; and the other, the interchange component, is one-half of the vector difference of the armature currents. This holds for any and all possible conditions. Since the load components of the armature currents are always equal, they will hereafter be designated by: $I_l = i_l + ji'_l$. The total external current is $2I_l$.

It is very important to note that, though entirely logical, it is merely for convenience that the armature current is divided into these two components, and that neither of them exists independently. The simplification is that it is thereby possible to study the action of the two armature currents through the effects produced by their interchange component alone, for the *external components* are alike, both in *magnitude* and *phase*.

In the foregoing deduction of the interchange component the only assumption made was that the complex expressions for the armature impedances were identical. If the same holds true for the synchronous impedances they might equally well be used, the only effect upon the diagram being to replace the armature induced e. m. f.s by the fictitious voltages E_1 and E_2, which are the open circuit voltages for the given field excitations; also E_0 would equal $E_1 - E_2$. In all of the following work this substitution will be made since it gives a direct connection between the field excitation and the armature voltage.

There are a number of important relations that exist in this diagram, Fig. 2, which should be mentioned. The vector equation for the armature voltage of the first alternator is: $E_1 = PD + I_1 z_s$. Since $I_1 = I_l + I_0$, this may be written: $E_1 = PD + I_l z_s + I_0 z_s = E + I_0 z_s$. Likewise the armature voltage of the second alternator is:

$$E_2 = PD + I_2 z_s = PD + I_l z_s - I_0 z_s = E - I_0 z_s.$$

That is, the synchronous impedance drop in each alternator may be resolved into two components, one of which is constant in magnitude and phase with respect to the terminal potential difference as long as the external component of the armature current is likewise constant, and the other depends upon the interchange current for its magnitude and phase. The vector E always bisects the difference between E_1 and E_2, viz., E_0. If the external circuit has a constant resistance and a constant reactance, the potential difference is proportional to the external current, and the phase relations of I_l and its component drop $I_l z_s$, with respect to the potential difference, are fixed. Since PD and $I_l z_s$ are proportional and the angle between them is constant, E will be proportional to have a fixed phase relation with the potential difference.

There are three distinct causes which will produce an interchange component in the armature current, but they all affect the armature voltages by changing their magnitudes or their phase relations. The first cause is an inequality in the field excitations; the second, an inequality in the power supplied by the prime movers, which occurs when the load is shifted from one to the other, and the third is a non-uniform angular velocity which is principally due to the action of the reciprocating parts and governors of the prime movers. All of these causes, however, produce one common effect, and that is that the combined heating loss in the alternators is increased, and if the interchange current is large, the additional heating may be so serious as to decrease their capacities. This heating loss, caused by the interchange component of the armature current, will be defined as the difference between the loss when there is an interchange component and when it is not present, provided, also, that the condition of the external load is fixed. When there is an interchange current the heating loss in the first alternator is: $[(i_l + i_0)^2 + (i'_l + i'_0)^2]r$. The normal heating loss is: $(i_l^2 + i'^2_l)r$. The heating loss caused by the interchange current is: $[(i_l + i_0)^2 + (i'_l + i'_0)^2 - (i_l^2 + i'^2_l)]r$. This reduces to the more convenient form: $I_0^2 r + 2r(i_l i_0 + i'_l i'_0)$. Thus, in general, the additional heating loss caused by the interchange current is not given by the usual expression for such a loss, viz., $I^2_0 r$, and it only reduces to this form when $\frac{i_0}{i'_0} = -\frac{i'_l}{i_l}$ —that is, when the interchange component is in quadrature with the external component.

Likewise the expression for the heating loss caused by the interchange current in the second alternator is:

[illegible]

The additional heating loss in both generators is the sum of the individual losses, and this reduces to: $2I^2_0 r$.

Therefore, the total heating loss caused by the interchange current is given by the usual expression of the square of the current multiplied by the sum of the armature resistances. The heating loss is greater in one generator than in the other, except when the interchange component is in quadrature with

the external component of the armature current, in which case the losses are equal.

The first method of producing an interchange component in the armature currents is by changing the field excitations of the alternators. A diminution in the field excitation of the first tends to decrease its armature induced e. m. f. with respect to that of the second, and, as the system attempts to regain its former equilibrium, there is a force developed which opposes this relative reduction and tends to equalize these e. m. f.s. There is but one way in which this may occur, and that is through the effect of the armature reaction on the impressed field. It is well known that a leading armature current increases the resultant field, which is the direct cause of these induced e. m. f.s, and that a lagging current reduces it. Thus the natural reaction that follows a reduction in the field of one alternator is the production of a leading current in that armature which, because of its magnetizing action on the field, opposes the reduction. Furthermore, we saw that the external component of the armature current was fixed by the character of the load, and so this leading current must be the interchange component of the armature current. If the field excitations of the alternators are alone varied the division of the load cannot be changed, except by the small amount which is due to possible variation in the losses, and thus under this condition the interchange component of the armature current is practically wattless with respect to the potential difference. Therefore, the effect of a reduction in the field excitation is to produce an interchange component in the armature current which is wattless and leading, and which opposes the reduction by virtue of its magnetizing action on the field. Since the reaction developed tends to bring about an equality of the armature induced e. m. f.s, the effect on the other alternator must be that of an interchange component in the armature current which is wattless and lagging, and thus weakens the field. Because of this equalizing action the potential difference will not be reduced as much by a given change in the field of one alternator as it would be if the generators were not in parallel.

The extreme case in which one alternator loses its field excitation entirely is interesting. Under this condition the resultant field is in phase with the armature current, since it is due to the effect of armature reaction alone, and thus the armature induced e. m. f., which is always in quadrature with the field producing it, is in quadrature with the armature current. The electromagnetic power developed by this alternator is zero and the entire load, as well as all of the losses, is supplied by the other. The resulting potential difference, which is probably somewhat more than one-half* its initial value, is used wholly in synchronous impedance drop in the first alternator, and the current is very large and leads the potential difference by slightly more than 90 degrees. In the second alternator the armature current is also very large, but lags behind the potential difference. The effect of a large armature reaction would be to increase the synchronous reactance, and with generators of this type the currents would not reach such high values.

When one alternator loses its field excitation and its ability to take any share of the load, the two generators cannot be working at the same point on their mutual speed-load characteristic. Furthermore, since the induced e. m. f. is always in quadrature with the armature current, there can be no synchronizing action to increase the load on this generator when its speed increases. Since, however, the resultant field is due to the armature reaction alone, its speed of rotation with respect to the armature conductors is determined solely by the frequency of the armature current, and this is supplied from the second alternator. Thus the frequencies of the induced e. m. f.s are the same, and are independent of the speed of the first prime mover. Therefore, if the field circuit of the first alternator is opened, the entire load is removed from its prime mover, and its speed increases to at least the no-load value. The currents in each alternator will greatly exceed their normal value due to the large interchange component which is produced.

*Theoretically it is one half.

A shifting of the load from one alternator to the other will always cause an interchange component in the armature currents, since the external components are equal. The load shifted from one machine to the other is given by the expression:

$$I_o \times PD \times \cos <^{I_o}_{I\,I_1}$$

The phase relationship of the interchange component may then be adjusted by varying the field excitations. We have seen that whenever there is an interchange component the combined heating loss in the alternators is increased. The loss will be a minimum when the interchange component is a minimum, and, for a given change in the load, this occurs when it is in phase with the potential difference. Thus, when the load has been shifted from one alternator to the other, the best condition, as far as heating is concerned, is not when the armature currents are in phase with the external current unless the power-factor of the load is unity. Whenever two identical machines are not delivering equal loads there is an interchange component in their armature currents and the total heating loss in both is greater than which they divide the load equally.

The third and most important cause which produces an interchange component in the armature current is the non-uniform speed of the prime movers. A complete discussion of the speed variation of prime movers is beyond the scope of this article, and it is sufficient to say that the relative angular acceleration of one of the alternators will produce a phase displacement of the armature voltages E_1 and E_2. Since these are the voltages corresponding to the constant impressed fields, the relative displacement of the armature conductors is equal to the displacement of

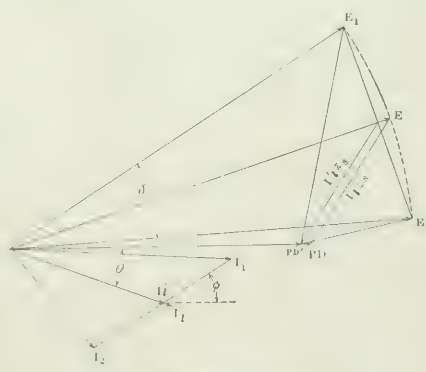


FIG. 3. LOAD DIAGRAM.

the voltages. At the instant when the first alternator, which has accelerated with respect to the other, has reached the point of maximum displacement and is about to retard its motion, the speeds of the two alternators are the same and the voltages E_1 and E_2 are numerically equal. The following equation may then be written:

$$(PD' + i_1 r - i'_1 x_s)^2 + (i_1 x_s + i'_1 r)^2 = (PD' + i_2 r - i'_2 x_s)^2 + (i_2 x_s + i'_2 r)^2$$

(See Fig. 3.)

Expand each side of this equation and collect the terms:

$$(i_1 - i_2)\,[2rPD' + (i_1 + i_2)\,z_s^2] = \quad . \quad . \quad . \quad (i'_1 - i'_2)\,[2x_s PD' - (i'_1 + i'_2)\,z_s^2] \qquad (6)$$

but, $(i_1 - i_2) = 2i_o$, $(i'_1 - i'_2) = 2i'_o$,

also $(i_1 + i_2)$ and $(i'_1 + i'_2)$ are the power and wattless components of the external current. Equation (6) may be written in the form:

$$\frac{i'_o}{i_o} = \frac{2rPD' + z_s^2 i}{2x_s PD' - z_s^2 i'} \qquad (7)$$

Let X be the total reactance of the load, R the total re-

sistance and Z the total impedance. If numerator and denominator of equation (7) are multiplied by $\frac{Z}{2\sqrt{Z^2 + z_s^2}}$ it will reduce to a more convenient form:

$$[illegible]$$

The sign of the second term in the denominator is changed for the reason that if i'_l is positive the external current leads the potential difference while it is customary to assign X a negative value for a capacity load. It will be observed that the phase relation of the interchange component with respect to the terminal potential difference is fixed by the character of the load.

In general, if the vectors E_1 and E_2 are equal, their resulting difference $E_0 = E_1 - E_2$ leads their sum $(E_1 + E_2)$ by 90 deg. The vector $(E_1 + E_2)$ is in phase with the initial armature voltage E and since I_0 lags behind E_0 by the $\tan^{-1}\frac{x_s}{r}$ it must lead E by the $\tan^{-1}\frac{r}{x_s}$. (This is a small angle, probably never greater than 8 deg.) It is then evident from Fig. 3 that for all ordinary conditions the projection of I_0 on PD is positive. Since the vector expressions for the armature currents are $I_1 = I_l + I_0$ and $I_2 = I_l - I_0$ the effect of the interchange current, when thus brought about by the variations in the speed of the prime movers, is to increase the load on the first alternator, which accelerates, and to decrease that on the other. The power component of the interchange current with respect to the terminal potential difference, which is alone responsible for this automatic shifting of the load, will be defined as the synchronizing current. Neglecting the losses in the alternators, which are usually not equal,* this definition of the synchronizing current gives a measure of the increase in the load on the first and the decrease on the second, which tends to bring the electromotive forces E_1 and E_2 into phase again. This is not the most common definition. Usually the wattless component of I_0 with respect to E_0 is called the synchronizing current. The reasons assigned are: that with respect to the armature voltages E_1 and E_2 it produces equal and opposite reactions on the alternators, increasing the load on the one which accelerates and decreasing that on the other; and that the other component of the interchange current produces the same reaction on each, viz., increases the load. But this definition of the synchronizing current can give no idea of the real amount by which the load on one alternator is increased and that on the other diminished, for it takes *no* account of the possible change in power due to the load components of the armature currents. These load components are equal and fixed in phase with respect to the potential difference. If as in Fig. 3 the load is inductive and E_1 leads E_2, as has been assumed, the power due to the load components of the armature currents and the respective electromotive forces is decreased for the alternator which accelerates and increased for the other. This is the opposite effect produced by the interchange current and under certain conditions the net change on the load might be zero. For example, if the interchange current is produced by the variation of the impressed fields alone, it is wattless with respect to the potential difference and has no synchronizing effect whatever. Therefore it seems more logical to define the synchronizing current as the power component of the interchange current with respect to the potential difference, provided that the interchange current is not produced by varying the power supplied by the prime movers, for then the conditions of operation are permanently altered by shifting the speed-load characteristics of the prime movers.

The vector diagram which applies to this case is given in Fig. 3. It should be noted of this diagram that as E_0 is always bisected by E it is perpendicular to it, since E_1 and E_2 are numerically equal. The component of the armature impedance drop due to the interchange current, $I_0 z_s$, is $E \sin\frac{\delta}{2}$ where δ is the angular displacement between E_1 and E_2. It will be seen that the resulting terminal voltage is reduced in the ratio of 1 to $(1 - \cos\frac{\delta}{2})$, and thus the variations in the speed will cause fluctuations in the potential difference, though in general they will be quite small.

The synchronizing current is $I_s = \frac{E \sin\frac{\delta}{2}}{z_s} \cos\phi$ This expression may be simplified by substituting for E and $\cos\phi$ their values in terms of the constants of the alternator and of the external circuit.

$$E = [(PD + i_l r - i'_l x_s)^2 + (i_l x_s + i'_l r)^2]^{\frac{1}{2}}$$

E, PD, i_l and i'_l are the normal values of the voltages and the power and the wattless components of the armature current before there was an interchange component. Expand the quadratic expression under the radial sign and collect the terms:

$$E = [PD^2 + I^2 z_s^2 + 2PD\,(i_l r - i'_l x_s)]^{\frac{1}{2}} \quad (8)$$

$$I = \frac{1}{2}\frac{PD}{Z}$$

$$i_l = \frac{R}{Z} I = \frac{R}{2Z^2} PD$$

$$i'_l = -\frac{X}{Z} I = -\frac{X}{2Z^2} PD$$

Substitute these values in equation (8) which then reduces to:

$$E = \frac{PD}{2Z}\sqrt{4Z^2 + z_s^2 + 4(Rr + Xx_s)}$$

The value of cos ϕ may be obtained from tangent ϕ:

$$\cos\phi = \frac{2Z^2 x_s + X z_s^2}{Z z_s \sqrt{4Z^2 + z_s^2 + 4(Rr + Xx_s)}}$$

The synchronizing current reduces to:

$$I_s = PD\left(\frac{x_s}{z_s^2} + \frac{X}{2Z^2}\right) \sin\frac{\delta}{2} \quad (9)$$

It should be observed that this simplified expression for the synchronizing current is only true when the impressed fields are such as to give equal armature voltages, that is, $E_1 = E_2$. PD is the normal potential difference.

The maximum angular displacement of the armature (δ) depends upon the mechanical construction of the moving parts, the action of the governor and other things of more or less indeterminate effect, so that its discussion is too complex to be attempted in this brief article. It is interesting, however, to note the effect upon the synchronizing current of the other factors, viz., z_s, X and R.

The interchange current is $I_0 = \frac{E \sin\frac{\delta}{2}}{z_s}$. It does not depend upon the character of the load although its synchronizing component does. With alternators which regulate very well on moderate power factors, x_s being usually small, the interchange current is large for a given relative angular displacement of the armatures, and the increased heating loss thus incurred may be great enough to considerably decrease their capacities. Thus very close regulation may have a serious disadvantage when alternators are operated in parallel.

For any given load condition the synchronizing current is a maximum when $\frac{dI_s}{dx_s} = O$. A solution of this equation shows that for the maximum synchronizing current $x_s = r$ (a very small value of x_s since in actual practice it may be from 10 to 20 times as great as r). Consequently a small synchronous impedance is favorable in that it increases the synchronizing power of the alternator.

For constant current output, that is, with Z constant, inspection of equation (9) shows that the synchronizing current is greatest when X is positive (inductive load) and equal to Z (X cannot be greater than Z), and that it is least when X is negative (capacity load) and equal to Z, that is, alternators operate in parallel better on an inductive load. When X is

* They are only equal [illegible]

zero, that is, on unit power factor, the synchronizing current is independent of the load and is the same as on open circuit.

The effect of the character of the load upon the parallel operation of two alternators may be quite forcibly shown by an example. The constants (per phase) of a 150-kw, 60-cycle, two-phase, 230-volt alternator are $r = 0.0172$ and $x_s = 0.354$; r may be neglected since it is but about 5 per cent of x_s. Let us suppose that two such machines will operate satisfactorily on an 85 per cent power factor inductive load of 326 amperes. Under this condition:

$$I_s = PD\left[\frac{1}{0.354} + \frac{0.181}{2\times(0.353)^2}\right] \sin\frac{\delta}{2}$$

$$= 3.55\,PD\sin\frac{\delta}{2}$$

$$\left[\begin{array}{l} Z = \dfrac{230}{2\times 326} = 0.353\ ohm \\ X = 0.527 \times 0.353 = 0.181\ ohm \end{array}\right]$$

Suppose that there is now thrown on these machines a condensive load requiring full-load current from each at 50 per cent power factor

$$I_s = PD\left[\frac{1}{0.354} - \frac{0.306}{2\,(.353)^2}\right] \sin\frac{\delta}{2}$$

$$= 1.59\,PD\sin\frac{\delta}{2}$$

$$[X = 0.306\ ohm]$$

That is, for the same angular variation in the relative positions of the armatures of the alternators, the synchronizing current has been reduced to 45 per cent of its former value. If the mechanical characteristics of the prime movers require a certain synchronizing torque to keep the alternators in step this relative angular displacement must increase to considerably more than double its former value (under inductive load) before the necessary reaction is developed. This increased allowable swing may be extremely undesirable or even dangerous if there are accumulative effects due to mechanical resonance. The fluctuations of the terminal voltage will be much greater and of probably a longer periodicity.

It might even be possible to put the alternators on such a heavy condensive load that the synchronizing current would no longer act to keep the machines in step but would actually tend to make them run in series. From equation (9) it will be seen that the necessary condition that this may occur is that $\frac{X}{2Z^2} > \frac{x_s}{z^2}$, for this makes I_s negative and so its effect is to reduce the load on the alternator which accelerates. Since R equals zero and r may be neglected this reduces to the condition that the total reactance of the load must be less than one-half of the synchronous reactance of the alternator. If this result is applied to the alternator under consideration we shall find that it is necessary to put the machines on a condenser load that takes more than 650 amperes per phase from each generator —about 200 per cent of full-load current—before the synchronizing current acts in this peculiar manner.

It is also interesting to note the effect of inserting capacity in the bus-bars between the machines. For a given load the synchronizing current is determined by the constants of the armature circuit. The synchronizing current is maximum when x is inductive reactance and equal to r (as we have already seen) and is minimum when x is capacity reactance and equal to r. When x is zero the synchronizing current depends solely on the constants of the external circuit. It would be zero only on unit power factor. For an inductive load it would have a true synchronizing effect, while on a condensive load the alternators would tend to run in series. Thus the effect of inserting capacity reactance in the armature circuit would first be to increase the synchronizing current to a maximum value. Beyond this it would fall off very rapidly and would be zero—if X were zero—when the capacity reactance was equal to the sum of the synchronous reactances of the alternator. A still further increase in the capacity reactance would tend to make the machines run in series.

The Most Economical Shape of Winding for Electrical Measuring Instruments.

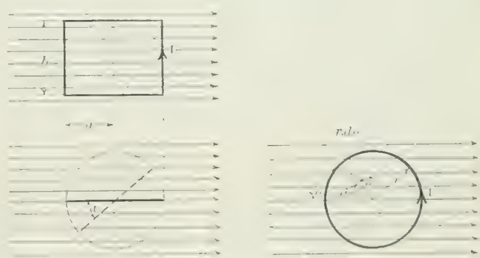
By A. P. YOUNG.

In electrical measuring instruments it is desirable that the ratio of torque to weight of moving element should be as large as possible, for in this way the effect of friction in the moving system is reduced and any inaccuracies due to this cause are greatly diminished.

Taking, for example, the case of a wattmeter or watt-hour meter, there is, in general, a movable coil of fine wire carrying a current proportional to the supply voltage, which moves in a magnetic field produced by coils which carry the main current. Of course, for given conditions the torque exerted on the movable coil could be increased by increasing the number of turns on the stationary winding or by increasing the ampere-turns on the movable coil; that is, by increasing either the turns on this coil or the current in the coil. Increasing the number of turns means a larger and more expensive winding, while increasing the shunt current (that is, the current in the movable coil) results in an increased loss of energy in the shunt circuit, which, of course, is undesirable. Supposing, however, that values have been chosen for the three factors, namely, (1) number of turns in the main winding, (2) number of turns in the movable coil, (3) shunt current, then the question will arise as to what shape of movable coil will give the greatest torque, using a certain length of wire, or, in other words, what shape of movable coil will give the greatest ratio of torque to weight of wire used.

In the following, consider a coil of only one turn, which is free to move in a magnetic field of constant and uniform density. Consider first the case of a rectangular winding, such as is shown in Fig. 1. Let

Current carried by coil $= I$.
Intensity of magnetic field $= B$.
Length of coil $= 2a$.
Breadth of coil $= b$.

Then when the plane of the coil is parallel to the magnetic

FIGS. 1 AND 2.—TORQUE FOR RECTANGULAR COIL AND FOR CIRCULAR COIL.

lines, the coil is in the position for maximum torque and, thus, in c. g. s. units the torque corresponding to this position is $2abBI$. If the coil is now rotated through an angle α, the torque corresponding to this new position is $2abBI\cos\alpha$. Therefore, the average torque corresponding to a variation of

$$\alpha \text{ from } +90^\circ \text{ to } -90^\circ = \frac{2abBI}{\pi}\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \cos\alpha\, d\alpha$$

that is, average torque $= T = \frac{2abBI}{\pi}\Big[\sin\alpha\Big]_{-\frac{\pi}{2}}^{\frac{\pi}{2}}$

$$= \frac{4abBI}{\pi}$$

Denoting the total length of the wire by l

$$2b + 4a = l$$

$$b = \frac{l}{2} - 2a$$

$$\text{Therefore, } T = \frac{4BIa}{2}\left(\frac{l}{2} - 2a\right)$$

$$T = \frac{2BIla - 8BIa^2}{2}$$

If l is kept constant and as a is varied:

$$\frac{dT}{da} = \frac{2BI.l}{2} - \frac{16BIa}{2}$$

T will be a maximum when $\frac{dT}{da} = 0$. Therefore, the value of a corresponding to the maximum value of T is given by the equation,

$$2BIl = 16BIa$$

that is, $l = 8a$.

This means that b must equal $2a$, or, in other words, the section of coil must be square. The average value of the torque corresponding to a square section is given by $\frac{2BIb^2}{\pi}$

Consider next a circular coil. Referring to Fig. 2, assume that the coil is in the position for maximum torque; that is, the plane of the coil is parallel to magnetic lines. Considering an element of the coil, $rd\Theta$.

Torque exerted on element $= BIr^2 d\Theta \sin^2\Theta$

$$\text{Torque exerted on whole coil} = 2BIr^2 \int_0^{\pi} \sin^2\Theta\, d\Theta$$

$$= 2BIr^2\left[\frac{\Theta}{2} - \frac{\sin 2\Theta}{4}\right]_0^{\pi}$$

$$= BI\pi r^2$$

The average value of the torque corresponding to a movement of the coil between 90° displacements on either side of the position considered, is given by,

$$\frac{2}{\pi} BI\pi r^2 = 2BIr^2 \qquad (1)$$

The length of wire used to produce this torque is

$$l = 2\pi r$$

If this length of wire is wound so that the section is a square, then length of side $= b = \frac{\pi r}{2}$

$$\text{Average value of torque} = \frac{2BIb^2}{\pi} = \frac{2BI}{\pi}\left(\frac{\pi r}{2}\right)^2 \qquad (2)$$

That is, using the same length of wire,

$$\frac{\text{Average torque exerted by circular coil}}{\text{Average torque exerted by square coil}} = \frac{4}{\pi}$$

or the circular coil gives approximately 27 per cent greater torque than a coil of square section, using the same length of wire in each case, and assuming that the magnetic field in which the coil moves is uniform.

This conclusion is interesting and is probably of greatest practical importance as applied to the case of a watt-hour meter of the commutator type. An instrument of this type consists of a rotating armature made up of a number of coils such as have been assumed above, and the torque exerted by this armature is proportional to the average value of the torque exerted by each coil. The foregoing conclusion shows that in such cases the spherical drum form of armature is the most economical.

In the case of permanent magnet instruments, where there is a rectangular coil moving in a radial magnetic field of permanent value, the torque is dependent solely on the current passing through the coil and independent of the angular position of the coil. For such instruments it is readily seen that the square form of coil is the most economical, which means that for an instrument of this type the square section of coil gives the greatest torque for certain values of the magnetic strength, moving-coil turns, moving-coil current and length of wire used.

A Composite Telegraph and Telephone System for Interurban Railways.

The Interurban Railway Company, of Des Moines, Iowa, has been testing, for the past year, a combined dispatching and commercial telegraph and telephone system that has many new and novel features. The system is being tried out on the Beaver Valley Division of the company's lines. On this division cars were originally dispatched by a single telephone line consisting of a single metallic circuit of No. 9 BB galvanized iron wire, carried on 35 ft. poles directly underneath a 25,000-volt, three-phase, high-tension line for a distance of about 40 miles.

On this single metallic line there are connected about 20 bridging local battery telephones, a telephone being located at each station and passing point on the main and branch or junction line.

Owing to the large amount of freight and express handled on this branch it was found necessary to either erect another telephone line or install a system of telegraph instruments on the existing telephone line. The latter was found to be the cheaper, and thought to be the better plan, since the telegraph is more reliable and better suited for certain classes of work than the telephone. The telegraph instruments were first connected as shown in Fig. 1, which illustrates the usual method of connecting telegraph instruments in series on a composite telegraph and telephone line. Since both sides of the telephone line are used as one side on the telegraph line, it is necessary at each intermediate telegraph station to cut a condenser in each side of the telephone line to open the line to the direct-current telegraph current and shunt it through the telegraph instruments. In using the telephone it is necessary to signal and talk through these condensers, and while they do not interfere with the small undulating voice currents used in talking, they do seriously interfere with the magneto signaling currents, especially where there are a large number of telephones used on the line. Aside from the expense of maintaining these troublesome condensers, it was found practically impossible to signal through them when six or eight intermediate telegraph stations were installed, as it was necessary to signal through eight or ten condensers in series. It was also found to be impossible to cut the telegraph instruments on the branch or junction line in series with those on the main line without installing another line wire on the branch line. To overcome these difficulties, and to secure other very desirable results, a method was devised of connecting the telegraph instruments in multiple. The three-point open circuit telephone keys are bridged onto both sides of the telephone line through balanced-wound impedance coils having three terminals. The end terminals are connected to the telephone line. The telegraph keys are connected between the middle point of the impedance coil and some source of direct-current supply, as illustrated in Fig. 2. The relays are bridged on in multiple with each other and with the keys between the middle terminal of this same impedance and grounded through about 1000 ohms of non-inductive resistance, X and Y; the object of the resistance X being to give an even distribution of energy through all the relays on the line when sending or receiving. It will be observed that resistance X, Fig. 2, is shunted out when receiving, and cut in when sending. When resistance X equals the combined resistance of the line and two impedance coils, the relays at each telegraph station will get the same amount of energy when receiving as when sending. The resistance "Y" also aids in obtaining an even distribution of energy to all the relays on the line by decreasing the per cent that the line resistance, which is a variable amount between each telegraph station, bears to the total resistance of any multiple telegraph circuit. Since the 500-volt railway circuit is usually available at all telegraph stations on interurban dispatching lines this affords a very convenient and reliable method of obtaining energy by connecting the key in between the middle terminal of the impedance coil and four or five 16-cp lamps in series, as illustrated in Fig. 2, so as to obtain 110 volts on the telephone line.

For the fifth or ground lamp it is best to use four 16-cp lamps in series multiple as illustrated in Fig. 2. With this combination there is no danger of the lamps burning out and throwing current at 500 volts potential on the telegraph line. The local sounder is connected in the usual manner, either with local battery, which, in this case can be ordinary dry batteries, since the sounder is on open circuit when not in actual use, or by shunting the ground lamp in a series of five. After a test covering a period of one year, it has been demonstrated that the above-described method of connecting telegraph instruments on the open-circuit multiple method on combined telegraph and telephone lines for interurban service has several well defined advantages over the series or closed circuit method. Energy is not being used except when keys are in actual use. All stations are independent of each other, and any one can be cut on or off the line at any time without interfering with the rest of the line. A break or opening in the instruments of one station does not affect the other stations on the line. It is impossible for an operator to go away and leave the line open by leaving his key open. The operator can cut his instrument off the line by opening the double-pole switch, Fig. 2, and practice without interfering with the rest of the service. If both sides of the telephone line should break, telephone service can still be maintained on each side of the break without making any changes in the instruments or the line. With the multiple or open-circuit system the telephone line does not have to be cut or changed in any manner and portable instruments can be plugged on or off the line the same as portable telephone instruments, as illustrated in Fig. 6.

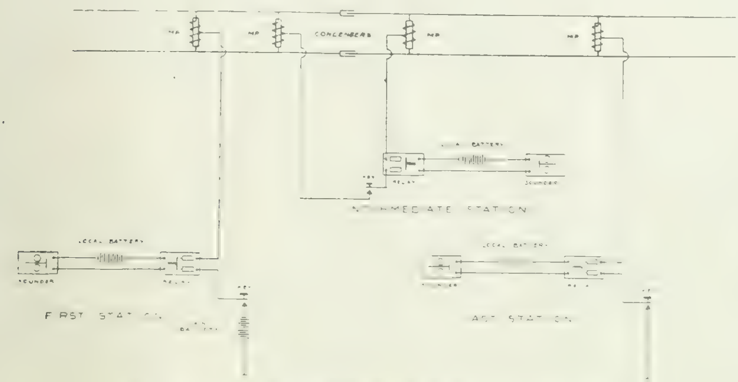


FIG. 1.—DIAGRAM OF CONNECTIONS OF TELEGRAPH INSTRUMENTS.

It is very convenient in reporting accidents, break-downs, and trouble on the line, where you do not wish the passengers and general public to hear, as they would if the telephone was being used. The multiple or open-circuit system requires no condensers and but one impedance coil at each station; whereas, the series closed-circuit system requires two condensers cut into the telephone line and two impedance coils cut across the line at each intermediate telegraph station.

Probably the greatest advantage of the multiple system over the series system in operating a combined telegraph and telephone line which parallels a high-tension line results from the system of connecting the balanced-wound impedance coil to line through relays and through resistance to ground. Figs. 3, 4 and 5 show different kinds of balanced-wound impedance coils which may be used.

Both sides of the telephone line being of the same potential no telegraph curent will pass from one side to the other through the telephones bridged onto the line, and, therefore, will in no way interfere with the telephone service. The great trouble with the telephone for dispatching purposes, especially when the telephone line parallels high-tension lines, is due to the extreme sensitiveness of the telephone receivers to the slightest trace of alternating current or a varying current of any description.

A well constructed telephone line must have the same resistance, impedance, inductance and capacity in each side of the line; not only must each side total the same, but each side must have the same between each talking station. The line must be so transposed that each side of the circuit shall occupy and travel in the same zone or position relative to all source of inductance half of the distance between each talking station.

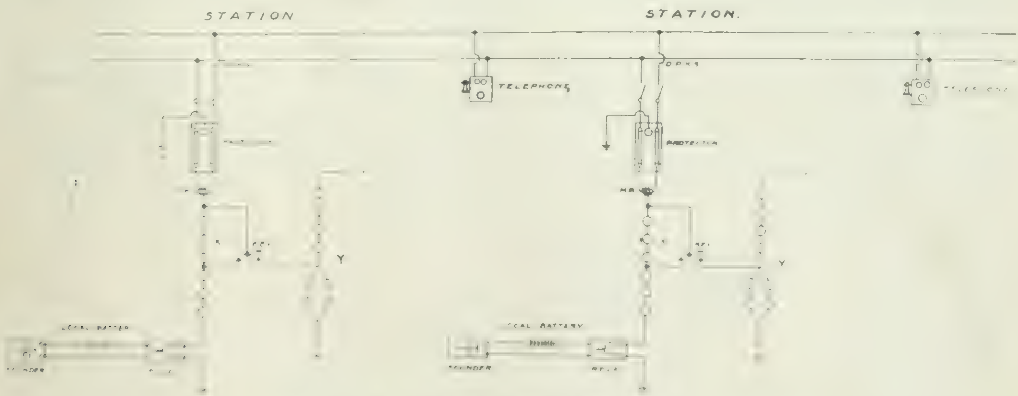


FIG. 2.—DIAGRAM OF COMPOSITE CONNECTIONS.

The line must be properly insulated not only from other lines, but from the ground and all other objects having capacity which would unbalance it. The greatest source of trouble in operating dispatching lines which parallel high-tension lines and the one most difficult to overcome arises from the compromising position the telephone line is made to occupy to satisfy two opposite and opposing conditions. One for the purpose of keeping the line clear of the ground, and the other for the purpose of preventing a high difference of potential from arising between both sides of the line and ground, which might be induced from

the high-tension line, or from some foreign line coming in contact with the telephone line. To satisfy one condition the line must be kept perfectly insulated and clear of the ground. To satisfy the other condition it must be brought near the ground in many places so that the striking distance is within the range of safe and moderate voltages. To accomplish this result the line must be brought within 1/100 of an inch of the ground in many places. The devices ordinarily used for this purpose consist of two carbon plates separated about 1/100 of an inch by perforated celluloid or mica, one carbon plate being connected

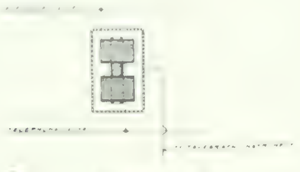
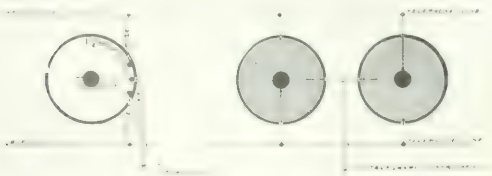


FIG. 3.—IMPEDANCE COIL.

to one side of telephone circuit and the other carbon plate connected to the ground. When a discharge takes place from one carbon plate to the other, it burns and blisters it and leaves that side of the line permanently grounded. The capacity of the grounded side is greatly increased, the telephone line becomes unbalanced, and so noisy as to become inoperative to telephone service.

It is then necessary to go over the line and clean the protectors. Dust and dirt also accumulate on these protectors with the same result. The installation of multiple telegraph instruments on telephone lines of this character overcomes most of the above mentioned trouble. The grounding of the neutral point of the impedance coils through the relays and non-inductive resistance serves to carry off the static and other stray electricity which otherwise would accumulate and discharge across the carbons and blister them. Thus, the installation of the telegraph instruments on the same line as the telephone, instead of introducing any new or increased complications or troubles, greatly diminish the existing ones. Since the installing of the telegraph instruments on the Beaver Valley dispatching line nearly all the trouble arising from blistered carbons in the protector has been eliminated. This leads to the conclusion that when telephone instruments are not needed, both sides of the telephone line, paralleling high-tension lines should be grounded through suitable balanced-wound impedance coils. But wherever the business on the line is important enough to warrant the expense, telegraph instruments should be installed.

A composite system not only doubles the amount of business that can be handled over a single line, but is much more re-



liable and convenient than either telegraph or telephone line alone. The telegraph and telephone are not both subject to the same troubles. Although the telephone is more sensitive to both atmospheric disturbances and induced currents from other lines, and consequently is less reliable than the telegraph, it is more convenient and better adapted for handling certain classes of business than the telegraph. For reporting cars, at passing points, and places where there are no operators, for communications between sub-stations and main stations, and all lines of business where it is necessary to get into close touch with each other, and where a quick and immediate response is required, and where one does not wish to talk through a second party, the telephone is unsurpassed.

There is sometimes a great deal of satisfaction in talking directly to the train crews, station attendants and other employees. For such work the telephone is most desirable. There are, however, times when a personal interview is not required and, perhaps, not wanted, and in such cases the telegraph has its advantages. The greatest trouble with the telephone for dispatching purposes is that the operating current is so small that the lines easily pick up sufficient foreign and induced current to interfere with the operating current, consequently the telephone instruments are very noisy. Telephone transmitters usually operate on from two to four volts, and as their resistance is

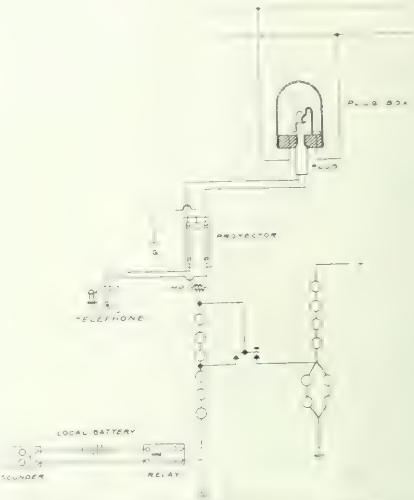


FIG. 6.—DIAGRAM OF PLUGGING-IN ARRANGEMENT.

from 10 to 20 ohms, they do not usually require more than one watt. This is a very small amount of power. If a transmitter could be designed to operate on 100 watts or more, the receivers could be made less sensitive to current from foreign lines, and would not be so affected by atmospheric conditions. The composite system has all the advantages of both systems with very little additional expense. It introduces no new troubles or conveniences and greatly diminishes the liability of total interruption of services. We are indebted to Mr. E. R. Cunningham, electrical superintendent of the Des Moines City & Interurban Railways, for the information contained in this article.

Vertical Shaft Rotary Converter at Chicago.

The Commonwealth Edison Company, of Chicago, has just installed in its Market Street sub-station the first vertical shaft rotary converter to be put in operation in an American central station. The same company has already in use five 2000-kw vertical shaft motor-generator frequency changers, which are very satisfactory. The frequency changers have step bearings similar in principle to those on the Curtis steam turbine; the weight of the bearing being carried on a film of oil or water forced under the bearing. The rotary converter under consideration, however, differs considerably in construction from the frequency changer sets. It is a 2000-kw General Electric machine running at a speed of 166 r. p. m. Provision is made for carrying the weight of the revolving armature either on a roller bearing or on an oil pressure bearing. The roller bearing has given good results in factory test runs, and it is confidently expected that it will be the form of bearing finally adopted.

To provide for operation, should changes be necessary during the perfecting of the roller bearing, however, an oil bearing, interchangeable with the roller bearing, has been provided, together with a set of pumps for maintaining the pressure in the oil bearing. Fig. 2 is a vertical sectional drawing showing the relation of parts. The armature of the machine revolves about a stationary central shaft or pivot, such as shown in Fig. 4. This stationary shaft, which is 23 ins. in diameter, carries on its upper end the interchangeable roller or oil pressure bearing. The armature is mounted on a sleeve which revolves outside of the stationary shaft. The weight of this sleeve and the arma-

The field magnet structure, carrying 18 poles, is supported on cast-iron pillars resting on a concrete base ring, as shown in Fig. 3. To keep the revolving armature in line, there are two guide bearings, each 14 ins. long, below the roller bearing. To change from roller bearing to oil pressure bearing, it is a simple matter to take the weight off the top bearing, withdraw the cap screws holding the top plate and change from a roller to oil pressure bearing or vice versa.

The advantages of the vertical shaft rotary converter are many. There is a saving of about 17 per cent of weight in the vertical shaft machines, as compared with the horizontal shaft

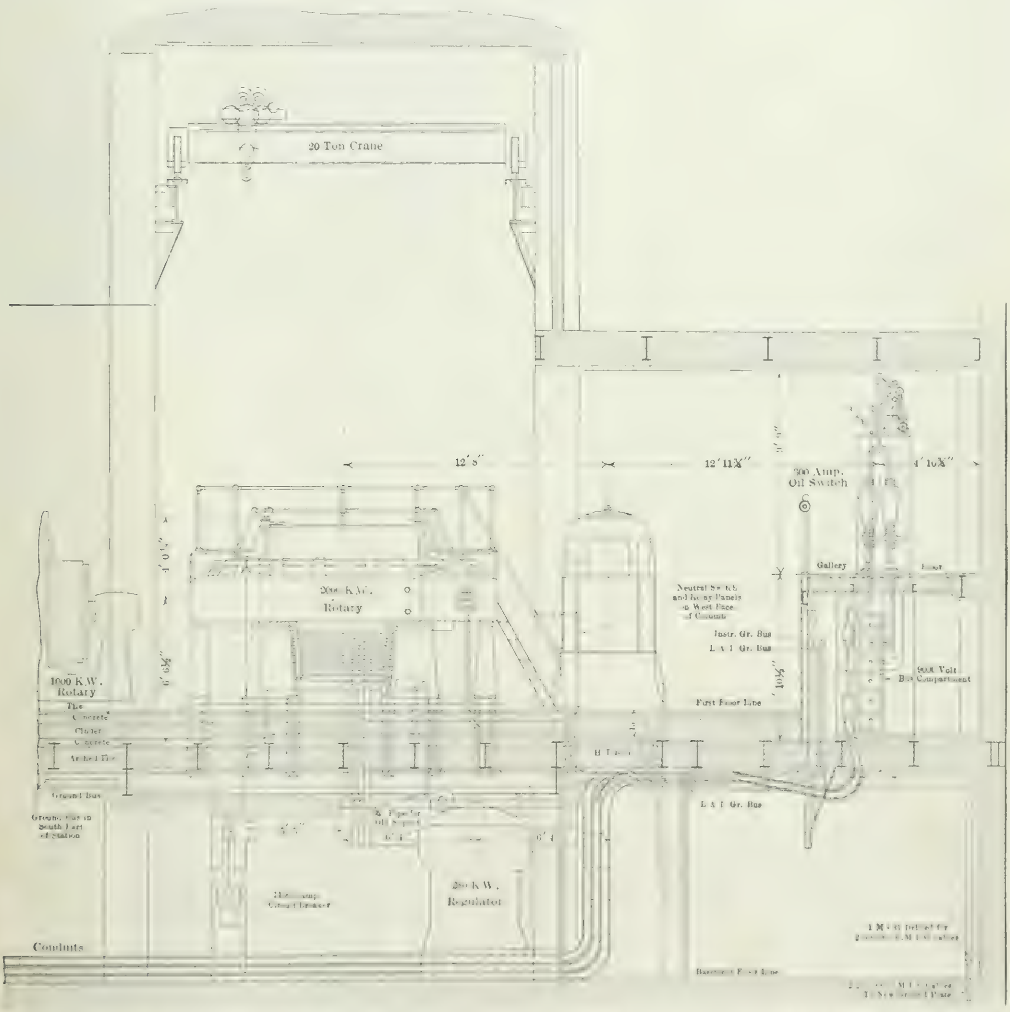


FIG. 1.—SECTIONAL ELEVATION SHOWING 2000 KW ROTARY EQUIPMENT IN MARKET STREET SUB-STATION OF THE COMMONWEALTH EDISON COMPANY.

ture which it carries is taken by the bearing at the upper end. To get at the roller bearing, it is only necessary to remove a steel cap from the upper end of the revolving sleeve, after having first relieved this steel cap of the weight of the armature and sleeve by means of screw-jacks. These screw-jacks, which are a permanent part of the machine, consist simply of a set of screws which are accessible from the basement below the machine.

machines this company has in service. The horizontal shaft machines, to be sure, run at a lower speed, but they have been the only ones available, so that leaving out of account the questionable possibility of building satisfactory higher speed horizontal shaft machines, there is an important reduction in weight by the vertical shaft construction. One of the most important advantages of this construction is the accessibility of the brushes. The brushes on the vertical shaft machine are

readily accessible to an attendant on a platform extending around the machine and resting just above the field poles. On a horizontal shaft machine the attendant must climb ladders in difficult positions. The weight of the vertical shaft, 2000-kw machine is stated to be about 67 tons. The diameter of the circular floor space occupied by it is 15 ft. 3 ins. The height above the floor is 9 ft. 3 ins. The 2000-kw horizontal shaft machines of the company occupy a floor space of 16 ft. 6 in. x 16 ft. 6 in., and extend 12 ft. 11 ins. above the floor and 3 ft. 7 ins. below, making the total over all height 16 ft. 6 ins.

The rotary is entirely supported by the steel and concrete floor of the building, as shown in Figs. 1 and 3; the building being designed to carry such loads on the first floor. The basement space under the converter is, therefore, almost clear save for electrical apparatus. This electrical apparatus consists of a 250-kw regulator on the alternating-current end and two single-pole, 11,000-ampere, solenoid-operated circuit-breaking switches in the direct-current leads. The direct-current leads go directly to the bus-bars, the solenoid control circuit only being taken to the converter control panel. An excellent idea of a typical arrangement of circuits and apparatus in this sub-station is given by Fig. 1. The 9000-volt, three-phase lines enter through conduit

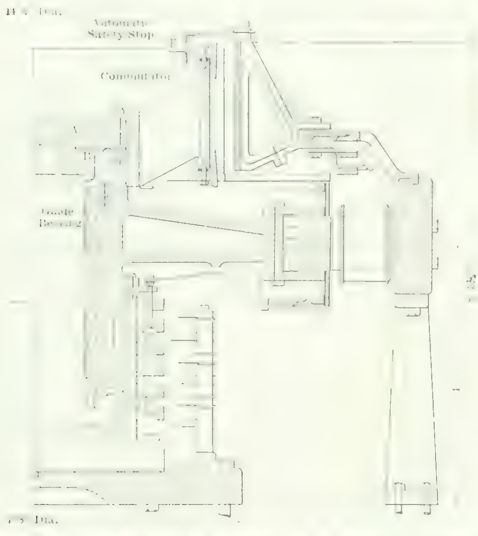


FIG. 2.—VERTICAL SECTION OF ONE HALF OF 2000-KW VERTICAL-SHAFT ROTARY.

from the left, pass along the basement floor and thence up to the high-tension bus compartments and switchboard at the right. The 300-ampere oil switch shown at the upper right-hand corner of Fig. 1 controls the alternating-current end of the rotary converter, this being the only switch in the chain of apparatus until the direct-current leads of the converter are reached. In other words, the regulator and rotary converter are considered as a unit and are conductively connected together. From the high-tension switch, the leads pass under the floor to the transformer, which is on the main floor of the sub-station, close to the rotary converter. The low-tension, six-phase leads of the transformer pass through the floor to the regulator in the basement and then up to the collecting rings of the converter, which are just below the armature. From the converter, the direct-current leads go by the shortest possible route to the direct-current bus-bars and the energy passes out thence over the direct-current feeders, so that a minimum amount of copper is required for leads and switch connections. The high-tension bus-bar compartments in the new part of the sub-station are built of concrete slabs made to order and assembled on the job.

This rotary converter gives direct current at from 240 to 300 volts. The neutral of the low-tension side of the transformer is connected to ground and to the neutral of the direct-current system, thus doing away with the necessity of direct-current balancing sets. This is the standard practice of the Commonwealth Edison Company. The rotary converter is the latest addition to a sub-station which already has four 1000-kw horizontal shaft rotary converters. An interesting economic fea-

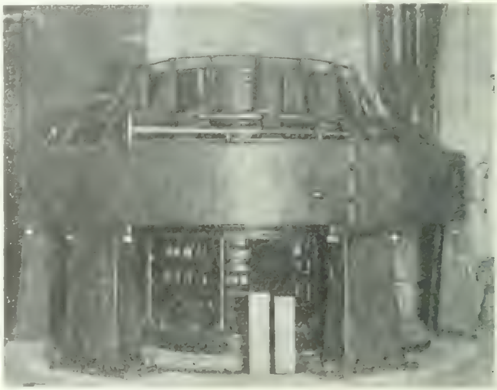


FIG. 3.—2000-KW VERTICAL SHAFT ROTARY CONVERTER.

ture in this sub-station is the use of a transformer giving an increased voltage for one of the rotary converters in order that the direct-current voltage delivered may be high enough to charge the storage batteries there installed. The transformer connections allow the converter to be operated at an alternating e. m. f. of from 300 to 360 volts, instead of 240 to 300 volts. This gives a direct-current voltage sufficient to take care of battery charging and abnormal operation in case the voltage on some feeder needs boosting. It is considered cheaper and more satisfactory to purchase a transformer of this kind with extra

FIG. 4.—STATIONARY VERTICAL SHAFT OF A 1000-KW ROTARY CONVERTER.

voltage connections than to buy and provide room for a booster for battery charging.

The company has also contracted for a 1000-kw vertical-shaft, rotary converter for its Randolph Street sub-station under the Masonic Temple. Fig. 4 shows the shaft of this machine erected under the sidewalk where it is to be located.

Letters to the Editors.

The Beginnings of the Rubber Industry.

To the Editors of Electrical World:

Sirs:—In your issue of Nov. 23 the statement is made in a very interesting article on rubber by the well known authority, Mr. F. J. Hall, that the price of this material is fixed by the demand. It may be of passing interest to your readers to quote from a book printed about a century ago and long out of print. "The substance called Indian Rubber or Caoutchouc was not known in Europe until the beginning of the eighteenth century, having been brought from South America as a great curiosity. It appeared in the shape of bottles, birds, or other fantastically molded forms. Nothing could be learned of its origin until a body of French Academicians undertook a voyage to South America in 1735 when it was ascertained through traveling through Brazil that it was an exudation from a tree called the heve." The narrative proceeds to tell how it is cured and molded into various forms. "The usual method of drying is to spread a thin coating of the milky juice upon molds - - - These are then dried by exposure to the heat of a smoke-fire. - - - layer after layer may be put on until the desired thickness is achieved. - - - It will then be found to retain any impression that may be given to it." Anent the price that obtains to-day, and by the ruling of "supply and demand," it may be of interest to note the then demand. "More than 52,000 lbs. of caoutchouc were imported into England last year, being nearly double the quantity brought during the preceding year. Its price is 1s. 6d. per pound." As the employment of rubber had not then reached the usefulness in the manufactures that obtains to-day is attested by the writer's note: "For many years its only use has been to rub out lead pencil marks and it has become an important industry." As a prophecy the historiographer proceeds to say: "A thin coating of the solution spread on any texture renders it impervious to air or moisture; while, at the same time, it can be folded in as portable form as before it received the preparation - - - The use of rubber applied to a fabric will permit of making pillows, and even beds out of bags and thus be air-tight and these being made with an air cock may be inflated at pleasure into elastic cushions."

New York. H. F. Frasse.

The Patent Office Gazette.

To the Editors of Electrical World:

Sirs:—The writer wishes to bring to the attention of your readers a recent action of the patent office in abridging the record of patent claims as published in the *Official Gazette*. Since Nov. 19 patents containing more than six claims have been cut down and only the first six claims thereof published. This is a matter of considerable importance to inventors and manufacturers in general, and should receive prompt and effective condemnation. Up to the present time the writer has seen no comment in the technical press on this subject.

The *Patent Office Gazette* is the only official general publication of the patents issued by the department, the claims of which are in a sense a part of the federal law, and as such should no more be abridged and thereby concealed from the general public than the laws and proceedings of Congress as published in the *Congressional Record*. The present action practically reduces the value of the *Gazette* to that of a mere index, for six claims of a patent often disclose no more than a small and possibly insignificant part of the subject matter of the invention, while the single illustration published has always been inadequate. Moreover, it will no doubt be found that attorneys will take advantage of the new rule and arrange the claims in such order that the first six when published will disclose practically nothing of the invention, if not actually misleading the reader as to the scope thereof.

There are a large number of inventors and others who subscribe for or have access to the *Gazette* and who follow up the record of patents in which they are interested. Heretofore in the majority of cases all of the information desired could be obtained directly from the *Gazette*, but under the new arrangement one who wishes to keep in fairly close touch with invention along a given line, or along several different lines, will have to procure complete copies of all patents issued along such lines, many of which on examination will then prove to be of little service except to cause him an unreasonable and unnecessary expense.

Such ill advised "economy" on the part of the Patent Office (if the slight saving in printing is responsible for this action) should meet with most emphatic protest in the press and at the department.

Syracuse, N. Y. H. C. Ford.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Turbo-Generators.—R. Pohl.—A paper read before the (British) Institution of Electrical Engineers. The author discusses the limitations of direct-current machines driven by steam turbines. The mechanical or speed limit of the armature is defined by the circumferential velocity for which the tensile stresses reach their permissible limit. It is invariably the stress in the end shells protecting the connections which first approaches the limiting values. With ordinary bronze castings the maximum permissible speed will be about 50 meters per second, while with special phosphor-bronze and manganese-bronze castings it will be 75 meters per second. There is also a "flash-over limit," the most important factor being the potential difference between two adjacent commutator bars. As a safe limit in the case of turbo-generators 40 volts may be taken. This limits the number of lines of force allowed to enter or leave an armature of given diameter. There is also a limitation to the "specific load" (ampere conductors per centimeter of armature circumference). The author finds that up to a rating of about 500 kilowatts a direct-current dynamo can be built to the requirements of the steam turbine while for ratings above 500 kilowatts it is not possible to construct direct-current generators running at so high a speed as the equivalent turbine demands. This limitation may be overcome by artificially reducing the speed of the steam turbine, or by arranging two generators in tandem coupled to one turbine, the rating of each being one-half of the turbine output. Each method involves increased cost, and can only be considered as a temporary measure. It has been said that homopolar machines might be suitable for the high speeds of steam turbines, but the author shows that they are impracticable owing to the excessive amount of active material required. Further progress in direct-current turbo dynamos must be made by extending the sparking and the flash-over limit. This can be accomplished by working with a higher circumferential velocity of the armature, by employing certain steel alloys of very low magnetic permeability and high tensile strength. A further possibility seems to lie in adjusting the commutating field so as to extend the specific load line without exceeding the sparking limit. The reactance voltage increases in proportion to the armature current, therefore the characteristic of the commutating field should be a straight line; unfortunately, however, such is not the case, the curve being convex. The author has found that the following method allows an adjustment of the form of the characteristic. Use is made of a shunt to the commutating pole winding, the resistance of which increases rapidly with increasing load.

Iron resistors of the kind used for Nernst lamps are particularly suitable, although thin copper wires may also be employed, for which, without enclosing them in air-tight bulbs, high temperatures may be permitted. As will easily be seen, the ampere-turns on the commutating poles as a function of the load will now rise according to a concave curve, thus compensating for the curvature of the characteristic. Experiments have shown that an almost exact straight-line relationship between the intensity of the commutating field and the load is thus obtainable within very wide limits. Finally, there is a possibility of further extending the flash-over limit by using a special armature winding. Such a winding is described, though it has not yet been tested experimentally.—Lond. *Electrician,* Nov. 29.. In the discussion which followed the reading of the paper, Mr. G. G. Stoney stated that he considered the author's output limits rather low, and Mr. E. J. Fox made a few remarks from the turbine builder's point of view. Mr. Miles Walker considered a number of points of importance to users of the machines in question, and described a form of winding used by the British Westinghouse Company to diminish the voltage between segments. Prof. Silvanus Thomson discussed the flash-over limit, and showed a drawing of a homopolar machine designed some 15 years ago. Mr. A. C. Eborall gave a few particulars of a Continental design of machine, and Prof. G. Knapp mentioned a number of points especially as regards the speed of response of the commutating pole to sudden variations of load. Mr. S. Evershed related experiences with an early machine, and Mr. A. G. Ellis showed some curves of maximum speeds and outputs.—Lond. *Elec. Eng'ing,* Dec. 5.

Design of Turbo-Generators.—H. M. Hobart.—A fully illustrated article on last year's progress in the design of electric generators for direct connection to steam turbines. During the last 12 months notable progress has been made in the manufacture of turbo alternators of very large rating, the largest being 9000 kilowatts. Some notes and illustrations are given on details of ventilating devices and means for securing the end-connections of alternator stator windings. Direct-current turbo-driven generators are satisfactory only in much smaller sizes, and some details are given of improvements in commutator construction, brushes, brush holders, special windings and field construction. Interpoles and compensating windings cannot be said to constitute necessary attributes of direct-current turbo-generators. Recent inventions in armature windings are of considerable promise and may lead to such good results as to enable interpoles and compensating windings to be dispensed with in some cases.—Lond. *Electrical Eng'ing,* Dec. 5.

Parallel Connection of Three-Phase Transformers.—G. Stern.—A translation with illustrations of his recent German paper on this subject.—Lond. *Electrician,* Nov. 29; Lond. *Elec. Review,* Nov. 15.

Lamps and Lighting.

Photometry of Colored Light.—F. L. Tufts.—In the case of colored light the definition of luminosity may be based on the rule that two similar surfaces illuminated respectively by two lights of different color are said to be of the same luminosity if, on rapidly replacing one by the other before the eye there is no sensation of flickering. This is the principle of the flicker photometer. In the present paper the author describes a new form of spectrophotometer for the measurement of color luminosities according to this definition and gives the results of measurements of the luminosities of the different parts of the spectrum as they appear to normal and to color-blind eyes. The chief results are as follows. The retina of the human eye contains two distinct sense organs—one, the luminosity sense, the other, the color sense. The luminosity sense is affected qualitatively in the same way by light stimuli of all wave-lengths within the visible spectrum, so that it reacts, after fatigue, always in the same way, no matter what kind of light is used to fatigue the retina. (The only exception to this is when the fatigue is caused by prolonged exposure to the long, or red, rays of the spectrum.) The relation between the wave-length and luminosity in the case of a 50-cp incandescent lamp may be represented by a wave-length luminosity curve which, for most eyes, is identical with the curve in Fig. 1. Deviations from this normal curve fall, for the most part, into one or the other of two classes: (1) The point of maximum luminosity may be displaced towards the red. (2) It may be displaced towards the green. Persons possessing perfectly normal color

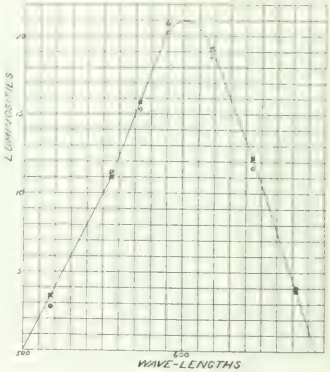


FIG. 1.—WAVE-LENGTH LUMINOSITY CURVE.

vision may have an abnormal wave-length luminosity curve, and color-blind persons as often have a wave-length luminosity curve belonging to class 1 as to class 2.—*Physical Review,* December.

Traction.

Car with Side Rods.—An illustrated description of recent tests made by J. Murphy in Pittsburg with a car equipped with two motors and side rods connecting the axles of each truck. Tables showing the saving effected by this car are given.—*St. R'y Jour.,* Dec. 14.

Overhead Construction.—An illustrated description of the overhead construction on a 15-cycle, single-phase railway in California. Bracket construction is used for both single and double tracks. Span construction is used only with three or four tracks.—*St. R'y Jour.,* Dec. 7.

Single-Phase Traction.—A. Heyland.—A translation of his German paper on the use of combinations of single-phase induction motors with slip-ring rotors, but without commutators, for traction purposes. The German paper has already been abstracted in the Digest.—Lond. *Electrician,* Nov. 22.

Railway Signals.—W. E. Foster.—The conclusion of the illustrated serial on railway signaling. In the present instalment the language of fixed signals is dealt with.—*Electric Journal,* December.

Installations, Systems and Appliances.

Obtaining Constant Current with Varying Potential Difference.—O. Sackur.—An illustrated description of an automatic regulator for obtaining constant current of varying potential difference. The current passes through a cell, decomposing water, the oxy-hydrogen gas generated escaping through a fine capillary. Within the electrolytic cell there is thereby created a pressure which is proportional to the current. This pressure is indicated on a manometer tube, and by means of connections of the manometer tube to a series of resistors, etc., the difference of level of the mercury in the manometer tube is maintained constant so that the current also remains constant. Tests show that this system works satisfactorily and that the current remains constant within two per cent, even when the working pressure varies more than 10 per cent.—Lond. *Electrician,* Nov. 15.

Switchboards.—B. P. Rowe.—The conclusion of his illustrated serial on electrically-operated switchboards. Notes are given on elevated panel instrument switchboards, wattmeter, watt-hour meter and relay panels, edgewise-type feeder switchboards,

field rheostats and field switchboards, direct-current exciter switchboards, station apparatus, auxiliary direct-current circuits, controlling and instrument switchboards, generator control pedestals, and calibrating jacks.—*Electric Journal*, December.

Mainz.—FURKEL.—The first part of an illustrated description of the municipal electric station of Mainz, the equipment of which is rated at present at 4000 horse-power. During the next year a 3600-hp steam turbine is to be installed. Three-phase currents are generated at 2300 volts, the frequency being 51.5.—*Elek. Zeit.*, Dec. 5.

Electrophysics and Magnetism.

Gradual Modification of the First Linear Sprectrum of Emission of Mercury.—E. CASTELLI.—With reference to Sir William Ramsay's discovery of the transformation of several elementary substances, the author describes an observation made by him in taking some spectra photographs of the electric arc in mercury vapor contained in a uviol lamp. He observed a considerable difference between the spectra when the uviol lamp was almost new and later after it had been working during short periods separated by long intervals for about 100 hours. He found that the group of three lines, of the wave-lengths 3663.3, 3654.9 and 3650.3 Angström units, had nearly completely vanished; while the three lines 5790.49, 5769.45 and 5460.97 which in the first experiment had given a scarcely visible photographic impression, now produced a much clearer and a more intense impression than any other line. "As it is now generally believed that the vibration corresponding to each line of the spectrum of an element must be considered as due to its positive ions, I think the modification I have noticed in what Prof. Stark calls the first linear spectrum of mercury, must be considered as depending on an alteration in the character of the positive monovalent ions, probably consisting in such a variation of the vibrating mass that it renders oscillations of a higher frequency impossible, while the vibrations of less wave-length, due to a state of a smaller ability for motion, are made easier and, therefore, intensified."—*Phil. Mag.*, December.

Gas Given Off from Aluminum Electrodes.—R. VON HIRSCH AND F. SODDY.—When cathode rays are generated by means of an influence machine in pure gases, the relation between the gas pressure p and the discharge potential V can be represented by $p^2V = \text{constant}$. This relation holds for pure gases independently of the amount of current in the tube, but does not hold at all for gaseous mixtures. During the passage of the discharge a gas is continuously evolved from the electrodes if they are of aluminum, which renders the gas initially filling the tube impure so that the above relations cease to hold. If, however, the discharge is passed for some hours, the gas being pumped out as evolved, so as to maintain the pressure within the range required for the production of cathode rays without unduly increasing the resistance of the tube, the value p^2V becomes a constant independent of the nature of the gas initially filling the tube, and is about one-fourth of the value of hydrogen. The authors endeavored to identify this gas, but have not yet succeeded. From its electrical behavior, it seems that it must be a pure gas, probably with a molecular weight of 4 or some multiple. The phenomenon is connected with the presence of some impurity in the aluminum.—*Phil. Mag.*, December.

Radium.—E. RUTHERFORD.—A paper on the production and origin of radium. Over the time of observation, 305 days, radium was produced in actinium preparations at a constant rate. By suitable chemical treatment it is possible to obtain actinium preparations which produce radium extremely slowly. The active deposit of actinium does not change directly into radium. The results of the author indicate that in the ordinary actinium preparation there exists a new substance which is slowly transformed into radium. This direct parent of radium can be chemically separated both from actinium and radium. Observations have not extended over sufficient time to settle whether this parent of radium has any direct genetic connection with actinium or not.—*Phil. Mag.*, December.

Selenium Cell.—Two papers by F. C. Brown and J. Stebbins deal, respectively, with the variation of the light sensitiveness of the selenium cell with pressure and with the effect of radium on the resistance of a selenium cell. A paper by E. Merritt gives the results of an investigation of the recovery of selenium cells after exposure to light, as influenced by the duration and intensity of the previous excitation. The author finds a remarkable resemblance between the behavior of selenium, as indicated by the change in its conductivity, and the behavior of a phosphorescent substance, as indicated by the intensity of its phosphoresence.—*Physical Review*, December.

Resistance.—H. K. ONNES AND J. CLAY.—An account of an experimental investigation of the change in the resistance of metals at very low temperatures and the influence exerted on it by small amounts of admixtures.—Lond. *Electrician*, Nov. 29.

Fused Salts.—H. M. GOODWIN AND R. D. MAILEY.—The first part of an account of an experimental investigation of the density, electric conductivity and viscosity of fused salts and their mixtures.—*Physical Review*, December.

Units, Measurements and Instruments.

Transportable Standard Cell.—R. E. DELURY.—A description of a transportable form of standard cell, the contents of which cannot mix even though the cell may be inverted or shaken. In a piece of tubing A (the first diagram of Fig. 2) of suitable thickness, 15 cm or 20 cm long and 1.5 cm to 2.5 cm in diameter, there is placed another piece B, 6 cm to 8 cm long and 0.5 cm to 1.0 cm in diameter. In the ends of A there is inserted a tight-fitting cork C through which pass the small tubes D, one of which is open, the other sealed. The lengths of the tubes D are so adjusted that they enter B just enough to

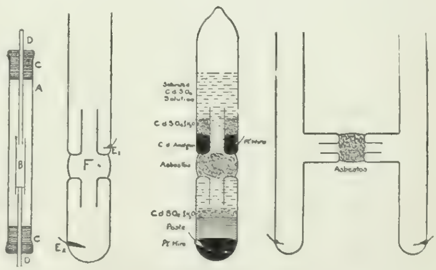


FIG. 2.—TRANSPORTABLE STANDARD CELL.

hold it co-axial with A. The whole is held horizontally and is rotated in the small pointed flame of a blowpipe—or, better, in the flames of two blowpipes pointing into one another. The tube A is melted in a narrow band nearly opposite the middle of B. At this point A adheres to B, and after the tubes are thoroughly fused together they are blown out. While the tube is still warm, the platinum wire E_1 is fused in above the bulb of the cell, in the usual manner. The corks are now withdrawn and one end of the cell is sealed and another platinum wire E_2 fused into it. The cell, which now appears as shown in the second diagram, is filled as follows: Mercury is put in the bottom of the tube by means of a small pipette or funnel made by drawing out a test-tube. Above this is placed the mercurous sulphate paste and cadmium sulphate crystals by means of a small tube. Then by means of a pipette sufficient cadmium sulphate solution is put into the cell to fill the bulb F. Air will thus be entrapped below F, and to remove it suction is applied at the end of the cell. On removing the suction, the solution will rush down to fill the space below the bulb. Some asbestos or glass-wool is now pressed down through the inside tube to fill the bulb F, packing it in fairly tightly, yet not so compactly as to make the internal resistance of the cell too great. Enough cadmium amalgam is then put in the space above F to cover the platinum wire E_1 completely. Above this is placed cadmium sulphate crystals and enough saturated cadmium sulphate solution is added to fill the cell about a centimeter above the end of the inside tube. Several centimeters above this point the tube is sealed or a cork is inserted, and the

cell is completed as represented in the third diagram. The H-form of cell is made transportable by employing a similar "double-trap" in the cross-tube connecting the two legs, as shown in the fourth diagram. In this case the asbestos is put into the bulb before the cross-tube is sealed to the legs.—*Physical Review*, December.

Standard Cells.—F. A. WOLFF AND C. E. WATERS.—A long paper on the Clark and Weston standard cells, with detailed description of their construction and of the preparation and purification of the materials, and the results obtained at the Bureau of Standards, in Washington. It is found that standard cells can be set up by different investigators with different materials, which agree to within a few parts in 100,000. Standard cells can also be constructed which show no appreciable change when carried considerable distances, even on ship board, provided ordinary precautions are observed. In a second paper, the same authors discuss the electrode equilibrium of standard cells. —*Bull. Bureau of Standards*, Vol. 4, No. 1, December.

Effect of Humidity on Manganine Resistances.—E. B. ROSA AND H. D. BABCOCK.—Their full paper on the variation of manganine resistances with atmospheric humidity, a preliminary account of which appeared in the ELECTRICAL WORLD for June 29, 1907.—*Bulletin, Bureau of Standards*, Vol. 4, No. 1, December.

Barretters.—An article on the use of barretters or bolometers made by an English firm for measuring small alternating or fluctuating currents. It consists essentially of a conducting wire or filament which has a high temperature-resistance coefficient and a small mass, so that small currents will appreciably raise its temperature, and thus alter its resistance. In the present instrument a fine carbon lamp filament is employed, with which the greatest variations of resistance occur with small currents. Fig. 3 shows the arrangement of the circuit for zero method.

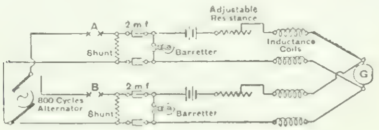


FIG. 3. DIAGRAM OF CIRCUIT.

A source of alternating current, such as a sine-wave alternator, is connected to two branch circuits, in one of which a rheostat is inserted at *A*. The other arm has the apparatus on line to be measured inserted at *B*. The barretters are connected through rheostats and batteries to the galvanometer.—Lond. *Electrician*, Nov. 22.

Effect of Frequency on Resistance and Inductance.—L. COHEN. —The resistance and inductance of a conductor depend on the distribution of the current within the conductor. In the case of a fluctuating or alternating current eddy currents with their accompanying magnetic fields will be generated within the conductor, which will alter the distribution of the current and consequently change the resistance and inductance of the conductor. For a straight, cylindrical wire the problem has been satisfactorily worked out, but the results obtained for a straight wire will not hold when the same wire is wound into a coil. The change in resistance of a coil for any given frequency is much larger than if the windings of a coil were drawn out into a straight conductor. The author has studied this subject again theoretically and experimentally and his experiments are in agreement with his theoretical results. (See ELECTRICAL WORLD, Sept. 21, 1907, p. 564.) He concludes that the change in resistance of a coil is a function of the frequency, the section of the winding and the pitch of the winding.—*Bull., Bureau of Standards*, Vol. 4, No. 1, December.

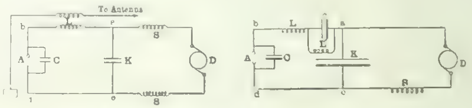
Self-Inductance of Rectangular Coil.—E. B. ROSA.—One of the most carefully constructed standards of self-inductance is that of Froehlich, who uses a large marble ring of rectangular section, wound with a single layer of fine silk-covered wire. Each turn of the wire lies in a plane passing through the axis of the ring, the wires being wound as closely as possible on the inner surface of the ring and uniformly spaced on the outer surface. The present author discusses the formula for the self-inductance of this coil, and by means of several numerical examples he emphasizes the serious error which may result from assuming the winding of fine wires to be equivalent to a current sheet; for a given spacing of the wires, the finer they are, beyond a certain point, the greater is the error arising from this assumption. The straight solenoid offers many advantages over the circular solenoid as a standard. It is easier to construct and measure the core, and immensely easier to wind, and the calculation of the self-induction from the dimensions is just as easy and just as certain.—*Bull., Bureau of Standards*, Vol. 4, No. 1, December.

Self-Inductance of Circles.—E. B. ROSA AND L. COHEN.—A critical discussion of the convenience and reliability of the various formulas which have been proposed by different authors for the self-inductance of closed rings of circular cross-section. —*Bull. Bureau of Standards*, Vol. 4, No. 1, December.

Mutual Inductance.—A. CAMPBELL.—An illustrated Royal Society paper on a standard of mutual inductances, whose value can be determined solely from geometrical dimensions. The design worked out by the author consists essentially of two coaxial helixes of equal and finite length, with a secondary coil midway between them.—Lond. *Electrician*, Nov. 22.

Telegraphy, Telephony and Signals.

High-Frequency Oscillations.—A. BLONDEL.—The well-known disposition of Duddell's singing arc for producing high-frequency oscillations is not applicable in high-tension continuous-current circuits, partly because of the short-circuiting of the dynamo by the arc, and partly because the necessary presence of self-inductance circuit hinders the rapid charge and discharge of the condenser. To avoid these defects, the author proposes the circuits shown in Figs. 4 and 5. Both are char-



FIGS. 4 AND 5.—HIGH-FREQUENCY OSCILLATIONS.

acterized by the fact that a condenser of very great capacity is associated with the much smaller condenser across the spark-gap. The large condenser *K* is charged directly from the dynamo *D* through one or two impedances *S*, on one or the other of the leads. These impedances might, however, serve without self-inductance; that is, might be mere resistances. In the first arrangement the large condenser *K*, which has a capacity at least five times as great as that of the oscillatory condenser *C*, receives a charging current limited by the presence of the impedances *S*. The spark-gap, which is shunted by the condenser *C*, produces the discharge of this condenser as soon as the sparking potential is reached. Then the condenser *C* recharges itself through the self-induction of *L* (there may be one on each spark-gap lead, or only one on one of the leads). The rapidity of this charging depends on the proper period of oscillation of the circuit *abCdeKa*, and is partly determined by the e. m. f. disposable at the terminals of the condenser *K*. On the other hand, the impedances *S* prevent the oscillations of the oscillating circuit from making themselves felt in the dynamo. The presence of the condenser *K* contributes to this result because the natural period of the circuit *DaKeD* is longer the greater the capacity of *K*. By using large inductance in *S* this period may be made as long as we please, and by adding to the resistance such oscillations are easily damped out. In the second arrangement illustrated, the formation of an arc is completely avoided because there is no direct communication between the dynamo and the spark-gap. The circuit *abCdeKa* is in effect cut by one or more condensers *c*. The self-inductance *L* may be all on one lead or may be divided. The arrangement may easily be so modified as to become symmetrical. These arrangements are self-regulating.—Lond. *Electrician*, Nov. 22.

Wireless Telegraphy.—K. E. F. SCHMIDT.—An account of an investigation of the effectiveness of the hydrogen spark-gap in wireless telegraphy. The author has determined the resonance curves obtained at a receiving station when the sparks at the sending station are produced in air and in hydrogen. Previously published laboratory experiments by the same author had shown decidedly that whereas with sparks in air it was very difficult to produce in successive attempts oscillations of constant intensity, under what were apparently identical experimental conditions, yet, with the sparks in hydrogen, the measurements made on different occasions were very concordant. In consequence of these benefits, the author has compared under conditions approaching those of actual telegraphy the resonance curves of his apparatus, when air and hydrogen spark-gaps were employed. Resonance curves are given for the sending circuits, and show, contrary to expectations, that the damping in both closed and open circuits with spark-gaps of 5 mm. and of 10 mm. is much greater in hydrogen than in air at atmospheric pressure. The logarithmic decrements in the closed circuit were 0.5 for hydrogen and 0.3 for air, and in the open radiating circuit 0.9 and 0.3. The radiating circuit was a "harp" of 10 wires 20 metres in length, held vertically, and 1 metre apart, plus a similar horizontal harp 5 metres from the ground. Measurements at a receiving station 350 metres distant show, in addition, that hydrogen yields effects considerably feebler than does air, as well as appreciably higher damping.—Lond. *Electrician,* Nov. 22.

Transmission of Pictures.—An article on the Belin system of electric transmission of photographs. It differs from the Korn system since no selenium is employed. The picture to be sent takes the form of a relief, over which a pointer passes, which controls a small rheostat. In the receiving apparatus an oscillograph causes a beam of light to move over a screen of graduated density, by which it is more or less intercepted.—Lond. *Elec. Eng'ing,* Nov. 28.

Telegraph Line Construction.—HARTUNG.—An illustrated article on the erection of telegraph lines in the German colonies in Africa, with special reference to the difficulties due to the lack of railways.—*Elek. Zeit.,* Nov. 14.

Miscelianeous.

Technical Training.—G. KAPP.—His presidential address to the Birmingham local section of the (British) Institution of Electrical Engineers dealt with the question of technical training of electrical engineers, and advocated the more general introduction of what is sometimes known as the "sandwich" system, in place of the premium-pupil system. In the "sandwich" system the student is allowed to work in shops without premium during the vacation. Most of the speakers who discussed the paper thought that the best system in any case depends upon the individual student and believed that workshop experience extending only the length of the vacations is too short. One speaker recommended alternating a year's practical work with a year's theory; another advocated a year's college training, followed by three years in the shops (during which time two afternoons a week shou'd be allowed for attendance at classes), then a winter session at college, a summer in the shops and a final winter course of college work.—Lond. *Electrical Eng'ing,* Nov. 21, 28.

Argentine.—GLIER.—A statistical article. The number of inhabitants of the Argentine Republic has increased from 4,625,000 in 1901 to 5,360,000 in 1906; the yearly import of electrical apparatus and machines has increased in the same time from $635,000 to $3,430,000. While in 1901 30 per cent of the total imports into the Argentine Republic came from the United States, only 9 per cent of the total imports came from this country in 1905. On the other hand, while Germany participated in imports to Argentine to the amount of 60 per cent in 1901, this figure increased to 54 per cent in 1903 and 56 per cent in 1904 and 1905. The chief objects of import are wire, incandescent lamps, dynamos, arc lamps, and measuring instruments.—*Elek. Zeit.,* Nov. 28.

BOOK REVIEWS.

THE CLASSIFICATION OF ALTERNATE-CURRENT MOTORS. By V. A. Fynn, M. I. E. E. London: "The Electrician" Printing & Publishing Company. 41 pages. 46 illustrations. Price, 3 s.

The difficulties to be surmounted in producing a consistent classification of alternating-current motors will be appreciated when one considers the large number of forms that have been proposed since the beginning of the development of single-phase commutator motors. If one allowed his opinions to be formed from present day electrical literature, he would consider that there are three general types of alternating-current motors, the synchronous, the induction and the commutator. In his classification, the author ignores the synchronous motor entirely, he represents the induction motor diagrammatically as possessing a commutator and he omits the word "commutator" when designating the various forms of alternating-current commutator machines. In spite of these seeming absurdities, Mr. Fynn has succeeded in obtaining a logically arranged and consistent designation of alternating-current commutator and induction motors.

According to the terms selected by the author, a "series motor" is one in which the field excitation varies in some proportion with the armature current and the speed of which varies with varying load; a "shunt motor" is one in which the working e. m. f. and the field excitation remain practically constant at all loads; a "conduction motor" is one in which the energy required for its operation is conveyed to the rotor by conduction, while in an "induction motor," the energy is conveyed by induction; a "self-excited motor" is one in which the exciting current comes from the rotor, while a "separately-excited motor" obtains its exciting current from the supply mains.

According to the above terms the well-known "conductively-compensated series motor" becomes a "neutralized, single-phase, series, conduction motor;" our old friend the "single-phase induction motor" becomes a "self-excited, partly-compensated, single-phase, shunt, induction motor," and the so-called "plain repulsion motor" is a "single-phase, series, induction motor." A Wagner induction motor would probably be designated as a "self-excited, partly-compensated, single-phase, shunt, induction motor started as a single-phase, series, induction motor." Although many of the names suggested by the author are entirely too long and awkward for general use, his method of classification deserves the serious consideration of all writers on alternating-current motors. The author deserves especial credit for his effort to abolish the term "repulsion motor," which has hitherto been applied to a type of commutator motor, with brushes short-circuited along one axis, in the operation of which there is absolutely no repulsive thrust, although the name commonly applied might lead one to believe that such a thrust does exist.

LINCOLN IN THE TELEGRAPH OFFICE. By David Homer Bates. New York: The Century Company. 431 pages; 800 illustrations. Price, $2.

As manager of the War Department telegraph office at Washington and cipher operator during the Civil War, Mr. Bates enjoyed peculiar and unrivaled opportunities to secure the material upon which this fascinating book is based. He and his associates, General Eckert and Messrs. Chandler and Tinker, were a quartette highly representative of the superior ability and character that the telegraph enlisted when it offered more of a career to talent than it does to-day. Their work under Staton, the great War Secretary, is set forth admirably in these pages, and a most interesting revelation is made of Lincoln from a new and fresh point of view, with a wealth of incidental fact and story.

There is much in this direct and incisive narrative, told in plain, nervous English, that is of technical interest, but, fortunately, Mr. Bates does not dwell on that aspect of the first great use of telegraphy in actual warfare. He gives, however, with good judgment, some very full data as to codes and cipher

dispatches, including actual cipher codes, telegrams and letters, all deserving of study. The art of military telegraphy has been built up since that time, and our own U. S. Signal Corps has done its brilliant share in a process that may be traced back to the days when a few hundred gallent young operators rallied to the service of both North and South, and, if called upon for the sacrifice, died gladly at their keys, upon the field of honor.

But it is with Lincoln that this human book deals, and after its perusal, one lays it down with a keener love and stronger admiration for that noble leader of men. All unconsciously, with a naivety that is for the author his best recommendation, Mr. Bates depicts Lincoln in the telegraph office in days of leisure and preparation, in moments of jest and jocularity, and in hours when suspense and anguish rocked as with earthquake throes the seat of government. Mr. Bates is both happy in his opportunity and felicitous in his poignant reminiscences of a time when the telegraph office at Washington and its wires and operators were the nerve centers of our Republic.

Neuere Elektrophysikalische Erscheinungen. By Ernst Ruhmer. Teil I. Fortschritte auf dem Gebiete der Telegraphie und Telephonie. Berlin: F. & M. Harrwitz. 213 pages; 215 illustrations. Price, 4 marks.

This section of the treatise on recent electrophysical applications, in its second edition, is devoted to the progress of telegraphy and of telephony. The principal subjects discussed are (1) the fast automatic telegraphs of Wheatstone, Delany, Pollak-Virag, Crehore and Squier, Murray and Siemens-Halske; (2) the various duplex telegraph systems; (3) telegraph cable apparatus, very briefly discussed; (4) long-distance printing telegraphs; (5) telautographs; (6) copying telegraphs. A full chapter is given to recent telephonic progress.

The book is descriptive and somewhat popular in form rather than technical. It is well illustrated, and will be useful to those interested in recent telegraphic or telephonic progress, whether technically trained or not. It is not particularly directed to the use of designers of such apparatus. Some of the descriptions are adequate and clear. Others are very brief and inadequate.

Polyphase Induction Motors.

In the type of induction motor illustrated herewith there have been introduced several new constructional features that

FIG. 1.—STATOR WITH WINDINGS IN PLACE.

contribute to an improved performance, but do not materially alter the appearance as compared with established practice of recent years.

An entirely new construction has been employed for the rotor. The ends of the bars are bevelled and the resistance ring, which is also bevelled, is clamped by bolts at both ends; this gives a very solid rotor of neat appearance. Partially closed slots are used in the rotor, and the winding consists of square bars, thoroughly insulated from the core.

In all except the very small sizes, the design is such that a current of air enters the motor at one end and passes out at the other, coming in contact with the outer surface of the stator core, and the inner surface of the rotor core. This gives a very effective ventilation.

The stator winding consists of form-wound coils laid into partially closed slots. The partially closed slot has been adopted as giving a machine with a better power factor than the open

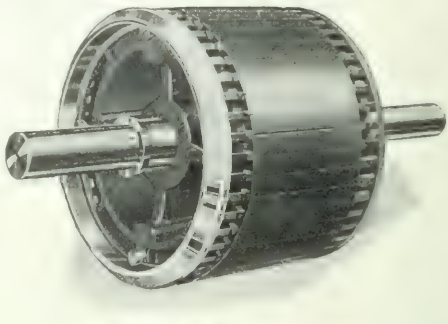


FIG. 2.—ROTOR OF INDUCTION MOTOR.

slot. Moreover, the air-gap is small, the large shaft running in bearings of special hard bronze composition permitting this construction. The whole arrangement is such as to utilize the active material to best advantage.

The performance characteristics of a 3-hp, three-phase, four-pole, 60-cycle, 220-volt motor are shown in Fig. 4. The high efficiency and power factor are seen at a glance. It is stated that the temperature rise does not exceed 40 deg. C. for continuous operation at full load, or 55 deg. C. at 25 per cent overload for three hours, and the motor will carry 150 per cent overload momentarily. The curves show the overload range in a striking manner.

No starting apparatus is needed for motors rated at less than five horse-power, because they may be connected directly to the supply lines. With motors rated at more than five horse-power use can be made of auto-transformers for lowering the voltage

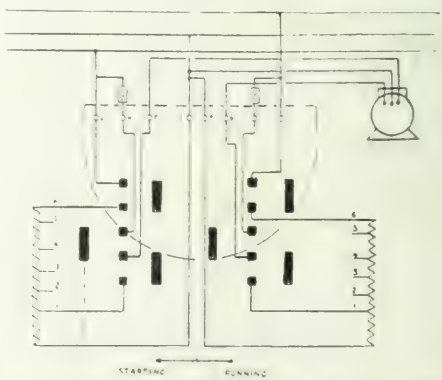


FIG. 3.—DIAGRAM OF CONNECTIONS FOR THREE PHASE AUTO-TRANSFORMER.

during the starting period, or of resistance in the primary circuits for limiting the current while starting. The former type of starter is recommended wherever a large starting torque

is required, while the latter type is advantageous for motors of not over 20 horse-power that are to exert a small torque while starting.

The above described induction motors and starting devices

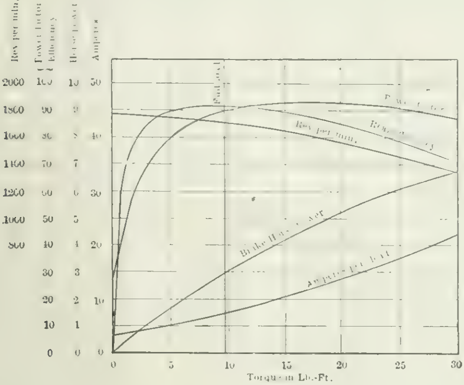
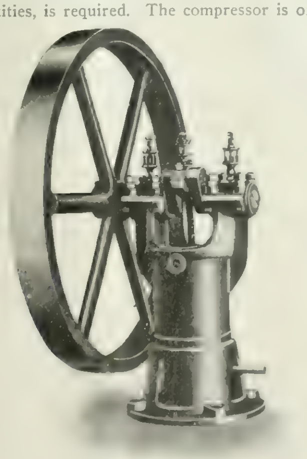


FIG. 4.—CHARACTERISTICS OF 3-HP, 220-VOLT, THREE-PHASE MOTOR.

have been developed by the Barriett Electric Manufacturing Company, Cincinnati, Ohio.

Belt-Driven Air Compressor.

The Westinghouse Air Brake Company has developed a small belt-driven compressor, which it is prepared to manufacture in large quantities. The compressor weighs 218 lbs., and its base is 12 ins. in diameter. Its compact build enables it to be located in limited space where power from shafting or small motor drive is available. It is particularly adapted to gas engine starting, automobile garage use, charging storage tanks for small pneumatic tools, general machinery cleaning and in a great variety of cases where compressed air at high or low pressure, but in small quantities, is required. The compressor is of the vertical



single-cylinder, single acting, water-jacketed type, operated by power delivered to a 30-in. flywheel, attached to a crank shaft, the rotation of which drives the piston in the cylinder by means of a connecting rod. The diameter of the air cylinder is 3 ins., the stroke of the piston is 4 ins. It is said to operate satisfactorily against any air pressure up to 250 lbs. At 250 r. p. m., its speed of maximum efficiency, and against 200 lbs. air pressure, approximately one brake horse-power is required to operate the pump.

Long Test of Automobile Spark Generator.

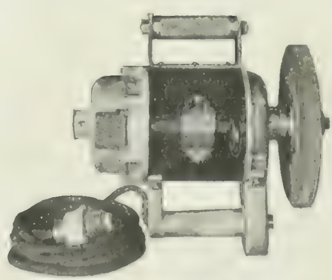
Visitors to the two automobile shows held in New York will recollect the interest aroused by the endurance test conducted by the Atwater Kent Mfg. Works as a demonstration of the high battery economy obtained with their spark generator for ignition. It will be recalled that in this test a spark generator was connected with six No. 6 Columbia dry cells, four spark plugs, and a Jones speedometer-odometer, the whole apparatus being sealed in a glass cabinet and run by an electric motor during the whole of both shows. At the beginning of the test the batteries tested an average of 16 amperes each, and at the end of the second show, with the odometer reading 4249.3 miles and the batteries testing over 6 amperes each, the plugs were still sparking.

As this test did not prove conclusively how much further the batteries might have run before the spark plugs began to miss, the Atwater Kent Mfg. Works transferred the entire outfit to the Chicago show, on the opening of which the batteries were again tested publicly, the cabinet resealed and the apparatus started running again. In the three weeks between the shows the battery had deteriorated somewhat, so that the cells tested only 4½ amperes average. The odometer was started at 4249.6 miles, and at 5328.6 miles the plugs began to miss. On publicly unsealing the cabinet, the batteries were found to test an average of three amperes. In other words, they had lost only 1½ amperes in over 1000 miles, which shows, more strongly than anything else could, the exceedingly small consumption of energy. The spark generator was in perfect condition, and on inserting fresh cells, regular sparks were obtained without readjustment. The makers state that it would easily have been possible to obtain sparks with cells testing as low as one ampere by readjusting the contact screw, but that for the purpose of the test the screw was adjusted to suit fresh batteries, and thereafter was not changed.

The apparatus was sealed at Chicago by F. E. Watts of the *Horseless Age*, and the sealing and testing of the cells was witnessed by C. A. Coey, S. Strasser of *Motor Age*, Chas. Miller and F. M. Ruwet. The cabinet was unsealed by S. Strasser in the presence of A. L. Haskell and James Vernon.

Portable Metal-Grinding Machine.

The accompanying illustration shows a portable metal-grinding machine that has been placed on the market by the Cincinnati Electric Tool Company, 630 Evans Street, Cincinnati, Ohio. The operating and controlling switch for the driving motor is located in the right-hand handle of the machine, so that the



PORTABLE METAL-GRINDING MACHINE.

operator need not release his hold for starting and stopping the motor. Air for cooling the equipment is furnished by a rotary fan mounted on the shaft.

The machine weighs 25 lbs. complete; the motor is wound for direct current at an e. m. f. of 110, 220 or 550 volts. It is arranged so that a buffing wheel can be substituted for the emery wheel. When arranged as a buffer, the machine is useful around garages, engine rooms, generating stations, etc., for polishing bright parts.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The holiday trade was of normal proportions, earlier losses being apparently recovered, and in staple lines conditions were better, due to the more seasonable weather. Although actual business did not increase in the leading industries, there was a more confident sentiment regarding the future, and numerous inquiries encouraging manufacturers to anticipate a steady improvement in orders early in 1908. Meanwhile, inventories are being taken and machinery thoroughly overhauled and repaired for the first time in many years. Statements made by representatives of various trades show that November business as a rule was very satisfactory. Business in general, they state, is sound and the outlook is very promising. In the steam-boiler trade, it is stated that there has been no let-up in orders and from the way that orders are being received, there is no reason to believe that business will not continue improving. In the business of railroad supplies a satisfactory condition exists. In some cases, however, it cannot be denied that business has fallen off somewhat in the past two months, but a speedy revival at the first of the year is looked for. The machinery trades do not seem to have suffered to any extent, many of the orders which had been delayed owing to financial troubles are now coming in, and there is every prospect of a steady increase in business in the near future. The tool and hardware trades suffered a falling-off during November, but these are now picking up. In the textile trades a similar hopeful view is expressed, and it is expected that the normal output will be resumed early in the year. Manufacturers of passenger cars state that they are clogged with orders which will keep them busy for the next three years; their factories have been running overtime for the past three months and yet they have not kept up with the demand. The official report of foreign commerce in November showed a trade balance of $93,655,751, which far surpasses any previous monthly record of exports. Conditions in financial circles are still very slow in approaching normal and as yet reflect little benefit from the current holiday purchasing. There was an increased inquiry for pig iron in some markets, but actual business still continues very quiet, and prices in general are much lower. The feature of the entire situation is a general suspension of furnaces and mills, and in finished lines it is figured that new business hardly covers 33 per cent of the total capacity. The demand for structural material was moderately good. Copper was weak and prices were again being forced below 13 cents. It is estimated that surplus stocks are very heavy and that production may have to be restricted to a greater extent before actual permanent betterment can be expected. The closing quotations were 13 3/16c. for Lake, 13 1/16c. for electrolytic, and 12 13/16c. for casting stock. Business failures during the week ending Dec. 19 as reported by *Bradstreet's* numbered 300, against 234 in the week previous and 227 in the corresponding week last year.

ADDED EQUIPMENT FOR BOSTON ELEVATED.—With the additions at Lincoln Wharf, Harvard and Charlestown power stations of the Boston Elevated Railway Company, now nearing completion, the total generating equipment of the system will reach approximately 50,000 kilowatts. The work of laying out and constructing these station improvements was placed in the hands of the Stone & Webster Engineering Corporation, of Boston, in accordance with the recommendations made by this firm for a system of generation and distribution of power which would provide for present and future demands. It was decided to add 5400 kilowatts in equipment to the Lincoln Wharf Station, 2700 kilowatts to the Charlestown, and 2700 to the Harvard power station. Direct-current steam engine driven generators were selected as the type of the new units in order to conform in general design to those already installed in the various stations. The Lincoln Wharf power station, located on the harbor front, is the largest modern steam plant operated by the company. It supplies power for surface and subway cars operated in the heart of the Boston business district, as well as a large proportion of the power for the elevated system. The old station contained three 2700-kw, 375-volt units driven by vertical cross-compound engines. The additions to this station required an extension to the power house 83 ft. x 152 ft. The former boiler equipment was 6000 horse-power of Babcock & Wilcox boilers; the new equipment includes eight 600-hp boilers of the same make. The new power units, two in number, are 2700-kw Allis-Chalmers direct-current railway type generators driven by engines with cylinders 42 in. x 90 in. x 60 in. stroke at a speed of 72 r. p. m. These machines are multipolar, compound-wound type, 570 volts.

GREAT NOVEMBER EXPORTS.—The exports of merchandise during November touched the remarkable total of $204,445,000, figures never before approached in the history of American foreign trade. This readily explains why banking houses were able to bring in during the month the record total of $63,463,000 of gold. From the complete returns of the Government on November's trade it is found that the increase in agricultural exports was far larger than that in non-agricultural. The total shipments of agricultural products were $122,772,000, which compares with $99,977,000 in October last and $104,943,000 in November, 1906. The increase in wheat shipments amounted to $8,178,000 over those of the previous year, and the increase in breadstuffs alone made up $9,320,000 of the total increase of $17,820,000 in all domestic products. Cotton shipments were $7,000,000 heavier. It is understood that exports of copper were also heavy during the month, and that they, too, have had much to do with this fine trade showing. For the 11 months of the present calendar year the trade balance in our favor is $385,405,000, which is some $37,000,000 under that for the same period in 1906, but nearly $40,000,000 above the balance for the same 11 months in 1905.

CRANE ELEVATOR CHRISTMAS.—The Crane Elevator Company, following its custom, has given its 5000 employees 10 per cent of their salaries as a Christmas present. To do this the company gives its men $350,000. Each employee of one year's standing is entitled to share in this distribution of the profits. The sum given this Christmas exceeds by $20,000 the record of any other year since the company inaugurated its profit-sharing plan. In the eight years which have elapsed since the company adopted this policy it has paid its employees in gifts the sum of $1,850,000. Employees on the sick list or laid off temporarily because of slackness of work receive their share just the same.

EQUIPMENT FOR IRON MOUNTAIN, MICH.—The Iron Mountain Electric Light & Power Company, Iron Mountain, Mich., has lately let contracts for new electric generating and arc lighting equipment, comprising a 250-kw Allis-Chalmers alternating-current generator, three-phase, 60-cycle, 2300-volt; a 10-kw belted exciter, a five-panel switchboard, and 75 Adams-Bagnall arc lamps of the latest pattern. The generator is of the revolving field, two-bearing type, belt driven.

ALTERNATOR FOR CHICAGO, INDIANA & SOUTHERN RAILWAY COMPANY.—The Lake Shore & Michigan Southern Railway recently purchased a 250-kw Allis-Chalmers engine type generator, 240 volts, two-phase, 60-cycle, and a 15-kw exciter unit for addition to the power equipment of the Chicago, Indiana & Southern Railway Company, a subsidiary line. The new generator will be installed at Danville, Ill.

LARGE COPPER SHIPMENTS.—By the shipment of 18,000,000 lbs. of copper last week through New York exports of the metal to Europe for 11 weeks, including small amounts to China, approximate 167,000,000 lbs., of which total the United Metals Selling Company sent 73,142,397 lbs., or almost 50 per cent. A feature of the week was the large total sent out by the United Metals Company—14,000,000 lbs. of 18,000,000 lbs. total. One shipment by this concern in particular is worthy of mention, that being a consignment in one lot of 6,141,830 lbs. to Rotterdam. This pretty well cleans up the 100,000,000 [illegible] sold by the company recently to foreign bankers.

FLEMING-HARRISBURG SALES.—Mr. A. M. Morse, the Chicago representative of Harrisburg Foundry & Machine Works, reports the following recent installations of Fleming-Harrisburg self-lubricating engines in Chicago territory: Minahan Office Building Company, Green Bay, Wis., one 400-hp, tandem compound standard engine, and one 250-hp standard. The Lak Shore Engine Works, Marquette, Mich., one 250-hp standard. Fleming Office Building Company, Des Moines, Ia., two 125-hp standard. Western Clock Manufacturing Company, La Salle, Ill., one 250-hp, four-valve. Geo. Ziegler Cômpany, Milwaukee, Wis., one 180-hp. four-valve, and one 125-hp standard. Chicago, Burlington & Quincy Railway Company, West Burlington, Ia., one 300-hp, cross compound, four-valve. Armstrong Brothers Tool Company, Chicago, one 100-hp standard. Eastman Kodak Company, Chicago, one 150-hp, four-valve (second order). Congress Hotel Company, "Auditorium Annex," Chicago, two 600-hp and one 400-hp, all of four-valve type. St. Luke's Hospital, "George Smith Memorial," Chicago, two 250-hp, four-valve. American Bottle Company, Streator, Ill, one 250-hp standard (second order). Morrison Hotel & Restaurant Company, "Boston Oyster House," Chicago, one 250-hp, four-valve. Vendome Hotel, Chicago, one 100-hp standard. The above engines are, with one exception, of the direct-connected type, having the electric generator mounted alongside the fly-wheel on a massive steel main shaft, and they furnish electric energy for motor and lighting loads. Several thousand horse-power of Fleming-Harrisburg engines have been installed in "The Loop" district, in the heart of Chicago's business district.

BEAR LAKE POWER.—Advices from Pocatello, Idaho, state that Judge D. W. Standrod has recently inspected the plant of the Bear River Valley Railway & Electric Company, in which he is heavily interested. He has since authorized the statement that he has taken over the entire holdings of the company and will at once reorganize a corporation to be composed of some of the most prominent and wealthy men in the state. Judge Alfred Budge will be a member of the company. A number of important improvements will be made at the plant in Paris and the institution will be placed on a firm financial basis. J. A. Tupper, an experienced electric light man of Pocatello, formerly connected with the American Falls Power, Light & Water Company, has gone to Bear Lake to look after Judge Standrod's interests in the plant until the reorganization of the company is completed and permanent arrangements made for the appointment of a local manager.

ELECTRICAL CATALOGUES.—A member of a foreign legation located at Washington desires to receive American catalogues and price lists of a variety of articles, as his government makes extensive purchases of many goods in these classifications. Details can be had from the U. S. Bureau of Manufactures.

TELEPHONE SUPPLIES.—Tenders will be received at the office of the Deputy Postmaster-General, Sydney, New South Wales, for the supply and delivery, at the Central Exchange, General Postoffice, Sydney, Australia, of 1000 telephones, wall, common battery; 100 telephones, table, common battery.

Financial Intelligence.

THE WEEK IN WALL STREET.—Notwithstanding the maintenance of high money rates, the stock market showed a disposition to advance in an irregular way, though the strength was apparently due simply to covering of shorts. The declaration of the regular dividend of the New York Central and other roads contributed more or less to discourage bearish speculators. It is not considered that money conditions can improve sufficiently to encourage very marked bullish activity until after the disturbing influence of the January payments is out of the way. Beyond the developments of the Vanderbilt properties, there was little in the record of the week's events to seriously affect the market. [illegible] slow progress toward reëstablishment of normal financial conditions throughout the country were regarded with satisfaction, but this was offset by recognition of the narrow position of the local money market and the unwillingness of banks to finance anything like speculative operations. More or less attention continued to be given to the dividend payments and prospects of various companies. Little business was transacted in electric and traction stocks, but prices were firm. On the Curb, while prices were irregular, the closing quotations were at a substantial recovery from the early low level, and the volume of trading was a little larger. Following are the closing quotations of Dec. 23:

NEW YORK.

	Dec 17	Dec 23		Dec 17	Dec 23
Allis-Chalmers Co ...	5½	5⅞	General Electric	111	110
Allis-Chalmers Co pfd.	15½	16½	Hudson River Tel......	—	—
Am. Dist. Tel.......	20	30	Interborough Met. com.	6½	6½
American Locomotive...	34¾	37	Interborough Met. pfd.	16	17¾
Amer. Locomotive pfd..	86½	88	Mackays Cos	51¾	51
American Tel & Cable..	—	50	Mackays Cos pfd......	58	59⅝
American Tel. & Tel...	100¼	101	Marconi Tel.	—	—
Brooklyn Rapid Transit.	37¾	38¾	Metropolitan St. Ry.....	21	—
Electric Boat	—	—	N. Y. & N. J. Tel.....	94	94
Electric Boat pfd.......	—	—	Western Union Tel.....	55½	55
Electric Vehicle	—	—	Westinghouse com.	[illegible]	[illegible]
Electric Vehicle pfd....	—	—	Westinghouse pfd.......	65	60

BOSTON.

	Dec. 17	Dec. 23		Dec. 17	Dec. 23
American Tel. & Tel..	101	101	Mass. Elec Ry pfd ...	[illegible]	—
Cumberland Telephone..	—	—	Mexican Telephone.....	—	1¼
Edison Elec. Illum.....	208	—	New England Telep.....	—	105
General Electric	—	—	Western Tel. & Tel..	—	—
Mass. Elec. Ry.........	—	—	West. Tel. & Tel. pfd...	—	—

PHILADELPHIA.

	Dec. 17	Dec. 23		Dec. 17	Dec. 23
American Railways.....	[illegible]	[illegible]	Phila. Electric	[illegible]	[illegible]
Elec. Co. of America...	8⅞	9¼	Phila. Rapid Transit....	17	17
Elec. Storage Battery..	[illegible]	[illegible]	Phila. Traction	[illegible]	[illegible]
Elec. Stor. Battery pfd..	—	—			

CHICAGO.

	Dec. 17	Dec. 23		Dec. 17	Dec. 23
Chicago City Ry.......	150*	150*	National Carbon	[illegible]	—
Commonwealth-Edison ...	—	78	National Carbon pfd....	—	—
Chicago Subway	[illegible]	[illegible]	Union Traction	[illegible]	—
Chicago Tel. Co.......	109	105	Union Traction pfd....	—	—
Metropolitan Elec. com..	16½*	16½			

*Asked.

DIVIDENDS.—The Havana Electric Railway Company has declared a dividend of 1½ per cent on the preferred stock, payable Jan. 15. American Locomotive directors have declared the regular quarterly dividends of 1¾ per cent on the preferred stock and 1¼ per cent on the common stock. The preferred dividend is payable Jan. 21. The common dividend is payable Feb. 26. Directors of the Evansville Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Jan. 2. Directors of the Bell Telephone Company, of Philadelphia, have declared the regular quarterly dividend of 1½ per cent, payable Jan. 15 to stock of record of Jan. 4. J. G. White & Company, Inc., have declared the nineteenth regular quarterly dividend of 1½ per cent on the preferred stock, payable Jan. 2. The Washington Water Power Company has declared a quarterly dividend of 1¾ per cent, payable Jan. 2. The Union Switch & Signal Company has declared the regular quarterly dividend of 3 per cent on the common and preferred stock. The El Paso Electric Company, of Texas, has declared a semi-annual dividend of 3 per cent on the preferred stock, payable Jan. 13. The Narragansett Electric Company, of Providence, R. I., has declared a quarterly dividend of $1 per share, payable Jan. 2. The San Paulo Tramway, Light & Power Company, Ltd., has declared a quarterly dividend of 2¼ per cent, being an increase of ¼ per cent. The Puget Sound Electric Company has declared a semi-annual dividend of $3 per share on the preferred, payable Jan. 1. The Manchester, N. H., Traction, Light & Power Company has declared a regular quarterly dividend of 1 per cent, payable Jan. 15. Directors of the Electric Boat Company have declared the regular quarterly dividend of 2 per cent on the preferred stock and a dividend of 2 per cent on the common stock. A dividend of 2 per cent on the common stock was declared a year ago. The common dividend is payable Dec. 31. The preferred dividend is payable Jan. 2. The American Telephone & Telegraph Company has declared the regular quarterly dividend of 2 per cent, payable Jan. 15. The directors of the United Traction Company, of Pittsburg, have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable Jan. 20. Directors of the Cincinnati Street Railway Company have declared the regular quarterly dividend of 1½ per cent, payable Jan. 1. Directors of Manning, Maxwell & Moore, Inc., have declared the regular quarterly dividend of 1½ per cent, payable Dec. 31. Directors of the Twin City Rapid Transit Company have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2. The Tri-City Railway & Light Company has declared a dividend of 1½ per cent on the preferred stock, payable Jan. 2. The United Traction & Electric Company has declared a dividend of 1¼ per cent on the capital stock, payable Jan. 2. The trustees of the Massachusetts Lighting Companies have declared a regular quarterly dividend of 1½ per cent, payable Jan. 15. Directors of the Manila, P. I., Electric Railroad & Lighting Corporation

have declared a quarterly dividend of 1 per cent on the capital stock, payable Jan. 2. E. W. Bliss Company has declared quarterly dividends of 2 per cent on the preferred stock and 2½ per cent on the common, payable Jan. 2. Directors of the Michigan Light Company have declared quarterly dividends of 1¼ per cent on the common and 1 per cent on the preferred, payable Jan. 2. Directors of the U. S. Telephone Company have declared a regular quarterly dividend of 1½ per cent on the preferred, payable Feb. 15. Directors of the Mexican Telegraph Company have declared a regular quarterly dividend of 2½ per cent on the capital stock, payable Jan. 15.

MASSACHUSETTS ELECTRIC REPORT.—The annual report of President Abbott, of the Massachusetts Electric Companies, owning traction and lighting properties, says: "The net results have been nearly identical with those of last year. There has been a certain amount of variation in the items—gross earnings increased $240,270, winter expenses were larger, cost of accidents was smaller—but the final result of all these variations is that net divisible income increased $15,050; or, in other words, remained substantially the same as last year." The surplus after dividends, however, was much smaller, amounting to only $174,462, against $329,779 in 1906 and $361,862 in 1905. The consolidated income account of the consolidated companies compares as follows with the previous year:

	1907	1906
Gross earnings	[illegible]	[illegible]
Expenses	5,000,652	4,883,552
Net earnings	$2,757,858	$2,634,688
Charges	[illegible]	[illegible]
Balance	[illegible]	[illegible]
Dividends	880,773	710,406
Surplus	$174,462	$329,779

The profit and loss statement of the parent company is as follows:

	1907	1906
Dividends on stock owned	$880,837	$710,498
Miscellaneous interest on notes	82,003	66,651
Total income	[illegible]	$777,149
Total expenses	[illegible]	18,395
Net income	[illegible]	$758,754
Interest on notes	157,500	157,500
Surplus	[illegible]	$601,254
Total surplus	[illegible]	778,173

The report adds: "The freight and express business has shown a gratifying increase on those parts of the Old Colony where it has been put in operation, but it has not been possible even yet to secure all the necessary rights to carry freight over the whole of that system. With respect to the physical condition of the property, it has improved over that of last year. Liberal charges to operating expenses for maintenance have been supplemented by the expenditure of $1,574,680 for construction, reconstruction and the purchase of additional rolling stock and other property. Whether or not it will be judicious to spend during the coming year the balance required to complete the reconstruction of the property, will depend upon the general business situation and the trustees do not intend to approve of any considerable new expenditures until that situation shall be clearer than it is at present. It was of the utmost importance that the work outlined two years ago should be done as quickly as possible. Without it the system could not have been operated economically and successfully. And in view of the developments of the general financial situation during the past year, the trustees are of the opinion that the wisdom of omitting the payment of dividends has been sufficiently demonstrated. The failure to pay dividends during the past year was not due to lack of earning power or to disastrous losses from accidents. The earning power has proven excellent. The trustees expect that when the operating companies shall have completed the reconstruction of their property they will be in such physical condition as to require only ordinary annual expenditures for maintenance and reconstruction, and that they will then be able to finance their needs without drawing from the treasury of the Massachusetts Electric Companies the dividends they pay in."

BOSTON AND BELL CONTROL.—Advices from New England say: "Financial Boston has been disturbed during the past month by the reappearance of the rumors that control of the American Telephone & Telegraph Company had finally and definitely passed to New York. The old rumor in a new garb is to the effect that the decline in the stock to below 90 resulted in the forced liquidation early this month of some very large New England accounts which have been transferred to New York parties, giving to the New York interests enough stock to insure the supplanting, at the annual meeting in March, of certain of the present directors who have held over from the day of the old American Bell Company. Further than this, New York control is to be emphasized by the dominance of the Mackay interests in the affairs of the telephone company, thus marking the consolidation in fact of the telephone and a large part of the telegraph business of the country. The facts of the situation make altogether different reading, and are of a sort to allay much of the doubt regarding the future course of telephone affairs. There has been no transfer on the books of the American Telephone Company of any large block, or series of large blocks, of stock either this month, or last month, or for several months preceding. Instead of marking the passing of stock control to New York the decline in the stock to 89¼ actually resulted in giving New England a greater measure of control than ever before. Over 1500 names have been added to the list of stockholders since Nov. 1, a large majority of whom are New Englanders. The American Telephone Company has at present over 23,000 stockholders, an increase since Jan. 1 of over 500 names.

SOUTHERN BELL TELEPHONE.—The annual report of the Southern Bell Telephone Company, just filed with the South Carolina Railroad Commission and embodied in the board's coming report to the Legislature, is an interesting recapitulation. Cost of real estate and buildings, $34,732.30; cost of equipment, $1,097,783.23; cost of toll construction, $437,462.43. Total cost, $1,551,982.96. Gross income from subscribers, $303,254.88; long distance, $51,555.48. Total, $364,810.38. Cost of operation, general expenses, $61,719.43; salaries paid, $130,-615.60; maintenance, $66,375.89; taxes paid, $13,203.87; dividends paid, none. Total, $271,914.79.

RUTLAND, VT., EARNINGS.—The annual report of the Rutland Railway, Light & Power Company for the twelve months ended November 30, 1907, shows total gross earnings for all companies of $224,361, an increase of $39,315, and net earnings of $104,459, an increase of $23,807. While the gross earnings of the Power Company for the year are given in the detailed report at $36,678, it should be noted that comparison is made with the earnings for nine months in the previous year, which amounted to $12,412.

UNITED STATES TELEPHONE.—The United States Telephone Company's statement for the month of October and ten months compares as follows:

	[illegible]	[illegible]		
October gross	[illegible]	[illegible]	Inc.	[illegible]
Expenses	12,953	12,396	Inc.	557
October net	[illegible]	[illegible]	Inc.	[illegible]
Ten months' gross	$385,199	$356,811	Inc.	$28,388
Expenses	[illegible]	[illegible]	Inc.	[illegible]
Ten months' net	$230,490	$212,092	Inc.	$18,398

CANADIAN BELL.—Advices from Winnipeg, Manitoba, Canada, state that Mr. C. F. Sise, president of the Bell Telephone Company, of Canada, has been in Winnipeg conferring with the Manitoba Government relative to disposing of the entire Bell lines in the province to the government. The provincial government has established a complete public system throughout Manitoba, driving the Bell interests to negotiate, leaving a government monopoly in the field.

WESTINGHOUSE AIR BRAKE.—The directors of the Westinghouse Air Brake Company have declared the regular quarterly dividend of 2½ per cent and an extra dividend of 2½ per cent, both payable January 31, 1908. The directors also acted on the resolution of the stockholders, passed Dec. 3, increasing the capital stock from $11,000,000 to $14,000,000. Out of the increase a 25 per cent stock dividend was declared.

BELL TELEPHONE OF PENNSYLVANIA.—The Bell Telephone Company, of Philadelphia, has filed notice at Harrisburg of an increase of its capital stock from $30,000,000 to $60,000,000, and of a change of name to "Bell Telephone Company of Pennsylvania." These changes are due to the absorption of the Pennsylvania Telephone Company and the Delaware & Atlantic Telephone Company.

BRITISH WESTINGHOUSE.—The managing director of the British Westinghouse Company has cabled that the holders of the debenture stock of the British company have authorized the issue of preference debentures upon the proposition to issue $1,500,000 of 4 per cent preference debenture stock.

GENERAL NEWS

Construction News.

DADEVILLE, ALA.—Bids will be received until Jan. 10 by the Town Council for $8,500 in bonds to pay for additional equipment and for improvements to the municipal electric light and power plant. J. B. Rylance is Mayor.

HARTFORD, ALA.—The citizens are contemplating making extensions to both the water and light plants during the next year. W. H. Whatley is superintendent.

TROY, ALA.—The Pea River Power Company is planning to develop water power on the Pea River at this point and will erect a 3000-hp plant. The company owns seven miles of water rights, and 100 feet of right of way from its power site to Elba. H. D. Boyd is secretary and treasurer.

FLORENCE, ARIZ.—A special election will be held here on Feb. 8 to vote on the proposition of granting the Florence Water, Light & Ice Company a franchise to construct and operate a water and light plant in the town. J. E. O'Connor is town clerk.

DE QUEEN, ARK.—The De Queen Light, Ice & Cold Storage Company is contemplating establishing a day service and installing meters. Paul Coleman is manager.

FORDYCE, ARK.—The Fordyce Light & Water Company is contemplating the construction of a new station. C. A. Parsons is manager.

LITTLE ROCK, ARK.—Contracts have been awarded for the grading for the Little Rock & Pine Bluff Traction Company's interurban railway between Pine Bluff and Little Rock. W. H. Langford is vice-president.

SPRINGDALE, ARK.—The Springdale Electric Light & Power Company has been granted a franchise to erect and operate an electric light plant in Springdale for a term of 25 years.

FAIRFIELD, CAL.—E. D. N. Lehe, of Dixon, is contemplating the construction of a transmission line up the valley from the sub-station near Cordelia.

HOLTVILLE, CAL.—The Holton Power Company is contemplating increasing the equipment of its plant by the installation of two 300-kw alternating-current generators direct-connected to water wheels. C. E. Paris, of El Centro, is general superintendent.

NEVADA CITY, CAL.—A local report states that the Southern Pacific Company has surveyors at work on the watershed between Sierra City and Downieville, and that the company has water rights and has staked out flumes and ditches which will give it a fall of 1100 feet, to furnish a series of power houses from which electrical energy will be furnished for the operation of the railroad over the Sierras. It is claimed that these water rights are located in the Tahoe forest reserve and cannot be obtained from the Government.

ONTARIO, CAL.—Charles Frankish, of this city, is interested in a project to build an electric railway to run from Ontario through Pomona and Chino, to Newport Beach, a distance of 35 miles. A company, under the name of the Ontario Interurban Railway Company, is being organized with a capital stock of $500,000 to carry out the project. Rights of way are now being secured.

RIVERSIDE, CAL.—Work will soon commence on the construction of the electric railway to connect Riverside and Colton. The franchise was awarded a year ago to the San Bernardino Valley Interurban Railway Company under the name of A. C. Denman, Jr. The road will be nine miles long.

SAN BERNARDINO, CAL.—The Lytle Creek Power Company is erecting a new circuit to furnish electricity for heating and lighting in residences. F. A. Worthley is manager.

SAN BERNARDINO, CAL.—The franchise to be used by the Home Gas & Electric Company, of [illegible], in connecting up its plant with the Lytle Creek Company in this city, was sold to C. S. Chesnut for $42. The franchise is over the county roads between the two cities.

DELTA, COL.—The Delta Electric Light Company is contemplating the installation of a [illegible]-hp engine and an alternating-current generator. J. E. Shue is treasurer and manager.

DENVER, COL.—The Summit County Power Company is constructing a hydro-electric power plant near Dillon, and will furnish electricity for the mines and mills in Summit County. The first installation will have a rating of 1500 kw. The company expects to have the plant in operation about April 1, 1908. W. C. Sterne is vice-president and general manager.

PUEBLO, COL.—The Pueblo & [illegible] Electric Railroad Company has been chartered with a capital stock of $300,000 by M. J. Verner, Lester Wolf and others. The company proposes to construct an electric railway from Pueblo to Fowler down the Arkansas Valley.

STERLING, COL.—The Sterling Public Service Company will install during the summer of 1908 one [illegible], three-phase, revolving field generator, direct-connected to [illegible] engine. T. M. Crane is superintendent.

HARTFORD, CONN.—The Hartford City Gas Light Company is considering the question of constructing an electric light plant in connection with the gas works on Arch Street. E. B. Bennett is president.

MANCHESTER, CONN.—The Glastonbury Power Company is changing the system in Manchester from 1040-104-volt, single-phase, 133 cycles, to 2300-230-115-volt, three-wire, three-phase, 60 cycles. The company has leased the plant of the Manchester Light & Power Company and at present is purchasing power. M. S. Bradley is secretary.

SOUTH MANCHESTER, CONN.—The Spring Silk Company is installing an electric plant to operate its plant by electricity.

THOMASTON, CONN.—The Thomaston Electric Light Company has notified its patrons that after Jan. 1, 1908, all flat rates for lighting service will be discontinued and all lighting service will be furnished at meter rates.

ATLANTA, GA.—The Georgia Railway & Electric Company is making plans to commence work on the extension of its lines to Buckhead in the near future, for which the board of directors has voted an appropriation.

CARROLLTON, GA.—The Carrollton Electric Company is making estimates on the cost of installing a three-phase alternator and Corliss engine; also starting a day service some time next year. J. G. Cheney is manager.

MADISON, GA.—Bids will be received by E. W. Butler, Mayor, until Dec. 31, for $50,000 water works, electric light and sewerage bonds.

SAVANNAH, GA.—The Savannah Lighting Company is contemplating installing a 500-kw steam turbo-generator set in February or March. S. Brown is superintendent.

WALLACE, IDAHO.—The Cœur d'Alene Power Company has completed arrangements to commence work on its plant near Wallace, and work will soon begin on the erection of the building, which it is expected will be completed soon after the first of the year. The cost of the buildings is estimated at $10,000. The equipment will be installed as soon as the buildings are completed.

POCATELLO, IDAHO.—The Idaho Consolidated Power Company contemplates the installation of a 2500-hp horizontal turbine water wheel. F. C. Stanford is manager.

CLINTON, ILL.—The gas, electric light and steam heating plants in this place have been sold by the Gas & Electric Development Company to a new company, organized by Philadelphia, Easton and Harrisburg, Pa., capitalists, under the name of the Clinton Gas & Electric Company. The capital stock of the new company is placed at $150,000. The new owners are contemplating many extensions and improvements to the plants.

DANVILLE, ILL.—The Danville & Southern Railway Company has filed an application with the City Council for a franchise to operate an electric railway from the public square to the city limits on the Perryville Road.

FISHER, ILL.—The town of Fisher has purchased the local electric light plant from J. W. Kidd for $6,200. The plant will be managed by the town board and will furnish more lamps for the streets.

SYCAMORE, ILL.—The Board of Supervisors of De Kalb County has granted the Exchange Telephone Company a franchise to do business in this county.

COLUMBUS, IND.—The City Council is advertising for bids for furnishing and installing two horizontal 150-hp boilers at the water works plant.

CRAWFORDSVILLE, IND.—A proposition has been submitted to the City Council for the reconstruction of the municipal electric light plant. The promoters offer to rebuild the plant and make it as good as new. They propose to organize a trust company guaranteeing to rebuild the plant and turn it over to the city. The city is to pay for the reconstruction in ten annual payments. At the end of ten years the plant is to be turned over to the city without further cost.

FORT WAYNE, IND.—George Krudop is erecting a planing mill in this city and installing modern machinery, which is to be driven by four electric motors. Electricity for operating the mill will be supplied by the traction company.

FRANKFORT, IND.—The city is contemplating installing a 600-kw generator, direct-connected to a cross-compound engine in the municipal electric light plant. W. H. Carter is superintendent.

GREENCASTLE, IND.—Paul H. White, of Indianapolis, has applied to the City Council for a franchise empowering his company to erect a high-tension transmission line through this city to furnish electricity for lamps and motors. The company contemplates the construction of a large power plant in the Indiana coal fields, in Vigo County, to generate electricity to be transmitted to Indianapolis. Frank M. Fauvre, of Indianapolis, is [illegible].

MONTICELLO, IND.—The Tippecanoe Electric & Power Company, a [illegible] will commence at once the development of the water power in the Tippecanoe River. The [illegible] of the dam and water power

in this city now used for a flouring mill, and will erect a new building and install new machinery for the generation of electricity. The dam will also be reconstructed and raised at least four feet higher. In addition to furnishing street and commercial lighting, for which it has secured a franchise in this city, the company will also furnish electricity for motors. The directors of the new company are Abraham S. Strauss, Henry Meyers and J. Garrett Smith, all of Chicago, Ill. Mr. Strauss is president of the newly projected traction line to be built from Frankfort to Chicago, via Monticello, and this plant is expected to furnish part of the energy for operating the road.

PRINCETON, IND.—The Cumberland Telephone Company is making extensive repairs and improvements to its system in this city and has applied to the City Council for an extension of time from Jan. 1 to May 1, 1908. It is the purpose of the company to install a central energy system, with the latest improved equipment. The company has also leased another building in which the exchange will be moved.

RICHMOND, IND.—The committee appointed by the City Council and Commercial Club to investigate the municipal lighting plant has reported advising that the plant be not sold to the Richmond Light & Power Company. The report of the plant for November shows the receipts to have been $6,652.27 and the expenditures $3,922.32.

TERRE HAUTE, IND.—The Terre Haute & Merom Traction Company has awarded the contract for the construction of its road to the Central States Construction Company, of Chicago, Ill. The road will be about ten miles in length and will extend from Terre Haute to Merom, Ind., and also to Robinson, Ill. The officers of the company are L. Brown, president, J. Warren Brown, secretary, and H. L. Bartlett, of St. Louis, Mo., treasurer.

TIPTON, IND.—The Tipton Electric Light Company is considering the question of installing a 500-hp water tube boiler in its plant next year. J. H. Stewart is manager.

WARSAW, IND.—A committee has been appointed to inquire into the feasibility of purchasing the Winona Water & Light Company's plant, which has furnished the city with water for many years and with light for a number of years. The company recently submitted a report to the City Council acknowledging a loss of $5,400 during the past eleven months.

ALBIA, IA.—The Albia Interurban Railway Company has commenced operating its line in Albia and to the Hocking, three miles south of the city. It is the present intention of the company to continue the railway to Hiteman, six miles north, and on to Buxton, 12 miles distant, in the same direction, work on which will commence early in the spring. John P. Reese is president of the company.

ATLANTIC, IA.—At a meeting of the stockholders of the Atlantic & Northern Interurban Railway Company, held recently, it was decided to construct an extension from Atlantic to Villisca, a distance of about 38 miles. The officials of the company were authorized to make the necessary preliminary surveys, prepare plans and specifications and report at the next meeting of the stockholders.

FORT DODGE, IA.—The Spirit Lake, Emmetsburg & Fort Dodge Railway Company is planning to begin construction work in the near future. The railway will be about 110 miles long and will connect Fort Dodge, Spirit Lake, Emmetsburg and intervening cities and towns. The company will furnish electricity to towns along the route. T. F McCartan, of Pocohontas, is president.

OSAGE, IA.—The Osage Electric Light, Heat & Power Company is planning to install an additional water wheel soon. Thomas Ferris is manager.

SPENCER, IA.—Plans are being made for extensive additions and improvements to the municipal electric light plant, including the installation of a direct-connected unit with a rating of about 60 kw, or a Corliss engine and generator of the same rating, belted; also a new 150-kw generator. Both units will be three-phase, 2300-volt, 60 cycles. A new switchboard, boiler feed pumps, heater, etc., will also be installed. R. L. Taylor is manager.

HARPER, KAN.—We are informed that the city contemplates the installation of an additional generator and two new boilers in the municipal electric light plant in the spring or summer. Horace A. Lee is superintendent.

CENTRAL CITY, KY.—The Central City Light & Power Company is contemplating increasing the equipment of its plant for the purpose of furnishing a day service to operate fans next summer. T. Q. Fortney is manager.

LECOMPTE, LA.—W. H. Jones, city clerk, writes that bids will probably be received about Feb. 1 for the construction of an electric light plant to cost about $10,000. Baldwin Wood, of New Orleans, is engineer in charge of construction of plant.

MINDEN, LA.—H. A. Davis and J. B. Story have applied to the Town Council for a franchise to operate a street railway franchise in the town of Minden.

OPELOUSAS, LA.—The city has recently placed an order for a 25-kw, 125-volt, direct-connected generator, to be belted to an engine now in use in the municipal electric light plant, to furnish energy for a 25-hp vertical Westinghouse motor, direct-connected to a Platt Iron Works turbine pump, to be used in connection with the city water works system. A. C. Jones is superintendent.

LEWISTON, ME.—We are informed that the Lewiston, Augusta & Waterville Street Railway Company is planning to place contracts during the next two months for the construction of two sub-stations, and also the purchase of two semi-convertible cars. E. D. Reed is general manager.

CRISFIELD, MD.—We are informed that the Crisfield Ice Manufacturing Company will make extensive additions and improvements to its plant, including the installation of new engines, dynamos and boilers; also 10 miles of line extension. C. O. Mills is chief engineer.

FREDERICK, MD.—The city has recently ordered another dynamo to be installed in the municipal electric light plant to furnish electricity for incandescent lamps, which will be used to light the city opera house and the municipal offices. If this experiment proves successful the city may enlarge the municipal plant and go into a general lighting business.

HOLYOKE, MASS.—The Board of Aldermen on Dec. 17 authorized the lighting department to secure a loan of $160,000 for additions and improvement to the municipal electric light station. The plans contemplate the purchase of a turbo-generator set, the rearrangement of the steam system and enlarging the storage room to hold 1000 tons of coal instead of the 200 as at present.

LYNN, MASS.—The City Council has entered into a contract with the Lynn Gas & Electric Company for lighting the city for a term of five years. The contract provides for 300 or more arc lamps and 1200 or more incandescent lamps. The arc lamps are to be of the enclosed alternating-current type of 2000-cp each, with an all-night service, the service to be charged for at the rate of $94.90 per lamp per year for the first three years of the contract, and $91.25 each per year for the remaining two years. The price for the past two years has been $98.55 each per year. The rate for incandescent lamps is to be $15.50 per lamp per year for the first three years and $15 each for the remaining two years. The present price is $16 each per year.

NEW BEDFORD, MASS.—The New Bedford Gas & Edison Light Company contemplates making extensions to its electric lighting system. Charles R. Price is treasurer.

PLYMOUTH, MASS.—The Plymouth Electric Light Company is making arrangements for substituting 32-cp tungsten filament lamps for the 25-cp carbon filament series incandescent lamps now in use. E. P. Roweel is superintendent.

BELLAIRE, MICH.—The citizens are contemplating increasing the output of the municipal electric light plant and will raise the dam next season, putting in a cement core, cement flume and bulkhead. Charles J. Evans is superintendent.

KALAMAZOO, MICH.—It is reported that the City Council is contemplating installing an alternating-current system in the municipal electric light plant next spring.

LINDEN, MICH.—The Village Council is considering the question of lighting the streets by electricity to be transmitted from Fenton.

MANCELONA, MICH.—The Antrim Light & Power Company is contemplating increasing the output of its plant. F. R. Joslin is manager.

MASON, MICH.—The managers of the municipal electric light plant are endeavoring to secure entire new equipment for the plant, but nothing can be decided until after the election in the spring. T. J. Rapp is superintendent.

SAULT STE. MARIE, MICH.—We are informed that the Edison Sault Electric Company is contemplating the installation of a new dynamo in its plant next spring. Alexander Dow is manager.

BLACKDUCK, MINN.—The Blackduck Electric & Telephone Company is in the market for a 35-kw, 250-volt, direct-current outfit with compensating set, or outfit to work on three-wire system of 125 and 250 volts. C. W. Jewett is vice-president and general manager.

FARIBAULT, MINN.—The Faribault Gas & Electric Company contemplates the installation of a producer gas engine plant. B. W. Cowperthwait is secretary and manager.

NAUSHWAUK, MINN.—The Village Trustees are receiving bids for the installation of an engine, 80-kw, alternating-current generator, switchboard, etc. G. A. Lindsay is manager.

OSAKIS, MINN.—The Osakis Milling Company is contemplating increasing the output of its plant to meet the increased demand for electricity. About 75 horse-power will be needed. William A. Olen is local manager.

ST. PETER, MINN.—Plans are being made to change the system of the municipal electric light plant from single-phase, 1000-volt, to three-phase, 2300-volt, and from belted to direct-connected machines. H. A. Hildebrandt is superintendent.

WASECA, MINN.—The Water and Light Board is contemplating changing the system of the municipal electric light plant from direct to alternating current in the spring. E. G. Guy is superintendent.

CORINTH, MISS.—The Corinth & Shiloh Electric Railway Company is contemplating the construction of an electric railway from Corinth to the National Park at Shiloh. The road will be 22 miles long and an overhead trolley system will be installed. The authorized capital stock of the company is $250,000, and the officers are A. Rubel, of Corinth, president; S. H. Rubel, vice-president and treasurer; M. T. Bynum, secretary, and W. J. Lamb, general manager.

GULFPORT, MISS.—The Gulfport & Mississippi Coast Traction Company has placed contracts for one 1500-kw Westinghouse turbine and Babcock & Wilcox boilers and accessories. W. F. Garenflo is manager.

MAGNOLIA, MISS.—The Magnolia Electric Light Company is contemplating installing a 100-kw generator and a 150-hp high-speed engine in its plant. Xavier A. Kramer is superintendent.

PONTOTOC, MISS.—The Pontotoc Light & Power Company is contemplating increasing the equipment of its plant and will install an 85-hp tubular boiler and establish a direct-current day service. R. L. Campbell is manager.

HIGGINSVILLE, MO.—The citizens are contemplating rebuilding the overhead system of the municipal electric light plant. Frank Monser is superintendent.

LEES SUMMIT, MO.—L. Schreechfield & Son, owners of the electric light plant, are negotiating with the town of Greenfield, four miles distant, to furnish electricity for lighting in that town.

MARYVILLE, MO.—The Maryville Electric Light & Power Company is changing its system from 133 to 60 cycles. J. C. Donnell is manager.

NEVADA, MO.—C. C. McFann, general manager of the Kansas City & Springfield Southern Railway, reports that surveys have been completed for the proposed electric railway between Nevada and Springfield with a branch line to Carthage. The road will be 140 miles long, including sidings, and will be operated by electricity. The power station will be located near Arcola. The company also contemplates establishing an amusement park near the Sac River. W. B. Forsyth is president.

ANACONDA, MONT.—The Montana Independent Telephone Company will soon commence construction work on its new plant in this city, and expects to have it in operation by Feb. [illegible]

COLUMBUS, NEB.—It is reported that a new electric light and power plant will be erected in this city in the near future.

EXETER, N. H.—Owing to an increase in demand for electricity for operating motors, the Exeter, Hampton & Amesbury Street Railway Company has been compelled to erect new transmission lines from the power house in Hampton to Exeter and through the town, to relieve the lines used for commercial lighting.

HAMMONTON, N. J.—The Hammonton Electric Light Company is planning to remodel its street lighting system in the spring. P. H. Garrison is superintendent.

PARK RIDGE, N. J.—The electric light committee is planning to install a gasoline engine and an additional generator in the municipal electric light plant to be used as an auxiliary, and also plans to raise the dam to secure more water power, and to extend its transmission line through the next town, for which it has a contract to furnish light. E. Vernon Smith is superintendent.

TRENTON, N. J.—Bids will be received until Dec. 31 by J. Willard Morgan, State Comptroller, for furnishing electricity needed for lamps and motors in and about the State House, for a period of three or five years. The maximum current required will be 1500 amperes, 110 volts, alternating-current, 60-cycle, single-phase for lighting purposes and desk fan motors; for elevators, motors, shops, blower fans, etc., the maximum current required will be 200 amperes, 220 volts, direct current. Bids must be submitted on a net flat meter rate for both classes of service.

CROTON FALLS, N. Y.—George Juengst & Sons, owners of the Croton Falls electric light plant, are contemplating the reconstruction of the plant and system at Brewster and Purdys. George Juengst, Jr., is manager.

GOUVERNEUR, N. Y.—The Hannawa Power Company has purchased the Gardner property on the west side and will construct a transforming station on that site. The property is located near the marble quarries, which the company expects to furnish with electrical power.

LIMA, N. Y.—The Lima-Honeoye Electric Light & Railroad Company contemplates extending its line eleven miles north to Rochester, and to Atlanta, 15 miles south, during the year of 1908. The company also expects to install a power plant in its gas field in Lima to furnish electric energy for all purposes. E. D. Watkins is manager.

LIVINGSTON MANOR, N. Y.—The Livingston Manor Electric Company is building a [illegible] 1400 feet of pipe line [illegible] inches in diameter and installing two 60-hp impulse water wheels. W. R. Woolsey is treasurer.

NEWPORT, N. Y.—The Newport Electric Light & Power Company contemplates extending its lines to Poland and Cold Brook in the spring. The Public Service Commission has granted the company permission to issue $[illegible] in bonds, the proceeds to be used for extensions to its system. James B. [illegible] is manager.

NEW YORK, N. Y.—The Otis Elevator Company, of New York City, has secured the contract for flash light signals for the elevators at the New York [illegible] House [illegible]

OSSINING, N. Y.—The Northern Westchester Lighting Company is installing an additional [illegible] phase transmission line to Peekskill. Stuart Wilder is vice president and manager.

RHINEBECK, N. Y.—The [illegible] Light & Power [illegible] contemplating making some line extensions in the spring. R. Raymond Rikert is manager.

ROSLYN, N. Y.—At a [illegible] of the Nassau Light, Heat & Power [illegible], held Dec. [illegible], the proposition to issue $[illegible] in bonds was [illegible] and confirmed.

ASHEVILLE, N. C.—The contract for the construction of the interurban electric railway between Asheville and Hendersonville has been awarded to the Carolina Construction Company.

BURLINGTON, N. C.—The Burgrahaw Traction Company has been granted a franchise by the Board of Aldermen to construct and operate a street car system in the city of Burlington for a term of 60 years. J. N. Harden, J. M. Cook and J. W. Murray are the promoters of the enterprise.

FAYETTEVILLE, N. C.—E. G. Maxwell, manager of the Cape Fear Electric Power Company, has announced that the plant will be finished by Jan. 1, 1908, and that electricity will be furnished to mills and foundries in this city. About 4000 horse-power will be available at first, which will be increased later.

ROCKY MOUNT, N. C.—The city has voted bonds to the extent of $80,000 for the construction of an entire new electric light plant and improvements to water works. The bonds are yet unsold, but when sold the city will be in the market for electrical machinery, engines and boilers. A. S. Lyon is superintendent.

WASHINGTON, N. C.—P. A. Tillery, superintendent of the municipal electric light plant, writes that the city will establish a day service about April 1, 1908.

EDGELEY, N. D.—The citizens are considering the question of installing an electric light plant in connection with the proposed water pumping plant.

FOSTORIA, OHIO.—The Lake Shore Electric Railway Company has entered into a contract with the Toledo, Fostoria & Findlay Electric Railway Company to furnish electricity to operate its road. A high-tension transmission line will be erected from Woodville to a sub-station at Pemberville, where a 400-kw rotary converter has been installed. The Lake Shore company will also furnish electricity for operating the Norwalk-Shelby line, and a portion of the Cleveland, Southwestern & Columbus railway between Lorain and Amherst.

GIBSONBURG, OHIO.—It is reported that the Toledo, Fostoria & Findlay Electric Railway Company is considering plans to build an electric railway from Gibsonburg to Jersey City by the way of Bradnor and Prairie Depot. It is said that the road will be built the coming summer.

MANSFIELD, OHIO.—The capital stock of the Massillon, Wooster & Mansfield Traction Company has been increased from $1,000 to $1,000,000.

MOUNT HEALTHY, OHIO.—The Village Council has granted the Fitzsimmons & Associates Telephone Company a 25-year franchise to operate a telephone system in this village.

SALEM, OHIO.—The Salem Electric Light & Power Company contemplates building a new plant next spring. D. L. Davis is secretary and manager.

WAUSEON, OHIO.—H. H. Williams & Company, owners of the Wauseon electric light plant, contemplate installing new boilers in their plant to take the place of the ones now in use. W. F. Hubbell is treasurer and manager.

CHEROKEE, OKLA.—The Cherokee Ice & Power Company contemplates the installation of a 90-kw alternating-current generator in its plant. Robert T. Lyon is manager.

PORTLAND, ORE.—Plans are being contemplated by A. Welch and the Willamette Valley Company for the construction of an electric railway from Portland to Salem, Eugene, Prineville, Yaquina and Ontario, with branches to numerous towns. The company will be incorporated under the name of the Portland, Eugene & Eastern Railway Company with a nominal capital stock of $1,000,000.

ALTOONA, PA.—F. G. Patterson, of Pittsburg, promoter of the Altoona, Hollidaysburg & Bedford Traction Railroad, states that arrangements have been made for furnishing capital to complete the line from Altoona to Newry at once, but owing to the stringency in money matters, it has been decided to postpone the work until next spring.

BLAIRSVILLE, PA.—The Citizens' Heat, Light & Power Company contemplates the installation of an 80-arc dynamo in its plant. R. H. Wiggins is secretary.

CHAMBERSBURG, PA.—It is stated that the Cumberland Valley Railroad Company will equip the Waynesboro branch for electrical operation within the next six months or next year.

GETTYSBURG, PA.—The Keystone Electric Light, Heat & Power Company contemplates erecting surburban transmission lines in the spring, taking in two towns. [illegible] is general manager.

HOMESTEAD, PA.—Bids will be received until Feb. 3 by Andrew Hill, borough clerk, for lighting the streets of this borough for a period of one, three and five years.

NEWTOWN, PA.—The Bucks County Electric Railway Company is contemplating the entire reconstruction of its line and installing modern equipment. W. H. [illegible]

[illegible] PA.—The [illegible] Electric Light & Power Company is contemplating rebuilding its entire plant next spring. Frederick [illegible] is manager.

WASHINGTON, PA.—At a [illegible] meeting of the [illegible] Council a committee [illegible] of Messrs. [illegible] and M[illegible] [illegible] of the Washington Electric Light Company, and endeavor to make terms on the granting of a franchise in the borough.

mortgage with the Guardian Trust & Safe Deposit Company, of Philadelphia, as trustee, to secure an issue of bonds to that amount for additional railways and other improvements. The mortgage covers properties of the Wrightsville & York, the York & Dover, York & Dallastown and Hanover & York Electric, and the York Haven and Red Lion and Windsor Railway companies, as well as those of the York Light, Heat & Power Company and York Suburban Land companies.

NEWPORT, R. I.—The Newport & Fall River Street Railway Company is changing the direct-current arc lamps in the street lighting system to the magnetite arc lamps. Robert S. Goff is manager.

BERESFORD, S. D.—Extensive additions and improvements are being made to the local electric light plant. The power house is being enlarged and a Murray-Corliss engine installed. Another generator will be added to the plant next summer. L. Wagner is owner and manager.

HUMBOLDT, TENN.—The Board of Public Works is contemplating establishing a day service in connection with the municipal electric light plant. W. A. Moore is superintendent.

MINERAL SPRINGS, TEX.—D. T. Bollar, president of the Fidelity Trust Company, of Fort Worth, and receiver for the Mineral Wells electric light and car system, on Dec. 18, ordered the entire plant to be closed down, including ice plant, electric light and all public utilities. The Fidelity Trust Company holds first mortgage on the plant, of which the St. Louis Car Company is a large creditor.

STOWE, VT.—The Mount Mansfield Electric Railway, which connects this village and Waterbury, a distance of 10 miles, was sold at auction on Dec. 20 for the American Trust Company, of Boston, Mass., the mortgagee. A. H. Soden, of Boston, Mass., president of the street railway company, purchased the road for $20,000. It is understood that Mr. Soden contemplates extending the railway from Stowe to Morrisville, a distance of eight miles.

FREDERICKSBURG, VA.—The Fredericksburg & Southern Railway Company will apply to the State Corporation Commission for a charter to construct and operate an electric railway from some point in Hanover County to Fredericksburg and northwestwardly, and also the operation of a street railway in the city of Fredericksburg, subject to the consent of the City Council. The officers of the company are W. C. Whitner, president; E. J. Smith, vice-president, and Alvin T. Embrey, secretary and treasurer.

PULASKI, VA.—John T. Loving, Mayor, writes that the municipal electric light plant is not adequate to meet the demands made upon it, and that the city is thinking of giving up the plant and granting a franchise to a private company. If this is done the equipment of the municipal plant will have to be greatly increased.

COLTON, WASH.—E. S. Aldrich, of Moscow, Idaho, manager of the Idaho-Washington Light & Power Company, writes that about $3,000 will be expended for work required in Colton. The company will do its own work.

SEDRO-WOOLEY, WASH.—Work will commence on the construction of the new electric railway between Sedro-Wooley and Anacortes, Jan. 1. B. J. Weeks is one of the chief promoters of the road.

TACOMA, WASH.—The Bismarck Mill Company, of Bismarck, will start work shortly on a steam power plant for the generation of electricity to supply the suburbs of Tacoma.

TACOMA, WASH.—Beal Foster and S. Lewis have been granted a franchise by the City Council to erect and maintain transmission lines for the transmission and distribution of electricity to customers outside of the city.

WHEELING, W. VA.—The Wheeling Electrical Company has notified the City Council of its intention to apply for an ordinance granting it a 50-year franchise.

ARKANSAW, WIS.—The capital stock of the Arkansaw Telephone Company has been increased from $2,400 to $5,000.

BERLIN, WIS.—O. C. Irwin, of Crawfordsville, Ind., has been in the city trying to interest capital in his electrical plant, which he wishes to remove from Crawfordsville, Ind., to this town.

BLAIR, WIS.—The capital stock of the Preston Farmers' Telephone Company has been increased from $5,250 to $12,250.

CHILTON, WIS.—Owing to the unsatisfactory service furnished by the Wisconsin Electric Light & Service Company, the City Council has refused to renew the contract for street lighting with the company, and the streets will not be lighted for some time to come. The Council may decide to use gasoline for lighting the streets.

MEDICINE HAT, ALB.—The Red Cliff Realty Company has recently installed an electric light plant. At present a 60-kw alternating-current generator is in operation. It is expected to enlarge the plant next summer and increase the equipment to 400 kw. C. W. Jewett, of Blackduck, Minn., has charge of the work.

OKOTOKS, ALB.—The by-law to purchase the local electric plant, as well as the by-law to erect a municipal plant, was defeated by the electors. This town is now without light, the local company having shut down because its plant was not a financial success.

VANCOUVER, B. C.—The British Columbia Electric Street Railroad Company is applying for a charter to build a railway from this city to Midway, a distance of about 210 miles R. H. Sperling is general superintendent.

VANCOUVER, B. C.—A unit of 10,000 horse-power is being installed by the Vancouver Power Company at its plant at Lake Buntzen. It will cost, approximately, $300,000. The work will be completed within a month and immediately afterwards construction will be started on the installation of two more units of the same size.

ST. VITAL, MAN.—The Council is considering the advisability of building and operating an electric street railway from this town to Winnipeg, approximately 11 miles. Address J. P. Dumas.

WINNIPEG, MAN.—The Winnipeg Electric Company is now making arrangements for the building of a suburban electric street car line to St. Vital, a distance of approximately 11 miles. Wilford Phillips is general manager.

WINNIPEG, MAN.—At the election held Dec. 10 the by-law to issue $200,000 in bonds for the purpose of constructing an underground conduit for placing the telegraph, telephone and electric light and power wires underground was defeated.

TORBROOK, N. S.—The Londonderry Iron Mining Company has decided to install a $40,000 electric plant at its mines here.

YARMOUTH, N. S.—The Yarmouth Electric Company is being formed to take over the stock of the street railway company and extend the line. The company will also install a plant for lighting the city with electricity, in addition to supplying electricity for operating the railway system.

BRANTFORD, ONT.—The Brantford Electric Street Railroad Company, under the agreement recently ratified by the City Council, gets a 45-year franchise. Within the first two years the company must lay between 6 and 7 miles of track and during the last 25 years must pay the city $2,500 per annum.

COBALT, ONT.—The Council has granted a franchise to the Central Railway Company for an electric railway. It is expected that work will commence on the construction of the Cobalt-Liskeard section next spring, which will cost about $250,000.

HAMILTON, ONT.—The Cataract Power Company has renewed its offer made to the City Council early in the year to install pumps and equipment at the Beach pumping station. The company offers to pump the required amount of water for the city's use for a term of six years, putting in the requisite pumps and electrical equipment into a building to be furnished by the city at the Beach water works plant, and to operate the same for a term of six years for the same amount that it cost the city for the water pumped during the year of 1906. At the end of the six years the company agrees to turn over the whole of the equipment to the city, free of cost, and also agrees to enter into a contract to supply power, provided that it had it for sale, at the rate of one-half cent per hour per horse-power. W. C. Hawkins is secretary and general manager of the Cataract Power Company.

INGERSOLL, ONT.—The City Council has decided to submit the proposition to the people to issue $50,000 in bonds for the purpose of acquiring the plant of the Ingersoll Electric Light & Power Company to be operated as a municipal electric light plant.

LONDON, ONT.—The city engineer has been instructed by the Board of Works to prepare plans for a new belt line to be operated by electricity in the north part of the city.

LONDON, ONT.—At the coming civic elections the ratepayers will vote on a by-law to provide $235,000 for a power distributing plant in connection with the Niagara Falls plant.

OTTAWA, ONT.—The Civic Electric Commissioners and the Ottawa Electric Light Company have come to terms, the city taking over the company's plant on Dec. 20 for $29,000. The commissioners offered $24,000 and the company asked $31,000.

WELLANDPORT, ONT.—We have been informed that the Dunnville, Wellandport & Beamsville Electric Railway Company will begin work on the construction of its road next spring. The road is to extend from Dunnville to Wellandport, St. Anns and Beamsville. The section from Dunnville to St. Anns, a distance of 15 miles, will be built next summer. James A. Ross is president of the company.

QUEBEC, QUE.—The Quebec Railway & Light Company will apply to the Dominion Government for permission to increase its capital stock.

QU'APPELLE, SASK.—The civic electric light plant here, which has been under construction for some months past, will be completed shortly. It will provide lights for the streets as well as residences and factories. Address C. F. Cates.

New Incorporations.

FORT SMITH, ARK.—The Nelson Investment Company was recently incorporated for the purpose of building, owning and operating electric street railway systems, water works, etc. The company is capitalized at $100,000, and the officers are: J. T. Nelson, president; J. M. Spaulding, vice-president; T. A. Trusty, secretary, and J. T. Wright, treasurer.

OAKLAND, CAL.—Articles of incorporation have been filed for the Oakland Transcontinental Aerial Telephone & Power Company, with a capital stock of $200,000, by Albert G. Rodkel and others.

BOISE, IDAHO.—Incorporation papers have been prepared for the Idaho & Nevada Southern Railway Company. The company proposes to build an electric railway to connect Jerome and Wells, a distance of 127 miles. The capital stock of the company is placed at $500,000. The officers of the company are H. L. Hollister, president; I. B. Perrine, vice-president, and R. M. McCollum, secretary and treasurer.

CHICAGO, ILL.—Articles of incorporation have been filed for the Central Illinois Railway Company by Josiah Burnham, Hugo De Loeb, George L. Turnbull and L. H. Strickler. The company is capitalized at $2,500, and proposes to construct and operate a railway from Chicago to Lyons, in Cook County, and to other points in the counties of Cook, Du Page, Will, Bureau, Peoria, Kendall, Grundy, La Salle, Livingston, Putnam, Marshall, McLean and Woodford.

ELDORA, IA.—Articles of incorporation have been filed for the Providence Township Mutual Telephone Company, with a capital stock of $10,000, by W. G. Mitchell and others.

KALAMAZOO, MICH.—Articles of incorporation have been filed with the Secretary of State for the Kalamazoo Power Company, by Frank W. Armstrong, C. S. Smedley, and H. H. Freeland, all of Grand Rapids, Mich. The company is capitalized at $50,000 and proposes to build a large power plant to furnish power and steam heating in the city of Kalamazoo, under the franchise recently granted to Mr. Armstrong by the City Council. Plans for the electrical plant are now being prepared by W. D. Ball, of Chicago, Ill. The present plan contemplates installing a plant of 10,000 horse-power to be operated by gas engines. According to its franchise the company is limited to a charge of eight cents per kw-hour for electric service.

KENSINGTON, MINN.—The Kensington Telephone Company has been incorporated with a capital stock of $10,000, by A. H. Christenson and others.

BELLEVILLE, MO.—The Red Bud & Belleville Interurban Railroad Company has filed articles of incorporation for the purpose of constructing and operating an electric railway from Belleville to Smithton, and thence to Red Bud, Ill. The incorporators are: Conrad Becker, Herman Schreiber and Dr. C. G. Smith, of Red Bud, Ill.; John Keller, of Hecker, Ill., and Benjamin A. Gundlach, of Belleville.

CARSON CITY, NEV.—The Northwest Light & Power Company has been incorporated with a capital stock of $1,000,000.

NEW YORK, N. Y.—The Casey-Electric Company has been incorporated with a capital stock of $10,000. The directors are Fred Knowlton and W. E. Allen.

NEW YORK, N. Y.—The Dunn Light Company has filed articles of incorporation with the Secretary of State with a capital stock of $25,000. The directors are Warren H. Dunn, Darlington, N. J.; Edwin S. Dunn, and Lawrence C. Shepherd, of New York.

SPRINGWATER, N. Y.—The Canadice Telephone Company has been incorporated with a capital stock of $7,200 by L. M. Doolittle and others.

NEW LONDON, N. C.—The New London Development Company has been incorporated with a capital stock of $10,000, by F. A. Silver, of Greensboro, and others. The company proposes to do a real estate business and to construct, purchase and operate electric light and power plants, etc.

SAWYER, N. D.—The Western Telephone Company has been incorporated with a capital stock of $50,000, by William Hodges and others.

BERGHOLTZ, OHIO.—The Bergholtz Electric Light & Power Company has been incorporated with a capital stock of $10,000, by E. Steimetz, James B. Marshall and others.

CINCINNATI, OHIO.—The Ohio Public Service Company has been incorporated with a capital stock of $10,000, by E. B. Smole, L. A. Ford, George H. Swift, G. P. Hunt and C. C. Werner, who are said to represent Eastern men. The company has a twenty-five year franchise for street lighting at Bradford, Ohio, where a contract has already been entered into. It is the intention to build lighting and water plants at various points in the state.

HAWKINS, WIS.—Articles of incorporation have been filed for the Hawkins Telephone Company, with a capital stock of $800 by Anton Paulson, A. C. Thompson, W. H. Pearce and others.

MORRIS, WIS.—Articles of incorporation have been filed for the Morris Telephone Company with a capital stock of $1,200 by Charles H. Holun, Peter Frederickson and Thomas Larson.

MANITOWOC, WIS.—The Farmers' Telephone Company has been organized to construct a [illegible] from [illegible] to [illegible]

Legal.

EIGHTY CENT GAS ILLEGAL.—Judge Hough, of the United States District Court, New York City, has handed down an exhaustive opinion on the eighty-cent gas case. He favored the report of the referee, Arthur H. Masten, but ordered slight modifications. Mr. Masten's opinion was in favor of the Consolidated Gas Company and against the Eighty-cent law, which was declared by the referee to be confiscatory. The court holds that the first prayer of the bill, relating to the constitutionality of the law, must be granted, upon the ground that both the statutes involved [illegible] of the [illegible] Gas and Electricity, were in contravention to the Fourteenth Amendment of the United States Constitution. The effect of this was that Judge Hough affirmed Mr. Masten's opinion that the Eight-cent gas law was not constitutional. It was ordered [illegible] that the Consolidated Gas Company [illegible] gas to New York City [illegible] thousand feet. [illegible] to Judge Hough [illegible] order. Taking up the [illegible] monopoly, the court states: "The monopoly is beneficial. To have the streets of Manhattan torn up to afford room for the mains of a rival is unthinkable." Speaking of the capitalization of franchises or the contention of the company that it has a right to expect a fair return upon "not only its tangible property, but the right to use that property in the gas business," the court disagrees, and says that return can only be expected from investment. Judge Hough says that in his opinion the best measure of valuing franchises is the stock issued against them by the incorporators, and places their value at $12,000,000, thus placing the total valuation of the company's business at $59,000,000 and the earnings much less than 6 per cent. Of the gas law, Judge Hough says that when under the guise of legislation rates are not fixed by action of a commission or subordinate, but by direct legislation, "representative government as prescribed by both Federal and State Constitutions is at an end."

RIGHT OF ELECTRIC COMPANY HOLDING EXCLUSIVE FRANCHISE TO RESTRAIN NEW COMPANY FROM EXERCISING SIMILAR RIGHTS.—The laws of the State of Pennsylvania empower boroughs to "light the streets" and, this authority having been construed by the courts to include the power to contract for lighting the streets by electricity, the borough of Muncy granted to the Muncy Electric Light, Heat & Power Company, which was organized for the purpose of furnishing light to the borough, the exclusive right to erect poles and extend wires on the highways of the borough for a period of ten years. Three years later the borough passed an ordinance granting to the People's Light, Heat & Power Company the right to place its poles and string its wires along the highways of the borough for the purpose of supplying electric light and power to the borough and its inhabitants, and, pursuant to this statute, the latter company commenced the construction of its lines. The Borough Company thereupon sought an injunction restraining the People's Company from going ahead with the work of erecting its poles and wires on the ground that it constituted a breach of its (the Borough Company's) contract with the borough of Muncy and an interference with its franchise. It was objected by the People's Company that the borough had no power to grant an exclusive franchise without express legislative sanction. It was held, however, that the borough did have such a right and that the Borough Company was entitled to an injunction restraining the People's Company from interfering in any way with its franchise. Neither company had any rights in the streets of the borough without the borough's consent. The borough, under the statutes, might have built its own light plant and refused all franchises to others, or it might have granted a franchise on its own terms and conditions. And what the borough might have done by itself it might do by contract with others. That is what it did in this instance. Instead of expending the public money in building a plant, it accepted the offer of the Muncy Company to build the plant in consideration of a franchise which was to be exclusive for ten years. It was a valid exercise of the borough's contractual power, on a valid consideration, and could not be rescinded directly or indirectly at the will of one party. Muncy Electric Light, Heat & Power Company vs. People's Electric Light, Heat & Power Company, Supreme Court of Pennsylvania, 67 Atl. Rep. 956.

JUDGMENT FOR DAMAGES AGAINST POWER COMPANY REVERSED.—The plaintiff, at the time of the accident which resulted in his injuries, was engaged in painting the roof of a factory building. As he was in the act of lifting a ladder used in his work, the end of which projected slightly over the edge of the roof, his hand came in contact with a neutral wire about eleven inches from the edge of the roof, and two feet distant from a 2300-volt wire. According to the plaintiff's testimony, he thereupon received a shock which rendered him unconscious and caused him to fall across the two wires, where he was found by his fellow workmen. The company claimed that the accident could not have been caused by touching the neutral wire, and a number of witnesses testified that they had taken hold of this wire, while the neighboring wire was carrying its regular high-voltage alternating current, and had received no shock whatever. The case was submitted to the jury with instructions that they were at liberty to refer the plaintiff's injuries to contact with either wire and to charge the company with negligence in maintaining either or both wires. Against this manner of submitting the case the company's evidence as to the harmlessness of the neutral wire was of little avail, and the jury returned a verdict in favor of the plaintiff and assessed his damages at $10,000. With reference to the actual state of evidence, it could not be definitely determined upon what ground the jury found the company liable, nor what weight was given to the evidence introduced in its behalf. Some of the jury may have attributed his injuries to contact with one wire, some to contact with another, and some may have been convinced that it was not negligence to string the wire 35 inches from the building; others that the negligence consisted in the location of the neutral wire; still others in the lack of insulating covering on one or both. In short, it was impossible to tell for what the defendant was held liable, when under the evidence it could only be held liable, if at all, for negligence in placing the neutral wire, or the wire nearest the building, that being the wire with which the plaintiff came in contact. For these reasons the verdict was reversed and a new trial ordered. Rasmussen vs. Wisconsin Traction, Light, Heat & Power Company, Supreme Court of W[illegible] W. Rep. [illegible]

[illegible] INSTRUCTIONS HELD NOT TO BE NEGLIGENCE ON PART OF LINEMAN [illegible] TO PRECLUDE RECOVERY OF DAMAGES.—The plaintiff, in company with another lineman and a [illegible] employed by the defendant [illegible]

[illegible] one pole and place it in position on another. The plaintiff had been informed that there was necessity for haste in order to get the transformer in place in time to furnish electricity for the lamps at a public function soon to be held. The transformer was taken down without mishap and carried to the pole to which it was to be attached. The plaintiff ascended the pole and affixed the cross-arm on which the transformer was to be placed. The next act in the process was to attach a pulley at some point on the pole far enough above the cross-arm to allow the hoisting of the transformer to the cross-arm by means of a rope through the pulley. To attach the pulley at the proper place, it was necessary to climb to the top of the pole, where electric wires belonging to the company were strung. The plaintiff saw the other men on the ground getting ready to throw him the rope necessary in hoisting the block and tackle to be used in raising the transformer, and he also saw the foreman take the cord containing the transformer to run it up under the pole. He accordingly, and without waiting for specific instructions, ascended to the top of the pole to attach the pulley to hoist the transformer and there came in contact with the wires of the company, which, without his knowledge, were at high voltage, which caused the injury for which the action was brought. One of the claims of the defense was that the instructions given to the plaintiff by the company, acting through the foreman, went no further than to require the plaintiff to attach the cross-arm, and that in going to the top of the pole the plaintiff voluntarily exposed himself to danger, for which voluntary exposure the company could not be held liable. In affirming a verdict of $30,000 in favor of the plaintiff, the court said in part: "If he had been slow to perceive these preparations, and dilatory in his part of the work, awaiting a specific direction for each act in the process, he would have been justly chargeable with inefficiency and neglect of duty. It would be strange doctrine to hold that the promptness of a servant in going forward to perform the well-known parts of a task he is set to do would relieve the master from his duty to furnish a safe place and warn the servant of the dangers of the situation to which his duty calls him. The master expects and is entitled to the exercise by the servant of reasonable zeal to see and do what is to be done by him in the course of the work in which he is engaged. Expecting this, he must anticipate it in the performance of his own duty to the servant, and his warning and protection must extend to all dangers which the servant will usually incur in the exercise of such reasonable zeal and diligence as are not known to the servant or obvious to ordinary observation, and which arise from causes controlled by the master. The plaintiff's diligence did not go beyond this ordinary and reasonable diligence to which he was bound. Under all the circumstances of the case the master cannot be allowed to excuse himself on the ground that specific directions to attach the pulley were not given." Reeve vs. Colusa Gas & Electric Company, Supreme Court of California, 92 Pac. Rep. 89.

Educational.

THE PENNSYLVANIA STATE COLLEGE.—Dr. Edwin Erle Sparks, at present professor of history in the University of Chicago, has been elected president of the college, and will assume his duties next June. Two important changes have been arranged for in the school of engineering. Professor J. P. Jackson, of the department of electrical engineering, has been appointed dean of the school, to succeed Professor L. E. Reber, of the mechanical engineering department, who has resigned to accept a position at the University of Wisconsin. Professor Hugo Diemer, formerly of the University of Kansas, has been appointed head of the department of mechanical engineering.

LECTURES AT SEATTLE.—Thirteen practical lectures in electrical engineering, by prominent electrical engineers of the Pacific Northwest, have been planned by the electrical engineering department at the University of Washington for the students in the engineering courses and for practical electricians of Seattle and nearby places. The lectures began Dec. 11, and will be held at 8 p. m. in Room 3 of science hall at the university. The first five lectures will be on "Telephones," by C. E. Fleager, superintendent of construction of the Pacific Telephone Company for Washington, Oregon and Idaho. The next five will be on "Central Station Practice," by James D. Ross, superintendent of the Seattle municipal light and power system. The last three will be given by John Hariberger, general superintendent of the Seattle-Tacoma Power Company, on the subject of "Electric Power Transmission."

Obituary.

MR. J. W. PERRY.—A special telegram from Newberry, S. C., of Dec. 13 says: "J. W. Perry, manager of the Bell Telephone Company in this city, died at his home to-day from blood poisoning. The malady was the result of a slight injury sustained several weeks ago, when he stuck a small piece of copper wire in his finger. Little attention was paid to the wound until a week ago, when blood poisoning set in. From that time until his death he suffered great pain. Mr. Perry came to Newberry a [illegible] of the Bell Telephone Company. During his residence here he made many friends. Mr. Perry is survived by his wife and several small children. The remains will be taken to Charleston for interment."

Personal.

PROF. J. P. JACKSON.

PROFESSOR JOHN PRICE JACKSON, whose appointment as dean of the school of engineering at the Pennsylvania State College is noted elsewhere in this issue, graduated from the course in mechanic arts and later from the mechanical engineering course of the above named college, receiving the degree of B. S. in [illegible] Engineering in [illegible]. He subsequently received the degrees of M. E. and E. E. from the same college. In his early career he [illegible] the Edison Illuminating Company, of Philadelphia, and the Sprague and Edison companies of New York City. He also obtained considerable experience while with the Western Engineering Company, of Lincoln, Nebraska. He was appointed Profeseor of Electrical Engineering at the Pennsylvania State College in 1894. At the present date the department of electrical engineering has an enrollment of more than 700 students. The school of engineering, of which Professor Jackson now serves as dean, offers courses, with options, in electrical, civil, mechanical, sanitary, hydraulic and electrochemical engineering. Professor Jackson is a member of the American Society of Mechancial Engineers, the American Institute of Electrical Engineers, the American Society for the Advancement of Engineering Education, the Harrisburg Engineers' Club and other technical organizations. He is a joint author of "Alternating Currents and Alternating Current Machinery" and "Electricity and Magnetism," two standard text-books in electrical engineering, and has written numerous articles on educational and engineering topics which have appeared in society transactions and other technical publications. Professor Jackson has acted as consulting engineer for various companies and towns. Among other work, he made a thorough test of the luminous arc lamp upon its appearance upon the market, and upon his recommendation it was adopted by the city of Harrisburg as a standard for city illumination. This installation, which was the first large equipment of the kind in this country, has given excellent service.

MR. A. L. KENYON, chief engineer of the Santa Rosa transmission plant in Peru and the Lima-Callao electric railway, arrived last week in New York on a short vacation.

MR. R. JEMISON.—Mr. Robert Jemison has retired from the presidency of the Birmingham (Ala.) Railway, Light & Power Company, and the board of directors has passed some very eulogistic and enthusiastic resolutions on his work for 20 years.

MR. W. S. DIX has recently severed his connection with Messrs. Sanderson & Porter, with whom he has been connected for seven years, and has entered upon the duties of sales engineer for the R. Thomas & Sons Company, with headquarters in New York City.

MR. R. O. JONES has been appointed chief engineer of the Dayton Hydraulic Machinery Company. Mr. Jones has had a wide experience in the manufacture and construction of pumps of all kinds, having been for the past nine years associated with the Jeanesville Iron Works, of Hazleton, Pa., and for several years past was their chief engineer.

CAPTAIN GODFREY L. CARDEN, U. S. R. M., will shortly go abroad on a commission from the U. S. Government to make a study of manufacturing conditions in Europe so far as they have a bearing on export trade. Captain Carden about four years ago made an extended tour of European manufacturing centers in the interest of the St. Louis Fair, and succeeded in having taken up all of the space assigned to European manufacturers.

MR. JOHN A. ROEBLING, son of Colonel Washington Roebling, of Brooklyn Bridge fame, owner of Beauxchenes, a $500,000 country estate on the St. Dunstan Road, between Asheville and Biltmore, North Carolina, has deeded over the entire property to the Home Mission Board of the Northern Presbyterian Church, and will return soon to his home in Trenton, N. J. Mr. Roebling says he is leaving Asheville because the city has gone for prohibition, of which he does not approve on principle.

MR. T. F. BECHTEL.—Mr. Thomas F. Bechtel, general auditor for the Grand Rapids-Muskegon Power Company since the amalgamation of that enterprise with the Grand Rapids Edison Company last summer, has resigned his position. This will take immediate effect, although Mr. Bechtel will remain with the company a reasonable period to admit of the appointment of a successor. He has made no definite business plans for the future and will make none until after his return from a trip to Florida and Cuba in search of rest and recreation. His relations with the company and with his associates have been pleasant and he leaves its service with the best of wishes for its growth. Mr. Bechtel has been connected with the electric light and power company since the organization of the Grand Rapids Edison Company, about twenty years ago. It was to his energy and personal efforts as secretary and treasurer, offices he filled for many years, that its extensive growth and successful business was largely due.

Trade Publications.

PORTABLE STORAGE BATTERIES.—The Westinghouse Machine Company, East Pittsburg, Pa., has issued Catalogue P, dealing with storage batteries for portable service.

PORTABLE INSTRUMENTS.—Bulletin No. 4554 of the General Electric Company has for its subject Type P3 voltmeters, wattmeters and ammeters, which are described and their details illustrated. Mechanically the instruments are strong and light, and of small size, so that several instruments may be carried with ease. They have a light-weight moving element not susceptible to damage in transportation, and one of the strongest recommendations of their reliability when used for laboratory or general testing purposes is their ability to give accurate indications when used in the vicinity of external magnetic fields. The voltmeters and wattmeters are constructed on the direct-reading dynameter principle, the ammeters on the well-known Thomson inclined coil principle. The pointer fluctuations are dampened by means of Foucault currents set up in a thin aluminum segment attached to the shaft. Pivots are made from the best grade of steel specially hardened and highly polished, and are suspended in high-grade sapphire jewels. Catalogue numbers, capacities and list prices are given in the bulletin, and full-sized sample scales of the various instruments are reproduced.

Business Notes.

THE NORTHERN ENGINEERING WORKS, crane bui[illegible] Mich., have installed in the power station of the St. Clair [illegible] pany, Port Huron, Mich., a fifteen-ton, 43-ft. span, travelin[illegible]

GOLD MEDALS FOR ALLIS-CHALMERS COMPA[illegible] medal has been awarded to the Allis-Chalmers Company fo[illegible] erators and motors by the authorities of the Jamestown Exp[illegible] the recommendation of the jury consisting of well-known [illegible] perts representing leading electrical interests of the country. [illegible] gold medal was also granted for the good judgment and taste shown in the design and erection of the exhibit, which has been one of the most attractive features of "Machinery Hall."

BELTED CORLISS.—The Allis-Chalmers Company, of Milwaukee, Wis., has just issued bulletin No. 1501, devoted to its belted Reliance Corliss engines. The popularity which these engines have attained is due to their reliability, durability and simplicity of construction. The Reliance pattern of the Reynolds-Corliss engine was designed to meet the demand for a strong and serviceable machine which would occupy less floor space and run at somewhat higher speeds than is usual in Corliss engine practice, thus, in many cases, better adapting it to be used as a prime mover for electric generators and other fast running machinery.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 17, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

873,702. ALTERNATING-CURRENT MOTOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 15, 1904. In a combination, a dynamo-electric machine having a distributed winding on each member, the conductors of each winding being permanently connected in groups, an external circuit connected to each winding, and means for varying the numbers of poles of both members.

873,703. ELECTRICALLY PROPELLED CAR OR LOCOMOTIVE; Edward H. Anderson, Schenectady, N. Y. App. filed April 5, 1906. Electric railway system in which the current is supplied to the locomotive as high voltage alternating current, during normal running, and as low voltage direct current while within the city limits. Relates to controller circuits.

873,705. INSULATING COVERING OR SHEATHING FOR CONTACT RAIL CONDUCTORS; William H. Baker, Lockport, N. Y. App. filed Oct. 19, 1905. A form of insulating sheath adapted to embrace the rail and having a locking piece or key serving to keep the sheath in place on the rail.

873,706. MOTOR TRUCK; Asa F. Batchelder, Schenectady, N. Y. App. filed May 28, 1906. Provides a motor truck in which the electrical and mechanical features are designed to co-operate to produce a truck which is simple, durable and of maximum electrical capacity. Includes manner of suspending motor frames.

873,714. DYNAMO ELECTRIC MACHINE; Joseph L. Burnham, Schenectady, N. Y. App. filed April 1, 1907. The field pole is divided into two sections, one larger than the other. The main winding is placed on the large pole and a regulating winding on the small pole.

873,715. ELECTRICAL ACCUMULATOR; Charles Busch, New York, N. Y. App. filed June 25, 1907. A form of electrode for storage batteries having a lead box or casing inclosing active material.

873,720. SWITCH STAND; Arthur D. Cloud, Chicago, Ill. App. filed Sept. 27, 1906. Has means for locking open an automatically closing switch and a magnet switch having opening and closing devices for releasing said locking means and controlled by the passage of a train on a side track or upon the main track.

873,721. TRANSFORMER; Jesse Coates, Lynn, Mass. App. filed Feb. 12, 1906. Form of arrangement of laminæ for a transformer core.

873,729. THROTTLE RELAY; Archibald S. Cubitt, Schenectady, N. Y. App. filed March 31, 1906. Relates to current relays adapted to govern circuit controlling devices in order to prevent the circuit conditions from becoming abnormal.

873,732. BATTERY TRAIN LIGHTING SYSTEM; Frank A. Decker, Philadelphia, Pa. App. filed April 4, 1906. Patentee has a battery box beneath the car body and compressed air pipes for transferring the solution from one tank to another.

873,737. AUTOMATIC CUT OUT FOR ELECTRIC CONTROLLERS; Arthur C. Eastwood, Cleveland, Ohio. App. filed Jan. 15, 1907. Relates to means for automatically cutting off the supply of energy to an electric motor and stopping it in such a manner that the operator may again start the motor in either direction by the operation of a master controller without manipulation of additional switches.

873,741. SWITCH OPERATING MECHANISM; Edwin E. Frederick, Bellevue, Pa. App. filed April [illegible], 1906. Provides means by which the successive movements of a device in the same direction will cause alternate movements of a [illegible]. Has a step by step ratchet device.

873,751. CONDENSER; Nelson S. Hopkins, Fort Wayne, Ind. App. filed Nov. 15, [illegible]. Patentee [illegible] of a condenser lapped in such a way that the thickness [illegible] at the edges is greater than at the center.

873,757. TRANSMITTING DEVICE FOR ELECTRIC TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed March 16, 1905. An arrangement for [illegible] Morse [illegible]

873,778. DYNAMO ELECTRIC MACHINE [illegible], N. Y. App. filed May [illegible] tor, an electric motor supplied thereby, a separate source of current for the generator field windings, means for varying the field current of said generator, and means for adjusting the magnetic time-lag of the generator field.

873,780. INSULATED COIL; Charles F. Peterson, Schenectady, N. Y. App. filed [illegible] coil which will be a self-contained unit without any wrapping or supporting means, and which is furthermore absolutely refractory.

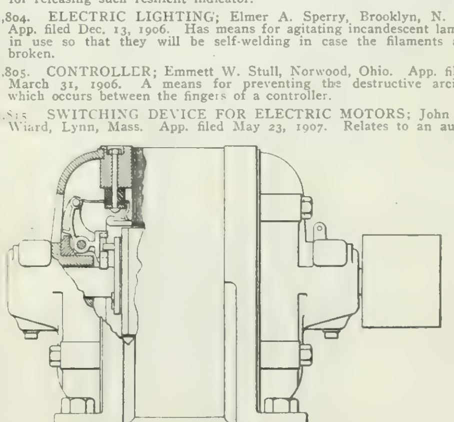
873,781. CABLE DRUM MECHANISM; Claiborne Pirtle, Cleveland, Ohio. App. filed March 6, 1907. A tension device for cables comprising a drum and an electric motor having its rotatable member connected in driven relation to the drum, and a resistance permanently in circuit with said motor.

873,793. SAFETY FUSE INDICATOR; Caroline N. Sachs, Hartford, Conn. App. filed March 11, 1904. An indicating device for a safety fuse comprising a resilient indicator and means broken by the fusion for releasing such resilient indicator.

873,804. ELECTRIC LIGHTING; Elmer A. Sperry, Brooklyn, N. Y. App. filed Dec. 13, 1906. Has means for agitating incandescent lamps in use so that they will be self-welding in case the filaments are broken.

873,805. CONTROLLER; Emmett W. Stull, Norwood, Ohio. App. filed March 31, 1906. A means for preventing the destructive arcing which occurs between the fingers of a controller.

873,815. SWITCHING DEVICE FOR ELECTRIC MOTORS; John B. Wiard, Lynn, Mass. App. filed May 23, 1907. Relates to an automatic switching device for electric motors arranged to change the connections of the motor from starting to running conditions. Has a centrifugal device on the motor shaft.



873,815.—Switching Device for Electric Motors.

873,839. AUTOMATIC SIGNALING DEVICE; Louis Caputo, East Boston, Mass. App. filed Aug. 23, 1907. Has special conductors between the track rails engaged by trolley wheels depending from the train.

873,846. CARTRIDGE FUSE ATTACHMENT PLUG; Robert A. Culta, Cambridge, Mass. App. filed July 3, 1907. A cartridge fuse attachment plug which cannot be destroyed by the burning of the fuse.

873,861. ELECTRIC FURNACE; Gustaf Holmgren, Westeras, Sweden. App. filed March 6, 1907. An electric induction furnace having a stationary iron core and melting chamber inclosing said core. A rotary magnet is effective to alternately magnetize the iron core so as to generate a current in the molten material of the furnace.

873,872. HOUSING; Hubert Krantz, Brooklyn, N. Y. App. filed Jan. 26, 1907. A small bracket or fixture adapted to be placed on a thumb-screw so as to cover up the circuit wire connection.

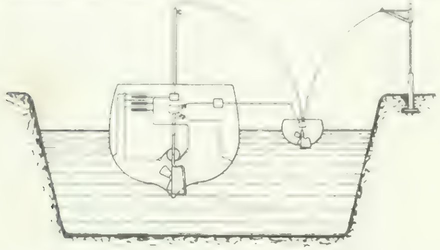
[illegible] PROCESS FOR THE PRODUCTION OF NITRIC ACID OR NITRIC OXID FROM ATMOSPHERIC AIR; Henry Paulding, Gelsenkirchen, Germany. App. filed April 6, 1906. The herein described process, consisting in heating air to a temperature of about 1200 degrees C. and then immediately blowing into the air thus heated a cooled off portion of air previously heated to the said temperature [illegible]

873,890. ELECTRIC SMELTING FURNACE; William R. Parks, Chicago, Ill. App. filed April 11, 1907. An electric furnace having a negative electrode with a circular gutter in its upper surface and [illegible]

carried to the Y. App. filed Jan. 15, 1907. Patentee has barred windows,

point on the ck Hoffman, Cincinnati, Ohio. App. filed June 30, 1906. A of the transforing connection for hose-couplings adapted to complete a tele-

873,943. PROCESS OF TREATING ORES; Frederick M. Johnson, San



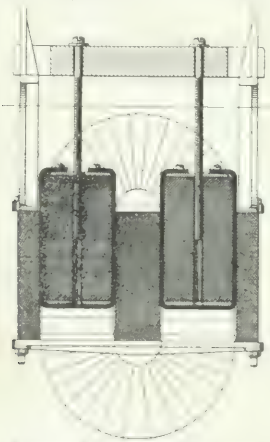
873,899.—Current Supplying Arrangement.

solution in a cyaniding tank with a soda solution which dissolves silver.

873,955. TROLLEY HEAD; Charles C. McClintock, Englewood, Col. App. filed June 25, 1907. Patentee has a trolley harp swivelled on a vertical axis and provides prongs or deflectors constituting a wire guard.

873,958. METHOD OF PRODUCING HOMOGENEOUS BODIES FROM TANTALUM OR OTHER HIGHLY REFRACTORY METALS; Marcello von Pirani, Wilmersdorf, near Berlin, Germany. App. filed March 18, 1907. The method of producing homogeneous bodies from tantalum and other highly refractory metals, which consists in creating a substantial vacuum, ionizing the residue of gas therein and subjecting the metal to the influence of an electric arc therein.

873,996. CONDUIT THREADING DEVICE; Albert H. De Voe, Elizabeth, N. J. App. filed Oct. 24, 1906. A cable creeper having wheels or rollers which engage the walls of the conduit tube and which



are propelled by a ratchet device to move the creeper along under the impulse of successive pulls on the operating cord.

874,004. TELEPHONE-TRANSMITTER; Howell W. Haff, Richmond Hill, N. Y. App. filed April 16, 1907. Covers an extremely sensitive form of transmitter having means for directing the sound against both the front and the rear wall of the instrument so as to get double efficiency.

874,016. TURN BUTTON FOR ELECTRIC SWITCHES; Henry E. Leppert, New Britain, Conn. App. filed Oct. 29, 1904. Relates to turn buttons for electric switches and has special means for attaching the button to its spindle with adequate security.

874,019. END CAP FOR ELECTRIC CONDUITS; Harry P. Moore, Newburyport, Mass. App. filed April 6, 1907. A stamped sheet metal

the usual burr which is liable to abrase the wire.

874,023. NON-INDUCTIVE RESISTANCE; James F. McElroy, Albany, N. Y. App. filed Feb. 21, 1907. Construction of electrical resistance unit, including a resistance wire wound in alternate longitudinal and transverse layers within an inclosing tube

874,024. ELECTRIC BELL; James F. McElroy, Albany, N. Y. App. filed Feb. 21, 1907. Relates to electro-magnetic trembler bells having an improved compact structure in which the electrical conductors are insulated from the frame of the bell. Used for high-voltage circuits

874,025. SYSTEM OF MOTOR CONTROL; Alexander McIver, Schenec-

circuits having contactors closed in an automatic progression. Relates to mechanical features and electrical circuits.

874,029. ELECTRIC HAT CURLING IRON; Joseph L. O'Brien, South

curved form for curling hats. It has longitudinal channels in which the resistance elements are received.

874,040. METHOD FOR DETINNING AND PRODUCING TIN COMPOUNDS AND OTHER PRODUCTS; Elmer A. Sperry, New York,

consists in reacting on the masses to be detinned with chlorine in the presence of stannic chlorid hydrate.

874,042. BLOCK SIGNALING APPARATUS; John D. Taylor, Edgewood Park, Pa. App. filed Aug. 24, 1907. Block signaling apparatus having a transformer specially designed for supplying alternating current to the track circuit of the system in a quantity to suit the requirements thereof.

874,064. ELECTROLYTIC CELL; Arthur E. Gibbs, Wyandotte, Mich. App. filed June 2, 1906. Electrolytic apparatus having a diaphragm and a cathode having projections embedded in said diaphragm.

874,085. RAIL BOND FOR RAIL JOINT CIRCUITS; William E. Karns, Parker's Landing, Pa. App. filed Jan. 29, 1907. In place of a rail bond wire of the usual form, patentee has spring plates fitting between the abutting ends of the rail.

874,118. TELEPHONE-TRANSMITTER; Carl J. Printz, Milwaukee, Wis. App. filed Dec. 31, 1906. A telephone transmitter, comprising a mouthpiece, a member with which the mouthpiece is connected, and an annular disinfectant receptacle having a contracted inner edge fitting between the mouthpiece and the said member and communicating with the interior of the mouthpiece.

874,147. THREE-WIRE MULTIPLE SYSTEM; Charles S. Winston, Chicago, Ill. App. filed March 12, 1906. Common battery telephone system having two wires extending throughout the multiple of the switchboard section of the lines for talking purposes, and a third wire provided for testing and signaling purposes.

874,163. ARMATURE WINDING MACHINE; Penrose E. Chapman, St. Louis, Mo. App. filed Aug. 15, 1904. The armature is supported transversely across the face of a chuck which has wire guiding fixtures applied thereto.

874,173. CONTROLLER REGULATOR; Cyrus P. Ebersole, Keokuk, Ia. App. filed April 15, 1907. Regulator for electric controllers adapted to prevent the hood from being removed from the base, although not preventing the movement of the hood.

874,178. CAUTERY; Lee De Forest, New York, N. Y. App. filed March 1, 1907. A system for cauterizing by high-frequency currents. Has an electrode consisting of a conducting member terminating in a cutting edge.

874,186. MAGNETIC BRAKE; Frederick G. Haldy, Stamford, Conn. App. filed June 17, 1907. A magnetic clutch having a pair of discs with intermediate bar electro-magnets having their opposite poles presented to their respective discs.

874,190. AUTOMATIC CIRCUIT BREAKER; Gerald W. Hart, West Hartford, Conn. App. filed Jan. 25, 1907. An electric switch in a door latch or lock whereby the lamps of a room will be extinguished when the tenant or guest leaves the room.

874,208. POLE CHANGER; Lee Kiblinger, Jackson, La. App. filed July 8, 1907. Pole changer in which momentum of a vibrating hammer is employed in such a way as to increase the abruptness in the make and break.

874,209. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 26, 1907. Means to neutralize the inducing effect of a power wire on neighboring lines of transmission and comprising a conductor placed in the neighborhood of the lines of transmission and connected in shunt with the return of said power wire.

874,219. BRAKE FOR POWER DRIVEN VEHICLES; Joseph N. Mahoney, Brooklyn, N. Y. App. filed Oct. 30, 1905. Electrical vehicle brake having a spring normally under tension by reason of a gear connection from an operating motor. Has hand-controlled devices by which the spring is released to apply the brake.

874,227. PORTABLE BURGLAR ALARM; Joseph L. Mulry, Pawtucket, R. I. App. filed Aug. 14, 1907. Burglar alarm having a small circuit-closing fixture attached to the window frame and quickly removable when desired.

874,229. CONTROLLING MECHANISM; John J. Nef, Chicago, Ill. App. filed Sept. 15, 1906. A governor for fluid pressure systems for operating air brakes. Designed to open the circuit of the pumping motor abruptly when a certain pressure is attained. Has a piston acting on spring cam mechanism.

874,245. LAMP SOCKET; John J. Rooney, Scarsdale, N. Y. App. filed Jan. 10, 1906. A long tubular lamp socket especially for use with miniature lamps on Christmas trees.

874,250. FIRE ALARM AND SIGNALING DEVICE; Louis Sackwitz, St. Louis, Mo. App. filed May 14, 1907. A simple form of circuit-closing device including spring clips associated with a wooden block

element.

874,284. GOVERNOR; Ira J. Babcock, Chicago, Ill. App. filed Nov. 7, 1906. A governor for air brake systems, including a spring-impelled piston displaced to move toggle levers into circuit closing relation

874,293. CIRCUIT BREAKER; Frank W. Blair, New York, N. Y. App. filed June 19, 1906. A circuit closer of the plug and jack type for

874,345. TROLLEY; George Keresztes, Pittsburg, Pa. App. filed Sept.

grooved roller with spiral grooves extending from the central groove to maintain the wire constantly guided thereon.

874,357. ELECTRIC GAS LIGHTER; John Dickens, Passaic, N. J. App. filed April 2, 1907. Gas lighter, including a casing enclosing dry batteries and having transverse spring blades by which the circuits are automatically completed when the batteries are inserted.

874,372. ELECTRICAL SIGNALING DEVICE; James P. Williams,

conductors between and beside the usual track rails and which are engaged by dependent brushes on the train.

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